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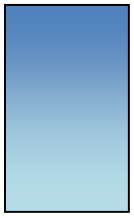

Logical Reasoning

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Preface

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Praise

Comments on the earlier 1993 edition, published by Wadsworth Publishing Company, which is owned by Cengage Learning:

> "There is a great deal of coherence. The chapters build on one another. The organization is sound and the author does a superior job of presenting the structure of arguments. "
>
> David M. Adams, California State Polytechnic University

> "These examples work quite well. Their diversity, literacy, ethnic sensitivity, and relevancy should attract readers."
>
> Stanley Baronett. Jr., University of Nevada Las Vegas

> Far too many authors of contemporary texts in informal logic – keeping an eye on the sorts of arguments found in books on formal logic – forget, or underplay, how much of our daily reasoning is concerned not with arguments leading to truth-valued conclusions but with making choices, assessing reasons, seeking advice, etc. Dowden gets the balance and the emphasis right.
>
> Norman Swartz, Simon Fraser University

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For the 2012 edition: This book is dedicated to my wife Hellan whose good advice has improved the book in many ways.

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CHAPTER 1 How to Reason Logically

The goal of this book is to improve your logical-reasoning skills. Your logical-reasoning skills are a complex weave of abilities that help you get someone's point, generate reasons for your own point, evaluate the reasons given by others, decide what or what not to do, decide what information to accept or reject, explain a complicated idea, apply conscious quality control as you think, and resist propaganda. Your most important critical thinking skill is your skill at making judgments—not snap judgments that occur in the blink of an eye, but those that require careful reasoning.

You are not reasoning logically if, when you want a gorilla suit for a Halloween party, the first thing you do is search for the word "Gorilla" in the Yellow Pages of the telephone book, and the problem here is not that you used a telephone book instead of the Internet.

High-quality reasoning is called *logical reasoning* or *critical thinking*. Logical reasoning skills can be learned and improved. It is not a case of "Either you're naturally good at it or you're not." Rather, every student is capable of reasoning well, and everyone is capable of improvement. The opposite of logical reasoning is uncritical thinking, examples of which are fuzzy thinking, believing what somebody says simply because they raise their voice, and narrowly thinking about a problem without bringing in the most relevant information.

This first chapter explains what it means to be logical—to reason logically. It demonstrates the usefulness of logical reasoning as a means to making more effective decisions about your own life—decisions about what to believe and decisions about what to do. The chapter begins a systematic program of study of all the major topics regarding logical reasoning. Along the way, the book focuses on developing the following five skills: (1) writing logically, (2) detecting inconsistency and lack of clarity in a group of sentences, (3) spotting issues and arguments, (4) detecting and avoiding fallacies (reasoning errors), and (5) generating and improving arguments and explanations. These skills will be taught here independent of subject matter.

This book does not emphasize philosophy over any other subject, and it is not a book about what you ought to believe about some subject.

Although many scientific studies of decision-making have shown that people tend to sift sources of information looking to reinforce existing views rather than to accept the view that is backed up with the better argument, our course is designed to combat this tendency.

Facing a Decision as a Critical Thinker

Imagine this situation. You are on a four-day backpacking trip in a national wilderness area with your friends Juanita and Emilio. The summer weather's great, the scenery is exotic, and you've been having a good time. Yesterday you drove several hours into the area and parked in the main parking lot. Then you hiked six hours to your present campsite. The three of you carried all your food, water, sleeping bags, and tents.

Last night you discovered that somebody had accidentally cracked the large water container. Now you are stuck with no water. Although there is a stream nearby, you wouldn't normally drink from a stream, and you remember that your packets of water-sterilization tablets are in

the pocket of your other coat—the one you left at home at the last minute. The three of you are thirsty and have only dehydrated food left, except for four apples. You wish you had bothered to haul in that twelve-pack of Dr. Pepper you decided to leave in the car's trunk.

What do you do? Nobody brought cell phones. You could yell, but that is unlikely to help; you haven't seen any other hikers since the trip began. You try yelling, but all you get is an echo. You briefly think about snow, but realize there isn't any. Emilio says he has an idea: Boil the water from the stream. When it cools, you could drink it and make breakfast and continue with your good times. Then Juanita mentions seeing a sign back in the parking lot:

> ***Warning, Giardia has been found in many streams in the area. Sorry, but we are out of sterilization tablets.***

"Giardia is a microorganism that makes you sick," she says. You and Emilio have never heard of it. Emilio says he's willing to bet that boiling the water will kill the critters. "Besides," he says, "our stream might not have Giardia. I'll take the first drink." Juanita winces. "No, don't do that," she says. "Let's just pack up and go home." When you ask her why, she explains that a friend of hers got Giardia and had a bad experience with it. She doesn't want to risk having the same experience. When you hear the details, you understand why. The symptoms are chronic diarrhea, abdominal cramps, bloating, and fatigue. "Also," she says, "the park signs about Giardia are probably posted because the organisms cannot be killed by boiling."

However, she admits that she isn't sure of her interpretation of the sign, and she agrees with Emilio that the nearby stream might not even contain Giardia, so she decides to do whatever the majority wants. She adds that the three of you might get lucky while you are hiking out and meet someone who can help, maybe a hiker who knows more about Giardia or has extra water-sterilization tablets. Then again, you might not be so lucky; you didn't pass anybody on the way in. Hiking out while you all have a bad case of Giardia might even be life threatening.

Emilio agrees to go along with the majority decision, too. He wants to stay, but not by himself. Still, he isn't convinced by Juanita's reasons. "Look," he says, "if the stream were poisonous, everything in it would look dead. There are water spiders and plants living in the stream. It's no death trap."

At this point you are faced with one of life's little decisions: What do you do about the water situation? Go or stay? Someone else might make this decision by flipping a coin. A logical reasoner is more rational.

A first step in logical reasoning is often to get some good advice. You already have some advice, but how do you decide whether it's any good? There is one best way to identify good advice: It can be backed up with good reasons. Juanita's advice to go back home is backed up by these reasons: (1) the consequences of getting giardia are pretty bad, and (2) the posted signs probably indicate that boiling won't work. Unfortunately, she is not sure about the boiling. So the burden falls on your shoulders. Can you back up her reasoning even if she can't? Or can you show that her reasoning isn't any good?

One way to support a statement is to point out that the person making it is an expert. So you think about Juanita's and Emilio's credentials. Let's see—Juanita is a student majoring in psychology, and Emilio is a communications major and works at a pet store. Does that make them authorities on Giardia and the safety of drinking water? No. So if you need an expert, you will have to search elsewhere.

But you ask yourself: Is it really worth your trouble to search for more information from an expert? That search will probably require a hike back to the ranger station near the parking lot. Rangers ought to be relative experts on drinking from their streams. If the expert's advice is to avoid drinking the boiled water unless you have sterilization tablets, then you'll have to hike all the way back to camp to tell the others and then start the process of packing up and hiking out. It would be a lot easier just to follow Juanita's advice to pack up and leave now.

So what do you decide to do? Let's say you decide not to search for more advice, and you recommend boiling the water and drinking it when it cools. You now owe it to Juanita and Emilio to give them the reasons behind your decision.

Your first reason, let’s say, is that you discounted Emilio's remark that if the stream were poisonous then everything in it would look dead. Deadly things can be alive and look healthy. You mention salmonella on delicious turkey burgers. You are certain that there are microbes that harm humans but do not harm plants and fish; you mention to Juanita and Emilio that crabgrass and catfish do not catch cholera.

Your second reason comes from reconsidering that sign at the ranger station. If nothing works to kill Giardia, then the warning probably would have been more serious; you wouldn't even have been allowed into the park or at least you would have been warned in person. The sign said the station is out of sterilization tablets, implying that sterilizing the water *will* make it safe. Safe in what sense? Sterilizing means killing or removing all the living organisms, but not necessarily all the harmful chemicals. If you were to sterilize water containing gasoline, that wouldn't make it safe to drink. So, the problem is definitely the microorganisms. Now surely the rangers know that hikers are apt to try to sterilize water by boiling it. You reason that if boiling wouldn't work, the sign would have said so. Then you vaguely remember hearing that people in Africa were told to boil drinking water to prevent cholera, and you think cholera is caused by a parasite or bacteria or something living in the water. Could cholera be that different

from Giardia, you wonder. Thinking about all this you conclude it is likely that boiling will do the trick. So, Juanita's worry about the danger of getting a bad disease such as Giardia is more than offset by the low probability of actually getting the disease if you boil the water. So, you recommend that your group stay in the mountains, boil the water and drink it after it cools.

That's how you have made your own decision. Is it a reasonable one? Yes, because it is based on high-quality reasoning. Is it the best decision—the one an expert would have made in your place? You don't know this, but yes, the experts do say that stream water will be safe if you boil it for a minute or two. Giardia is caused by protozoa which can't live for long at high temperature. Other micro-organisms can survive this heating, but they usually won't cause any human illness. The reason people use water-purification tablets instead of boiling is for convenience; using the tablets avoids all the extra time for the water to boil and then later to cool to drinking temperature.

Now let's turn to the principles of logical reasoning that have been used in this situation. The principles, which are the focus of the next section, are neither rules nor recipes; they are pieces of advice that must be applied flexibly. They are called "principles" only because it sounds odd to call something "piece of advice eleven" or "thing to do seven."

Advice for Logical Reasoners

All of us use these principles every day, so this discussion is just a reminder of what you already know. One principle is to ask for reasons before accepting a conclusion, unless you already have good enough reasons. You applied this principle when you asked Juanita why she thought it best to leave. Similarly, if you expect people to accept your own conclusion, then it's your responsibility to give them reasons they can appreciate.

> If you expect people to accept your own conclusion, then it's your responsibility to give them reasons they can appreciate.

Let's examine that last remark. A conclusion backed up by one or more reasons in any order is called an **argument**, even when the reasoner is not being argumentative or disagreeable. The word "argument" is a technical term we will be using frequently in this course. Being logical means, among other things, that you should give an argument to support your conclusion if you expect other people to accept it. But give people arguments they can understand. Don't get

overly technical. Otherwise, you might as well be talking gobbledygook. Tailor your reasons to your audience. Your goal in giving an argument is to design your reasons so that your audience sees that the reasons *imply* the conclusion. Another way of saying this is that your audience should see that the conclusion *follows from* the reasons given to support it.

———CONCEPT CHECK———

Which of the following passages contain an argument in our technical sense of that word?

a. I hate you. Get out of here!

b. I'm sure Martin Luther King Jr. didn't die during the 1960s, because it says right here in the encyclopedia that he was assassinated in Memphis in 1998.

c. The Republican Party began back in the 1850s as a U.S. political party. Abraham Lincoln was their first candidate to win the presidency.

d. I don't believe you when you say Martin Luther King Jr. could have been elected president if he hadn't been assassinated.

Try to discipline yourself to read and answer these sample exercises before looking up the correct answer in the footnote below, and before reading on. You do not need to write out the answer. The exercises are designed to test your understanding of concepts in the material you have just read. If you can answer the Concept Checks, then you will be ready to tackle the more difficult Exercises at the end of each chapter.

———[1]

Let's continue with our introduction to the principles of logical reasoning. (There are quite a few more principles to be uncovered.) For example, in the camping-trip story, you paid attention

---

[1] The answer to the present Concept Check is (b), even though there is an error in the encyclopedia because King was really assassinated in 1968. Choice (a) is not the correct answer because, although it does show two people having a disagreement, neither one is arguing in our technical sense of "argument," because neither is giving reasons for what is said. Choice (c), on the other hand, merely describes the Republican Party. One moral to draw from this Concept Check is that an argument based on incorrect information is still an argument; a bad argument is still an argument. A second moral is that an argument can have just one reason, although most arguments use more than one.

both to what Juanita said and to what Emilio said, and you wished there was a park ranger nearby to ask about Giardia. The underlying principle you applied is to recognize the value of having more relevant information. In the camping situation, it would not have been irrational to choose to pack up and go home, but it probably wouldn't have been the best decision. The point is to make your decision on the basis of a serious attempt to assess the relevant evidence. You did this when you paid attention to probabilities and consequences—you **weighed the pros and cons**—of going or staying. That is, you weighed the benefits and drawbacks.

Here's a picture above of what to do. Think of a balance scale in which objects can be placed on either side of the scale. Put the pros on one side and the cons on the other, but assess each one by its significance or "weight." After all the pros and cons are assessed this way and added onto the scale, the winner is the side that tilts downward. Some considerations weigh more than others, so it's not just a matter of which side has a longer list of reasons. Weighing means considering how much you'd gain or lose if one of the consequences were to occur. Also, you should consider how probable it is that a particular consequence would really occur. Don't give much weight to a possible consequence that is one in a million.

More precisely stated, the procedure of weighing the pros and cons is a decision procedure that requires

> (1) considering the possible courses of action (pack up and hike back out, stay and boil the water, go on a search for a wet leaf to lick, and so forth),
>
> (2) guessing the consequences of those various courses of action (being thirsty, continuing the camping trip, getting a disease),
>
> (3) evaluating those consequences (being thirsty is a negative, continuing the camping trip is a positive, getting a disease from Giardia would be terrible), and

(4) considering the probabilities that those various consequences will actually occur (It is 100 percent probable that you won't be thirsty after you drink from the stream. It is only very slightly probable that you'll catch a disease if you drink boiled water.)

It can be helpful to delay making important decisions when that is practical. During the extra time, you will have an opportunity to think through the problem more carefully. You could discover consequences of your decision that you might not have thought of at first. For example, in the camping situation with Emilio and Juanita, you might have quickly agreed to let Emilio taste the water first to see whether it had Giardia. Perhaps only later would you have thought about the consequence of his becoming too sick to hike back out of the forest. Would you have been able to carry him back to safety?

Faced with a question of what to do or believe, logical reasoners try to weigh the pros and cons if they have the time; they search around for reasons that might favor their conclusion while not hiding anything negative. That is, they identify the reasons in favor of taking a specific position on the issue, and they identify the reasons against taking that position; then they weigh the two sets of reasons and arrive at a conclusion fairly.

Here is a second example of logical reasoning that weighs the pros and cons. Imagine that a few days ago you promised Emilio you would go to the movies with him this Friday evening. You have every intention of going, but you are mildly considering going with Juanita instead, and telling Emilio you are sick, even though you aren't sick. Telling him you are sick while instead going with Juanita would be called an alternative action. Let's weigh the pros and cons of taking the original action or this alternative action. (We won't consider other alternative actions, such as asking Emilio whether Juanita can go with the two of you.)

One possible consequence of going only with Juanita is that you would have more fun. It's not that you would have no fun with Emilio; it's just that you believe it would be more fun to go only with Juanita, all other things being equal. You estimate that the odds are about 60-40 in favor of more fun if you go with Juanita instead of Emilio. Another possible consequence is that Juanita will at first be flattered that you asked her to go with you.

There is still another possible consequence to consider: You will be breaking your promise to Emilio, which would be morally wrong and thus have a negative value. It wouldn't be as negative as letting Emilio drink water that you know will cause a disease, but it is clearly negative, and the probability of this consequence is 100 percent; that is, it is certain to occur if you tell Emilio you are sick. In addition, if Emilio finds out, then your friendship with him might end. This is also a negative, and one that is likely to occur, but then again Emilio might never find out what you've done. Finally, there is one more consequence worth considering: If Juanita finds out you broke your promise to Emilio, she will consider you less trustworthy than she originally thought. This is a negative, too. At this point, you cannot think of any other consequences that should be taken into account.

After pondering all this, you realize that it is likely that most of the negative consequences will actually occur if you do go out with Juanita, and these negatives are worse than the extra fun you'd have with Juanita and that it's only about sixty percent likely that you will have more fun with Juanita. So the negatives weigh more than the positives. After weighing the pros and cons of the two alternatives this way, you decide to keep your promise to Emilio. That is logical reasoning in action.

A critical thinker doesn't always use the procedure of weighing the pros and cons. Weighing the pros and cons will give you a good answer only in limited situations where you know the important consequences of your potential actions and where you have enough time to consider those consequences. In many situations, the best thinking requires taking shortcuts--making quick guesses or relying on a trusted friend to make the decision for you.

Logical reasoners need to be flexible thinkers. For example, in a situation where you're playing baseball and a friend yells "Duck!" it is illogical to spend much time searching around for good reasons. The logical thing to do is to duck down immediately. Nevertheless, even in this situation you didn't duck without a good reason. You know from previous experience that "Duck" said in a certain tone of voice means that there is a danger to your head that requires lowering it fast and protecting it from a sudden impact. You know not to stick your head up and say "Where's the duck?" Similarly, if someone were to run out of the Wells Fargo Bank building shouting, "Look out, the bank is being robbed," it wouldn't be logical to spend much time wondering what river bank the person is talking about. The point is that logical reasoners assess what is said in light of the situation. That is all part of our common sense.

Be sensitive to the situation. If you happen to know what time it is when someone passes you on the street and asks you, "Do you know the time?" it is illogical to answer only "Yes" and walk away— unless you are trying to irritate the person who asked the question.

Real life decision-making often must work in a dynamic, unpredictable environment. In the business world, new competitors appear, prices rise or fall, opportunities that were available at one time are not available at another. The uncritical decision maker is unaware of these changes and continues to make decisions as if in the old environment.

Alert decision makers understand the need to know when time is getting short and a decision is needed. This sort of recognition requires frequently asking in the background, "Should I continue to weigh the pros and cons, or should I stop and act now?"

> The less time available, the more rational it becomes to be reactive and to act on intuitions or 'gut instinct.'

———CONCEPT CHECK———

Ramone's friend says, "Ramone, look at those two white guys on the other side of the street. They look friendly. The blond guy with him looks like he would rip your lungs out just to see what would happen. The other one is just as fierce, and he's carrying the radio I lost yesterday; it's got my sticker on the side."

If Ramone leaves believing that the two guys are friendly because his friend said, "They look friendly," then he has violated some principle of logical reasoning. What principle?

- Reasons should be tailored to the audience.
- Don't take people too literally.
- Consider the possible courses of action.
- Weigh the pros and cons.

———[2]

Like everyone else, you are curious, so you are open to adding new beliefs to your old beliefs. There are logical—that is, appropriate—ways of doing this, as well as illogical ones. The goal is to add truths, not falsehoods. For example, you are waiting in the grocery store checkout line and notice a magazine's front-page headline, "World War II Bomber Discovered Intact on Surface of Moon."

You didn't know that, did you? Well, it wouldn't be logical to believe it. Why not? Here are three reasons: (1) Bombers can't fly to the moon, (2) no one is going to bust the national budget to send one there by rocket ship, and (3) there aren't any alien-piloted UFOs that snatch military antiques. The principle behind this logical reasoning is:

> Use your background knowledge and common sense in drawing conclusions.

---

[2] The second choice is correct. From what else the friend says, you should be able to tell he was being sarcastic and wasn't serious about the two guys being friendly. He didn't mean for Ramone to take his statements literally.

There is a Calvin and Hobbes cartoon in which Calvin finds some charred rocks and ashes in his back yard and claims this is dramatic proof that UFOs landed in his backyard. That cartoon also illustrates the following principle of logical reasoning:

> Extraordinary statements require extraordinarily good evidence to back them up.

A bit of charcoal is not extraordinarily good evidence of a UFO landing, but you ought to have extraordinarily good evidence if you are going to believe in such an unlikely event.

Similarly, if I were to say to you, “I met my friend Tiffany Whetstone at the Co-op Grocery yesterday afternoon," you would demand very little evidence that this is so. Perhaps the confirming word of a mutual friend would settle any doubts you might have. However, if I were to say to you, “I met my friend Tiffany Whetstone, who has been dead for the last ten years, at the Co-op Grocery yesterday afternoon," you would probably think I was lying or crazy. You certainly would demand extraordinarily good evidence before accepting what I said as true. In this case, even a confirmation by our mutual friend would be insufficient evidence. However, suppose I said instead, “I met my friend Tiffany Whetstone at the Co-op Grocery yesterday afternoon. She has a wooden leg and had just won two sets yesterday in her doubles tennis match. She is the best player on her tennis team in Antarctica." You ought to think I was joking. If you find that I’m not, then you ought to think that my statement is weird, though not as weird as the one about her being dead for ten years. It could be true that she played tennis in Antarctica and has a wooden leg, but you ought to suspend belief until you get some very good evidence. By not relying on the principles of logical reasoning, some people are apt to make the mistake of believing too easily that there are World War II bombers on the moon, that UFOs have landed in someone's backyard, and that dead friends have come back to life. All these things might have happened, but currently available evidence is extremely weak. The only reason to believe these things is that a few people have said they’ve happened. And you have lots of background beliefs and common sense that suggest these things very probably did not happen.

It is a sign of being logical if the degree of confidence you have in your reasons directly affects the degree of confidence you place in the conclusion drawn from those reasons. A person who believes strongly even though the reasons are flimsy is being stubborn or dogmatic.

———CONCEPT CHECK———

Here are three arguments about the issue of how David's uncle died. All three are arguing for the same conclusion—that David's uncle died of a drug overdose. Which of these arguments should be considered the most convincing, using only your background knowledge and common sense?

a. David said that his uncle died of a drug overdose, so his uncle must have died of a drug overdose.

b. David's uncle died of a drug overdose because we know that David predicted two years ago that this is how his uncle would die.

c. Look, the coroner's report specifically says that David's uncle is dead. Also, everybody in the neighborhood knows that the uncle did drugs every day. So, his uncle died of a drug overdose. I don't know what David thinks, though.

———[3]

Following the rules of logical reasoning comes more easily to some people than to others. All of us, however, are capable of improvement, and we all should want to improve, because improvement has a yield, a payoff: you tend to minimize your false beliefs, and you perform actions that don't have such bad consequences.

Being logical isn't the only way to make high quality decisions. Sometimes these decisions are made by accident; sometimes they are made in illogical ways, such as by following a horoscope. In the long run, however, statistics show that the smart money is on logical reasoners. Logical reasoning pays. When the expert says, "Hey, don't drink that stuff; it could kill you," the logical reasoner will defer to the expert and put down the cup. The irrational thinker will think, "Experts have been wrong in the past; I'm drinking anyway."

Everyone knows that the best decisions are based on facts, but how do we go about distinguishing facts from all the opinions we are faced with? This book provides many helpful

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[3] Answer (a) provides the best reason to believe that David's uncle died of a drug overdose. Although the world has lots of liars in it, we generally take people at their word unless we have a reason to be suspicious. Answers (b) and (c) give worse reasons. Answer (b) asks us to believe David's prediction from two years earlier. It makes more sense to trust what David is saying today (which is what we have in answer (a)) than what he said two years ago about the future. Answer (c) gives us a very good reason to believe that the uncle is dead but gives only a very weak reason about the cause of death. Maybe the uncle did drugs but got hit by a truck. So, answer (a) is best. (The best information would be the coroner's report or a police report on what caused the death, but you don't have that information to use.)

hints on this topic. One hint is that a fact is the same thing as a truth, and a truth does not change depending upon how many people accept it. A second hint is to avoid accepting inconsistencies; they are a sure sign of error. We made use of this logical-reasoning principle when we noticed that Juanita's advice to end the camping trip was inconsistent with Emilio's advice to continue it. Detecting an inconsistency doesn't reveal where the fault lies, but it does tell us that a fault is present. If some man says the surface of Neptune on average is colder than 200 degrees below zero, and his sister says that it's not nearly that cold, one of the two must be wrong about the facts. We know this even if we don't know the facts about Neptune. So, one of the cardinal principles of logical reasoning is:

> Be consistent in your own reasoning and be on the lookout for inconsistency in the reasoning of others.

Here is a definition of inconsistency:

> **Definition** Statements are *logically inconsistent* if they conflict so that at least one of them must be false because together they imply something is so and also not so. Similarly, a group of instructions is inconsistent if together the instructions imply that somebody must both do and not do something.

———CONCEPT CHECK———

Which of the following, if any, are most likely *not* principles of logical reasoning?

- Don't accept inconsistent beliefs.
- You ought to give an argument in defense of what you want another person to believe.
- The degree of confidence you have in your reasons should affect the degree of confidence you have in your conclusion.

———[4]

Statements are logically inconsistent with each other if you can tell just from their meaning that they can't all be true. A group of statements is **logically consistent** if it's not logically

---

[4] All are principles of good reasoning.

inconsistent. Because a statement is usually made with a declarative sentence, we commonly speak of *sentences* being consistent or inconsistent with each other and don't mention the word "declarative." Also, we usually don't use the word "logically."

———CONCEPT CHECK———

Create two sentences about basketball that are inconsistent with each other.

———[5]

Examples of Good Reasoning

So far we've explored the importance of reasoning logically in situations that require a decision—either a decision about what to do or a decision about what to believe. Along the way we've introduced a variety of rules of thumb for good reasoning, that is, high-quality reasoning. We have called these *principles of logical reasoning*. We have examined short examples of good reasoning and short examples of bad reasoning. The Giardia example was a long example of good reasoning.

Here is a second, long example—one that is slightly more complicated and uses some other especially interesting principles of good reasoning. The scene is a jury room in which jurors are discussing whether Jesse Mayfield is guilty of armed robbery. The State of Alabama, represented by the prosecutor, has charged Mayfield with using a handgun to hold up the All-Night Grocery in downtown Birmingham.

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[5] Michael Jordan is a basketball player. No, he's not.

Juror Washington Jones begins the dialogue by reasoning about the case presented by the prosecuting district attorney against Mayfield. Another juror, Dr. White, disagrees with what juror Jones says. Each of the two speakers offers his own argument about which explanation of the defendant's actions is best.

Jones: OK, let's consider what we know. We know there was a crime, since we can believe the grocery owner's testimony that all the night's receipts are missing. The grocery clerk confirmed that testimony. She is the lone eyewitness to the crime; there were no others in the store at 2 a.m., when she said the crime was committed. We also know the grocery's videotaping system had been broken all week. The prosecutor has also proved that Mayfield arrived at the grocery that night at about 2 a.m. The evidence for that is that the time was on the grocery receipt found in his wastebasket when the police arrested Mayfield at his house later that morning. Mayfield matches the general description of the robber given by the clerk at 2:30 a.m., when she talked to the police. So we've got to conclude that Mayfield was in the store at 2 a.m. and that the robbery occurred before 2:30 a.m., probably at 2 a.m. The clerk also stated that the robber ran out of the store and headed into a nearby apartment complex. Mayfield lives in an apartment in the direction she pointed to. A neighbor told the police that Mayfield ran up his apartment's steps sometime around 2 a.m. that night. What else do we know that can be considered as evidence against Mayfield? Let’s see. Mayfield has no record of robbery, but he was convicted of minor assault against a neighbor six years ago. Well, that's about it. Does that make the case for the prosecution?

Dr. White: Yes, he's guilty; there's no other explanation for the evidence. I say we vote right now.

Jones: Hold it, Doc. There is another explanation, and Mayfield's defense attorney gave it to us. Maybe Mayfield was there all right, but just to buy a bottle of whiskey, and the clerk stole the money that night after Mayfield left. She could have hidden the cash and then called the cops. The whole case against Mayfield hangs on what she alone says. Mayfield says he is innocent, but he admits being in the store in the early morning to buy whiskey. The prosecutor admitted that none of the stolen money was found, and no gun was found. So, all the facts fit that other explanation just as well as the prosecution's explanation. Besides, there is an additional reason to suspect the clerk: The defense has shown that she was thrown out of her college sorority for stealing their petty cash. I say the defense attorney has shown that Mayfield could have been framed. Sure, there's some evidence against Mayfield, but not enough.

Dr. White: Mayfield is as guilty as sin. He won't even look the judge or the prosecutor in the eye when they talk to him. Very suspicious. You left that out of the story, Jones. Mayfield's an alcoholic, too. Think of the number of crimes committed by alcoholics. They need that next drink, right? Also, even though he now admits being in the All-Night Grocery that morning, Mayfield lied about being there when he was first arrested, didn't he?

Jones: Yes, but what does that prove? He was arrested with his wife present, which is why he lied about being there, according to his defense attorney. He said she wouldn't let him buy whiskey with her money. Now, about that guilty look. Guilty looks don't make you guilty. I can think of ten reasons why he looks that way. The case against Mayfield isn't proven, at least not beyond a shadow of a doubt. Better that five robbers go free than one innocent person gets locked up. What do the rest of you jurors think?

Dr. White: That's just crap! He's guilty! Listen, you can't call that nice young white clerk a liar. It's Mayfield who's the liar!

If all this is supposed to contain an example of good reasoning, what is so good about it? Well, first, Jones uses the following principle of logical reasoning when he is explaining the facts of the robbery case: Explanations should fit all the relevant facts. Second, Jones demonstrates good reasoning in that he understands his responsibility to back up his conclusion that the case against Mayfield isn't strong enough. Jones backs it up by showing that a second explanation, the frame-up story, fits the facts just as well. In doing so, he listens to the opposition, tries to consider all the evidence, and weighs the pros and cons. By pointing to the defense attorney's explanation of the facts and cautioning his fellow jurors that the D.A. has not presented enough evidence, Jones uses a key principle of logical reasoning:

> Your opponent's explanation is less believable if you can show that there are alternative explanations that haven't been ruled out.

Jones demonstrates an understanding of the fact that weaker reasons require a more cautious conclusion; he doesn't overstate his conclusion. He is careful to follow the principle: Don't draw a conclusion until you've gotten enough evidence; he doesn't rush to judgment. Jones obeys another principle of logical reasoning: Stick to the subject. White goes off on a tangent, talking about alcoholism and whether Mayfield looked the judge and DA in the eye. The comment about the clerk being white is also irrelevant, and probably racist. On the other hand, all of Jones's remarks are relevant.

There is much more that could be said regarding the reasoning in this robbery case. We won't pursue this case study any more, but in later chapters we will explore all the principles of logical reasoning that were just mentioned.

This book is concerned with many other kinds of reasoning, not just with argumentation. For example, when you are trying to summarize a complicated explanation of allowable deductions on I.R.S. income tax form 1040 Schedule C, you are not arguing, but you are doing some critical thinking. Your critical thinking skills also involve assessing whether a group of sentences are consistent, whether a proposed definition is successful, whether an advertisement gives any useful information about a product, whether a speaker is being fair in a debate with an opponent, whether a statistical sample was biased, and whether someone's supposed scientific explanation is unscientific. This book is designed to improve all these other critical thinking skills, too, even though they don't directly involve arguments.

Review of Major Points

This chapter emphasized that logical reasoning is your guide to good decisions. It is also a guide to sorting out truth from falsehood. This chapter began with several case studies of logical reasoning. It also pointed out some common errors in reasoning. From these examples we were able to extract the following **principles of logical reasoning**: (1) ask for reasons before accepting a conclusion, (2) give an argument to support your conclusion, (3) tailor reasons to your audience, (4) design your reasons to imply the conclusion, (5) recognize the value of having more relevant information, (6) weigh the pros and cons, (7) consider the possible courses of action, (8) look at the consequences of these various courses of action, (9) evaluate the consequences, (10) consider the probabilities that those various consequences will actually occur, (11) delay making important decisions when practical, (12) assess what is said in light of the situation, (13) don't take people too literally, (14) use your background knowledge and common sense in drawing conclusions, (15) remember that extraordinary statements require extraordinarily good evidence, (16) defer to the expert, (17) remember that firmer conclusions require better reasons, (18) be consistent in your own reasoning, (19) be on the lookout for inconsistency in the reasoning of yourself and others, (20) check to see whether explanations fit all the relevant facts, (21) you can make your opponent's explanation less believable by showing

that there are alternative explanations that haven't been ruled out, (22) stick to the subject, and (23) don't draw a conclusion until you've gotten enough evidence.

These principles are merely pieces of advice; they are not rules or recipes. All the points, principles, and problems discussed in this chapter will receive more detailed treatment in later chapters. Those chapters will continue to systematically explore the intricacies of being logical. Although not all the logical principles in the world will be introduced in this book, all the most important ones will be. Regarding the problem of whether some are more important than others: not to worry; the relative importance of the principles will become clear as we go along.

As you investigate arguments during the course, you will improve the following skills:

- RECOGNITION of arguments
- EVALUATION of arguments
- CREATION of arguments

> "Critical thinking is skeptical without being cynical. It is open-minded without being wishy-washy. It is analytical without being nitpicky. Critical thinking can be decisive without being stubborn, evaluative without being judgmental, and forceful without being opinionated."
>
> --Peter Facione

Glossary

argument An argument is a conclusion backed up by one or more reasons. In this sense of "argument," there is no requirement that there be two people who disagree about anything.

critical thinking: Critical thinking is when you turn off your mind, relax, and float downstream. Hmm. Not such a good definition, is it? Maybe you can do better.

inconsistent A group of statements is inconsistent if it implies that something is so and not so. [Chapter 9 is devoted to this concept.]

issue The specific point of disagreement that inspires someone to present an argument. The argument's conclusion favors one side of the issue over the other.

topic The general area of the issue. If the issue is whether Americans prefer southern European food to northern European food, then the topic might be American taste preferences.

weigh the pros and cons In deciding on taking an action, you weigh the pros and cons by looking at alternative actions that can be taken, then considering the probable good consequences of each action and the probable bad consequences while weighing the positive and negative impact of each consequence. It's a kind of cost-benefit analysis.

Exercises

1. Columbus Day is an American holiday. Write a short essay that weighs the pros and cons and then comes to a decision about whether there should be more or less public celebration (by Americans and their institutions) on Columbus Day, October 12. Here is some relevant background information to reduce your research time. Christopher Columbus was a brave explorer, an adventurer, a breaker of new ground. Unlike Leif Ericson of Norway and other explorers who also visited the Western Hemisphere before Columbus, Columbus was the principal European who caused large numbers of other Europeans to follow him to the hemisphere. He was integral in causing the Western hemisphere to now have its long history of European culture. He brought new technology and new religion that spread throughout the hemisphere. He sent attack dogs to maul naked Indians, seized Caribbean women as sex slaves, and disemboweled other natives who resisted conquest. Many were hanged, some were burned alive. He chopped off the hands of thousands who were slow in producing the gold he wanted. Many Arawak Indians responded by committing a series of mass suicides. He shipped 500 Arawak Indians back on Europe as slaves, although 200 died on the voyage. He brought Western diseases which spread across North and South America, almost depopulating what is now California. He helped convince many people that the Earth is round. He brought new American foods to Europe and introduced European foods to the Americas. Thanks to Columbus, the wheel and the domesticated horse entered the Americas.

2. Suppose your family has decided it needs a new car. Also, suppose your family has enough money to buy a car, although the car's cost is a factor to consider. You have been asked to make all the other family decisions about the new car, such as which car to buy, how and where to buy it, what financing to use, and so forth. Create—that is, make up—the primary reasons for the car choices you make. Maybe you want it to use in the family business, or maybe you want to use it as a second car that is always available to take your live-in Aunt Mary to the doctor twice a week, or maybe you want it to be the family's primary car. Make your situation realistic; don't, for example, have your primary reason be to have a getaway car for a bank robbery. Once

you've created the situation, make recommendations to your (pretend) family. Describe how you went about making your decision. Include details, and be sure to mention what sources of information you used to help you with your decision. Concentrate on being clear in expressing yourself and on trying to make a logical decision, that is, a rational decision.

3. During the rest of the school term, create a journal of pieces of reasoning. Collect examples of reasoning that you find in your own experience. Sources might be web pages, newspaper or TV ads, magazine articles, conversations, books, and so on. Cut out, photocopy, or write up each example on a regular-size page (8.5 x 11 inches). Below each example (or on an accompanying page) identify where the reasoning came from, including page number and the date of publication or broadcast or conversation you heard. Then identify the reasoning that occurs, and defend your identification. Your goal should be fifteen examples. Staple your fifteen pages together in the upper left corner, adding a cover page containing your name and class hour. The best journals will be those that contain a wide variety of examples of ideas from this chapter and future chapters, such as (a) examples of deceptive techniques by advertisers, salespersons, and propagandists, (b) examples of reasoning errors discussed in later chapters, (c) examples of violations of several principles of good reasoning or good criticism, and (d) two to four examples of good reasoning.

4. For the following hypothetical situation, state what decision you recommend and why you recommend it. Weigh the pros and cons, and describe your process of weighing the pros and cons.

> A West Virginia radio telescope recently detected an unusual signal beamed in our direction from somewhere across the Milky Way galaxy. After six months of study by the world's best scientists, it is agreed that the signal comes from an intelligent source and contains the message which says, when translated into English, "Can you hear us? Describe yourself and where you are located." The continuously repeating message also includes a very brief description of the other civilization, indicating that they are a hydrocarbon-based life form that lives on two planets around a central star. Their signal gave no indication they know we exist. You, a leading government official, have been asked by your president for your opinion about how or whether Earth should respond to the message.[6]

■ 5. Assume the quotation contains a sensible argument with a word or phrase taken out and replaced with a blank. Choose the best way to fill in the blank.

---

[6] Here are some helpful hints on this question. How expensive would a response be? What's to be gained from making contact? Would it make any difference if they were a predator civilization? What are the chances we could ever meet them? Are they more likely to be less advanced than us, or more advanced than us?

"Juan's envelope has got to be here somewhere _____ I had it when I left class, I had it when I ate lunch after class, I had it when I was getting in the car to drive here, and I know I didn't drop it until I got in here. The envelope is a mystery, but it can't just disappear, can it?"

a. but suppose
b. therefore
c. because
d. but it's not the case that
e. and[7]

6. Select some decision you made this week and write a short essay (under two pages, typed double-spaced) in which you explicitly weigh the pros and cons of making the choice you made as opposed to alternative choices you might have made.

7. Weigh the pros and cons of whether to sign up for an Internet version of a college course in Asian history instead of the regular version in which you sit in a classroom in front of the instructor. Assume the course tuition is the same either way.

8. Consider Emilio's reason for drinking the untreated stream water: "Look, if the stream were poisonous, everything in it would look dead. There are water spiders and plants living in the stream. It's no death trap." Which statement below best demonstrates the *weakness* of Emilio's argument in favor of drinking the water?

a. In arguments, some statements are true; some are false. You cannot always tell which.

b. Some things that will kill water spiders won't kill the plants, and vice versa.

c. Many things that are harmful to humans are not harmful to water spiders.

d. Before making a decision one should weigh the pros and cons, yet Emilio isn't considering the pro side of his own position, namely that water spiders and plants need water, too.

9. In weighing the pros and cons of the camping situation with Emilio and Juanita, you considered whether to pack up and go home, stay and boil the water, or hike for help. If you failed to notice that Juanita had hiked in with a cell phone which you could use to call for information about Giardia, then you would have failed to

a. consider all the possible courses of action.
b. identify the consequences of a course of action.

---

[7] Answer (c).

c. evaluate the consequences of the action.
d. consider the probability that the consequences will occur.

10. In weighing the pros and cons of the camping situation with Emilio and Juanita, you considered whether to pack up and go home, stay and boil the water, or hike for help. If you failed to notice that if you stayed and boiled the water, then you couldn't drink it right away but would have to wait until it cooled, then you would have failed to

a. consider all the possible courses of action.
b. identify the consequences of the course of action.
c. evaluate the consequences of the course of action.
d. consider the probability that the consequences will occur.

11. In weighing the pros and cons of the camping situation with Emilio and Juanita, you considered whether to pack up and go home, stay and boil the water, or hike for help. You briefly noticed that, if you stayed, then you might all become sick. However, suppose you failed to notice how bad this would be. For example, you might need medical treatment but be too sick to go for help. So, in weighing the pros and cons, you failed to

a. consider all the possible courses of action.
b. identify the consequences of the course of action.
c. evaluate the consequences of the course of action.
d. consider the probability that the consequences will occur.

12. In weighing the pros and cons of the camping situation with Emilio and Juanita, you considered whether to pack up and go home, stay and boil the water, or hike for help. Suppose you considered packing up and hiking home and noticed that you could get very thirsty on the hike back. If you failed to notice that you definitely would get very thirsty in this situation, then you would have failed to

a. consider all the possible courses of action.
b. identify the consequences of the course of action.
c. evaluate the consequences of the course of action.
d. consider the probability that the consequences will occur.

CHAPTER 2 Claims, Issues, and Arguments

Every argument contains at least one intended conclusion plus one or more supporting reasons, called premises. However, in some passages it is not easy to tell whether an argument occurs at all, nor what the premises and conclusion of an argument really are, nor how other arguments in the passage are related to that argument. This chapter explores that understatement. It begins with an introduction of special phrases that often indicate the presence of premises and conclusions. Then the chapter investigates the problems of identifying the unstated premises and conclusions. For especially complex argumentation, the chapter introduces a diagramming technique that can provide a helpful display of the argument structure.

What is a Statement?

Statements are what is said. More accurate, statements are things that are said that are either true or false. They are also called *claims*. Here is one: "Neptune has the fastest winds in the solar system." A statement that is especially important to us might be called a *proposition*, *assertion, judgment*, *hypothesis*, *principle*, *thesis*, or, in some situations, a *law*. Statements have to be capable of being true or false. So, if you say, "Is it midnight?" then you've not made a statement. Suggestions, commands, and proposals aren't statements either. The suggestion "I suggest we should get a new refrigerator," and the command, "Stand back!" and the proposal, "Let's quit studying," are not statements. It would be very odd to call any of them "true" or "false." The following *are* statements: "She suggested we should get a new refrigerator," and "He commanded us to stand back," and "He proposed that we use the office budget to buy a new refrigerator."

Although there is a difference between a declarative sentence and the statement made with that sentence, this book will often not honor that distinction and will speak of declarative sentences themselves as being statements or claims.

———CONCEPT CHECK———

Is the following sentence a statement?

> The biggest question your pre-historic ancestors faced was, "Is that thing behind the bushes my next meal, or am I *its* next meal?"

———[8]

You can't spot the claims if you don't speak the language. In the passage below from a famous Valley girl, try to decide whether the phrase in italics is (used to make) a claim. You won't be able to figure this out if you don't understand a little Valley-girl-ese.

> So, I loan Whitney my copy of *GQ*, right, and she drops strawberry yogurt right on the cover, and *like I could totally be so edged*, but I tried to be cool.

To tell whether it's expressing a claim, you don't have to be able to figure out whether it's true, but only whether it could be—whether it's the sort of thing that might be true or might be false. The passage does make the claim. Its claim is that the speaker could be upset by Whitney's dropping strawberry yogurt on her copy of *GQ Magazine*.

In spotting statements or claims, you need to pay close attention to language. One of the following is a claim and the other is not. Which is which?

> I promised to give you $5. I promise to give you $5.

---

[8] Answer: The question itself is not a statement, but the larger sentence containing the question is. The larger sentence is used to make a statement about the question.

What is an Argument?

The word *argument* has more than one meaning. In this book we will not use the word in the sense of being unpleasantly argumentative. Instead, it will mean at least one conclusion supported by one or more reasons, all of which are statements.

It takes only one person to have our kind of argument, not two. Saying that two people are "in an argument" means that there are two arguments, not one, in our sense of "argument." Each of the two persons has his or her own argument. In short, our word *argument* is a technical term with a more precise meaning than it has in ordinary conversation.

Statements that serve as reasons in an argument are also called ***premises***. Nothing to do with the yard sign that says, "Keep off the premises." Any argument must have one or more premises. And it will have one or more "inference steps" taking you from the premises to the conclusion. The simplest arguments have just one step. Here is an example of a very simple argument that takes you to the conclusion in just one inference step from two premises:

> If it's raining, we should take the umbrella.
>
> It is raining.
>
> So, we should take the umbrella.

———CONCEPT CHECK———

Match the numbers with the letters.

a. Only a claim, with no reasons given to back it up.

b. An argument using bad reasons.

c. An argument using good reasons (assuming that the arguer is being truthful).

d. None of the above.

1. What time does the movie start?

2. This card can save you a lot of money.

3. Vote Republican in the next election because doing so will solve almost all the world's problems.

4. John Adams was the second president of the United States. My history teacher said so, and I looked it up on *Wikipedia* with my phone.

———[9]

To find out whether an argument is present, you need to use your detective skills. Ask yourself whether the speaker gave any reason for saying what was said. If you get a satisfactory answer to your own question, then you probably have detected an argument, and you've uncovered its conclusion and premises. In detecting an argument, your main goal is to locate the conclusion, then the reasons given for that conclusion, while mentally deleting all the other sentences and phrases that are not part of the argument.

For any conclusion, the premises used directly to support it are called its **basic premises**. In a more complicated argument, there may be reasons for the reasons, and so on. But these reasons for the reasons are not part of the core. The core of the argument is the conclusion plus its basic premises.

Every argument has to start somewhere, so it is not a good criticism of an argument to complain that all its premises have not been argued for.

———CONCEPT CHECK———

Select the one best choice for the conclusion of Sanderson's argument in the following disagreement.

> *Sanderson:* Do you realize just what sort of news you get on a half-hour American TV news program?
>
> *Harris:* Yes, newsy news. What do you mean?
>
> *Sanderson*: Brief news, that's what.
>
> *Harris:* Brief news like boxer shorts?
>
> *Sanderson:* Ha! Look at a time breakdown of the average half-hour news program broadcast on American TV. It is nine minutes of news!
>
> *Harris:* What's the rest?

---

[9] d 1, a 2, b 3, c 4. Passage (1) is a question, not a claim. A claim is an assertion that something is true, and it is usually made with a declarative sentence.

Sanderson: Eleven minutes of commercials, six of sports, and four of weather. You can't do much in nine minutes. I say nine is not enough if you are going to call it the "news." What do you think?

Harris: It is enough for me. News can be boring. Besides, if the American public didn't like it, they wouldn't watch it.

Sanderson: Now that's an interesting but ridiculous comment. But I've got to go now; we can talk again later.

Sanderson's conclusion is

a. If the American public didn't like brief TV news, they wouldn't watch it.

b. Do you realize just what sort of news you get in a half-hour American TV news program?

c. That's an interesting but ridiculous comment [about the American public's taste].

d. There is not enough news on a thirty-minute TV news program in America.

e. An average half-hour American TV news program is eleven minutes of commercials, nine of news, six of sports, and four of weather.

After choosing Sanderson's conclusion from the above list, comment on the quality of his argument for that conclusion.

[10]

[10] Answer (d) is correct. Sanderson's conclusion is that more time should be spent on the news during a thirty-minute TV news program. Answer (e) is wrong because it is simply a fact that Sanderson uses in his argument. It is something he wants the reader to believe, but it is not something he is arguing for. Regarding the quality of Sanderson's argument, saying only "I don't like his argument" is insufficient; it doesn't go deep enough. This kind of answer is just opinion. To go deeper, the opinion should be backed up by reasons. The weakest part of Sanderson's argument is that he isn't giving us good enough reasons to believe his conclusion. He makes the relevant comment that news occupies only nine minutes out of thirty. He then suggests that you cannot "do much in nine minutes," and he evidently thinks this comment is a reason to believe his conclusion, but by itself it is weak. He probably believes it is obvious that nine is brief, but he ought to argue for this. It's not obvious to his opponent, Harris. Harris could respond by saying, "You can do nine minutes' worth of news in nine minutes. What do you want instead, ten minutes?" Sanderson should have mentioned that too much important news is left out in nine minutes and then tried to back up this remark.

What is the Issue?

We argue in order to settle **issues**. Issues arise when there is uncertainty about whether to accept or reject a claim, or about what to do or not do. For example, someone argues for the claim that you ought to quit eating strawberry yogurt because it causes cancer, and you wonder whether it really does cause cancer. You are wondering about the following issue:

> whether eating strawberry yogurt causes cancer.

It's common to express an issue by using the word "whether" to indicate the uncertainty involved. You don't want to express the issue by taking just one side of the issue.

When two people are "in an argument," they are divided on the issue. The metaphor is that they are on opposite sides of the fence.

A second, common way of expressing an issue is to present it as a question:

> Will eating strawberry yogurt cause cancer?

The question also brings out the uncertainty and doesn't take a side. It would be a mistake to say the issue is *that* eating strawberry yogurt causes cancer. That way of present the issue destroys the uncertainty and presents only one side of the issue.

The issue is not the same as the topic. The topic is food and health. Topics are more general than issues; issues are more specific than topics. When you find an argument, the issue is whether the argument's conclusion is correct.

———CONCEPT CHECK———

The following sentence shows that the writer is confused about the difference between an issue and a claim:

> The issue of whether an oppressive government is better than no government is a claim open to refutation.

What is the best way to rewrite the sentence in order to remove the confusion?

> a. The claim of whether an oppressive government is better than no government is an issue open to refutation.
>
> b. The issue of whether an oppressive government is better than no government is a refuted claim.
>
> c. The claim that an oppressive government is better than no government is controversial and open to refutation.
>
> d. The issue of whether an oppressive government is better than no government is a position open to refutation.

———[11]

---

[11] The topic is oppressive governments. The issue is whether an oppressive government is better than no government. One position on that issue is the claim that an oppressive government actually is better than no government. This claim is controversial. Thus you should select c as the answer to the above question. That answer is the only one that isn't using one of the following terms incorrectly: issue, position, claim.

Our example above used the slippery term "refutation." If you claim what somebody just said is false, then you aren't refuting their claim; you are simply disagreeing with it. In order to refute it, you'd have to make a successful case that what they said is false. You can't refute someone's claim merely by contradicting it.

———CONCEPT CHECK———

What is the issue in this argument?

> You politicos keep arguing that institutions can't be changed when, in fact, they change all the time. Haven't they ever heard of the institution of slavery? It's gone from this continent, isn't it?

a. Can institutions be changed?

b. Whether the institution of slavery changed.

c. That institutions can be changed.

d. That institutions can't be changed.

———[12]

The notion of an issue is explored more deeply in a later chapter.

What is a Proof?

People often argue in order to prove something. But that word "proof" is a tricky word. There are different standards of proof in different situations. You have to meet a higher standard if you are proving a new theorem in mathematics than if you are proving to your neighbor that you saw the same film he did last week. Basically, though, a **proof** is a convincing argument, an argument that *should* convince your audience, not simply an argument that *does* convince them.

———CONCEPT CHECK———

---

[12] Answer (a). A *yes* answer and a *no* answer would be giving opposite answers to this issue.

Suppose you cannot locate that favorite blue shirt you want to wear. You've looked in the closet where you usually keep your shirts. You remember washing it at the Laundromat in your apartment building last week. Maybe you hung it back in the closet after that, or maybe you didn't. You can't remember. You don't remember any other time it has been out of the apartment recently. Could you be having a memory problem? You do remember your worst case of bad memory; last year you were sure your apartment key was on the kitchen table, but then you found it an hour later on a shelf in your refrigerator. But after thinking about this you decide that is very unlikely the shirt loss is because of memory failure. You decide to do a more careful search. You look through each item of clothing in your closet, on the closet floor, and in the drawers in your dresser where you place other clothes. You look a few more places in your apartment. Then you remember that occasionally you hang clothes in the closet on top of other clothes hanging there because you don't have enough coat hangers. So, you search your closet one more time looking under everything hanging there. Still no shirt. So you conclude, "This proves the shirt was stolen." You start thinking about your three friends who have been in your apartment since the last time you saw that blue shirt. David was there when you went out for an hour to get party supplies. The shirt would fit him. That proves the shirt was stolen.

A logical reasoner hearing this story might say, "That's not really a proof," and this judgment would be correct. What else would it take for you to have a real *proof* the shirt was stolen by David?

[13]

Indicators

Spotting an argument and assessing whether the argument is any good are two distinct abilities. Usually you use them both at the same time. You don't go looking for arguments without also evaluating them. However, before you can evaluate an argument, you have to identify it, so let's begin with this skill. Detecting arguments can be difficult sometimes, but there are clues to

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13 It's more likely you lost your shirt in the Laundromat than to a thief in your apartment. You can't have a proof without being sure that the shirt wasn't lost at the Laundromat or on your travels back from there. If you could rule this out, then you'd have a stronger case that it was stolen. Even so, that evidence about the Laundromat is not going to be available to you. Also, for a decent proof you'd need some more direct evidence of a thief, such as a friend telling you he saw David wearing it yesterday, or a neighbor telling you she noticed someone leaving your apartment yesterday carrying a blue shirt. Most probably you'll never get a proof your shirt was stolen even if it was, because having a proof requires having a totally convincing case.

look for. The start of a conclusion is often indicated by the word *therefore*, *so*, or *thus*. In addition to these **conclusion indicators**, the terms *because* and *suppose-that* signal that a reason is coming. Since the technical term for reasons is *premises*, the terms *because* and *suppose-that* are called **premise indicators**. The logical reasoner is always on the alert for premise indicators and conclusion indicators.

Often, however, arguers are not so helpful, and we readers and listeners have to recognize an argument without the help of any indicator terms. And even when we have indicator terms, we can't rely on them 100%. Those same terms might have other uses. For example, do you see why the conclusion indicator *so* is not working as a conclusion indicator in the following?

> Air contains molecules. Dirt does, too. So does water.

There's no argument here, just a sequence of claims. The word "so" is indicating another term in the sequence. It is working as the word "and" usually works.

———CONCEPT CHECK———

Does this sentence by Albert Einstein contain a conclusion indicator word that is actually working to indicate a conclusion?

> The unleashed power of the atom has changed everything save our modes of thing, and we thus drift toward unparalleled catastrophe.
>
> a. yes b. no

———[14]

———CONCEPT CHECK———

Do all strong arguments have two or more premises plus at least one conclusion?

> a. yes b. no

———[15]

---

[14] Answer (a). Einstein is giving an argument, and uses the word "thus" to indicate his conclusion that the human race is drifting toward unparalleled nuclear catastrophe.

[15] Answer (b). Some good arguments have only one premise. Here is an example: "Viruses are the simplest life forms on Earth, so that virus you are looking at with your microscope is simpler than other life forms."

When looking for an argument within a passage, you need to be alert that sometimes the conclusion is stated before the premises, sometimes after the premises, and sometimes embedded in the middle of the premises. Often, sentences are included that are neither premises nor conclusions; they are there for elaboration or for some other purpose, such as to entertain, to describe, to explain, to discount a possible complaint, and so forth.

Here is an example of an argument from authority that contains both kinds of indicator phrases:

> Because the encyclopedia says that the whale shark is the biggest fish in the ocean, it follows that the whale shark really is the biggest fish on Earth.

The word *Because* indicates a premise, and the phrase *it follows that* indicates the conclusion. Indicators come before what they indicate. After identifying this argument, you might go on to evaluate it as being fairly strong, but as leaving out the crucial information about whether there are freshwater fish bigger than any fish in the ocean. There aren't.

This table provides more examples of indicator phrases:

Premise Indicators

since

because

for the reason that

assuming

suppose

as indicated by

is implied by

given that

in view of the fact that

for

granted that

one cannot doubt that

Conclusion Indicators

therefore

consequently

thus

this means

so

it follows that

shows that

implies that

proves that

leads me to believe that

hence

in conclusion

for this reason

accordingly

the moral is

means that

we can infer that

as a result

can only be true if

The following phrases by themselves are not indicator phrases:

if	on the contrary
yet	and
nevertheless	also

So, do not trust these words to reliably indicate either a premise or a conclusion. Occasionally words that could be indicators do not function as indicators. Look at the word "since" in this example:

> *Since* November when the inflationary spiral ended, state taxes have been high. State farm subsidies will therefore continue to rise.

This passage does contain an argument, and the conclusion indicator word *therefore* signals the conclusion, but the premise indicator word *since* isn't functioning to indicate a premise. It is working as a time indicator. Because *since* has multiple meanings, you need to determine whether it is functioning as a premise indicator in the particular situation you are looking at.

The good news is that when it *is* a sign that some element of an argument is present, it always indicates a premise and never a conclusion.

Notice how different these two arguments are.

> She's not here, so she's gone to the supermarket.
> She's not here, since she's gone to the supermarket.

The two arguments have different conclusions, don't they? One of the arguments is much stronger than the other. Which one is that?

———CONCEPT CHECK———

Identify the indicator phrases in the following passage:

> I've been in love with you ever since you began going out with my friend Charles. So you shouldn't say no one loves you now that he doesn't love you anymore.

———[16]

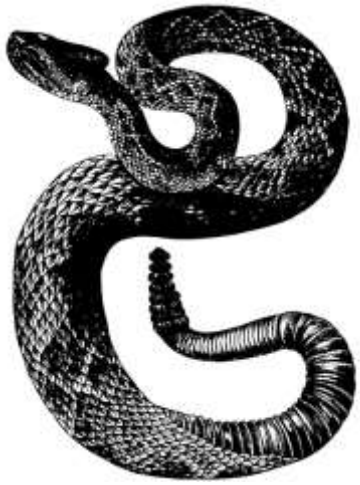
When you are suspicious that an argument is present in a passage, the best strategy for finding it, besides simply asking the arguer whether they are arguing, is to ask yourself which statements in the passage would be reasonably convincing premises for which other statements.

———CONCEPT CHECK———

Do these passages contain arguments? If so, locate the conclusion. Identify each indicator phrase as being either a conclusion indicator or a premise indicator.

16

> *So* is a conclusion indicator. *Since* is not operating as a premise indicator.



a. Never pick up a recently killed rattlesnake, because its nerve reflexes enable it to bite for some time after death.

b. Never pick up a recently killed rattlesnake. Its nerve reflexes enable it to bite for some time after death.

c. In a country with a billion people, even if you're a one-in-a-million type guy, there are still a thousand just like you.

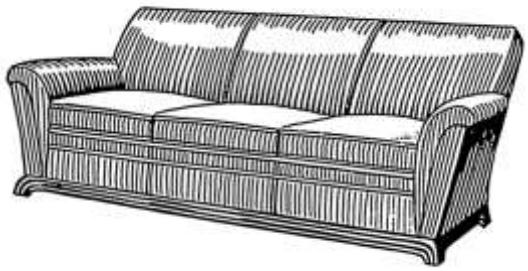
d. Though rare on Earth, plasmas are the most common form of matter in the universe, even more common than gases.

[17]

[17] (a) This is an argument. The conclusion is that (you should) never pick up a recently killed rattlesnake. *Because* is the premise indicator. (b) This is an argument with the same conclusion as in (a). Notice that the word *because* appeared in (a) but not in (b). Consequently, you have to work harder to locate the argument in (b). Good writers use indicator words to show their intentions to the reader. (c) This is not an argument. If there are a billion people, then being one in a million is not very special, is it? (d) This is not an argument. This kind of plasma has nothing to do with blood plasma. Besides solids, liquids, and gases, matter also takes the form of plasmas. A plasma is super-ionized in the sense that every electron has been stripped away from the nucleus. There are no ordinary atoms in a plasma. All stars are made of plasma. So are electric sparks.

Discount Indicators

It is very common for passages containing arguments also to contain claims that are neither premises nor conclusions but instead send a signal that another claimed should be de-emphasized or discounted. Here's an example where the phrase "Even though" is added to suggest that the cost of the sofa should be de-emphasized:



> Even though that sofa is very expensive, we should buy it anyway because we need one and this one is already here in the apartment we are going to rent.

The claim "The sofa is very expensive" normally would be taken as a reason not to buy the sofa. That claim is discounted with the phrase, "Even though." That phrase is called a "discount indicator."

A discount claim is not a premise.

Discount indicators point to relevant factors that would normally count against the conclusion being drawn; the discount claim is there to reject the factor or de-emphasize it. Discounting often increases the psychological persuasiveness of the argument because it shows that the arguer has paid attention to all the relevant factors.

The following terms are frequently used as discount indicators:

> even though
>
> I realize that..., but
>
> in spite of the fact that
>
> while it may be true that

Rewriting Arguments in Standard Form

Can you spot the conclusion and premises in this argument?

> All machines have a finite working lifetime, and even though that big tree doesn't look like a typical machine it is really just a biological machine; therefore, I believe it will stop working someday, too.

The claim "That big tree doesn't look like a typical machine" is a discount claim. The argument's conclusion is "That big tree will stop working someday." This conclusion does not occur explicitly in the passage. The conclusion is slightly hidden in the words that follow the indicator word *therefore*. We readers have to figure out that the word *it* is referring to "that big tree," and we must also mentally strip away the word *too* and the phrase *I believe*. The reason to remove "I believe" is that it is clear the arguing isn't trying to convince that he or she believes the conclusion, but is trying to convince you that the conclusion is true. After appreciating all this, we can give the following more explicit picture of the argument:

All machines have a finite working lifetime.
That big tree is really just a biological machine.

That big tree will stop working someday.

Creating this clear list with the conclusion below the line is called **rewriting the argument in standard form.** In place of a line, if you add the symbol ∴ before the conclusion, then that is also putting the argument into standard form. The term "standard form" means standard format.

The argument we've been analyzing was originally a single sentence, but this one sentence now has been shown to be composed of four statements, one being a discount claim and the other three being the core argument.

The process of transforming an argument into its standard form is like the subconscious mental process that occurs when a logical reasoner "sees the argument" in a passage. Normally, you would take the trouble to display the argument in standard form only when confronted with an especially complicated argument that you must figure out very carefully. Nobody is suggesting that from now on you sit down with the morning newspaper and rewrite all its arguments into standard form. However, trying your hand at rewriting a few simpler arguments will help build up your skill so you can succeed with more complicated arguments when the stakes are higher.

Here is a list of what you should pay attention to when rewriting an argument in standard form:

- List the premises, followed by the conclusion
- Remove extraneous sentences including discount phrases
- Remove indicator phrases

- Replace pronouns with their antecedents if possible
- Draw a line between the premises and the conclusion (or else place a '1∴' before the conclusion)
- Add implicit premises
- Remove ambiguity wherever possible
- There is no need to number the premises because premise order should not make any difference

———CONCEPT CHECK———

Rewrite the following explicit argument in standard form. Do not bother with unstated assumptions.

> Even though you might be tempted, never pick up a recently killed rattlesnake, because its nerve reflexes enable it to bite for some time after death.

———[18]

Conditionals and the Word *If*

The word *if* is not in the list of premise indicator words. You cannot rely on *if* to indicate a premise. Here is why. In argument A below, the word *if* is followed by a premise, but in argument B it is part of the conclusion.

A. If, as we know, all men are mortal and Jeremiah is a man, not a god, then he is mortal, too.

---

[18] It is important to remove the first pronoun from the premise. Here is the standard form of the explicit argument:

> The nerve reflexes of a recently killed rattlesnake enable it to bite for some time after death.
> ---
> You should never pick up a recently killed rattlesnake.

One implicit assumption here is that you don't want to be bitten; another is that you should act in a way that avoids what you don't want.

B. If a mercury thermometer is given prolonged heating, it will break. This is because prolonged heating will cause the mercury to expand a great deal. But the thermometer will break apart whenever the mercury expands this much.

Let's examine argument B more carefully. Does it assume that a mercury thermometer is actually given prolonged heating? No. Notice also that the conclusion is not that the mercury thermometer will actually break, but only that it will break *if* heated. The conclusion is an if-then statement: if the thermometer is heated, then it will break. So, the *if* is not indicating a premise, nor is it indicating a conclusion; it is performing another function. These if-then statements are called **conditional statements** or **conditionals**. When we say, "If we cancel the picnic, I'll be happy," we are offering a conditional, but not offering an argument.

A statement can be a conditional even if the companion word *then* is not present. For example:

> If the Campbell's Soup Company puts less salt in its soup, sales of Campbell's soup will increase.

Does it follow from this conditional claim that Campbell's Soup Company does put less salt in its soup? No. Is the speaker committed to the claim that sales of Campbell's soup will increase? No, the commitment is only to an increase on the *condition* that the company does something about the salt. That is why conditionals are called "conditionals."

Should you conclude from the original conditional statement that, if Campbell's sales do *not* increase, then the company failed to put less salt in its soup? Yes, this last conditional statement, called the **contrapositive** of the original statement, follows with certainty from the original conditional statement. We will explore contrapositives in more detail in a later chapter.

Conditionals have a **standard form** which is "If A, then B."

Often conditionals are expressed in other ways. For example, here is a conditional that contains neither an "if" nor a "then:"

> The larger a star the quicker it burns up and dies.

Rewriting it in standard form produces:

If a star is larger, then it burns up and dies quicker.

———CONCEPT CHECK———

The Governor of Alaska (on left)

Suppose you were to learn for certain that if a person is the governor of Alaska, then he or she is a U.S. citizen. If so, can you be *absolutely sure* that if somebody is not a U.S. citizen, then he or she is *not* the governor of Alaska?

———[19]

Is the following conditional making a true statement about the real world?

If President John F. Kennedy was born in Bangladesh, then he was born in Asia.

Yes, it is true, and it is true even though both the if-part and the then-part are false. There's a big lesson with that example:

> The truth of a conditional does not require the truth of its parts.

[19] Yes, you can be sure. This is the contrapositive of the original conditional.

Later in this book we will explore in more depth the logic of conditionals, that is, reasoning correctly about conditionals.

———CONCEPT CHECK———

Answer "yes" or "no, not always" to these conditional claims:

a. If it's an apple, then it's a fruit.

b. If it's a fruit, then it's an apple.

c. It's an apple if it's a fruit.

d. It's a fruit if it's an apple.

e. It's not a fruit if it's not an apple.

f. It's not an apple if it's not a fruit.

g. If the current president of the United States were also the leader of Pakistan, then the president would be the leader of an Asian country.

h. If the tallest building in the U.S. is only 15 feet tall, then there is no building in the U.S. taller than 30 feet.

i. If Joshua Dicker or his dad, Stuart, are invited, then Joshua Dicker's dad is invited.

———[20]

Deductively Valid and Inductively Strong

The primary goal in argumentation is for the conclusion to follow from its basic premises either with certainty or with high probability. Technically, this means the arguer desires the argument to be deductively valid or to be inductively strong.

---

[20] (a) yes (b) no (c) no (d) yes (e) no (f) yes (g) yes (h) yes (i) no. In (i), if the *or* were *and*, then the answer would be yes.

The concept of deductive validity can be given alternative definitions to help you grasp the concept. Below are five different definitions of the same concept. It is common to drop the word *deductive* from the term *deductively valid*:

> An argument is **valid** if the premises can't all be true without the conclusion also being true.
>
> An argument is **valid** if the truth of all its premises forces the conclusion to be true.
>
> An argument is **valid** if it would be inconsistent for all its premises to be true and its conclusion to be false.
>
> An argument is **valid** if its conclusion follows with certainty from its premises.
>
> An argument is **valid** if it has no counterexample, that is, a possible situation that makes all the premises true and the conclusion false.

This argument is valid:

> All emeralds are green.
> The stone placed in the safe deposit box is an emerald.
> So, the stone placed in the safe deposit box is green.

Here is a very similar argument that is not valid. Can you see why?

> All emeralds are green.
> The stone placed in the safe deposit box is green.
> So, the stone placed in the safe deposit box is an emerald.

That last argument has a counterexample. You can imagine a situation where all emeralds are green and the stone placed in the safe deposit box is green jade. That's a situation where the premises are true but the conclusion isn't. That situation is a counterexample.

An argument that is not valid is called **invalid** or **deductively invalid**. In **deductive arguments**, the arguer intends for the argument to meet the standard of being deductively valid. There are other, unrelated uses of the word "valid" such as when we say that word is not valid in a Scrabble game, or that is a valid way to travel from Paris to Amsterdam.

In **inductive arguments**, the arguer intends the argument to satisfy another standard, that the conclusion follow with high probability but not certainty from the basic premises. If it does, the argument is said to be **inductively strong**. Inductive strength is a matter of degree, unlike with deductively validity.

The distinction between deductive and inductive argumentation was first noticed by the Aristotle (384-322 B.C.E.) in ancient Greece. Since arguers don't always have clear intentions about whether their goal is to create a deductive valid or an inductively strong argument, it is very often up to the logical analyst to decide which treatment works best.[21]

When we study inductive arguments in later chapters we will see that an inductive argument can be affected by acquiring new premises (evidence), but a deductive argument cannot be. For example, this is a reasonably strong inductive argument:

> Today John said he likes Romina.
> So John likes Romina today.

but its strength is changed radically when we add this premise:

> John told Felipe today that he didn't really like Romina.

---

[21] The term "inductive argument" is ambiguous. In some other books, what we call an "inductive argument" is called a "non-demonstrative argument," and in those books an inductive argument is required to use premises that state a series of observations that exhibit a pattern of some kind, and it has to use a conclusion that says the pattern holds more generally beyond the specific series of observations. This second kind of inductive argument is what in a later chapter we will call an "induction by enumeration" and an "empirical generalization." On any proper definition of "inductive argument," an inductive argument does not logically imply its conclusion.

With inductively strong arguments there is a small probability that the conclusion is false even if all the premises are true, unlike with deductively valid arguments.

Several later chapters are devoted to exploring deductive validity and inductive strength, but it is important to note that even if your argument is deductively valid or inductively strong, it should not succeed in convincing people of your conclusion unless they know that its premises are true. If you are a critical thinker who is faced with such an argument, and you don't know whether one of the premises are true, then you will suspend judgment about whether the argument is successful until you find out whether all the premises are true.

Uncovering Implicit Premises

Reasoners often leave parts of their reasoning unstated. Emilio left something unsaid when he argued that "If the stream were poisonous, everything in it would look dead. There are water spiders and plants in the stream. It's no death trap." Emilio meant for Juanita and you to assume that the water spiders and plants in the stream are not dead. He just didn't say so explicitly. It was too obvious.

Implicit premises are the unstated claims or unstated assumptions of the argument. For instance, suppose a biologist argues that there is nothing ethically wrong in the fact that about thirteen animals per day are killed in her laboratory, because the deaths further her scientific research. In this argument, she uses the unstated assumption that, if something done to animals furthers someone's scientific research, then it is not ethically wrong. In this case, by exposing the implicit premise we analysts can get a clearer idea of what sort of reasoning is going on. How did we figure out which assumption she was making? We mentally noted that with this assumption the argument would be deductively valid, and so we used the principle of charity and said this is what she must have been assuming. Of course we could be wrong. To know for sure what she is assuming, we would have had to ask her.

The researcher also believes that 1 + 1 = 2, but this is not an implicit premise in her argument because it is not a premise intended to support the conclusion.

Let's talk about directions. Is New York to the right of Chicago? Or would you say it's to the left? If you think about what you know of U.S. geography, this isn't a difficult question. Chicago is in the interior of the U.S., and New York is on the Atlantic Coast, the East Coast.

New York is east of Chicago, but how about right of Chicago? That's not quite the same thing, is it?

Whether New York is to the right depends on what you can safely assume about your perspective. The answer is "Yes, it's to the right" if you can safely assume directions are to be judged by someone above the U.S. and facing north and looking down onto Earth because from that perspective the directions of east and right are the same direction.

But suppose you make a different assumption. If you were standing on the North Pole, you could say New York is left of Chicago. If you were standing inside the Earth at its center, you could say the same, but it would be very odd to assume that the judgment is to be made from either of these perspectives.

So, the bottom line here is that it's correct to say New York is to the right of Chicago *if* you make the normal assumptions about perspective, and logical reasoners make the usual assumptions unless there's a good reason not to. Critical thinkers are charitable and not overly picky; they always pay attention to what assumptions are appropriate for the situation. But they aren't so charitable that they overlook significant errors. Some arguments require making an assumption that really is not acceptable, and this is a sign that the argument is faulty or fallacious.[22]

Common sense assumptions are almost always safe assumptions. Common sense is the collection of common beliefs shared by nearly every adult in your civilization. Here are some more examples:

- rain is wetter than dust
- you shouldn't stick a knife in your eye
- sons are younger than their fathers
- a week is longer than a minute
- mountains are too heavy to carry in your pocket
- the U.S.A. has a president, not a king.

When an argument relies on an assumption that is part of common sense or common background beliefs or what you can see right in front of you, then the assumption is normally left implicit in the conversation. Why bother stating the obvious?

Here is a definition of "implicit premise." Look for the word "intended."

---

[22] These two words say about the same thing: *faulty*, *fallacious*.

Definition An **implicit premise** of an argument is a statement that does not appear explicitly but that is intended by the arguer to be a premise to help make the conclusion follow from the premises.

The phrase *intended. . .to help* plays a crucial role in identifying the implicit premise. Notice how you immediately think about the author's intentions when you hear the following argument:

> Tantalum can be melted, too, because all metals can be melted if you raise their temperature enough.

melted tantalum

Choose the implicit premise from the following list:

a. Some metals melt.

b. Tantalum can be melted if all metals can.

c. Tantalum is not a metal.

d. Tantalum is a metal.

e. All metals melt.

Not everything the arguer believes at the time counts as a premise in the argument, only the beliefs needed to make the conclusion follow--with certainty or with probability. For example, the arguer undoubtedly believes statement (a)—that some metals melt—but the arguer is not assuming this in order to get her conclusion to follow from her premises. Instead, she needs to assume that tantalum is a metal. With this premise, her argument is deductively valid. Without the implicit premise, her argument is deductively invalid. So, the answer is (d), not (a). Here is

her deductively valid argument rewritten in standard form, a format that makes it easier to see all at once, with premises above the line and conclusion below the line:

All metals can be melted if you raise their temperature enough.
Tantalum is a metal. (implicit premise)
———————————————————————————————

Tantalum can be melted.

The argument is now more clearly deductively valid, thanks to your detective work at uncovering the author's intentions about what is being assumed.

Arguments don't come to us with labels as being deductive or inductive. We who are trying to understand an argument will look to see if the argument meets either standard—being deductively valid or being inductively strong—and we will look for implicit premises that are needed for the argument to meet that standard. For example, do this with the inductive argument in the following concept check.

———CONCEPT CHECK———

What is the missing premise in this passage?

Most soft minerals will make a compound with tantalum, so baxalite will, too.

———[23]

The most common implicit premises are definitions of words, principles of grammar, rules of semantics[24], theorems of mathematics, and the commonly held beliefs of our civilization. We might argue that because Dwayne loves Jesus, Jesus is loved by Dwayne. This deductively valid argument depends on a grammatical principle about passive voice transformation that we rarely need to spell out. Everybody who speaks English can follow the inference, even though few of us could actually write down this or the other grammatical and semantical rules of our own language.

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[23] Implicit premise: Baxalite is a soft mineral.

[24] This book does not emphasize your knowing the difference between grammar and semantics. "He him ignored" contains a grammar error. The grammatically correct sentence, "He ignored yesterday who is knocking at the door tomorrow," contains a semantic error because it violates the meaning of words about time, but it is grammatically OK.

There is another important, implicit assumption in the above argument. The word *Dwayne* names the same person throughout the argument. If we violate this assumption or tentative agreement among speakers, then we are said to be **equivocating**. Logical reasoners avoid equivocation, but a writer who bothered to explicitly remind us of this fact about the word *Dwayne* would be cluttering up the argument with too many details.

Many jokes turn on who holds what assumption. In the following joke, Suzanne says essentially that one of Jack's assumptions is mistaken:

> Jack: Get those drugs out of this house; nobody is going to risk my daughter's sanity.
>
> Suzanne: You can't risk what's not there, Jack.

———CONCEPT CHECK———

If you understood that joke, then you saw that (pick one):

a. Jack assumed that his daughter is sane.

b. Jack assumed that Suzanne is insane.

c. Suzanne assumed that Jack's daughter is sane.

d. Jack assumed that Suzanne's daughter is insane.

e. Suzanne assumed that Jack is insane.

———[25]

Locating Unstated Conclusions

Just as we detect missing premises by using our knowledge of indicator terms and of what is needed for deductive validity and inductive strength, so we can also use that knowledge to detect missing conclusions. What is the **implicit conclusion** in the following argument?

> All insects have exactly six legs, but all spiders have exactly eight legs, so now what do we know about whether spiders are insects?

---

[25] Answer (a). Suzanne assumed that Jack's daughter is insane, but that wasn't one of your choices; the joke also turned on Jack's assuming that his daughter is sane, which is choice (a). Both assumptions are needed to make the joke work, however.

You, the reader, have to figure out the conclusion for yourself: that spiders are not insects.

People who are unwilling to do this detective work will miss the point of many passages. Here is a slightly more difficult passage that expects you to find the implicit conclusion. What is it?

> The Academy of Motion Picture Arts and Sciences was formed, in 1927, with a brief "to raise the cultural, educational, and scientific standards" of film. That noble purpose was sustained until July 12, 2013, the release date for the film "Grown Ups 2," in which a frightened deer urinates on Adam Sandler's face. In the animal's defense, one could argue that it was merely taking movie criticism to a higher and more clarifying level.

A "brief" is a directive. That final comment about the deer taking movie criticism to a higher and more clarifying level was a humorous remark, not meant to be taken literally. The implicit conclusion is that the noble purpose of the Academy of Motion Picture Arts and Sciences was no longer sustained after July 12, 2013. One of the major reasons in support of this conclusion is also implicit: that the deer's urinating on Adam Sandler's face in the film "Grown Ups 2" on July 12, 2013 did not achieve the noble purpose of the Academy.

———CONCEPT CHECK———

What is the implicit conclusion you are supposed to draw in the following joke?

> My father had a lot of patience with me when I was growing up. Whenever he got mad at me he would slowly count to ten. Then he'd lift my head out of the water.

a. All people have fathers.

b. My father had a lot of patience with me when I was growing up.

c. My father was impatient with me when I was growing up.

d. My father would lift my head out of the water after a slow count to twenty.

[26]

Unstated premises are very common. Unstated conclusions are less common and more difficult to uncover. If you were presented with the following conditional and knew nothing else, then it wouldn't be an argument. It would just be a claim. But let's suppose you can tell from the background situation that an argument is intended. If so, what's the conclusion and the key missing premise?

If it looks like a duck, walks like a duck, and quacks like a duck, then it's a duck.

The unstated conclusion is that it's a duck. All you have explicitly is one premise. The other premise is that it does look like a duck, walk like a duck, and quack like a duck.

What is the unstated conclusion you are supposed to draw from the following piece of reasoning by an upset American?

---

[26] The argument is an indirect way of saying my father was impatient, so the answer is (c).

> I can't feed my kids, and whitey's on the moon. Rats bit my little sister. Her leg is swelling, and whitey's on the moon. The rent is going up. Drug addicts are moving in, and whitey's on the moon.

The unstated conclusion is that the government's spending priorities are faulty, specifically that the government, which is run by white people, spends too much on moon shots and not enough on social services for poor non-white people. It can be very difficult to distinguish a jumble of statements from a group of statements intended to have a conclusion that you draw yourself. There is no mechanical way of telling which is which. However, it often can be done, and in this group of statements about whitey on the moon, no one would have said them this way unless they expected their reader to draw that conclusion about the government's spending priorities.

Later in this book we will be analyzing arguments and not simply finding them, but while we have this argument in front of us, let's briefly analyze it. At a deeper level, the argument is one-sided because it finds many reasons for why we should think the spending priorities are faulty while paying no attention to reasons for why the government might be making the right decision in sending a person to the moon. A high level analysis would try to uncover what those reasons might be, then weigh the pros and cons of changing government spending priorities. Also, a good reasoner will not simply attack the argument in the passage, but also should mention how the arguer could make an improved case for the conclusion. We won't stop here to make that improved case. If we turn now from analysis to rhetoric, it should be pointed out that the argument is very eloquent, not the kind of dry writing one finds in a philosophy journal. This eloquence will help a reader remember the argument long after a similar argument written in the usual newspaper-ese is forgotten.

OK, let's return to the problem of uncovering arguments. Occasionally a clever or diabolical speaker, will present all sorts of reasons for drawing an obvious conclusion but will never quite

draw that conclusion for you. The speaker is disguising an argument. On the other hand, the speaker could get defensive and say, "I didn't make that argument, you did." Speakers who are good with innuendo do this to you.

When you are in that situation and faced with some statements that could constitute an argument with an implicit conclusion, but maybe do not, then how do you tell whether you have an argument or not? There is no simple answer to this question; it is a matter of the delicate application of the principle of fidelity. If it is clear what conclusion the writer hopes you will draw, then there is an argument; if not, there is no argument. But there can be borderline cases where it is just not clear what the answer is, and so you need more information.

Detecting Obscure Argumentation

It takes detective skills to detect the essence of an argument among all the irrelevant remarks that people make while they argue. Speaking of detective skills, I was 14 years old when my mother, a second-string member of the Folies Bergère dance group in Paris, was dancing for the French Foreign Legion in Morocco. She left me with Mathilde, an indifferent governess and a veteran of the French Resistance. It was a dark and stormy night in Paris when Mathilde came up behind me, reached into my shirt, and.... But I've gotten off the subject, haven't I?

———CONCEPT CHECK———

photo by Fernando de Sousa, Melbourne, Australia

Two people are sitting in a dark movie theater a row behind you, and you hear this conversation.

> *Man*: Do you have the two snakes we brought in with us?
>
> *Woman*: No, I thought you had them.
>
> *Man*: Oh!

You should draw a conclusion from this conversation, even if no speaker is asking you to draw a conclusion. What conclusion?

[27]

Another difficulty in spotting arguments is that they can differ greatly in their structure. Instead of backing up a conclusion by only one package of reasons, an arguer might give a variety of lines of argument for the conclusion. That is, the arguer could produce two or more sets of reasons in support of the conclusion, and might even add why the opposition's argument contains errors. Jones did this in our earlier courtroom story. He gave a set of reasons for acquittal by arguing that there is an alternative explanation of all the facts about the robbery. In addition, he argued that the prosecution's strong reliance on the clerk's testimony is no good because the clerk stole from her sorority.

Arguments can have other complexities, too. Often arguers defend one or more of their reasons with reasons for those reasons, and even reasons for those reasons, and so forth. An arguer may simultaneously argue for several conclusions, or draw a second conclusion from a first conclusion. So, the structure of an argument can become quite complex. However, just as molecules are composed of atoms, so complex arguments are composed of "atomic" arguments, each with its own single conclusion and basic reasons to back it up. Breaking down complex arguments into their simpler elements in this way can make the complex arguments more understandable.

Mathematics can contain obscure arguments. Math professors who create a proof rarely state every step in their proof. However, if the argument is correct, that is, sound, then the reasoning from any one step to another can be reconstructed as a deductively valid argument. For math experts, the reconstruction process is easier than for the rest of us.

> In mathematical reasoning, it is customary to assume implicitly all the principles of mathematics you need to carry out the reasoning.

[27] Snakes have gotten loose near you in the theater.

Here is an interesting dialogue that contains an obscure argument. Evidently this dialogue occurred several centuries ago.

> King: I told you to bring me a head of a witch, and you've given me the head of a necromancer.
>
> Executioner: The Inquisition has declared that all necromancers are witches.
>
> King: Oh, all right then.

By saying, "Oh, all right then," the king infers that he has in fact been given the head of a witch. In his reasoning, he uses the following deductively valid, but implicit, sub-argument:

> All necromancers are witches.
> ---
> All heads of necromancers are heads of witches.

Let's do more exploration of how arguments have sub-arguments. If you were asked whether the statement "she probably won't be here to chair the meeting" is a premise or a conclusion in the following argument, the right response would be to say "Both" because it is a basic premise, but it is also argued for.

> She's got the flu again, so she probably won't be here to chair the meeting. Therefore, *I'll* have to do it. Damn!

The word *so* is a conclusion indicator of the sub-conclusion, and the word *therefore* is a conclusion indicator of the final conclusion, or last conclusion. Here are the two arguments:

> She's got the flu again.
> So, she probably won't be here to chair the meeting.

> She probably won't be here to chair the meeting.
> So, I'll have to chair the meeting.

Now it is clearer how the same sentence is both a premise and a conclusion.

———CONCEPT CHECK———

The word *so* is a conclusion indicator in the following passage. Is it an indicator of the final conclusion or only of a sub-conclusion on the way to the final conclusion?

> It's safe to conclude that all the patients given the AIDS antidote now have red hair. Remember, Janelle had red hair before the experiment, and there has been no change in her hair color; Rudy has fairly red hair; and Sam's hair has now changed to red, hasn't it? So, all three have red hair. But these three are the only patients that were given the AIDS antidote.

———[28]

Descriptions and Explanations

Critical thinkers need to pay close attention to language. What is a language? As we all know, a language is a dialect with an army and a navy.

More seriously, a language is a tool we use for many purposes. We use it to intimidate, to promise, to perform marriages, to forgive, to apologize, and to insult. But most of our reasoning occurs when we use language to describe, explain, or argue, which is why this book concentrates on these three uses: we use language to describe a situation, to explain why an event occurred, and to argue that our conclusion should be believed.

---

[28] Sub-conclusion. This sub-conclusion is a basic premise for the final conclusion that all the patients given the AIDS antidote now have red hair.

But it can be difficult to distinguish these three uses from each other. Here is a quick summary of the differences among the three:

- A *description* says that it's like that.
- An *explanation* says how it came to be like that.
- An *argument* tries to convince you that it is like that.

Arguments aim at convincing you that something is so or that something should be done. Explanations don't. They assume you are already convinced, and they try to show the cause, the motivation, or the sequence of events that led up to it.

Explanations of events often indicate the forces or causes that made the event occur. In the case of events that are human actions, such as Dwayne's unscrewing the lid on a jar of peanut butter, the explanation of Dwayne's action might appeal to his intentions, such as his wanting to satisfy his hunger. Intentions are mental causes.

———CONCEPT CHECK———

Is this an argument or an explanation?

> Let me explain myself more clearly. The car will explode if you drop the match into the gas tank. You don't want that, do you? So, don't drop the match in there.

———[29]

To appreciate the difference between a description and an explanation, consider one of the current limits of medical science. Scientists do not know what causes pimples, but they do have a clear understanding of what pimples are. That is, they can provide a detailed description of pimples, but they can offer no explanation of why some people get them and some do not. Regarding the topic of pimples, scientists can describe but not explain.

———CONCEPT CHECK———

Is this an argument or an explanation?

---

[29] This is an argument for the conclusion that you should not drop the match in the gas tank. The speaker misused the word "explain." Instead of using the phrase, "explain myself," the speaker should have said, "spell out my argument."

Shut up!

———30

When we explain, we normally explain events, not persons or objects. Historians don't explain Napoleon. They explain why he did what he did.

Arguments are different still. An argument is designed to convince someone to do something or to believe something, which it does by giving specific reasons. For example, we could argue that Napoleon became emperor of France because history professors say so. Notice that this argument doesn't describe the event (of Napoleon's becoming emperor of France) or explain it. The argument simply gives a reason to believe that it occurred.

> The main goal in a good argument is for the conclusion to follow from the premises.

Although descriptions need not be explanations, and although arguments are different from both, in real life they get jumbled together. This is fine; we don't often need them to occur in their pure form. However, it's hard to appreciate all that is going on in a jumbled whole unless we appreciate the parts.

———CONCEPT CHECK———

Below are three passages about the same topic. Say which one is the argument, which is the description, and which is the explanation.

a. It's raining cats and dogs. If we go on the picnic today, we will get really wet, and probably be unhappy.

b. We shouldn't go on the picnic because we will get really wet and probably be unhappy.

c. It's raining cats and dogs there at the picnic area because the thunderstorm finally blew in from the North.

———31

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30 Neither.

If Betsy Ross says, "The new flag I designed has red and white stripes with thirteen stars," is she explaining the flag? No, she is just describing it. She is not explaining where the flag came from or what motivated her to make it. She isn't talking about causes. Nor is she arguing about the flag. However, if Betsy Ross says something a little more elaborate, such as "The new flag I designed has red and white stripes with thirteen stars for the thirteen new states," she is describing the flag and also explaining why it has thirteen stars instead of some other number.

If Betsy Ross says, "I designed the flag because I wanted to help our new nation," she is only explaining why she designed it; she is not arguing that she designed it, nor is she describing the flag.

Couldn't you say that when Betsy Ross says, "The new flag I designed has red and white stripes with thirteen stars" she is explaining what the flag is like? Well, people do say this, but they are being sloppy. She is just describing.

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[31] (a) description, (b) argument, (c) explanation. The word "because" appears in both the argument and the explanation, which should tell you that the word "because" is not a reliable indicator of whether an argument or an explanation is present. However, if an argument is present, then the word "because" indicates a premise and not a conclusion; but if an explanation is present, then the word "because" probably indicates a cause or motive.

———CONCEPT CHECK———

Is the following passage most probably an argument, an explanation, or a description?

> The most striking thing about Beijing, indeed about all of China, is that there are people everywhere. You need to imagine yourself in a never-ending Macy's sale. There are lines to everything. You have to get in a line to find out which line to be in.[32]

———[33]

There are several good reasons to learn to distinguish arguments from explanations. You would be wasting your time explaining what caused some event if the person you were speaking to did not believe the event ever occurred. Instead, you should be directing your comments to arguing that the event did occur. Or, suppose you take an author to be arguing when in fact she is explaining. If you complain to yourself about the quality of her argument and dismiss her passage as unconvincing, you will have failed to get the explanation that is successfully communicated to other readers of the same passage.

An argument and an explanation are different because speakers present them with different intentions. Arguments are intended to establish their conclusion. Explanations aren't. They are intended to provide the motivation of the actor or the cause of whatever it is that is being explained.

———CONCEPT CHECK———

For each passage, indicate whether it is most probably an argument, an explanation, or a description.

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[32] From Cheri Smith, *Suttertown News*, Sacramento, CA, March 19, 1987.

[33] It is most probably only a description. It is at *least* a description because it describes Beijing as being a crowded city containing many lines. Nothing is explained. There is no explanation of why Beijing has so many people, or why it has so many lines. You might try to conceive of the passage as being an argument for the conclusion that Beijing is crowded and has lines, but no reasons are given in defense of this claim. It probably would be a mistake to say the passage uses the reason that Beijing has many lines to conclude that it is crowded. This would probably be a mistake, because the comments about lines seem to be there to illustrate or describe in more detail the crowded nature of the city, not to make a case for the claim that the city is crowded.

a. The apple fell because the drying stem was no longer strong enough to resist the weight of the apple.

b. You should eat an apple a day because doing so will keep the doctor away.

[34]

Suppose you and your friend Edward are standing in an apple orchard looking at an apple that just fell to the ground in front of you. Edward, who is a scientist, explains that the apple fell because the force of gravity pulling down on the apple caused tension in the apple stem and eventually broke it once the stem had dried out and got brittle; gravity then was able to pull the apple toward the center of the Earth until the resistance of the ground stopped the fall. His explanation is not an argument that the apple fell. It is taken for granted that the apple fell; what's in doubt is why this occurred. When Edward appeals to the existence of gravitational force and to the structural weakness of the apple's stem to explain why the apple fell, he is giving a possible explanation of why it happened, perhaps even the right explanation. Nevertheless, he doesn't defend his explanation. He doesn't argue that his is the right explanation. He doesn't give any reasons why the apple's falling should be explained this way instead of by saying that "It was the apple's time" or by appealing to magnetic attraction between the apple and the iron core at the center of the earth.

[34] (a) This is an explanation of the apple's falling, (b) This is an argument concluding that you should eat an apple a day.

Let's now investigate how to distinguish explanations from arguments when they are jumbled together. You create both when you explain why event E occurred and then argue for why this explanation of E is better than alternative explanations. For example, articles in science journals are often devoted to arguing that one explanation of a phenomenon is better than a previously suggested explanation. Sometimes arguments are offered as to why someone's explanation of an event is the right one, and sometimes the argument is intermixed with the explanation. Nevertheless, the argument and the explanation are distinct, not identical. Even if an argument does not accompany the explanation, every scientist who claims to offer the explanation of some event has the burden of proving that their explanation is the best one.

———CONCEPT CHECK———

You remember the dinosaurs, don't you? They appeared on Earth back in the day when New Jersey was next to Morocco. Construct an argument for the fact that dinosaurs became extinct 65 million years ago without explaining that fact. According to the theory of evolution, this is approximately the time that the Rocky Mountains and European Alps were created. And it was at about this time that the world got its first plants with flowers. (Don't worry too much about the quality of the argument; just make sure that it is an argument and not an explanation.)

———[35]

A velociraptor[36]

———CONCEPT CHECK———

Construct an explanation, but not an argument, for the fact that dinosaurs became extinct 65 million years ago. (Don't worry too much about the quality of the explanation; just make sure that it is an explanation and not an argument.)

———[37]

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35 Argument: The experts in geology and biology confirm this, and they generally agree among themselves, except for a few lone wolves such as the creationists. (Note: That was an argument, not an explanation.)

36 This photo from Wikipedia Commons Graphics is licensed under the Creative Commons Attribution 3.0 Unported license to Salvatore Rabito Alcón.

37 Here is one explanation. A six-mile-wide rock crashed into our planet 65 million years ago, knocking up so much dust that the planet was dark for about a month. During this month the weather turned very cold, and the dinosaurs' main food died. The dinosaurs could not quickly adapt to the new conditions, and they died. (The air sure must have smelled bad that

The topic of distinguishing arguments from explanations will be given its own chapter later in this book.

Review of Major Points

We briefly explored the differences among descriptions, arguments, and explanations. Descriptions state the facts, report on states of mind, express values, and so forth. Arguments aim at convincing you that something is so or that something should be done. Explanations don't. They assume you are already convinced and instead try to show the cause, the motivation, or the sequence of events that led up to it. We noted that some arguments are strong enough to be called proofs.

Arguments are normally given to settle an issue one way or the other. An argument's topic is more general than the issue it addresses.

Premise and conclusion indicator phrases serve as guideposts for detecting arguments. Almost all arguments have some implicit elements. The most common implicit premises are statements of common knowledge, definitions of words, principles of grammar, and rules of mathematics. Rewriting arguments in standard form is a helpful way to display their essential content. Arguments can have quite complex structure; for example, there are often sub-arguments within longer arguments.

Arguments can be evaluated as being deductively valid or inductively strong. With inductively strong arguments, the premises support the conclusion with high probability, but there is a small probability that the conclusion is false even if the premises are true, unlike with deductively valid arguments. If an argument has a counterexample, then it can't be valid. All the topics of the present chapter get more detailed treatment later in the book. We humans seem to be better at detecting errors in other people's reasoning than in our own, so it takes careful self-monitoring in order to reason logically about our own beliefs.

Glossary

argument A conclusion plus one or more basic premises.

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month!) Another explanation might not point out that a rock crashed into our planet but instead might blame dinosaur deaths on their gorging on psychotropic plants. Other explanations could blame their death on their choking on volcano ash and dust, or their catching a special disease, or their being killed for food by extraterrestrial space aliens who landed on our planet.

basic premises The basic premises for a conclusion are those premises that directly support the conclusion rather than indirectly support it. Indirect premises are premises in support of other premises, such as those in support of the basic premises.

conclusion indicators Words or phrases that signal the presence of conclusions but not premises. Examples: So, therefore, thus, it follows that.

conditional statement An if-then statement. An assertion that the then-clause holds on the condition that the if-clause holds.

counterexample to an argument a possible situation that makes the premises true and the conclusion false. A possible situation is a logically possible one. A situation in which half of my ancestors died childless is not a possible situation.

deductive argument An argument intended to meet the standard of being deductively valid. [Later chapters are devoted to deductive and inductive argumentation.]

deductively valid An argument is deductively valid if its conclusion follows with certainty from its basic premises. [This chapter introduced four other, equivalent definitions.]

description A statement or sequence of statements that characterize what is described. Descriptions state the facts, report on states of mind, make value judgments or explain the situation. A pure description does not argue.

discount indicator A term in an argument that indicates the presence of a claim that discounts or de-emphasizes a relevant factor. That claim is neither a premise nor a conclusion.

equivocating Changing the reference of a term from one occurrence to another within an argument.

explanation A statement or sequence of statements designed to show the cause, the motivation, or the sequence of events leading up to the event that is being explained. Pure explanations do not describe. Nor are they designed to convince you that something is so or that something should be done.

final conclusion In a chain of arguments, the last conclusion, the conclusion that isn't used as a premise.

implicit premise A statement that does not appear explicitly in an argument but that is intended by the arguer to be a premise to help make the conclusion follow from the premises.

imply A statement P implies a statement Q if Q has to be true whenever P is. Informally, speakers might say "P means Q" instead of "P implies Q."

indicator term A conclusion indicator term is a word or phrase in an argument that is usually followed by the conclusion; a premise indicator term is usually followed by a premise.

inductive argument An argument intended to meet the standard of being inductively strong.

inductively strong An argument is inductively strong if the conclusion would be very probably true if the premises were to be true. Inductive strength is a matter of degree.

invalid Not deductively valid. Even strong inductive arguments are deductively invalid.

multiple argumentation A passage containing more than one argument.

premise A claim that is used as a reason in an argument.

premise indicators Words or phrases that signal the presence of premises but not conclusions. Examples: Because, since, for the reason that.

standard form A single argument rewritten with its basic premises above the line and its conclusion below the line. The premises and conclusion should be expressed as complete sentences. Pronouns should be replaced with their antecedents (the nouns themselves) wherever possible. The order of the premises is not important. Indicator words and other fluff words are stripped away. When an argument is in standard form, it is supposed to stand alone with everything significant stated explicitly so that the reader can view the whole argument and understand what it is without needing additional information from the context.

sub-conclusion The conclusion of an argument that occurs among other arguments.

Exercises

General Exercises

1. If two people disagree with each other, then one of them is not a critical thinker.

a. true b. false

■ 2. According to the U.S. Department of Agriculture's Food and Drug Administration, the four major food groups are corn, pork, beer, and Jell-O salad with marshmallows. Which food group is preferred by future Italian diplomats?

a. corn
b. pork
c. beer

d. Jell-O salad with marshmallows.[38]

3. Ok, you math geniuses, a farmer had 17 sheep, and all but 9 died. Then the farmer was given 2 from his brother but both died. How many of the farmer's sheep were left? [Hint: Not 8.]

4. Describe what is going on in the following paragraph. What is its main purpose? Is there an argument? Is anything explained? What? Is there any description? The paragraph is about Catherine the Great's wedding in Russia in 1745. She was a sixteen-year-old bride-to-be of the seventeen-year-old future emperor.

> Catherine's premarital nervousness did not come from fear of the nocturnal intimacies that marriage would demand. She knew nothing about these things. Indeed, on the eve of her marriage, she was so innocent that she did not know how the two sexes physically differed. Nor had she any idea what mysterious acts were performed when a woman lay down with a man. Who did what? How? She questioned her young ladies, but they were as innocent as she. One June night, she staged an impromptu slumber party in her bedroom, covering the floor with mattresses, including her own. Before going to sleep, the eight flustered and excited young women discussed what men were like and how their bodies were formed. No one had any specific information; indeed, their talk was so ill-informed, incoherent, and unhelpful that Catherine said that in the morning she would ask her mother. She did so, but Johanna—herself married at fifteen—refused to answer. Instead, she "severely scolded" her daughter for indecent curiosity.
> –Robert K. Massie

Detecting Single, Explicit Arguments

■ 1. What is the conclusion indicator term in this argument?

> If it rains, then it's a bad time for a picnic. So, we shouldn't go there for a picnic since Svetlana knows it's raining there now. At least that's what she heard.

a. If

b. Then

c. So

d. We shouldn't go there for a picnic

e. None of the above[39]

---

38 You can distinguish a serious question from a joke, can't you?

39 Answer (c).

■ 2. What is the premise indicator term in this argument?

We already know the solution to Rafael's third math problem is a number which is divisible by 8. I think the answer is probably 32. At any rate, we can suppose that for any number, if it is divisible by 8, then it is divisible by 16. So, the solution to his third problem is divisible by 16. Isn't 32 divisible by 16?

a. I think
b. at any rate
c. we can suppose that
d. if
e. so[40]

■ 3. Which sentence below probably is *not* being used to make a claim (that is, a statement)?

a. I wonder if we should turn back.

b. Financial ruin from medical bills is almost exclusively an American disease.

c. I learned a long time ago that *minor* surgery is when they do the operation on someone else, not you.

d. My bumper sticker asks, "Do you believe in love at first sight, or should I drive by again?"[41]

4. Identify all the conclusion indicators and premise indicators, if any, in the following passage:

> The Philadelphia company's letter said they would place their call to us here in Los Angles at 2pm their time. They are in a time zone that is three hours east of us; therefore, we should expect their call at 11am our time, but if they don't call then let's go to plan B.

■ 5. The sentence below is quite likely

a. an argument or explanation b. neither an argument nor an explanation

> Dynamic Random Access Memory (DRAM) chips were once the popular choice for memory storage on personal computers since, unlike the SRAM chip, they were less

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[40] Answer (c).

[41] Answer (a), assuming you are going to take this question seriously, but the jokes in c and d might be a reason to doubt this assumption. Usually declarative sentences are used to make claims, but not always. The declarative sentence "I promised to meet you" is true or false, but the declarative sentence "I promise to meet to" is neither.

expensive per byte and the DRAM design essentially required using only one transistor per bit.[42]

■ 6. The following passage contains

a. an argument b. a report of an argument c. neither

Through a process of trial and error, early people slowly learned that some contaminated food made them sick, while other contaminations improved the flavor, made an exhilarating fruit drink, or helped preserve the food for longer periods of time. In modern times, scientists learned that the contaminations are due to bacteria, yeast, and molds.[43]

7. The sentence below is quite likely

a. an argument b. not an argument

The life of a respected technical professional has few spare moments because there's all that work from running labs to teaching to speaking at colloquiums to writing grant proposals to selling research programs to administrating or managing to maybe even finding a few minutes to think about what to do.

■ 8. Which are the premise indicators in the following list?

if, then, yet, nevertheless, on the contrary, but, thus, suppose that[44]

■ 9. Which are the conclusion indicators in the following list?

if, then, yet, nevertheless, on the contrary, but, thus, suppose that[45]

■ 10. Does this argument contain any premise indicators that are working to indicate premises? If so, identify them.

President Kennedy was smart to have approved the Bay of Pigs invasion of Cuba in 1961 since he could be reasonably certain the USSR wouldn't physically intervene to help

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[42] Answer (a). This is probably an explanation. It is explaining why dynamic random access memory (DRAM) chips were once the popular choice for memory storage on personal computers.

[43] Answer (c). It is just a description.

[44] Suppose that.

[45] Thus.

Cuba, and since he wanted to do something that could overthrow the left-wing government.[46]

11. Is the word *since* working to indicate a premise or conclusion in the following?

Since 5 p.m. I've been hungry.

12. Add a premise indicator, remove the conclusion indicator (without replacement), and rewrite the following argument as a single sentence.

Ever since the inflationary spiral ended, state taxes have been high. State farm subsidies will therefore continue to rise.

13. Is the word *suppose* working as a premise indicator in the following?

I suppose you're right that the New York Giants have a better passing game than the L.A. Rams.

14. Add a premise indicator, remove the conclusion indicator (without replacement), and rewrite the following argument as a single sentence.

The average length of an ear of popcorn has been longer ever since the 2010 planting regulations were adopted. State sales of popcorn will therefore continue to prosper.

■ 15. Is this really a statement?

Ah, America, the land of catastrophic wealth imbalance, may its flag ever wave.[47]

■ 16. Consider the following argument:

All those containers contain petroleum since each one has a blue top and all petroleum containers have blue tops.

Let A = All those containers contain petroleum.
B = Each of those containers has a blue top.
C = All petroleum containers have blue tops.
D = Everything with a blue top is a petroleum container.

---

[46] Yes, the word *since* is used twice as a premise indicator.

[47] Yes, it is a making two statements, that America is a land of catastrophic wealth imbalance and that America's flag should continue to wave. The second statement is probably meant sarcastically.

Which one of the following would be a symbolic representation of the argument in standard form?

a.	b.	c.	d.	e.
A	D	C	C	A
B	C	A	B	D
---	---	---	---	---
C	A	B	A	C[48]

17. Is the argument in the previous question deductively valid?

■ 18. Does the following contain an argument, and if so what are its conclusion and premises?

> By the age of seven, Snow-White had grown more beautiful than her stepmother, the Queen. Then the Queen asked her mirror: "Mirror, mirror on the wall, Who is the fairest of us all?" and it answered: "Queen, thou art the fairest in this hall, But Snow-White's fairer than us all." Horrified, the envious Queen called a royal hunter and said: "Take the child into the forest. Kill her, and bring me her lung and liver as a token."[49]

19. Which of the following sentences contain explicit argumentation—that is, explicitly contain the two elements required to be any argument (a conclusion plus one or more premises)?

> a. Among all creatures, humans are distinguished by the extent to which they wonder about things that do not immediately affect their subsistence.
>
> b. Every man is a potential killer, even if he believes otherwise. What I mean to say is, every man is capable of taking a life. And man is not the only creature on Earth who is a potential killer.

---

[48] Answer (d). To get this answer you had to remember that premise order is irrelevant.

[49] Not an argument. Could it be interpreted as an argument for the conclusion that Snow White is the fairest of them all? Couldn't the reasons for this conclusion be that the mirror said so? No, what is happening in the passage is not an argument trying to convince the reader or the queen of this conclusion. Instead, the queen asked a question about who is the fairest, and the mirror answered that it is Snow White and proceeded to describe Snow White. The passage is a narrative, a story. The passage does give sufficient information to draw the conclusion that Snow White is the fairest for the reason that the mirror said so, yet the reader is not expected to do this kind of reasoning. The reader can tell from the rest of the passage that the writer's intent is merely to provide the information that Snow White is fairest and then to elaborate on the point by providing the information about the mirror.

c. If you were to pick an apple at random from that basket, then you'd probably get one without a worm in it.

d. Stop right there, Jack; it's not raining today, so you won't need to take that umbrella. Put it back.

20. The following passage is most likely

a. an argument b. not an argument

Although rattlesnakes are the most common poisonous snake in North America, there are four types of poisonous snakes on the continent: rattlesnakes, copperheads, moccasins, and coral snakes. The first three belong to the pit viper group, and the most reliable physical trait by which to identify them is the pair of pits between the eye and the nostril. These pits are heat sensitive and allow the snake to sense its prey. Keep in mind that a snake's venom is designed for catching food, not attacking people.

■ 21. Is the following passage an argument? Why or why not?

If you get lost in the woods and no one responds to your calls, walk downhill until you come to a stream. Then walk downstream; you'll eventually come to a town.[50]

■ 22. Identify the discount claim and the discount indicator in the following passage.

Svetlana came over this afternoon in an even worse state than this morning. She is so mad at Li that I worry what she's going to do. She asked for the knife back that she loaned us. I realize that we did promise to give it back soon, but she's so agitated right now that, if we return it, I think she's going to use it on Li. So, let's lie to her and say we can't seem to find the knife.[51]

23. What is the role of the last sentence in the argument of this passage?

If it rains, then it's a bad time for a picnic. So, we shouldn't go there for a picnic since Svetlana knows it's raining there now. At least that's what she heard.

---

[50] No argument. The passage is giving you advice, not reasons for the advice. You could imagine someone creating an argument from this. It might be that the advice should be taken because it will lead you to safety in this situation, and you ought to accept advice that will do this.

[51] The discount indicator is "I realize that ... but" and the discount claim is "We did promise to give the knife back soon."

24. Identify the implicit conclusion in this argument:

> Robert Smalls was assigned to the slave crew of a Confederate ship at Charleston, South Carolina during the U.S. Civil War. When all the officers had gone ashore, he seized control of the ship, put on a Confederate officer's hat to hide his black face and sailed past the unsuspecting Confederate canons of Fort Sumter in Charleston harbor. Upon reaching the Union Navy off the coast of South Carolina, he turned over the ship to them. He later was made a captain in the Union navy and given command of the ship until the end of the war. So, are you so sure you were correct when you said, "There were no black heroes during that war"?

■ 25. (a) Identify the conclusion of this argument. (b) Assuming the premises are true, is the argument strong or weak?

> No, table tennis could not have been invented before the American Revolution. This is because table tennis needs plastic balls, but plastic wasn't invented by 1775 when the Revolution began.[52]

■ 26. Identify the conclusion indicator term, if there is any, in the following argument:

> According to the *New Encyclopedia of the People of Russia*, King Ferdinand and Queen Isabella united Aragon and Castille into the modern country of Spain in 1469. They founded the Spanish Inquisition in 1478 as a branch of the government and appointed Torquemada to be the grand inquisitor. This government agency caused all sorts of official terror, and was generally bad for Europeans, although it brought certain short-term benefits to the Catholic Church. On the other hand, King Ferdinand and especially Queen Isabella paid for Christopher Columbus' trip west to find Asia, and this was very beneficial for the European world because it opened up new sources of wealth, adventure, and knowledge, although there may have been some negatives for the local tribes in the New World. So, Ferdinand and Isabella's marriage had both good and bad consequences for Europe. Nevertheless, when you weigh the pros and cons, you've got to admit that the good heavily outweighs the bad—for Europeans.

a. according to
b. nevertheless
c. on the other hand
d. so
e. There is no conclusion indicator[53]

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[52] (a) Table tennis could not have been invented before the American Revolution. (b) Strong. This is a good argument.

[53] Answer (e).

27. The sentence "I now pronounce you man and wife," when said by an American judge (justice of the peace) to a couple who have applied for a license to be married, is

a. a claim but not an argument

b. an argument

c. none of the above

28. He's so good at chess he doesn't even refer to that piece as *the horse*.

Argument for the conclusion that he doesn't even refer to that piece as the horse.

Argument for the conclusion that he's good at chess.

A claim.

Neither an argument nor a claim.[54]

29. Identify the conclusion indicator and the conclusion in this argument:

Slavery in Saudi Arabia was officially abolished in 1962. That means that if they still have slaves it's under the legal "radar."

a. The indicator is "That means" and the conclusion is that slavery in Saudi Arabia is under the legal "radar."

b. The indicator is "That means" and the conclusion is that slavery in Saudi Arabia was officially abolished in 1962.

c. There is no conclusion indicator, but the conclusion is that if Saudi Arabia still has slaves, then it is under the legal "radar."

d. The indicator is "That means that if" and the conclusion is that Saudi Arabia still has slaves, and this is under the legal "radar."

e. None of the above.

30. Describe the following numbered passages by placing the appropriate letter to the left of each number.

a. Merely a claim or statement with no reasons given to back it up.

---

[54] Answer (c).

b. An argument using bad reasons.

c. An argument using good reasons (assuming that the arguer is being truthful).

d. None of the above.

1. You said that all deliveries from your firm would be made on Mondays or Tuesdays and that you would be making a delivery here one day this week. Since it is Tuesday morning and we've had no deliveries this week, your firm should make a delivery today.

2. That night, over icy roads and through howling winds, Paul Revere rode the 60 miles, and even before the British got into their transports, word had come back to Boston that the King's fort at Portsmouth had been seized and His Majesty's military stores stolen by the rebellious Americans.

3. Will you or won't you take me and Johnny Tremain across the Charles River?

4. Not a word to the old gentleman, now; not a word.

31. Arguments in newspaper editorials, unlike ordinary arguments, are usually presented in standard form.

a. true b. false

Conditionals

1. Does the following sentence express a conditional statement?

An ostrich is a bird; some birds can fly; but an ostrich cannot.

a. yes b. no c. can't tell

■ 2. Is the following conditional true?

If kids who are abused usually become abusive parents when they have children, and John Drew is being abused by his mother, then when he grows up he is likely to abuse his own children.

a. yes b. no c. need more information to tell[55]

[55] Yes. Then then-part follows from the if-part.

3. If the if-part of a conditional claim is true, and if the conditional claim itself is true, will the then-part *have* to be true?

4. Is the following statement an argument?

> If you had struck this match when it was dry, even though it's now wet, then it would have burst into flame.

Implicit Elements of Arguments

■ 1. If there is an argument present, then there will always be a premise present, even if some of the premises are not present because they are implicit.

a. true b. false[56]

2. According to this textbook, if a premise or a conclusion is implicit, then it is:

a. very probably true.

b. always uncertain.

c. unstated.

d. none of the above.

■ 3. Identify the implicit conclusion of the following argument, then indicate whether the argument is inductive or deductive.

> AIDS will kill everybody who gets it, and your mother has gotten AIDS so you can draw your own conclusion. [57]

4. What is the conclusion of this argument by analogy?

> To say that TEX, the scientific word processor language, takes a little effort to learn is like saying that with a little effort you could build your own full-scale, working Challenger spacecraft and run your own space shuttle program. Surely you don't believe you can do this, do you?

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[56] Answer (a). If *all* the premises were left unstated, there would be no arguing and instead merely the making of a claim.

[57] Conclusion: Your mother, too, will be killed by AIDS. The argument is deductive; and it is deductively valid.

5. Rewrite this argument in standard form so that it is deductively valid: "Joshua, quit that! Justine isn't bothering you!" There is at least one implicit premise.

6. When the senator says, "Murder is wrong," and the reporter says, "Well, then you must think capital punishment is wrong, too," the reporter is making an argument, but she is leaving a lot unsaid. Her most significant implicit premise is that the senator thinks

a. Murder is a kind of capital punishment.

b. Capital punishment is a kind of murder.

c. Capital punishment is neither right nor wrong.

d. If capital punishment is wrong, then murder is wrong.

7. Identify the principal implicit element (and say whether it is a premise or a conclusion) in the following argument regarding the correctness of the theory of biological evolution.

> According to the fossil record as it is interpreted by evolutionists, spiders have been on earth for 300 million years but have not changed. Yet, if evolution were really working, surely they would have changed by now, wouldn't they?

8. Identify the most significant implicit premise used in the following argument:

> All good Americans hate cancer and love the first lady. So, Roberto Salazar Rodriguez loves the first lady.

■ 9. Give the standard form of this deductively valid argument, adding the significant implicit premises, if there are any:

> If the moral thing to do is always whatever your society says, then Nazi brutality was morally OK in Nazi Germany. Therefore, the moral thing to do is not always whatever your society says it is.[58]

10. What premise is probably being assumed to make the following argument be deductively valid?

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[58] Here is the standard form:

> If the moral thing to do is always whatever your society says, then Nazi brutality was ethically OK in Nazi Germany.
>
> Nazi brutality was not morally OK in Nazi Germany.
> ---
> The moral thing to do is not always whatever your society says it is.

Tom New is running for state treasurer of Indiana, so he knows a lot about public finances.

a. If a person knows a lot about public finances, then the person is running for state treasurer of Indiana.

b. If a person is running for some public office, then the person probably knows a lot about public finances.

c. Tom New is a candidate with financial savvy.

d. Anybody who runs for state treasurer of Indiana is financially ambitious.

e. All candidates for federal office know a lot about public finances.

f. If a person is running for state treasurer of any state, then the person knows a lot about public finances.

g. People who know a lot about public finances often run for state treasurer in Indiana.

■ 11. The following statement is not an argument, but the reader most probably can assume that the speaker believes what?

Stick your hands up or I'll blow your head off.

a. The hands of the person being spoken to are not up.

b. If you stick your hands up, I will blow your head off.

c. The two people have guns.

d. If I blow your head off, then your hands were up.

e. I will blow your head off.[59]

12. Rewrite the conclusion of this argument as a declarative sentence.

What do you mean "We should let a pregnant woman decide whether she has an abortion"? If you let them decide, then you are letting people commit murder. You can't let them do that, can vou?

Multiple Arguments

[59] Answer (a).

1. What is the most significant implicit premise used in the first sub-argument of this argument chain?

> She's got the flu again, so she probably won't be here to chair the meeting. Therefore, I'll have to do it. Damn!

■ 2. Write out the standard form of the first sub-argument in the following argument.

> Galileo said good science uses mathematics, yet Charles Darwin's work on evolution uses no mathematics. Therefore, Darwin's work on evolution is not good science.[60]

3. In the following passage, (a) does Alice argue? If so, what is her conclusion? (b) Does her employer argue? If so, what is his conclusion?

> "Maybe. Maybe not," Alice said as her eyebrows bulged. "But that's beside the point. He should not be allowed anywhere near that project. Keep him out of there. Get somebody else," she said. Her employer had other ideas, evidently. He responded, "Listen Alice, you might be in charge of that project, but you're wrong, dead wrong. Think about it." "Look," said Alice, biting through her words, "there is no way in hell that I'm going to permit him to do that, and if you don't like it, you know what you can do with it." After several days, things quieted down between the two of them, but last week Alice received her termination notice. That was the day she bought the poison.

a. Alice is arguing that he should not be allowed anywhere near that project.

b. Her employer is arguing that she bought the poison.

c. Her employer is arguing that he should be permitted to work on the project.

d. Nobody is giving anybody reasons.

■ 4. In this complex argument, one of the statements is an intermediate conclusion rather than the final conclusion. Identify it.

> You should do well, since you have talent and you are a hard worker. I know you have talent, even though you don't believe it, because I've seen you perform and you're better than most people I've seen do this. Besides, Lady Gaga and Beyoncé both say you're talented.

---

[60] The sub-argument in standard form is:

> Galileo said good science uses mathematics.
> ---
> Good science uses mathematics.

a. You should do well.
b. You have talent.
c. You are a hard worker.
d. I've seen you perform and you're better than most people I've seen do this.
e. Lady Gaga and Beyoncé both say you're talented.[61]

5. Consider the following complex expressions which are composed of simple claims. The simple claims are abbreviated as A and B and C. For each of the complex expressions, say whether it is an argument or merely a claim:

a. A, but not B.

b. A, but not B, and consequently C.

c. A, which is why B, but not C.

d. A and B follow from C.

e. A and maybe B, or perhaps C.[62]

Creating and Improving Arguments

1. Research the issue of whether the United States can afford to expand its space program. Take a side and create a 200- to 300-word argument in defense of your position. Give credit to your sources (that is, use footnotes to say where your information came from).

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[61] Answer (b). Here is the main argument:

You have talent.
You are a hard worker.

You should do well.

Its first premise is not basic because it is argued for. Here is that argument:

I've seen you perform and you're better than most people I've seen do this.
Lady Gaga and Beyoncé both say you're talented.

You have talent.

[62] (a) claim, (b) argument. Try to work (c) and (d) and (e) on your own.

■ 2. Lesley and Rico say they've found a deductively valid, simple argument that, when rewritten in standard form, is a mixture of true and false sentences in which the premises are all true. Why is this unusual?[63]

3. The following passage is an argument. Construct a new argument that defends the opposite conclusion but that devotes about half its attention to countering the points made in the first argument.

> America should have more alcoholics. Here is why. Drinking alcohol makes you feel good, and Americans deserve to feel good, if anybody does. Legislators who are alcoholics will be off playing golf or hanging out in bars; they will be preoccupied and therefore won't pass so much harmful legislation that rips off us taxpayers. Besides, if I want to be an alcoholic and don't do anything to harm you, then you shouldn't be telling me what I can do with my body; it's my body, not your body, right?

You will be graded on the clarity of your argument, your ability to foresee counters from your opponents, and the absence of silly, naive, or irrelevant comments. The upper limit on your new argument should be two pages, typed double-spaced.

4. Construct an argument defending your position on the issue of whether there ought to be a law permitting the county public health department to start a needle exchange program. Under this program, drug addicts would be given new or clean hypodermic needles in exchange for their old or used needles, no questions asked. The purpose of the program would be to slow the spread of AIDS in the county.

Background: Assume that it is a misdemeanor to possess a hypodermic needle that has not been prescribed by a doctor and that it is a misdemeanor for a doctor to prescribe or give away hypodermic needles and other drug addiction paraphernalia except for certain listed problems, such as diabetes and allergies.

You will be graded not on what position you take but on the clarity of your argument, your ability to foresee counters from your opponents, and the absence of silly, naive, or irrelevant comments. Keep your argument to two pages, typed, double-spaced.

5. This is an exercise to be done by four students working as a group. The group chooses an issue to debate in front of the rest of the class, but the issue must be approved by the instructor. The group meets outside of class to research the issue. A typical issue might be whether the college should spend more money on athletic scholarships and less money on other projects. Another issue might be whether U.S. defense spending should be cut. Two students agree to

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[63] In a valid argument with true premises, the conclusion has to be true, too. So, there couldn't be any false statements. What Lesley and Rico are saying is contradictory.

argue for a yes position on the issue; the other two students agree to argue for the no position. During the class debate, all four students speak alternatively, each for five minutes or less. Speakers may use their time either to present arguments for their own position or to attack arguments presented by the opposition. When the four are done, the rest of the students in the class get to ask them questions or otherwise enter into the debate. The goal of the exercise is to show a significant understanding of the issue and to carry out good logical reasoning on the issue. Depending on your instructor, students who are not in the group of four may be required to summarize and discuss the quality of the reasoning of the group.

Descriptions, Explanations, and Arguments

1. Are the following three passages most probably expressing arguments, explanations, descriptions, or what?

a. A quartz crystal oscillator is very small and contains a crystal of the mineral silicon dioxide that can be made to vibrate when stimulated electrically.

b. A clock's quartz crystal oscillator is a fascinating device that is not as complicated as it may seem to be. Here is how it works. Power from a small battery makes the crystal vibrate, and when this happens the crystal gives out pulses of current at a very precise rate, a fixed electrical frequency. A microchip reduces this rate to one pulse per second, and this signal activates the time display mechanism for the second hand.

c. Many clocks and watches contain a quartz crystal oscillator that controls the hands or the time display. Power from a small battery makes the crystal vibrate, and it gives out pulses of current at a very precise rate—that is, a definite frequency. A microchip reduces this rate to one pulse per second, and this signal activates the time display mechanism.[64]

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[64] a. Description of a quartz crystal oscillator. Not an explanation.

b. This is an explanation of how a quartz crystal oscillator works in a clock. The passage also provides some additional description of the inside of a clock that uses the oscillator.

c. Like passage (b), this one describes the inner workings of a certain kind of clock. Compared to (b), it is harder to tell whether any explanation is present, but probably one is present. To tell whether an explanation is present, the reader must look at what is said, then try to reconstruct the intentions in the mind of the speaker. If the intentions were to say (1) what causes what, (2) what motivates an action, (3) what purpose something has, or (4) what origin something has, then an explanation is present. Otherwise, there is only description.

2. Suppose you asked someone to explain why tigers eat meat but not plants, and you got the answer, "Because a zookeeper once told me that's what they eat." You should consider this to be an incorrect answer. Why?

a. You asked for some sort of explanation of why tigers eat meat but not plants, yet the answer mentioned nothing about plants.

b. You requested an explanation but got an argument instead.

c. Zookeepers usually have no idea what tigers eat.

d. Nobody thought to mention that meat is not made out of plants.

3. Suppose you have asked your English instructor why Ernest Hemingway won the 1954 Nobel Prize for literature, and suppose she answers, "He won because the Swedish Nobel Committee liked his short stories and novels about his own experiences in World War I and in the Spanish Civil War of the late 1930s." She is

a. explaining but not arguing.

b. explaining and arguing.

c. only describing.

d. describing and arguing.

e. only arguing.[65]

4. When Betsy says "I'm angry," she is reporting information about her state of mind, not arguing for a conclusion. But is she explaining or not explaining here state of mind?

5. The following passage is primarily

a. a description

b. an argument

c. a request

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[65] Betsy Ross is describing, but she might or might not be explaining, depending on the context. If she just makes this statement out of the blue, she is not offering a cause for some event, nor offering a motivation for what happened. She is simply describing the state of her body or mind. However, if the context were that she has just been asked to explain why she ripped her new flag to pieces, her response would count as an explanation of this action.

About two-thirds of the salt in sea water is sodium chloride. Other substances present are magnesium chloride, sodium sulfate, potassium chloride, and calcium chloride. In the remaining one percent of salts are tiny traces of about forty different elements, including iron, uranium, silver, and gold. The percentage of gold is so small that you would have to process tons of seawater to get even a tiny amount. If the salt were taken out of all the seawater in the world and distributed across the land, it could cover all the land areas on Earth with a layer 500 feet thick.[66]

6. The following passage is primarily

a. a description

b. an argument

c. a request

The sun's rays do not fall vertically outside the tropics, even at noontime. June 21 in the northern hemisphere is the day of the year with the longest daytime. On this day, the perfectly vertical fall of the sun's rays is farther north than on any other day of the year. This special, farthest north place is actually a line of places around the earth at 23.5° north latitude. It is called the Tropic of Cancer. The day when the sun reaches the Tropic of Cancer is called the solstice, and it begins the summer. Hawaii is the only part of the U.S. that is south of the Tropic of Cancer.

7. Is this passage primarily an argument or an explanation?

[66] Answer (a). The passage is describing the constituents of sea water; it is not giving reasons for some conclusion nor requesting anything of the reader.

Mayfield is guilty because the FBI report says that his fingerprints match those on the countertop beside the cash register.

8. Is this passage primarily an argument or an explanation?

The passenger died because the driver was drunk and speeding on the freeway.

9. Take a least two of the following sentences and work them into an argument on the issue of which computer your office should purchase.

a. The Apple clone is cheaper than the Cray-Sinclair, although both are within our budget.

b. The Cray-Sinclair computer is faster than the Apple clone.

c. The Cray-Sinclair won't run Word, and the Apple clone runs all the software we want right now.

d. The Cray-Sinclair has a better service contract than the Apple clone.

Evaluating Arguments

Although much of the rest of this book is devoted to the topic of evaluating arguments, here are some initial exercises.

1. How good is this argument? Is it inductively strong? Is it valid?

Anytime you murder someone you are killing that person.
So, if a pilot kills someone during the battle, the pilot is murdering that person during the battle.

■ 2. How good is this argument? Is it inductively strong? Is it valid?

Anytime you murder someone you are killing that person.
So, if a pilot murders a person during the battle, then the pilot kills someone during the battle.[67]

3. Evaluate the quality of this argument:

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[67] This is a very strong argument. It is deductively valid and all its premises (there's just one) are true.

> Nathan was arrested for breaking and entering. At the trial two witness who didn't know each other or Nathan testified that Nathan committed the crime. The defense attorney said Nathan was 10 miles away at the time, but the only evidence for this was Nathan's own claim that he was 10 miles away at the time.

4. Evaluate the quality of this argument:

> All ice eventually melts when heated to over 47 degrees Fahrenheit. The ice in the refrigerator of the President of France was heated to over 47 degrees Fahrenheit that day. So, the ice in the President's refrigerator eventually melted.[68]

■ 5. Does this argument have any counterexamples? If so, find one.

> All cats are interesting animals.
> All cats have fur.
> So, all interesting animals have fur.[69]

6. Does this argument have any counterexamples? If so, find one.

> All cats are interesting animals.
> All interesting animals have fur.
> So, all cats have fur.

■ 7. Does this argument have any counterexamples?

> Either Juan is coming to the party and bringing the beer or Tom is staying home and watching his favorite program. Juan is definitely coming to the party. Therefore, Juan is bringing the beer.[70]

8. Discuss the following argument. At the very least, describe it and evaluate it. Are some reasons better than others?

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[68] The argument meets the standard of being deductively valid. But you'll have to suspend judgment about whether the argument is a good reason to believe the conclusion because you don't know whether one of its premises is true. You don't know whether it is true that the ice in the refrigerator of the President of France was heated to over 47 degrees Fahrenheit that day.

[69] The following situation is a counterexample: a situation where all cats and crocodiles are interesting animals and all cats have fur but crocodiles don't. In this situation the premises are both true but the conclusion is false, so we have a counterexample that shows the argument was deductively invalid.

[70] You can imagine a situation where Juan comes to the party without the beer, while Tom says home and watches his favorite program. In that situation the premises are true while the conclusion is false. So this is a counterexample, and the argument is deductively invalid.

Drinking alcohol causes kidney disease, traffic accidents, and other serious problems. In addition, the singer Michael Jackson says drinking is an undesirable habit. Your older brother says no one will kiss a person whose breath smells like alcohol. Therefore, no sensible, intelligent person should ever drink.

CHAPTER 3 Writing with the Appropriate Precision

To be a good communicator, you should be precise enough for the purpose at hand. When faced with a claim that someone wants you to accept, or when you are given a recommendation for what you should do, your first response ought to be to ask yourself two questions: (1) What do they mean? and (2) Why do they think that? This chapter is devoted to question (1). Writers and speakers make mistakes in what they mean in many ways. This chapter focuses on being insufficiently precise and being overly precise.

People are *insufficiently* precise in three ways--by being ambiguous, or too vague, or overly general. They are *overly* precise by giving too many details or by being pseudoprecise.

Suppose you say to a sales person in an art supply store that the number of pounds of clay you want to buy is somewhere in the neighborhood of seven to eight. Are you being imprecise? Not necessarily. If you don't really care whether you are sold seven pounds, or eight pounds, or seven and a third pounds, then what you said is precise enough. In that case, it is proper to say you were being precise. There is no sense in being more precise. But if you say to a friend, "Stand somewhere pretty so I can take a good picture," then you probably should be more precise if you want to be a good communicator.

Being Ambiguous

Newspaper headlines are a notorious place where the rules of grammar get bent, and we readers have to make the best of it. The following headline is about retaliation for the trade barriers between the U.S. and Japan:

More Sanctions Coming, Japan Warned

This headline is difficult to interpret. Is Japan doing the warning, or is Japan being warned? There is no way to tell; the headline has more than one reasonable interpretation. Because there is more than one interpretation, the headline is said to be **ambiguous**. It is the kind of ambiguity called "amphiboly." Ambiguity is one way of the many ways writers can be imprecise.

Here is another imprecise headline that can be taken in two ways:

Air Force Considers Dropping

Some New Bombs

Are officials going to delete a weapons program, or are planes going to drop some new bombs on the enemy? Because most readers read only the headlines and not the story that goes with it, many readers will end up believing something different from what was intended by the headline writer. If you are doing the writing, you have to realize in advance that your reader will be faced with ambiguity.

In the Japan headline, ambiguity occurs in the grammar and thus in the meaning of the whole sentence; in the Air Force headline, ambiguity occurs in the meaning of a single word. In the first case, the problem is **ambiguity of syntax**; in the second it is **ambiguity of semantics**. There is also **ambiguity of emphasis**; you can say something very different with the sentence, "I love you," if you emphasize "love" or, instead, "you." Ambiguity comes in three flavors. Amphiboly is ambiguity of syntax. Equivocation is ambiguity of semantics. Accent is ambiguity of emphasis. It is not usually important to be able to explicitly distinguish the kinds; the main point is to notice sources of imprecision that block effective communication.

Definition If a word, phrase, or sentence is too imprecise (for the needs of the audience) because it has two or more distinct interpretations, it is *ambiguous*.

Ambiguity is a kind of imprecision; it's a way of being unclear. So, one principle of good communication is to avoid ambiguity.

———CONCEPT CHECK———

The grammar of the following headline is ambiguous. How?

> ***Egyptians Are More Like Italians Than Canadians***

———[71]

Context and Background Knowledge

The sentence "He is at the bank" doesn't contain enough clues for you to tell whether he is at a river bank or a financial bank. Therefore, the term *bank* occurs ambiguously.

However, that same word does not occur ambiguously in the following sentence:

> Leroy is at the bank frantically trying to withdraw his savings before the financial system collapses.

The river bank interpretation would now be too strange, so the word bank here means financial bank.[72] The other words that occur in the sentence give strong clues as to which sense is meant.

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71 The headline could mean "Egyptians are more like Italians than Canadians are" or "Egyptians are more like Italians than like Canadians."

These surrounding words are part of the **context** of the sentence. The context can also include surrounding sentences and paragraphs. In addition, the context includes the situation in which the sentences are used, the time, the identity of the speaker, and the speaker's body language. In the above example, the word *bank* is unambiguous not only because of the context but because of our background knowledge that people withdraw savings from financial banks and not river banks. That is, we can **disambiguate** in favor of financial bank and against river bank.

The conclusion to be drawn from this example is that the principle "Avoid ambiguity" requires not that you completely avoid using words that have multiple meanings but only that you avoid them when they interfere with communication. The corresponding principle for the listener or reader is to use the context of the sentence and your background knowledge to identify what statement is being made with the sentence.

Definition A *statement* is what a speaker or writer states, usually with a declarative sentence.

The one declarative sentence "Leroy is at the bank" can be used to make two statements: in one context, a statement about a river bank; in another context, a statement about a financial bank.

Do you see why the failure to properly disambiguate using context is the key to the effectiveness of the following joke?

> As Yogi Berra advised: "When you come to a fork in the road, take it."

Yogi Berra was intentionally ambiguous about the reference of the word “it.”

The following joke about America’s First Lady turns on ambiguity in the reader’s presuppositions; she is not making the same presupposition the waiter is making:

> The President and the First Lady are eating out in a restaurant.
>
> *Waiter*: Madame, what would you like to drink?
>
> *First Lady*: A glass of your house white wine will be fine.
>
> *Waiter*: And for an appetizer?
>
> *First Lady*: Tonight, we will skip the appetizer.
>
> *Waiter*: And for the main dish, madam?
>
> *First Lady*: I'll have the T-bone steak.

---

72 The two meanings seem to be quite distinct. Actually they arose from the same prior word *bank*, which meant what we now mean by "shelf!" People used to think of moneykeepers as storing their wealth on shelves, and they used to think of the side of the river as a shelf that stored dirt above the water.

Waiter: And for the vegetable?

First Lady: Oh, he'll have the same thing.

———CONCEPT CHECK———

Consider this ambiguous sentence construction: "I saw the man on the hill with a telescope." It is very ambiguous. Which one of the following is not a legitimate disambiguation?

a. The hill with a telescope was where I saw the man.

b. I was on the hill with a telescope, and the man saw me.

c. The man with a telescope, who was on the hill, was seen by me.

d. I was on the hill and I used a telescope to see the man.

———[73]

The word *inconsistent* has multiple meanings that can produce difficulties. A person is said to be "inconsistent" if they change their mind more often than you'd expect. That sense of the word is synonymous with *inconstant*. However, in this book the word *inconsistent* is normally used in the technical sense of logical inconsistent — implying that something is both so and not so. Here is an example of a logical inconsistency from Woody Allen: "I don't believe in the afterlife, but I'm going to take a change of underwear." We readers quickly realize that Allen's statement implies he believes that there isn't an afterlife but also that there is. That shocking revelation is what gives his joke its punch.

———CONCEPT CHECK———

During the last few months, Beth has liked Mark off and on from one week to the next. Is she being inconsistent or not?

———[74]

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[73] Answer (b). The problem is with "the man saw me," because the original sentence implies I did the seeing, not that I was seen.

[74] Well, she has changed her mind and is being inconsistent in the sense of being inconstant or fickle, but she is not being logically inconsistent in the way that it is inconsistent to say "x is greater than 11 and also less than 11." The first sense of *inconsistent* concerns time, but logical inconsistency does not.

The word *some* also has multiple meanings. It can mean "at least one and possibly all" or "at least one but not all." Only the context can reveal which. Here's a context in which it is used in the first sense. Suppose three people corner me in an alley at night. After a brief but futile attempt to solve the problem with words, I pull a knife and say, "Get out of here, or some of you are going to die." Here, I am using the word *some* to suggest at least one, and possibly all, will die. I don't mean some will and some won't. For a second example using this sense of the word *some*, suppose I bring back rock samples from a mountain. I then do a chemical analysis of one rock and discover that it contains sulfur. So I say, "OK, now we know that some of those rocks contain sulfur." Here *some* means at least one and possibly all. On the other hand, if I say, "I grade on a curve, and some of you are going to flunk," I mean at least one but not all. Your sensitivity to context and background knowledge enables you to pick the intended sense of *some*.

———CONCEPT CHECK———

Which of the two meanings of *some* is intended in the following sentence, or can't the reader tell?

> The survey of major corporate executives indicates that 60 percent of those sampled believe that some American graduates are not trainable for any entry-level management position in their corporations.

———[75]

Having more than one meaning is not necessarily a sign of ambiguity, but only when it inhibits communication. If you say, "I don't want to fish on that muddy bank. Let's stay in the boat," you won't cause a communication problem, despite the fact that the word "bank" might refer to a muddy financial bank instead of a bank along the edge of the water. Speakers and writers who use phrases that have multiple meanings can legitimately count on the audience or readers to pay attention to context and to rely on their background knowledge in order to remove potential ambiguity. Good writers do not make their readers struggle hard to do so, though.

If I say, "I climbed a tall mountain last year," I am not saying something ambiguous simply because I did not say the name of the mountain. Maybe the context didn't require naming the specific mountain. However, if I were to ask you which mountain you climbed last year, and you replied with "I climbed an interesting mountain last year," then you *are* being ambiguous, and probably evasive.

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[75] At least one but not all. Choosing the other interpretation of *some* would require the speaker to believe that maybe *every* graduate is untrainable; but surely the speaker isn't that pessimistic.

———CONCEPT CHECK———

Explain why the following statement is humorous.

> Elasas and other researchers say they believe that aspartame can do more damage over a long period of time than federal health officials.

Hint: it has to do with syntactic ambiguity.

———[76]

Here is an example of how ambiguity affects argument quality:

> Shipments of our tools to Toronto take place on Mondays. Today is Monday. So, there is a shipment of our tools to Toronto today.

This is a sloppy argument because the first reason is ambiguous. Is the first reason saying that we ship *every* Monday or only that, whenever we do ship, it is on a Monday (but not necessarily every Monday)?

A common kind of ambiguity occurs when the speaker leaves out important information about the *comparison class*. Suppose David says to Janice at a high school basketball game, "He's tall, wouldn't you say?" and Janice replies with, "Compared to what? He's tall for a high school student, maybe even tall for a high school basketball player, but not compared to professional basketball players." Janice is asking for information about the comparison class so she can disambiguate the remark and then evaluate it.

———CONCEPT CHECK———

What are the two comparison classes that are mentioned in this dialogue?

Janice: The U.S. has the best health care system, don't you think?

David: Maybe, are you talking about how the system works for the wealthiest in American society?

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[76] Personally, I believe federal officials can do *more* damage than aspartame, not less, don't you? The passage takes a shot at the federal health officials. To remove the disambiguation difficulties, add the word *believe* at the end of the sentence.

Janice: Oh, no I wasn't thinking about them. I was thinking just about the average person in North America. The typical American is the healthiest, don't you think?

[77]

Disambiguation by Machine

What sort of instructions do you give a computer when you want it to disambiguate by being sensitive to context? You need to teach it to use the appropriate background knowledge encoded in its database. For example, suppose you want to build a computer, let's call it *Watson*, to understand English and then to translate English into another language. How would Watson handle these two sentences?

> Time flies like an arrow in the sky.
>
> Fruit flies like a banana.

When you read these two sentences, you figured out unconsciously that *flies* is a verb in the first sentence but not in the second. Much of our understanding of English requires a great amount of unconscious disambiguation of this sort. It would be extremely difficult to program Watson with everything it needs to "know" to do this kind of processing for all possible English sentences.

To explore this problem further, try to make sense of the following statement:

> The chickens are ready to eat.

Are the chickens ready to do something, or are they about to be eaten? No ambiguity problem occurs with this grammatically similar statement:

> The steaks are ready to eat.

When you read this statement, you unconsciously searched your background knowledge for whether steak is the kind of thing that eats other things, and you were then able to rule out that interpretation of the statement. It is difficult to program a computer to do this. If there is ever going to be an artificially intelligent computer program that uses background knowledge to disambiguate, then someone is going to have to instruct it to do all the information processing that is done unconsciously by us humans, who are naturally intelligent.

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[77] Janice's comparison class is average persons in each of the three countries of North America. She would have been saying something more likely to be true if she had been speaking about the comparison class David had in mind, wealthy people in different societies in the world.

In the 1950s, when the field of computer science was beginning, many computer designers and programmers made radically optimistic claims about how they were on the verge of automating language understanding and language translation. The U.S. government was convinced, and it invested a great amount of money in attempts to automate language translation. For example, it funded a project to develop a computer program that could readily translate from English to Russian and also from Russian to English. After years of heavy investment, one of the researchers tested the main product of all these efforts by feeding in the following English sentence:

> The spirit is willing, but the flesh is weak.

The researcher then took the Russian output and fed it into the machine to be translated back into English, expecting to get something close to the original sentence. Here was the result:

> The vodka is strong, but the meat is rotten.

As a consequence, the government drastically reduced funds for machine translation.

These examples of the failure of machine translation show us that ambiguity is a serious obstacle to any mechanical treatment of language understanding.

Semantic Disagreements

When two people disagree, the source of their disagreement might be that they are using the same term in two different senses. If they could clear up the ambiguity, their so-called **semantic disagreement** might end. Here is an example:

> 1st speaker: Since you're from Brazil and speak Portuguese, you are not an American.
>
> 2nd speaker: We South Americans are as American as you North Americans, and I say you are an ignorant Yankee who will someday choke on your own conceit.

The first speaker is probably a U.S. citizen who believes that only U.S. citizens are "Americans." The second speaker uses "American" more broadly to refer to anybody from North, Central, or South America. Their disagreement is a semantic disagreement. More informally this is called a **verbal disagreement**, and the speakers are said to be “talking past each other.” Semantic disagreements are disagreements about meanings, but substantial disagreements are disagreements about how the world is or about what should be done. Ambiguity is one cause of semantic disagreements, and clarifying the meanings of terms will often resolve that kind of disagreement. Substantial disagreements, such as whether U.S. citizens are more conceited than Brazilians, are much harder to resolve.

Equivocation

If you went to an electronics store to buy a music system on sale only to discover that the store didn't have the advertised item and that they were now trying to sell you a higher-priced one instead, you might be upset. The store's technique is called *bait and switch*. In reasoning, too, it is unfair to begin an argument using a word with one sense and then later use it in a different sense. That's **equivocating**. Equivocation is the illegitimate switching of the meaning of a term during the reasoning. For example, the word *discrimination* changes meaning without warning in the following passage:

> Those noisy people object to racism because they believe it is discrimination. Yet, discrimination is hard to define, and even these people agree that it's okay to choose carefully which tomatoes to buy in the supermarket. They discriminate between the over-ripe, the under-ripe, and the just right. They discriminate between the TV shows they don't want to watch and those they do. Everybody discriminates about something, so what's all this fuss about racism?

The passage begins talking about discrimination in the sense of denying people's rights but then switches to talking about discrimination in the sense of noticing a difference. The conclusion that racism doesn't deserve so much attention doesn't follow at all. Because of the switch in meanings, the reasons for the conclusion are ultimately irrelevant. The speaker was equivocating.

For a second example of equivocation, watch the word *critical* in the following passage:

> Professor Weldman praises critical thinkers, especially for their ability to look closely and not be conned by sloppy reasoning. However, critical thinkers are critical, aren't they? They will attack something even if it doesn't deserve to be attacked. Isn't it irritating to meet someone who is always knocking down everything you say, for no good reason? These critical people don't deserve to be praised, do they? Evidently, then, Professor Weldman praises people who do not deserve to be praised. What a confused person he is. He should take a course in critical thinking himself.

Many people are apt to confuse the two meanings of *critical thinker*. Does it refer to a picky person or to a perceptive thinker? The title of this book was changed from *Critical Thinking* to *Logical Reasoning* for that very reason.

———CONCEPT CHECK———

Fill in the blank with one of the phrase below: "Dolores has more money than Barbara, and Barbara has more money than Terri, so Dolores _____ more money than Terri."

a. does not have

b. might have

c. most probably has

d. has

_____[78]

Isn't the answer (d)? This question will seem trivial to you if you have properly used your background knowledge about how test questions work, thus discounting the possibility that the two Barbara words might refer to different Barbaras. Wouldn't you have been upset if this were a real test question and the answer was (c) because you were supposed to worry that maybe two different Barbaras were being talked about? Your experience in test taking tells you to assume that Barbara refers to the same person unless there is some reason to believe otherwise, which there isn't in this example. Because we readers do properly make such assumptions, we would accuse a test maker of equivocating if the correct answer were supposed to be (c).

Being Too Vague

In the statement "Jane Austen is a poor person," the term *poor* is ambiguous. The ambiguity can be removed by expanding the context of the statement and saying, "Jane Austen is a poor person to choose for such a complicated job." Suppose, instead, the ambiguity is removed by saying, "Jane Austen is a financially poor person." Now the ambiguity is gone but the vagueness remains. Noticing the vagueness, you might well ask, "*How* financially poor?" You recognize that financial poverty is a matter of degree. When there is a matter of degree about whether something is an x, then the word x is said to be **vague in that context**.

When somebody uses the word *bald*, it can be reasonable to ask about the degree of baldness by saying, "Just how bald do you mean?" But when someone uses the word *seven* it would not be reasonable to ask, "Just how seven do you mean?" Nor would it make sense to ask, "Seven to what degree?" *Seven* is one of those rare words that is not vague.

Imagine a man having just enough hair that you have a tough time telling whether he is bald. Perhaps he is on the fuzzy borderline between bald and balding. You may want to say that he is

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78 The answer is in the next paragraph of the text.

"bald, by and large" or perhaps that he is "not exactly bald but surely doesn't have much hair." In the first case you are saying he is bald, but in the second case you are saying he is not bald. The existence of this borderline case of being bald is what makes the word *bald* vague. Vagueness is fuzziness of meaning. The line between bald and not bald is not sharp; it is fuzzy.

Definition An expression x is *vague* when it is imprecise either because there are borderline cases of being an x; or because there are degrees of being an x.

Fuzzy phrases are vague, but fuzzy heads are not. Language and thought can be vague; the physical world cannot be.

Judges often tear their hair out trying to deal with fuzzy language. They must decide what counts as "stealing," for example, and they don't like borderline cases. They are always trying to make language be more precise. Suppose a prosecutor charges a delivery person with stealing, because she used snow from a homeowner's yard to resupply the ice in her van's ice chest. This taking of snow is a borderline example of "stealing," but the judge has to make a decision; either she is innocent, or she is not. The judge cannot say she is "sort of innocent." If the judge of an appellate court decides that the action is not stealing, that very decision helps redefine the term *stealing* for future cases. It sets a precedent. This example shows that:

———CONCEPT CHECK———

Following are four choices

Re-definition is a way to remove vagueness.

y in their vagueness. Rank them, beginning with the l

I'll meet you _____

a. outside Sears' north entrance next to where the Salvation Army lady usually stands.

b. nearby.

c. at the north entrance of the Sears store.

d. at Sears.

[79]

To find language that is free of ambiguity and vagueness, look to the terminology of mathematics, computer programming, and symbolic logic. Computers cannot easily tolerate imprecision; we have to be precise about everything when we program a computer. In ordinary conversations with human beings we don't need to be as precise. Saying "I'll probably go to see that film with you soon" is good enough for a human. Saying "The probability is 72 percent that I'll go to the film with you within the next forty-two to forty-six hours" would be strange because it is too precise. It's a social convention that we usually don't go to the trouble of being precise unless we need to be.

Scientists do need to be precise. They speak of "volt," not "jolt." They use "species" instead of "kind of critter." Scientists define their terms more precisely than the rest of us do, and this precision is one key to their success. Our ordinary word *bug* is vague and not as useful in accurately describing our world as are the scientific words *insect* and *arachnid*, which have fairly sharp definitions. For example, a creature must have six legs to be an insect and eight to be an arachnid. That's what distinguishes mosquitos from spiders. Count the legs on a cockroach sometime and you'll know which way to classify it. The term "bug" has many more borderline cases than "insect" and "arachnid." Retaining the familiar but vague term *bug* in communications among biologists would be an obstacle to the growth of the science.

Precision is helpful not only in scientific classification but also with scientific measurement. If scientists measured feet using a notion of feet that varied with each scientist's own foot, can you imagine the difficulties?

But vagueness has its advantages. If you make a vague claim, it is harder to show it is incorrect than if you make a precise claim. The disadvantage is that the vaguer claim may be less useful than the precise one. Here is an example of how one employer used vagueness for an advantage: The employer's ad for a new employee said new employees can make up to $30 an hour. The phrase "up to" is a so-called "weasel word" that protects the employer who has never given anyone over the minimum wage. If you weaken a claim by inserting a term that makes the claim harder to criticize, then you've inserted a so-called *weasel word* or *weasler*.

> "In this business a little vagueness goes a long way."—Jerry Brown, California politician

79 The appropriate order is (a) (c) (d) (b).

Critical thinkers are sensitive to the fact that the strength of an argument can vary with the vagueness of its ingredients. Which would be the safest conclusion, and thus strongest argument? When you know that 100 Ohio voters were sampled and 70 of them said they'd be voting for the Republican candidate, would it be safest to conclude that over 65% of Ohio voters will vote for the Republican candidate or instead to conclude that most Ohio voters will vote for the Republican candidate? Drawing the vaguer conclusion makes for the strongest argument.

> The less specific the conclusion of an argument, the stronger the argument.

———CONCEPT CHECK———

When does a near object become a far object?

———[80]

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80 The difference between near and far is vague, that is, it is a matter of degree and there are borderline cases. It is helpful to think of x being near or far from y relative to z. Now it is easier to see that in addition to being vague the question depends on what the y and z are. You might have mentioned that if we are talking about distance, then far things have more distance than near things. Whether something x is near or far depends on several factors such as the x: Which object you are talking about? [A nearby star is farther away than a far away restaurant across town]. It depends also on y: x is near or far from what thing y? [Near you or near something else? Your right hand is near you but not near the South Pole]. You cannot always assume the z is you. For example, what if the question were being asked in a context in which z is the planet Mercury, and you wanted to know whether Neptune is near or far from Saturn compared to Mercury. So, if you answer with "I can tell if it is near or far by measuring its distance from me," then the answer wouldn't be helpful. Suppose you were to learn that Neptune is 4.4 billion kilometers away from you. What would that tell you about whether Neptune is near or far from Saturn compared to Mercury? Nothing. Finally, the answer depends on the speaker's interests [Philadelphia is near New York City if you are interested in drawing a map of the U.S., but it is far from New York City if you are interested in walking there on your lunch break from your office in downtown Philadelphia]. Hopefully your answers was not just that big objects are closer than small objects. Consider a big elephant only two feet away from you. It is still not close compared to the distance your shirt is from you.

Being Too General

Vagueness is not the same as generality. What, then, is generality? This is harder to explain. It's something like broad.

A statement is called a **generalization** if it uses a general term. A **general term** refers to a class of objects. The general term *metal* refers to the class of metals. Classes are sets or groups. Classes are more general than their subclasses and usually are more general than any of the members of the class. For example, the term *detective* is more general than *English detective*, which in turn is more general than *Sherlock Holmes*. The latter term is not general at all; it is specific.

Being overly general can cause imprecision. Suppose you are asked, "Who would you like to see run for your state's attorney general in next year's election?" You would be answering at too general of a level if you responded with "Oh, a citizen." The term *citizen* is neither ambiguous nor vague, but it is too general of an answer. The questioner was expecting a more specific answer.[81]

Often we state generalizations with quantity terms, such as 17, one-half, all, many, or some. For example, the statement "All metals conduct electricity" is a generalization about metals. So is "Many metals are magnetic." The former is called a **universal generalization** because of the quantity term *all*, whereas the latter is a **non-universal generalization** because the quantity term is something less than all. By using the word *many*, the speaker implies that the property of being magnetic need not be as universal (pervasive) for metals as the property of conducting electricity. Saying that "33 percent of all metals are magnetic" is also a generalization. It is a non-universal generalization, a **statistical generalization**. Universal generalizations are sometimes called categorical generalizations.

When someone says, "Generally speaking, adults prefer chocolate ice cream to vanilla ice cream," the word *generally* here indicates a non-universal generalization. It means most of the time but not necessarily all the time. Ditto for *in general* and *usually*.

Generalizations aren't always easy to detect. "A shark can be dangerous" is a generalization about the class of sharks. Generalizations about time are even more difficult to spot. "This grain

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81 Is the word *tree* in "He purchased a tree at the nursery" ambiguous or vague or general? In answer to this question, consider the fact that the word *tree* could refer to apple tree or maple tree, but that's not ambiguity, because there are not multiple **meanings** involved, only multiple **references**. If there were a problem about whether the tree is a phone tree, then there would be ambiguity, but the context here rules out the phone tree. However, the term *tree* does denote (refer to) a class—the class of trees of which apple and maple are members. So, *tree* is general even if not ambiguous. Is it also vague? It is vague only insofar as you have trouble with borderline cases. Because we do have trouble telling whether tall shrubs are trees, to that extent the word is vague. Consequently, the answer to our original question is that the term *tree* is not ambiguous, yet it is both vague and general. However, it is not important for most persons to be skilled at classifying a term this way. That is a skill for philosophers and linguists.

of salt is water soluble" is a universal generalization about the class of all times, because the speaker is essentially saying that if this specific grain of salt were put in water at any time, it would dissolve.

———CONCEPT CHECK———

When the child care worker says, "I caught your baby almost every time I threw him in the air," she is generalizing about the times she threw your baby. Her generalization is

universal

non-universal

———[82]

Suppose you know Jane Austen's street address and you know that your friend Sarah needs to get in touch with her. You and Sarah are citizens of the U.S. and are in Iowa. If Sarah asks you if you know where Jane Austen lives and you say, "I think she lives in the United States," Sarah will think you are weird. Your answer is too general. You are violating the rule of discourse that

> a person should answer with the appropriate precision for the context, and not be overly general.

Vagueness, ambiguity, and overgenerality are three forms of imprecision. Imprecision, in turn, is intimately connected to lack of sufficient information. For example, when a salesperson describes a music system as "powerful," and "having twice the clarity of the competition," and "being well designed," you are getting a bunch of imprecise descriptions and hardly any information at all. There is a certain safety in imprecision. It's the kind of safety enjoyed by writers of fortunes for Chinese fortune cookies. These fortunes are always sufficiently imprecise that anyone can find a way of making them apply to his or her own life. A fortune says, "You will have success tomorrow." This is surely true, because almost everyone will have some success at something, even if it's only the success of tying one's shoelaces in the morning before getting hit by a truck. Here is an astrological example of safety via imprecision:

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[82] Answer (b). It is non-universal because it permits exceptions, and that's a good reason to fire the child care worker.

> Astrologer Judi sees a good year for all Zodiac signs, except that those born under the signs of Scorpio, Taurus, Aquarius, and Leo will remain in a continuing state of transformation—a period of intensity. "My advice to people with these signs is to do what has to be done and do it the very best you can. This will be very important."[83]

How could you test whether this astrological forecast turned out as predicted? Untestability due to imprecision is one of the negative aspects of astrological predictions.

The value of a precise claim, as opposed to an imprecise one, is that you learn so much more when you learn that it is true. Saying that Latonya is twenty-three years old is more informative than saying she isn't a teenager any more. Putting a number on her age makes the claim more precise and thus more informative. Nevertheless, making a precise claim is riskier than making an imprecise one. If her twenty-third birthday is still a week away, then calling her twenty-three is incorrect but saying she's not a teenager any more is correct.

> The more precise a claim, the more informative it is if it does turn out to be true.

Another value of precise claims is that they are easier to check. If someone says that the city of Vacaville has ghosts, the person is not being very precise about where or when or how the ghosts appear. As a result, scientists won't pay much attention. However, if someone reports that two ghosts in blue gowns appear at midnight in front of the Vacaville City Hall whenever there is a full moon, this claim is more worthy of scientific attention, provided reasonable eyewitness testimony exists to support it. The scientist now has a better idea of how to test this ghost story as opposed to the original, imprecise one. In short, the precise claim is more readily testable, and testability is a scientific virtue.

———CONCEPT CHECK———

It's Monday and you are a factory manager who has just sampled some of the resistors manufactured in your electronics factory today. All of them are defective. However, you believe you have detected the cause of the problem, and you have some good ideas about how to fix things for tomorrow. After making those changes, you have to forecast the quality of

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83 This was a real prediction. It is from "Astrologers Make Their Predictions for 1991," by Pat Christensen, *The Independent*, January 1,1991.

tomorrow's production of resistors. Which one of the following statements would be most likely to be true?

a. All of Tuesday's total output of resistors will work OK.

b. Most of Tuesday's total output of resistors will work OK.

c. Some of Tuesday's total output of resistors will work OK.

———[84]

The moral again is that there is safety in imprecision.

———CONCEPT CHECK———

It's Monday and you are a factory manager who has just sampled some of the resistors manufactured in your electronics factory today. All of them are defective. However, you believe you have detected the cause of the problem, and you have some good ideas about how to fix things for tomorrow. After making those changes, you have to forecast the quality of tomorrow's production of resistors. Which one of the following statements would be most likely to be true?

a. Over 90 percent of Tuesday's total output of resistors will work OK.

b. Exactly 95 percent of Tuesday's total output of resistors will work OK.

c. At least 95 percent of Tuesday's total output of resistors will work OK.

d. 94 to 96 percent of Tuesday's total output of resistors will work OK.

———[85]

Saying "exactly 95 percent," if it were true, would be much more informative than hedging with "over 90 percent."

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[84] Because (c) is the least precise, it is also the most likely to be true.

[85] The least precise answer is (a). Here is another way to think about it. There is more room for success in "90 to 100" than in "at least 95" or in "94 to 96." Notice that answer (a) is not especially vague or ambiguous; the problem is just imprecision, but the kind that doesn't involve vagueness or ambiguity.

Giving Too Many Details

Communicators sometimes communicate ineffectively by offering too many details for the purpose at hand. They can do this by digressing or getting off the topic, but they can also do it by staying on topic with too many relevant details. The common metaphor here is that their audience will fail to see the forest because they're being told to look at too many individual trees.

Being Pseudoprecise

The nineteenth-century American writer Mark Twain once said he was surprised to learn that the Mississippi River was 1,000,003 years old. He hadn't realized that rivers were that old. When asked about the "3," he answered with a straight face that three years earlier a geologist had told him the Mississippi River was a million years old. In this case, "1,000,003" is not precise; it is silly. Technically, "1,000,003" is called **pseudoprecise**. Pseudoprecision is an important cause of fallacious reasoning when quantifying something—that is, putting a number on it.

Definition A claim is *pseudoprecise* if it assigns a higher degree of precision than circumstances warrant.

Predicates can pick out properties, as when the predicate "is a blue car" picks out the property of being a blue car. Being old is a vague property; being 77 years old is more precise. Placing a number on some property can improve precision in describing the object. But not always. Placing a number on a property of an object is pseudoprecise if (1) the property cannot be quantified, that is, it doesn't make sense to put a number on it, (2) the object cannot have the property to that degree of precision, or (3) the object could have the property to that degree of precision but the person is not justified in claiming that much precision.

Let's consider some examples of this. The Mississippi River story is an example of type 3. A number (1,000,003) is used by a person (Mark Twain) to quantify (measure with a number) some property (age) that an object (the Mississippi River) has. The river could be precisely that old, but Twain was not justified in claiming that much precision. Even the geologist couldn't know enough to place such a number on the age of the Mississippi.

For an example of pseudoprecision of type 1, suppose you heard that Mark Twain admired Andrew Jackson 2.3 times as much as he admired the previous president, John Quincy Adams. You would be hearing something pseudoprecise, because the precision is a sham. All you can sensibly say about admiration is that some is strong, some is weak, and some is stronger than others. Forget about numbers.

Although quantifying can often improve precision, there is a limit to how precise you can get this way. For example, if you were to read that Napoleon Bonaparte was 5 foot 1.4748801 inches tall, you shouldn't believe it. Measuring people's height doesn't make sense to this many decimal places. Inhaling can raise a person's measured height by tenths of an inch, while taking a bath can lower it by a hundredth. Too precise a height for Napoleon is an example of pseudoprecision of type 2.

If a statistical report mentions that the average size nuclear family in your community has 2.3 children, is this number pseudoprecise? No. The 2.3 statistic is the result of dividing the whole number of children in nuclear families by the whole number of nuclear families. It doesn't imply that any real family has 2.3 children, which would be silly.[86]

———CONCEPT CHECK———

[86] Note that the sentence uses the word imply in the sense of "require." The word imply also can be used in the sense of "suggest," although it usually will not be used that way in this book.

Which one statement below probably suffers the most from pseudoprecision?

a. There are an average of 1.5 guns in each household in Dallas, Texas.

b. Our company's computer can store 64,432,698,003 characters simultaneously.

c. The first flowering plant appeared on earth nearly 100 million years ago.

d. Today, David used his new precision laser distance-measuring tool and discovered the diameter of the cloud overhead to be 0.4331 times the diameter of the cloud that was overhead yesterday at the same time.

e. The reading head of the computer's magnetic disk is 0.4331 inches from the disk itself.

[87]

Improper Operationalization

Suppose a newspaper headline reported "Number of Christians in the World Increases." The article does not tell you how the researchers decided whom to count as a Christian. You have to guess. Did the researchers mail a questionnaire to all the Christian churches in the world asking for membership totals? This way of counting would miss everyone who considers himself or herself a Christian but who isn't affiliated with a specific church, and it would over-count those persons who belong to more than one church. Did the researchers instead do a small poll of New Orleans and then assume that the rest of the world is like New Orleans as far as religion is concerned? There are many other operations they could have used to count Christians. The operation or method the researchers used could make a difference to their count. That is, the **operationalization** of the term *Christian* would make a difference in what the study says is the total number of Christians.

Definition The *operationalization* of a term is the operation or method used to tell whether the term applies.

When you question the operationalization of a term, you are essentially asking, "How did they measure that?" The word *Christian* and other imprecise terms need good operationalizations if accurate claims are going to be made using them. Without a good operationalization, a claim using the term will suffer from inaccuracy, pseudo- precision, or both.

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87 Answer (d). Can a cloud be given a width to an accuracy of a ten thousandth of an inch?

———CONCEPT CHECK———

What operationalization problem occurs here?

> Lying by politicians is up 10 percent in New York this year.

———[88]

Does South America have more political instability than Central America? It is more difficult to establish claims that use imprecise terms such as *political instability* than it is to establish claims that use precise terms such as voltage or mile. That's one reason why social scientists have a tougher job than physical scientists in making scientific advances.

Let's consider the special problem of the social scientist. Suppose the newspaper reports on a scientist's finding that rich females are more intelligent on average than poor males. The logical reasoner will ask, "How did the researcher figure out who is rich and who is intelligent?" Let's focus on the term *rich*. If the researcher merely asked each person whether he or she was rich, the answers are going to be very unreliable. But perhaps the researcher operationalized the concept of *rich* in some other way. Did she check each individual's finances and decide that anybody making over $100,000 per year was rich and anybody under that was poor? Even one cent under? If so, then the researcher does not mean what you and I do by the term *rich*. Unfortunately, most of us get our information indirectly and not by reading scientific reports that specify the operationalization procedures of the key terms under study. Instead, we have to hope that the other scientists who refereed the report checked on the procedures and approved them.

Operationalizing the vague term *intelligent* is as difficult as the term *rich*. And some ways are better than others. Which among the following is the best?

a. Intelligent people are smarter than unintelligent people.

b. See whether the word intelligent has positive connotations.

c. Use an IQ test.

d. Ask the people involved whether they are intelligent.

e. Ask a large random sample of people whether they believe rich females are more intelligent than poor males.

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[88] The main problem is how to measure lies. One sub-problem is that liars will cover up their lying. A second sub-problem is that even if you can uncover the lies, you must still find a way to count them because there is a fuzzy border between lying and stretching the truth.

Only (c) and (d) are operationalizations, so (a), (b), and (e) can be ruled out. Method (e) is a way to answer the question of whether rich women are more intelligent, but it's not a way to measure intelligence. Method (d) can be ruled out because of the subjectivity; people can be expected not to give honest assessments of themselves. That leaves the IQ test as the best of the lot.

Typically, an IQ test measures the ability to answer written questions. So, a typical IQ test is not an ideal measure of human intelligence. For example, if a person were to do poorly on an IQ test yet have been the primary inventor of an automobile engine that is 20 percent more energy efficient than all other existing automobile engines, that person should still be called "intelligent." In short, intelligence can show itself in many ways that aren't measured on an IQ test. But the other way works; if you do well on an IQ test you've got to be intelligent.

When you do read a headline such as "Biologists Report That Dolphins Are More Intelligent than Polar Bears" or "Political Scientists Report That South America Is More Stable Politically Than Central America," you probably should give the reporter the benefit of the doubt that the scientists used some sort of decent operationalization for the key terms. If you can actually discover what operationalization was used, and you have no problem with it, you can believe the scientists' report more firmly. And if you learn that the scientists published their results in a mainstream scientific journal and not in the *Proceedings of the Conference on "Star Trek" Film Reruns*, you can be even more confident in the report. It is safe to assume that the editors of the scientific journal checked to see that there were no significant problems with the operationalization of the key terms, nor any other problems with the scientific study. That wouldn't be as safe an assumption to make about the editor of the *Proceedings of the Conference on "Star Trek" Film Reruns*, nor even a safe assumption to make about editors of daily newspapers or TV news programs. And especially not for writers of individual blogs on the Internet.

———CONCEPT CHECK———

When a Gallup poll reports that Americans are 5 percent happier with America now that the U.S. has completed negotiations on an international fishing treaty designed to say who can fish for which fish, critical thinkers know that the most difficult term for the pollster to operationalize was

a. reports

b. that

c. 5 percent

d. poll

e. happier

———[89]

Here is a more difficult question that covers several of the topics in this chapter at once.

———CONCEPT CHECK———

"Social scientists from the University of Michigan report that over a quarter of all Canadian citizens they tested who had driven into Detroit from Canada on a Saturday night had blood alcohol levels of .05 percent or greater." This sentence probably

a. contains pseudoprecision.

b. is exaggerating.

c. needs operationalization of the evaluative term "Saturday night."

d. is relying too heavily on loaded language.

e. none of the above.

———[90]

Creating Helpful Definitions

Not everybody uses the word "definition" the same way. Sometimes when you ask for a definition expecting to be told how the word is normally used, you receive something else entirely: "Neurotic means he is not as sensible as I am, and psychotic means he's even worse than my brother-in-law." The definition of a word can serve a variety of purposes other than simply stating how everybody uses the word. Understanding this is helpful to the critical thinker. In addition, people use a wide variety of techniques in creating definitions, so it is important to know about these techniques if you want to understand the definitions and spot errors in those definitions. Because errors in creating definitions can be an obstacle to

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[89] Answer (e). How do you quantify (put a number on) happiness? Notice that *happier* is the evaluative term. The term 5 percent is not hard to operationalize. What is hard to operationalize is "5 percent happier," but that is not one of the answer choices.

[90] Answer (e). The .05 percent level can be accurately measured, so answers (a) and (b) are not correct. The word Saturday is not evaluative. There is no loaded language here. Thus, by elimination, the answer is (e).

communication, this section is designed to improve your skill at avoiding these errors. Hopefully you will not use what you learn here to create these errors on purpose, as a means of manipulating others.

Different Definitions for Different Purposes

We've seen that one purpose in giving a definition of a word is to tell how the word is normally used. Another purpose is to make a joke. Very often, a definition is designed to make the word be more precise. A definition of *dog* as "an animal like that pet over there" would be of little help to a biologist. A biologist needs a more precise definition. Every time a high court judge makes a decision in a case of assault, it sets a precedent that makes the legal term *assault* more precise.

Suppose I hire you to visit the corner of Watt Avenue and Marconi Boulevard and to count the number of nice cars that pass by during lunchtime each day for a week.

You, the logical reasoner, will think to ask me to define my key terms "nice car" and "lunchtime" if I hadn't done this already. Suppose I define "nice car" as a car that currently retails for over $30,000, and define "lunchtime" to mean from noon to 1:30 P.M. OK, now things are clearer.

At the time cars were invented, horses were a better known source of power, so it was common to say the more powerful of two cars had more "horsepower." The term was also used to represent the power of water wheels, motors, and even people. Clarity was added to all this when the experts finally agreed on a more precise definition:

> Definition: One *horsepower* is the power needed to raise a weight of 550 pounds by one foot in one second.

Precising definitions are definitions that make the correct meaning more precise. We have just seen three examples of precising definitions: for "nice car," "lunchtime," and "horsepower."

As you may have noticed from the above discussion, you can't always find a proper definition in the dictionary. There is no definition of "nice car" there.

When a new law is written, it often begins with a precising definition of a key term, but then when court cases reveal that even with this definition there isn't sufficient precedent or established usage to determine how the term applies in some important case, then jurors, legislators and judges step in to make the definition even more precise.

Let's look at an example. The Fourth Amendment to the U.S. Constitution prohibits "unreasonable searches and seizures." What exactly does that term mean? Well, it's a matter of a mix of common sense, legislation and judicial decision. In the 1991 case of California v. Hodar D, the Court considered the case of a suspect who threw away a packet of drugs while running

from the police. The drugs were then confiscated by the police. Have those drugs been seized unreasonably? "Yes," said the defense lawyer. "No," said the prosecutor. To resolve the dispute, the Court had to more precisely define "unreasonable seizure." It decided that if the suspect keeps running after dropping his materials, then no unreasonable seizure of those materials has occurred and the materials will later be admissible as evidence.

In redefining terms used in a court decision, the judge is guided in part by what can be learned about the intentions of the legislators who enacted the law, and in part by what the judge conceives to be in the public interest. Other people who provide precising definitions usually are not guided by those aspects of the situation. Consider anthropologists. At the time that the famous anthropologist Dr. Louis Leakey sent the 26-year-old Jane Goodall into Tanzania in Africa to study chimpanzees, the term "human being" was defined in part as "the tool-making animal." We humans were known as "Man the Tool Maker."

But Dr. Goodall made a remarkable discovery. She found a chimp that can strip leaves off a straight twig, insert the twig into the entrance of a termite mound, wait a few seconds, pull out the twig loaded with termites, and use its lips to strip off the termite snacks. Termite shish-kabob. This was the first scientific discovery that another species makes tools. The behavior is not instinctual and must be passed on from one generation to the next by teaching.

When Goodall submitted her report about using twig-tools to get termites, Dr. Leakey wrote back, “Now we will have to redefine *tool* or redefine *human* or accept chimpanzees as humans. After some turmoil within the community of professional anthropologists, they decided to redefine "human." Dictionary writers had to follow their lead.

Definitions serve other purposes besides making a term more precise. Powerful political institutions can exert their power by defining terms their own way. An ordinance was once proposed to the city of Cambridge, Massachusetts, to outlaw "all animal experimentation involving pain with inadequate anesthesia." It required adequate anesthesia for all experimentation on animals. However, it permitted inadequate anesthesia for rats and mice. Lest you think there is an inconsistency here, the ordinance noted that rats and mice are not animals, at least not according to the U.S. Department of Agriculture's definition of *animals*, to which the ordinance referred. Evidently, the Department of Agriculture has the power to define

animals not to be animals. Such is the power of government, the power of the word, the power to control definitions.

Not only do people create definitions for a variety of purposes other than simply to describe how everybody has been using the word, but they also use a variety of definitional techniques. Let's consider some especially important ones. If you did not know what a labrador retriever is,

I might be able to define the term by pointing to a specific dog and saying, "This is what I mean." A definition by pointing is an *ostensive definition*. Ostensive definitions are a kind of definition by example. If I define physical science as "something like geology, chemistry, astronomy, or physics," I am giving a *definition by example*. Dictionaries cannot use ostensive definitions, but occasionally they do use definitions by example. A dictionary definition is called a *lexical definition* because dictionaries are called lexicons. Here is an example of a lexical definition that is not a definition by example:

> Vixen means "female fox."

The definition is correct, so the definition's sentence is a true sentence.

A *stipulative definition* stipulates how a new term is to be used from now on. If I define the term boke to be a broken coke bottle, I have *coined a new term* for our language, although there isn't much chance my definition will be adopted by other speakers. In 1840, in his introduction to *The Philosophy of the Inductive Sciences*, William Whewell wrote: "We very much need a name to describe a cultivator of science in general. I propose to call him a 'scientist.'" Whewell's stipulative definition caught on. It has now become a correct lexical definition.

Persuasive definitions are another category of definitions. Take the definition of atheist proposed by William, an acquaintance of mine: "By atheist I mean a non-Christian pervert who will rot in hell." Well, the definition is not especially accurate because it doesn't reveal the way most other people use the term atheist. It's more of biased description or persuasive definition, not a lexical one.

Sometimes a definition of a term will offer some operation or procedure to tell whether something should be called by that term. The procedure of asking a woman whether she is pregnant and taking a "yes" answer to indicate pregnancy would be an *operational definition* of pregnant that a social science researcher might use when studying whether pregnant women have a better diet than other women. This operational definition isn't what most of us would give if we were asked to explain what pregnant means, but it could succeed at identifying who is and who isn't pregnant and so deserves to be called a definition of "pregnant."

———CONCEPT CHECK———

Create an operational definition of popular TV show.

How to Avoid Errors when Creating Definitions

Let's turn now from examining the purposes and kinds of definitions to the more important topic of avoiding errors in definitions. Here is a faulty lexical definition:

> By definition, a *square* is a four-sided, plane, closed geometrical figure in which all angles are 90 degrees.

Did you notice the problem? The definition permits too many things to be called squares. It lets in any rectangle. So we say it is *too broad*. The same kind of error is made when vegetable is defined as a food that is not a fruit.

Here is the opposite kind of error:

> By definition, a triangle is a three-sided, plane, closed geometrical figure with equal sides.

This definition rules out triangles that don't have equal sides, so it is *too narrow*. Both kinds of errors would be committed at the same time if someone were to define a vixen as a young fox. The definition is too broad because it permits young male foxes to be vixens. It is too narrow because it rules out old female foxes.

CONCEPT CHECK

Is the following proposed definition too broad, too narrow, or both? Why?

> Science: The study of geology, biology, chemistry, or physics.

[91]

Ambiguous definitions and overly vague definitions are two other faults in constructing definitions. Suppose you did not know the meaning of the slang term *put down*, and I defined it this way:

> By definition, a *put down* is a shot intended to harm.

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91 It is too narrow because it leaves out biochemistry and astronomy.

If you didn't know that a put down is something done verbally, you might be misled into thinking that it is something that can be done with a pistol. So, the definition suffers from ambiguity.

Definitions by example are always vague. Defining dog in terms of a dog's genetic makeup would be less vague and better biology than defining it as something like a collie. Figurative language in a definition always produces an overly vague definition. That would be the problem if we defined *dog* as "man's best friend" or defined *president of a country* as "pilot of the ship of state." Science and mathematics have progressed in part by carefully avoiding imprecise definitions whenever possible.

Scientific definitions are usually overly complex for the nonscientist. Hoping to learn how to distinguish a spider from other bugs, the nonscientist might ask a biologist to define *spider*. If the biologist gave a definition that referred to the spider's genetic code, the definition would fail to elucidate. That is, it wouldn't get the point across.

Defining *dog* for a third grader by giving several examples would be vague, but appropriate. After all, we give definitions in order to achieve the purpose of getting the meaning across to others. If we achieve our purpose, that is all that counts, vagueness or no vagueness.

Failure to convey the grammatical category is also a source of error. If the audience doesn't know the grammatical category of the term *lassitude*, then defining it as "when you feel very tired" could mislead an unwary member of the audience into supposing that the definition could be substituted this way:

> Monroe's lassitude got him fired, so
>
> Monroe's when you feel very tired got him fired.

Suppose someone had never heard the word *nigger*, and you defined it for them as "black person." By covering up the negative connotation, you would have been offering a faulty definition that could get the user in trouble. So, failure to convey the term's connotation is the type of error here. It could be corrected by defining nigger as "derogatory term for persons with black skin."

Another way that a definition can fail is by being circular. The author of a circular definition makes the mistake of improperly using the term that is supposed to be defined. For example, the person who defines apprentice as "someone who is an apprentice to a laborer" is not informing anybody of anything other than the grammatical category of apprentice.

Circularity can also be a problem with a chain of definitions, even if no single definition in the chain is itself circular. Here is an example:

> Effect is that which is produced by a cause.

Cause is that which produces an effect.

Another kind of error in the definition process occurs in the following pair of definitions:

An airline stewardess is a woman who provides service to airline passengers during flight.

An airline steward is a male airline stewardess.

This is an inconsistent definition because it implies that a steward is both male and female. To remove the gender identification of steward and stewardess, airlines at the end of the twentieth century began recommending use if the genderless term flight attendant. Usually it is not important, and is even sexist, to identify the sex of a worker or occupation. That's the main reason that the term mailman is dying out, to be replaced by postal carrier.

———CONCEPT CHECK———

When someone gives the lexical definition of atheist as "non-Christian," the error is to give a definition that

a. commits an attack on the arguer, not the argument.

b. is too broad.

c. is too narrow.

d. is circular.

Errors in operational definitions are especially hard to avoid. The problem is really to minimize the degree to which the class of things identified by the operational definition deviates from the class identified by the lexical definition. For instance, suppose some scientists report that

> American homes are neater now than they were in 1900.

Before you accept the scientists' claim, ask yourself how the term *neater* was operationalized. A good reporter would provide the reader with the actual operational definition. A reader not given this information would have to worry that the term was operationally defined by counting the number of objects in the house; the fewer objects, the neater the house. That definition is both too narrow and too broad and thus isn't true to the lexical definition of *neat* that you use. Readers should put less faith in a scientific report if they can't be satisfied that an important term was adequately operationalized.

CONCEPT CHECK

What is the main flaw in this set of definitions?

> *Vague* means "suffering from vagueness."
>
> *Vagueness* means "the result when vague words are used."

[92]

One final reminder about definitions: they serve several purposes, not just making meaning more precise, or accurately reporting the common meaning. For example, let me define "minor back surgery." It is back surgery on someone else.

Review of Major Points

When communicating appropriately, we ignore irrelevant inexactness. But communication can break down when the inexactness is relevant to our concerns. Ambiguity, vagueness, overgeneralization, pseudoprecision, improper operationalization, and presenting too many details are all sources of imprecision and potential obstacles to communication. Vagueness can

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92 Circularity.

almost never be entirely eliminated from our statements, but excessive vagueness should be, as should overgeneralization and excessive multiple meaning (ambiguity).

Vagueness is not the same as ambiguity. For example, the word “purple” is vague because there is no sharp boundary between purple and not purple, but it wouldn't be proper to call the word ambiguous, since there are not a small number of distinct interpretations. With vagueness, the uncertain interpretations form a continuum.

To stay on track, the logical reasoner must be sensitive to inadequate precision that occurs in semantic disagreements, some of which are due to equivocation or faulty operationalization. The logical reasoner must also be aware of the effects on communication due to context, background knowledge, and the difference between a universal and a non-universal generalization.

Clear, precise definitions are an aid to communication. Definitions are used not only to inform people of the meanings of words but also to make jokes, remove vagueness, and push a political agenda. Definitions come in various flavors: ostensive, lexical, stipulative, operational, and by example. Helpful definitions are often difficult to create, especially operational ones. Definitions can be faulty because they are too broad, too narrow, ambiguous, vague, inappropriate for the audience, misleading as to grammatical category or connotation, circular, or inconsistent.

Glossary

ambiguity A type of imprecision; a term or phrase is ambiguous if the context cannot be used to sufficiently rule out all the term's possible meanings but one.

ambiguous definition A definition that expresses the meaning ambiguously.

broad definition A term's definition that would permit too many things to be called by that term.

circular definition Using the term to be defined as part of the term's own definition.

comparison class The class of things a comparison is being made among.

context The sentence that a word or phrase occurs in, plus the surrounding sentences, the situation in which the sentences are used, the time, the identity of the speaker, and even the speaker's body language.

definition by example Defining a term by indicating examples of things appropriately named by that term.

disambiguation Using context and one's background knowledge to detect the intended interpretation (meaning) of a phrase with multiple possible interpretations and thereby remove the potential ambiguity.

equivocation Illegitimately switching from one meaning of a term to another on different occasions, or simply using one term that has two meanings, and the context cannot readily be used to rule out all but one meaning.

general terms Terms that refer to a class of objects. For example, *Sherlock Holmes* is a specific term; *detective* is a general term. *Human being* is even more general.

generalization A statement containing a general term, usually as its subject. For example, the statement "Politicians have aggressive personalities" is a generalization about the class of politicians. Generalizations explicitly or implicitly use quantity terms to attribute properties. In our example, the quantity term all is implicit or unstated.

inconsistent definition A definition that expresses the meaning inconsistently.

lexical definition A dictionary definition.

narrow definition A term's definition that would permit too few things to be called by that term.

non-universal generalization A generalization that does not require the property to apply to every member of the class. For example, saying "Most stars are not surrounded by life-sustaining planets" is a general statement about stars, but it is non-universal because the quantity term is not all (or an equivalent) but most.

operational definition A definition given by stating an operation or method to follow in deciding whether the term applies.

operationalization The operation or method used to tell whether a term applies in a particular context.

ostensive definition A definition by example offered by a speaker who indicates the example by pointing.

overly vague definition A definition that expresses the meaning too vaguely.

persuasive definition A definition that could be used to persuade the hearer to take a particular stand on an otherwise controversial issue. A definition that is not objective.

precising definition A definition that makes the meaning more precise.

pseudoprecision A claim is pseudoprecise if it assigns a higher degree of precision than circumstances warrant. It occurs whenever a number is placed on some property that an object has when (1) the property cannot be quantified, (2) the object cannot have the property to that degree of precision, or (3) the object could have the property to that degree of precision but the person is not justified in claiming that much precision.

quantify To put a number on something in order to measure it.

quantity term A term assigning a quantity to a class. Examples: 17, each, every, most, all, some, and no.

semantic disagreement A disagreement about meaning; also called a *verbal disagreement*. Clarifying terms can resolve a semantic disagreement.

specific term A word or phrase that refers to a single object rather than to a class of objects. For example, Madonna is specific, but woman is general.

statement What a speaker or writer states. Uttering a declarative sentence is the usual way to make a statement.

statistical generalization A generalization whose quantity term is a percentage or statistic.

stipulative definition Stipulating how a term will be used from now on. Coining a term.

universal generalization A generalization that applies a property to every member of the class that is being generalized about. For example, saying "All Americans are rich" applies the property of being rich to every member of the class "Americans." Universal generalizations are sometimes called categorical generalizations.

vagueness Fuzziness of meaning. For example, the word closer is vague (but not ambiguous) in the sentence "Step closer." Vagueness is not always an obstacle to good communication. The vague remark “Step closer” is precise enough in response to the question, "Did you say to step back or step closer?"

weasler A weasel phrase that is inserted into a claim to make it harder to criticize or refute. You are a weasel if you place an ad saying “You can make up to $30 per hour”

when you don't intend to pay over $8 per hour nor give anyone more than $15 per hour even if they work for you all their life.

Exercises

Imprecision

1. Newspaper headline writers are notorious for creating headlines that are ambiguous or have a funny alternative interpretation. The ambiguity can be removed by applying the principle of charity. Do this on the following headlines. Rewrite three of them so that they are unambiguous and don't have a humorous interpretation:[93]

a. Red Tape Holds Up New Bridge

b. Prison Warden Says Inmates May Have 3 Guns

c. 19 Feet Broken in Pole Vault

d. Babies Are What the Mother Eats

e. Police Discover Crack in Australia

f. Sharon to Press His Suit in Israel

g. Buildings Sway from San Francisco to L. A.

h. Cause of AIDS Found—Scientists

i. Potential Witness to Murder Drunk

j. Jerk Injures Neck, Wins Award

k. Terminal Smog Not Lethal

■ 2. (a) Add a comma to disambiguate the following headline and remove the humor. Make no other changes in the headline. (b) Say why the headline is humorous.

---

[93] From *Red Tape Holds Up New Bridge and More Flubs from the Nation's Press*, edited by Gloria Cooper, collected by the Columbia Journalism Review, Putnam Publishing Group, copyright by Columbia University of New York, 1987.

Honduran Military Chief Quits Saying He Is Fatigued[94]

■ 3. Suppose a menu states, "You can have eggs and juice or cereal." Replace this ambiguous statement with one of the following statements. The replacement must be a legitimate interpretation of the sentence in the menu, yet it must disambiguate the sentence to make it clear that the customer cannot have both eggs and cereal. The best replacement is:

a) You cannot have both eggs and cereal.

b) You can have eggs, but not juice or cereal.

c) You can have (eggs or juice) and cereal.

d) You can have either eggs and juice, or else cereal.

e) You can have eggs, and you can also have your choice of either juice or cereal.[95]

■ 4. If Mario says, "Some of these grapes have seeds in them," can you be sure he also means that some of them don't, assuming that he intends to make a true statement?[96]

5. The following statement might appear in a recommendation letter:

In my opinion, you will be very fortunate to get this person to work for you.

How does this statement send two messages?

6. Which one of the following is not an ambiguous recommendation that simultaneously supports and attacks the job candidate? Assume that the sentences occur among many other sentences describing the candidate.

a. I simply cannot recommend this person highly enough.

b. I most enthusiastically recommend this candidate with no qualifications whatsoever.

c. In my opinion you will be very fortunate to get this person to work for you.

---

94 "Honduran Military Chief Quits, Saying He Is Fatigued." In other words, what he said when he quit was, "I am tired." The silly interpretation that the comma helps remove is "Honduran military chief has been saying he is tired, but now he has stopped saying this."

95 Answer (d). Choice (a) is incorrect because it is not a way to interpret the original sentence, although it is an implication of the sentence when it is interpreted as (d).

96 You cannot be sure. Maybe Mario ate two grapes from a bowl of a hundred grapes, found seeds in both, didn't examine any others, and then made a cautious statement about what he knew for sure at that point.

d. The recommendation that I can offer for this candidate is that she works hard and is productive.

e. I would urge you to waste no time in making this candidate an offer.

7. If a headline were to say "New Pill Controls Birth Twice a Month," it would be unintentionally funny. Which one rewriting of it says only what was most probably intended?

a. New Pill Works Twice a Month to Control Pregnancy

b. New Birth Control Pill can be Taken Twice a Month

c. Taking New Pill Twice a Month Promotes Birth

d. Taking New Pill Controls Pregnancy Two Times a Month

8. According to this chapter, what are the greatest obstacles facing the A.I. program of natural language processing? Give examples of the obstacles. Begin your answer by defining both *AI* and *natural language*.

■ 9. Suppose a hunter walks all the way around a tree trying to get a shot at a squirrel. Meanwhile, the squirrel never leaves the tree but keeps crawling away from the hunter so that he can never can get a clear shot at the squirrel. In other words, the squirrel keeps the tree between the hunter and itself. When John Brown and Henrietta Lacks discuss this hunting situation, John says the hunter circled the squirrel because the squirrel never left the tree and the hunter got to the north, east, south, and west of the tree. Henrietta disagrees, saying the hunter never circled the squirrel because he never got round to the back of the squirrel. This disagreement between John and Henrietta is about what?

a. Whether John is being honest.

b. Whether the squirrel could have been shot.

c. Whether the hunter would agree with John.

d. Whether the squirrel was circled by the hunter.

e. Whether circling really brings you back to the place where you started.[97]

■ 10. The disagreement between John and Henrietta mentioned in the previous question

a. is not merely a semantic dispute.

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97 Answer (d).

b. turns on the ambiguity of "circled the squirrel."

c. turns on the difference between a hunter and a killer.

d. is one that a logical reasoner would have no trouble in adjudicating in favor of John.[98]

11. Explain why the following passage contains a semantic disagreement rather than a substantial disagreement.

> Emilio: When you think about American foreign policy, you've got to admit that Andre is a real American. He is always first to fly the flag. He supports America when other Americans are bad-mouthing it.
>
> Juanita: Andre is a citizen of Argentina who is living here and hoping to become a citizen. So, he's not a real American. He just happens to support American foreign policy.
>
> Emilio: You've got to admit that Andre would support America against its enemies.
>
> Juanita: What about his not being an American citizen?

12. The following four choices for completing the sentence vary in their precision. Rank them, beginning with the most precise. Starting with the new budget, our country will be

a) focusing more on the unemployment problem.

b) making changes for the better.

c) changing the definition of unemployment as far as statistics are concerned for computing the percentage of workers who are unemployed.

d) reconsidering the unemployment calculations.

■ 13. Rewrite the following statement in a way (your choice) that makes it less vague:

> You have to get more centered and in touch with yourself.[99]

■ 14. Rewrite the following statement in a way (your choice) that makes it vaguer:

> You have to get more centered and in touch with yourself.[100]

---

98 Answer (b). Since the dispute is merely verbal, answer (a) is not correct.

99 In rewriting the sentence, you will have to add information that was not specifically contained in it. For example: You have to decide which of your interests are more important than others; rank these interests; then change your life so that you try hardest to satisfy the highest ranking ones.

15. Rewrite the following sentence to make it vaguer.

Pele died of asphyxiation during the Brazil-Argentina soccer championship in 1987.

16. As far as logical reasoning is concerned, identify the most significant difficulty with the following astrological forecast:

May 20 is an unusually bad time for a Leo or a Scorpio to make major decisions.

a. Some astrologers might not like either a Leo or a Scorpio.

b. A bad time for a Leo is usually a good time for a Scorpio.

c. Ambiguity occurs with time because it could mean time of day or time of week or time in music.

d. The difficulty is with not specifying which major decisions.

e. There have been some bad times at Ridgemont High School, says Beyoncé.

17. Use a vague term in two contexts. Make it clear, without saying so directly, that vagueness is not a problem in the first but is a problem in the second.

18. Find a vague word or phrase in a recent daily newspaper. Clip the article, paste it to a regular-size page, and write on the page why the statement is vague. Say whether the vagueness interferes with the communication, and why.

19. Create an original sentence that is too imprecise for the context because it is too general. Say why it is too general.

■ 20. Rewrite the following sentence to make it less precise:

Federer was defeated by Nadal in some U.S. Open tennis tournament or other.[101]

21. Take your answer to the previous question and rewrite it to make it even less precise.

■ 22. Rewrite the imprecise sentence "It is raining fairly hard over there right now" to make it less precise. Explain why it is less precise.[102]

---

100 You need to focus.

101 Somebody beat somebody in a tennis tournament.

102 You might have rewritten it as follows: "It is raining now." This reduces the information conveyed by the sentence and thereby makes it less precise.

23. The following statement is from an astrology forecast. It is imprecise. Why? What are the sources of imprecision?

> Soon, you will be involved in an unusual relationship.

24. Why would a critical thinker say the following report from the planning commission is odd?

> If traffic density continues to grow as predicted, then the flow at Howe Avenue and Marconi Boulevard should become congested in two years from next December 21st.

25. [difficult question] Consider the following political problem, and choose the best amendment to the law below. The treasurer Jesse Unruh of the State of California died in office in 1988, and the governor nominated a replacement, his friend Dan Lungren. Lungren's nomination was voted on by the two houses of the State Legislature—the Senate and the Assembly. The vote occurred within 90 days of the governor's submission of the nomination to the two houses, and the Senate approved the nominee but the Assembly disapproved. The problem this raised was whether Dan Lungren could go ahead and take office. The following is the relevant part of the Constitution of the State of California, Article V, Section 5:

> (a) [T]he Governor may fill a vacancy in office by appointment until a successor qualifies.
>
> (b) Whenever there is a vacancy in the office of the Superintendent of Public Instruction, the Lieutenant Governor, Secretary of State, Controller, Treasurer, or Attorney General, or the State Board of Equalization, the Governor shall nominate a person to fill the vacancy who shall take office upon confirmation by a majority of the membership of the Senate and a majority of the membership of the Assembly and who shall hold office for the balance of the unexpired term.
>
> (c) In the event the nominee is neither confirmed nor refused confirmation by both the Senate and the Assembly within 90 days of the submission of the nomination, the nominee shall take office as if he or she had been confirmed by a majority of the Senate and Assembly; provided, that if such 90-day period ends during a recess of the Legislature, the period shall be extended until the sixth day following the day on which the Legislature reconvenes.

Provided the two houses do vote on a nominee, the trouble is that for the nominee to take office, paragraph (b) appears to state that the nominee needs to be approved by both houses, but paragraph (c) implies that the nominee does not need to be. If the intent is really as paragraph (b) appears to state, then the constitution should be amended to clear up the ambiguity. Assuming the intent is also to leave intact the notion that the nominee may take office if neither house actually votes on the nomination, the best amendment would

a) Replace in paragraph (b) "shall take office upon confirmation by a majority of the membership of the Senate and a majority of the membership of the Assembly" with "shall not take office upon confirmation by a majority of the membership of the Senate and a majority of the membership of the Assembly unless voted upon."

b) Replace in paragraph (c) "neither confirmed nor refused confirmation" with "not confirmed."

c) replace "is neither confirmed nor refused confirmation by both the Senate and the Assembly" with "is neither refused confirmation by the Senate and the Assembly."

d) replace "neither confirmed nor refused confirmation" with "not refused confirmation."

■ 26. "Some women volleyball players are taller than some men volleyball players of the same age." This sentence expresses[103]

a. no generalization.

b. a universal generalization.

c. a non-universal generalization.

27. Create a true, explicitly universal generalization about racism that uses the word *racism*.

28. Create a true, explicitly non-universal generalization about racism that uses the word *racism*.

■ 29. Give one original example of a true universal generalization about the class of fish and one example of a true non-universal generalization about fish.[104]

30. Suppose Brad's height is determined to be 5.1147 feet. It was, let's say, measured by using the following operation. Scientists placed a horizontal bar on Brad's head while he stood next to a vertical beam. They marked on the vertical beam where the floor was and then marked on the beam how high the bottom of the horizontal bar reached. Using very precise instruments, the scientists then measured the distance between the marks.

What did you notice that was unusual, from a critical thinking perspective, in the previous paragraph?

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[103] Answer (c). The sentence expresses a non-universal generalization about women volleyball players. To be a universal generalization the first "Some" would need to be replaced with "All."

[104] A universal generalization uses *all* or its equivalent; a non-universal generalization uses a term that is less universal, such as *many* or *most* or *some* or *two-thirds*. For example, here is a universal generalization: All (healthy) fish can swim. Here is a non-universal generalization: Many fish are smaller than the typical house cat. Both generalizations are true.

31. Comment on the most significant operationalization problem of the following statement from a scientific report: "People who lie are more likely to have been born in May than people who don't."

32. For the following disagreement, answer these questions: (a) Is the disagreement factual or merely verbal? (b) If it is factual, state the fact in dispute and then state what observation, test, or discovery would settle the dispute. If it is verbal, identify the key term in the dispute and state the different senses in which the two persons are using it.

> *Leonard*: I visited Elvis Presley's grave in Tennessee last summer. I know the King is dead, but it is hard to believe.
>
> *Angela*: The King isn't dead. He is still influencing music. He is alive and well and living in London where he works as a ghost writer.
>
> *Leonard*: Ha! A ghost maybe, but not a ghost writer. Elvis departed this world in Las Vegas and was buried at Graceland in Tennessee. Why do you say he's ghost writing?
>
> *Angela*: A music magazine I read said he is. Everyone in the article said he is still active musically.

■ 33. Read the following dialogue and decide whether the dispute is merely verbal (a semantic disagreement) or factual (substantial disagreement):

> Serena: Did you hear that Andrea is in Kaiser Hospital with brain injuries from that motorcycle accident? She is alive but so lifeless lying there, so pitiful, no brain activity, just a slowly beating heart and a faint breath. David, you've really got to visit her before she dies.
>
> David: No, she has already died, because she has no brain activity. I heard this from Jesse, who talked to the doctor. I'll go to the funeral instead.[105]

34. Create an original example of equivocation. Underline or italicize the term that changes meaning.

35. "When a liquid turns to vapor, it loses heat and gets colder." In the previous sentence, what is the antecedent (referent) of the word *it*? Is the word referring to the liquid or the vapor or both? The sentence won't be clear or understandable to a reader who does not have scientific

---

[105] The dispute is merely verbal. The disputed term is *dead*. If the two would just agree on what *dead* means, they would resolve their conflict, because there are no other facts in dispute. Samantha believes that *dead* means there is no heartbeat or breath, but David believes that *dead* means there is no brain activity.

background knowledge about the principle behind the refrigerator. Rewrite the sentence to remove the ambiguity in the antecedent.

36. (a) Your instructor will supply you with a blank sheet of paper. Use it to list six statements that you believe to be true about your state or its government. Put your name on the paper. You won't be graded on the quality of your answers but only on your participation, (b) When asked by the instructor, exchange your paper with someone else. On the other person's paper, place an asterisk next to the statement that you believe is the least precise or most vague, (c) On the paper, place a question mark next to any statement that you believe to be questionable because it is either false or susceptible to a false interpretation, (d) Your instructor will ask the class to provide examples of statements from the papers that are imprecise and that are questionable, (e) When asked by the instructor, get together with the person whose paper you have and explain why you made the assessments you did in parts (b) and (c). (f) When asked by the instructor, hand in the paper containing your assessments.

■ 37. Comment on the following passage:

> Because of the influx of Hispanics and Asians, only about 16 percent of the United States will be white (and non-Hispanic) by the year 2020, according to statistics produced by the scientific research firm.

a. The term *United States* is pseudoprecise.

b. The term *Asian* was operationalized improperly.

c. The year is vague.

d. The term *statistics* is ambiguous.

e. None of the above.[106]

■ 38. Occasionally in disputes about the theory of evolution, someone will say it is a theory and someone else will disagree, saying that evolution is, instead, a fact. This is probably an example of a semantic disagreement. Explain why.[107]

---

106 Answer (e).

107 The first person could mean *theory* in the sense of a set of general principles, but the second person could mean *theory* in the sense of an uncertain statement, one not backed up by evidence. Both persons would be correct with their own usage of the term. A Texas law that was on the books from 1974 to 1984 required that all state-supported school textbooks clearly distinguish scientific fact from mere theory. In particular, the Texas law required the theory of evolution to be taught as a hypothesis on an equal par with the creationist "theory." This law perpetuated an error in the philosophy of science that turns on the three-way ambiguity of the word *theory*. When a detective says, "My theory is that the butler committed the crime," the word *theory* means (1) the same as "hypothesis"

39. What is the first and what is the last general claim made in the U.S. Declaration of Independence? Defend or explain your choices.

■40. How do you tell the difference between a big person and a not so big person? [108]

41. A reporter who is accused of quoting a politician "out of context" is being accused of taking a phrase one way when the context indicates it should be taken another way. Create an original example of this.

---

or "educated guess." The word *theory* can also mean (2) a general explanation or general system of accepted laws. In addition, the term can also mean (3) unjustified opinion or mere hypothesis. The theory of evolution is a theory in sense (2), not the other two. The legislators were probably confusing the three senses. When we **distinguish fact from opinion**, we mean that a factual claim is an opinion backed up with a solid justification. If a claim is a fact, then it is not just somebody's opinion—it is a true opinion, as far as the experts can tell. It is important here that the vast majority of experts agree; if they disagree with each other, it would be jumping to conclusions to call a theory a "fact." The theory of evolution is sufficiently well justified scientifically that it deserves to be called a "fact." Creationist theory, on the other hand, is without a solid scientific justification, despite the loud objections of a few of its advocates. It has many religious supporters but no significant scientific support. Although the theory of evolution is a fact in the sense in which we say that anything we have good reason to call "true" we also call a "fact," the theory of evolution is not a specific fact as is "This water boiled at about 212 degrees." The theory of evolution is a moral general fact because it is so wide-ranging. It is general because it is a comprehensive system of principles that is used for explaining a wide range of specific facts, such as the fact that dinosaur bones are buried more deeply than human bones, the fact that DNA proteins in human cells are more like those in monkeys than those in tomatoes, and hundreds of other specific facts. Creationism is also a theory in the sense of being general and not specific. It is general, but it is not a general fact. So, what is the answer to the question, Is evolution a theory or a fact? The answer is that it all depends on how the terms are being defined. It could be both; it might also be neither; or it could be one but not the other. The theory of evolution is a fact in the sense of being true. Yet the theory of evolution is not a specific fact because it's a general truth and not a specific truth. The theory of evolution is a theory because it's an integrated set of principles. Yet the theory of evolution is not a theory in the sense of being a mere opinion without a solid scientific justification.

[108] This question is about vagueness; spot that and you get half the credit. It is also about ambiguity; spot that and you get the other half. Assuming we mean "big person" in the sense of the physical size of the person, then the difference between a big person and a not so big person is vague; there is no sharp line between a big person and a not so big person. Nevertheless, it is incorrect to say you never can tell whether a person is big or not. There are many cases where the answer is clear; if a person weighs 300 pounds, then they are big, even if there is no precise number of pounds they need to lose in order to become not so big. The difference between big and not so big regarding size is not one of ambiguity but of vagueness. There is, however, an ambiguity in the question, because there is another sense of "big person." There is, however, an ambiguity in the question, because there are other senses of "big person." Someone with good character or someone who is generous or forgiving is sometimes called a "big person." A big person also is a manager over other employees, who are not so big persons. The big person is the boss, the person in charge, the leader. If you spotted this ambiguity, then you got the full credit for this question. There was another way to get that second half of the credit for this question: by noticing that there is an ambiguity in the comparison class. You might express this idea by saying: Big as compared to what? Big for an adult male, or big for a first grader? Credit was subtracted if you said anything silly or incorrect, such as a big person should weigh 220 pounds.

■ 42. The italicized phrases in the following items are vague. Are they too vague, given the likely context in which they are expressed, or are they OK?

a. The government *wastes* millions of dollars every week. I can think of a lot better things to do with that money. Let's use those millions for education and health care instead.

b. Stop right there! Put your hands *up* slowly, or I'll shoot you in the back.

c. Nurse, please give the patient *some* of that pain killer.

d. *Add* milk even though the recipe doesn't call for it. Go ahead. Do it now.

e. Mom, I know you've already given me $500, but I still don't have enough money to buy the car. Can I have *more*?

f. Letter to the editor of a medical journal: Medicare payment limits for outpatient prescriptions need to be raised by 10 percent because our study indicates that the elderly use a *sizeable* percent of all outpatient prescriptions.

g. Letter to the editor of a medical journal: Last year, our state's poison control centers *handled* 338,304 telephone calls at an average cost of $18.24 per call. The state's health department has rigorously evaluated and analyzed the state poison center system by conducting onsite visits to each local poison center operation. They confirm the $18.24 figure, and have recommended continued funding for another five years. The legislature should take the health department's advice.[109]

43. All creationists agree that the universe was created during six days by God's design. After a careful reading of the Bible in 1658, one creationist, Irish Anglican Archbishop James Ussher, calculated the origin of the world to be at 9 am, Sunday, October 23, 4004 B.C., Greenwich Mean Time. Referring to the chapter's definition of *pseudoprecision*, did the Archbishop probably make a mistake of type 1, 2, or 3?

---

[109] Here are answers to parts (b) and (c).

b. Not too vague. There is no need for more precision in such a situation. Turning around and saying, "How far up do you mean?" would be likely to be answered with a bullet.

c. The answer depends on the nurse's background knowledge. The phrase would be too vague if the nurse has no access to more precise directions as to the kind and exact amount of the painkiller that the doctor expects to be administered. The phrase would not be too vague if the doctor could presume that the nurse already had access to such directions, say, on the patient's chart. A simple answer to part (c) such as "Not too vague" or "Too vague" would not adequately demonstrate depth of insight into the exercise.

■ 44. Is more better than less?[110]

■ 45. Discuss the following dialogue:[111]

> Philosopher: What do you think of working with gray clay?
>
> Artist: I hate all pieces of clay. They are too hard to work with; I like paint.
>
> Philosopher: Do you hate that statue of David?
>
> Artist: No, it's magnificent.
>
> Philosopher: But it's a piece of clay! So, you hate it and don't hate it.
>
> Artist: Wait a minute!

Definitions

■ 1. Operationalize the term *acid*. Make it sufficient for a junior high school science text.[112]

■ 2. Describe what is wrong with this lexical definition:

> By definition, a vixen is a kind of fox.[113]

3. Create a non-operational definition of *acid* that would be appropriate for third graders.

■ 4. Which kind of definition is this? (lexical, stipulative, operational, ostensive, etc.)

> "I defined *Republican*," the pollster said, "to mean anybody who checked the Republican box on the enclosed form."[114]

---

110 It all depends on what you are comparing. More pain is not better than less pain. More happiness is better than less happiness.

111 The philosopher is being unfair to the artist. When saying, "I hate all pieces of clay," the artist did not mean to be taken literally; the artist meant, "I hate *working wit*h all pieces of clay," and this is consistent with liking a piece of clay that someone else has worked with.

112 Perform the litmus test. Take a strip of purple litmus paper and dip it into the liquid. If, when removed, the paper is red, then call the liquid an acid.

113 The definition is too broad. It is imprecise because it does not say what kind of fox, and it should say what kind because not all foxes are vixens.

114 An operational definition.

5. Suppose you define *liquid water* to a six-year-old in the following way:

> *(Liquid) water* means the wet stuff that comes out of your faucet when you wash your hands. It is also the stuff in rivers and lakes and puddles.
>
> This definition
>
> a. commits the error of failure to elucidate.
>
> b. is circular.
>
> c. is a definition by example.
>
> d. is stipulative and lexical.
>
> e. is an operational definition.

6. Suppose you define (*liquid) water* to a five-year-old as "the wet stuff." The definition is

a. too narrow.

b. circular.

c. too broad.

d. autonomous.

7. In an ordinary conversation, if you were to define *steam* as the white stuff given off in the air when water is boiled, your definition would probably be acceptable. However, to a scientist, this definition would be incorrect. Find out why, then write an explanation of why your first definition was unacceptable. Hint: Steam is not white.

■ 8. Analyze the errors in the following reasoning:

> According to the dictionary definition of *science*, a science is a body of knowledge amassed in a systematic way. Because a telephone book and a repair manual both are systematized bodies of knowledge, it follows that they, too, are sciences. Thus, the following is a correct listing of some of the sciences: physics, botany, repair manual, chemistry, geology, psychology, telephone book, astronomy, anthropology.

Is the definition too broad, too narrow, or both? How would you improve on the dictionary definition?[115]

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[115] The definition of *science* is too broad because it includes too many things among the sciences. Being systematic is only one of the requirements for science. The definition of *science*

9. Construct a definition of *bat* that is too broad but not too narrow.

10. Construct definitions of the terms *ballistic missile* and *cruise missile* that make it clear whether a cruise missile is a ballistic missile. Do not use the term *cruise missile* in your definition of *ballistic missile*. This exercise may require additional research.

11. Consider this argument: "Today it will rain or snow there, but not both. Since it is raining there, it's not snowing. Here is an analysis of it in sentential logic:

    R is the sentence "It will rain there."

    S is the sentence "It will snow there."

Then the pattern of the above argument is

    R or S, but not both R and S.

---

could be improved to prevent phone books and repair manuals from being included by noting that science is a systematic way of explaining and predicting events. Science is not merely a systematic collection of facts.

R
So, Not-S

and that is the form of a valid argument in sentential logic.

In this analysis of the argument, the definitions are

a. lexical.
b. stipulative.
c. circular.
d. inconsistent.
e. vague

Explain why your answer is correct. One major part of this question is to find the definitions.

12. Define the phrase *legal right to privacy*, then create an argument defending your definition. You are encouraged to use outside research to enrich your answer.

13. Give an operational definition of *water* for an adult audience.

14. Describe any flaws you notice in the following definitions.

a. By *tall woman,* I mean "a woman over 5'9"."

■ b. "History is an account, mostly false, of unimportant events which are brought about by rulers, mostly knaves, and soldiers, mostly fools." (Ambrose Bierce)[116]

c. *Apple pie* means a pastry with apple filling.

d. The definition of *likes better* that I used in my report on whether rich women like sex better than poor women was to count the number of "yes" answers from women who answered my question "Do you like sex?"

e. The definition of *busybody*: a curious person.

116 Too figurative, and thus too imprecise for seriously conveying the meaning of *history*.

CHAPTER 4 How to Evaluate Information and Judge Credibility

Suppose a friend of yours says she just read that several soldiers who were lost in action during the most recent U.S. war in the Middle East have been discovered in graves in Antarctica. She is making an unusual claim. In this chapter you will learn more about assessing the credibility of claims, especially unusual ones, and assessing the credibility of people and sources that might be used in justifying claims. A person's credibility on some issue is their ability to offer solid grounds for deciding the issue. Credibility is a matter of degree, and it involves both the honesty of the person and how much of an authority they are. The more general knowledge you have about life and the world the better able you are able to judge who is an authority on what. For example, we all know that a man who is loud is usually an authority, and someone who is louder is even more of an authority. Oops! Cancel that last point. The kernel of truth in that last joke is that there is some correlation between someone's outwardly appearing confident and their actually being an authority, but too often the listener over-emphasizes the outward appearance.

The Principles of Charity and Fidelity

When someone says something that is obviously false, the logical reasoner will look deeper and not be too quick to find fault. Maybe the person meant something true but simply slipped up. "I collided with a stationary truck coming the other way," a male driver wrote in an insurance statement, attempting to summarize the details of an accident. Because a truck cannot be simultaneously moving and stationary, you note the inconsistency but are charitable and assume that the person didn't literally mean what he wrote. Maybe he meant that he collided

with a truck carrying paper stationery, or maybe he meant that the truck was stationary but that he, himself, was coming the other way.

By trying to make sense of apparent inconsistencies, and by trying to make sense of false statements that are too obviously false, we are applying the **principle of charity** or the principle of charitable interpretation. This principle is really a request to be kind and to try to make reasonable sense of odd statements.

Besides applying the principle of charity, we want to respect the **principle of fidelity**. That is, we should preserve the intended meaning of the speaker's original statements when interpreting them or analyzing them. We don't want to twist the original so that the speaker would react with "Hey, I didn't mean that." Nor should we be so charitable that we are blind to real falsehoods and real inconsistencies.

> The principle of fidelity requires you to preserve the intended sense of the speaker's original statements when you interpret them.

———CONCEPT CHECK———

Suppose you are trying to interpret what someone meant by saying "You will have some good luck." Which of the following interpretations would violate the principle of fidelity?

a) You will have some good luck today, or soon.

b) You will have something positive happen to you.

c) You will cause somebody to have some good luck.

d) Eventually good luck will happen to you, but it won't be that far off.

[117]

It is important to accurately represent what people are intending to say. If they intend to say something that turns out to be false or inconsistent, they are being false or inconsistent, and that is that. It's their confusion, not yours. But what do you do when faced with a statement that is blatantly inconsistent? For example, suppose a friend of yours says, "I don't believe in God's existence; nevertheless, God exists." Perhaps your friend intended to say something consistent, so you ask yourself, "What else could the sentence mean?" Maybe (but just maybe) it means "I find it hard to believe in God's existence; nevertheless, I actually do believe in God's existence." That would not be inconsistent. When you are in doubt about apparent inconsistencies or weirdness, ask the speaker to clarify if you can. The burden is on the speaker not to confuse you.

Tension may occur between the principles of fidelity and charity. To maintain fidelity, the analyst will say that a sentence that appears to make a false statement is in fact false, yet to be

[117] Answer (c). It twists the original statement by changing who the good luck will happen to, whereas statements (a), (b), and (d) are all reasonable interpretations of what the original statement might have meant.

charitable the analyst will try to find a way to interpret it to be true. Consequently, applying the principles is an art that requires a delicate sensitivity.

———CONCEPT CHECK———

Applying the principles of charity and fidelity to the sentence "The musician Tommy Tutone is dead, but alive," it would be best to say what?

a. Tommy Tutone is probably not a musician but a detergent.

b. "Dead" means "not alive."

c. "Alive" means "his music is still listened to."

d. There are some people who are biologically both dead and alive.

e. If a person is dead, then the person cannot be a musician.

———[118]

When Should You Accept Unusual Statements?

We all know that observations are not infallible. In ancient Egypt at the time of the pharaohs and their pyramids, a group of magicians would walk into the marketplace and begin displaying their powers. The lead magician would hold up a walking stick that had been carved in the shape of a snake and pass it around the audience. Soon after getting it back, the magician would hold up the stick, call on the supernatural powers of the Egyptian gods, and throw the stick on the ground. There the stick would turn into a live snake and crawl away into the crowd, leaving the audience stunned and even more in awe of the power of the pharaoh and his magicians.

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[118] Answer (c). If you say that a person is physically dead but that his music is still listened to, you are not being inconsistent. Answer (a) also is consistent, but that answer violates the principle of fidelity.

Did the stick really turn into a snake? "No, that's impossible," you are apt to say, "because it's got to be a trick." That is right. Unknown to most people, there is a certain Egyptian snake that can be temporarily paralyzed by applying well-placed pressure to the back of its neck. A physical shock to its head can un-paralyze it. The lead magician's stick looked like this snake. After the stick had been passed around and while other magicians were performing other tricks, the lead magician switched sticks with a magician who had been carrying the paralyzed snake. When the lead magician threw the snake down head first, it woke up and crawled away—naturally, not supernaturally.

The magician's audience accepted the performance as a straightforward demonstration of the powers of magic and the supernatural. The typical Egyptian did not approach the demonstration with the critical attitude of the modern logical reasoner. Instead, he or she was more gullible and already predisposed to accept supernatural explanations for surprising phenomena. A logical reasoner such as yourself would demand better evidence before accepting the magician's explanations, because you have a better feeling for what is a likely explanation and what is not. You know that it's more probable that sleight of hand is behind the snake trick or that some natural but little-known phenomenon is the secret.

Being logical requires the ability to identify strange events, and it requires a knowledge of the best way to go about explaining why the events appear to be happening. A strange event is an

improbable one, and **probability is always assessed against a base of background knowledge and available evidence**. Strange events or statements are improbable because they conflict with what else you believe.

The core of background knowledge that you use in making judgments of improbability is called **common sense**. It is the knowledge that most of us acquire in the normal process of growing up in our society, that cars need a steering wheel, that sticks don't become snakes, and all that. The common sense of today's logical reasoner is quite different from the common sense of the ancient Egyptian.

Because of your common sense, you probably won't believe an email from Nigeria offering to pay you to help launder some money, and you wouldn't believe the following headline if it were to appear in a supermarket tabloid:

DYING MAN'S BRAIN PUT IN COMA WOMAN

You probably know a few people who could use a good brain transplant. The gullible person will buy the newspaper to learn more details about the world's first successful brain snatch. However, you as a logical reasoner will first ask yourself, "Why am I finding out about this in the supermarket checkout line?" If it is true, why haven't you heard about it on the TV news, or from your friends? This headline is inconsistent with your background knowledge about the state of medicine today. You don't have to be a doctor to know that brain transplants have yet to be attempted. At most, small bits of brain tissue have been transplanted. If a brain transplant were even going to be attempted, there would have been a lot of advance publicity. A person who did not know these facts of medicine could easily be conned by the headline. For the rest of us, the most it should do is sensitize us to noticing whether other newspapers or the TV news mention any recent brain transplant attempts. Reading the article in the tabloid would be unlikely to provide the logical reasoner with any good reason to believe the original headline.

Acceptance is a matter of degree. Even for claims you accept, you will accept some more strongly than others.

Can you spot the faulty assumption underlying the following word problem in this fifth grade mathematics book? Look at it from the perspective of a book editor who is trying to decide whether to publish the book and is checking the quality of the math problems.

Dr. Richard Feynman and his daughter Melissa visit a glass factory that makes marbles. Marbles are stored in different colored bins regardless of the colors of the marbles.

green bin marbles: 215 degrees

yellow bin marbles: 150 degrees

blue bin marbles: 70 degrees.

Melissa collects one marble from the green bin and three from the yellow bin. Richard collects one marble from the blue bin and two from the green bin. What is the total of the temperatures of the marbles collected by the father and daughter?

This is a very strange question, isn't it? The ridiculous assumption is that adding these temperatures gives a total worth knowing.

The critical thinker, unlike the naive thinker, is on guard against accepting stupid assumptions. Yet there are situations in which, even though they are ridiculous, you might still need to accept them, at least temporarily. For example, if you are a student in an arithmetic class, and your teacher seems to be serious about wanting you to answer the question above about adding the temperatures of marbles, then you apply your critical thinking skills and think, "OK, it's a dumb question, but I'll do the math computation and get the right answer."

We are continually asked to accept assumptions in arguments, definitions, explanations, and interpretations of the world around us. As critical thinkers, we need to be aware of those assumptions and consider whether we really want to make them.

———CONCEPT CHECK———

Suppose you are having dinner with a married couple from your apartment building. You pass the husband the rice, but he declines and says he doesn't like to eat rice because this was almost the only thing he had to eat for a month while he was captured and held as a P.O.W. (prisoner of war) in the last war. That's an understandable reason to avoid rice, but then his wife comments that she doesn't like to eat rice because she was force fed rice while kidnapped by space aliens. Oops! When you laugh, and she responds that she's not kidding and that four years ago she was captured and held for three days in an alien spaceship that was hiding in a trench in the middle of the Pacific Ocean, *then* what should you think? You probably should think that she's a little crazy or very foolish. Why are you justified in making this evaluation of your neighbor?

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119 First off, her claim about kidnapping by aliens from outer space is an extraordinary claim. Really odd. Common sense says that no one has ever been kidnapped by space aliens. If someone actually were, it would be the biggest news you've ever heard in your life, and everyone you've ever met would know about it, even if the abduction were to have occurred in some obscure country. The experts all say that creatures from outer space have never visited

Assessing a Source's Credibility

Our most reliable source of information is our own observations, but when these are not available, then we turn to other sources of information. When we don't have access ourselves to information about whether a claim is credible, we can look at the source of the claim, at where it's coming from, at who's saying we should believe it. Some sources are more credible than others.

If the claim is not unusual and it comes from someone you have a reason to trust, then go ahead and believe it. If your friend says he ran out of gas in his car last week, then go ahead and believe it. It is not always unwise to accept unsupported claims if they are not extraordinary and nothing much turns on whether you believe it or not. But if he says he met the Prime Minister of England last week and was invited to speak to a session of their Parliament next Monday, then ask for more evidence before you believe this unusual claim very strongly.

> It is *not always unwise* to accept unsupported claims.

The *Weekly World News*, *The Star*, and *The National Enquirer*, are popular tabloids whose headlines shout out from the racks near the checkout lines of supermarkets and drug stores. Too often they will exaggerate their stories and will print almost anything anybody says, so long as it is entertaining. They will portray the stories as being true without checking whether they are. The editor of the *Weekly World News*, when asked about the reliability of the stories he prints, admitted this when he said, "Of course we are skeptical about some of the stories, but we wouldn't question ourselves out of a story, particularly when it has no health-related ramifications." The editor added, "If we got a fellow who said he was taken aboard a UFO, for instance, we would really see no reason to check it out if it was entertaining, a good story. If we did some probing, we could find out that he'd been in a mental hospital for the past 60 days and

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our planet. There's no evidence, and all significant claims that it occurred did not check out. They say serious claims of alien abduction are just the product of foolish misunderstanding or an insane mind. So, that's why it's perfectly OK to evaluate your neighbor as being a little crazy or very foolish. Yes, you have to be open to the possibility that she has access to information that no one else has, but the burden of proof is on her to produce extraordinarily good evidence that what she's saying is correct. Her passing a lie detector test wouldn't count as good evidence, would it?

then [have to] kill the story." When the reporters locate somebody who calls himself an "expert on UFOs," they aren't apt to question the credentials and will merely report that "experts on these matters have said ...."[120]

Tabloids are notorious for trying to convince readers by appeal to **anecdotes**. Anecdotes are reports of individuals' own experiences. There is nothing wrong with gathering information from individuals, but a few unsystematically acquired anecdotes do not constitute a scientific proof. For example, Lupe says to you, "Forget about seatbelts. They do more harm than good. I was in a car accident once, and the doctor said it was lucky that I wasn't wearing one. If I had been wearing one, I would have been burned up with the car. Instead I was thrown through the windshield and only broke my neck and back." This anecdote may support the generalization that car seatbelts shouldn't be used, but it cannot stand up to statistics showing that, overall, people with seatbelts suffer fewer injuries. It is understandable that you might want to pay more attention to your friend Lupe than to some statistical report from people you do not know, but it is more reasonable to pay attention to the statistics. By the same token, if Lupe had asked her doctor, no doubt the doctor would have said she was lucky not to have had the seatbelt buckled in this special case but that in the future she should buckle up. The doctor's own views about seatbelts will probably have been acquired by paying attention to the statistics, not to the anecdotes of his own few patients.

> It is more reasonable to pay attention to the statistics than to anecdotes from your friends.

Although the "coma woman" headline in the *Weekly World News* isn't a good enough reason for you to change your beliefs about brain transplanting, the same headline in more reputable publications *should* cause you to change your beliefs. The same information backed up by a "Yes, it's true" comment from your doctor, also would be a good reason to believe the story.

Some of our most valuable knowledge is knowledge about which sources are credible sources and which are not.

Let's consider a more credible source of information than a grocery store tabloid, namely the president of the United States. How credible is the president when he tells you something? Well, it depends on what he tells you, doesn't it? If he says Manila in the Philippines has just suffered a 7.0 earthquake, then he's a very credible source of information. If he says the

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120 From Eddie Clontz, Reuters dispatch, reprinted in *The Sacramento Bee* newspaper, November 26, 1988, p. A2.

candidate from the opposition party doesn't deserve your vote, he is a much less credible source of information.

Most people think their own observations are a completely reliable source of information. If you saw it, then it's so, right? Not necessarily. Think about magicians and optical illusions. And then there's always the problem of faulty memory. When James says he remembers shaking the hand of the president when he was four years old, does the adult James really remember shaking the hand of the president when he was four years old, or does James just remember being told that he did? Sometimes what someone wishes to be true can affect what they observe as when they report observing the Madame at the séance talking to their recently deceased grandmother. Memories can be tricky. Logical reasoners know that there's always some small possibility that what they remember observing may not be quite as they remember it.

When you assess a person's credibility as, say, an expert on tropical medicine, you'll not want to make this judgment on the basis of whether they are friendly and smile and give you eye contact and a sincere handshake. That's irrelevant to whether they can speak reliably about tropical medicine, but it's not irrelevant to whether you want to invite the person to lunch tomorrow. If your local doctor were to say, "She is an expert on tropical medicine," that would be much more helpful to you than your noticing that she has a copy of *The Journal of Tropical Medicine* in her hand. Of course if you were to find out that this copy contained an article written by her, then that would go a long way in telling you she really is an expert and should be trusted when she is speaking about tropical medicine.

———CONCEPT CHECK———

If you wanted to know whether electricity will flow through certain kinds of plastic, who would be the most credible source of information?

a. A friend of yours who has invented and patented three kinds of plastic toys.

b. The county librarian who specializes in government documents.

c. A professional proofreader who has just worked on a new textbook about plastics and electricity.

d. Your neighbor who is an electrical engineer.

e. The sales representative of the largest plastics manufacturer in your state.

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Logical reasoners discriminate among sources of information. They trust information from a reputable scientific journal over information from a daily newspaper. They trust the newspaper over their neighbor. Here is a ranking; they trust *The New York Times*, *The Wall Street Journal*, *The Washington Post*, *The Los Angeles Times*, and perhaps *Newsweek* magazine, followed by network TV news, the local daily paper, and then local TV stations. They are suspicious of TV docudramas and political blogs and their friends' tweets, and they don't trust grocery store tabloids and political leaflets left at their front door. But this is a very crude ranking.

Seeking a Second Opinion

Suppose you see this headline in the *Weekly World News*: "Tot Falls 5,000 Feet and Lives!" Should you believe it? Well, that depends on what it means. Does it mean that the tot fell from a plane without a parachute? If so, you'd expect this stunt tot to be a flat tot, wouldn't you? But maybe the tot did have a parachute. If so, the story could well be true. When you see such a headline, you are sensitized, or should become sensitized, to wonder whether some crucial information has been left out.

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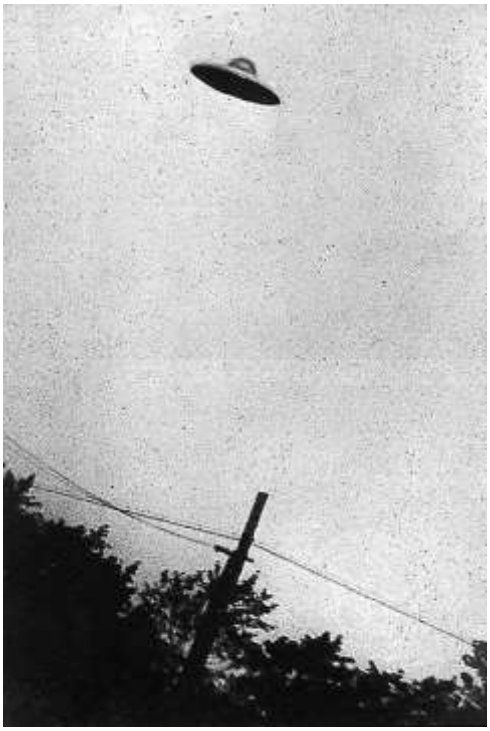
[121] Answer (d). The electrical engineer would be required to learn this sort of thing as part of his or her professional training. Proofreaders need not know anything about what they are reading. Librarians might be able to find the right book, but they themselves wouldn't necessarily be able to understand the book. The inventor might know about electrical flow in some plastics used in some plug-in toys, but the inventor would look to an electrical engineer for advice.

Even if you were to stop and read the story and find out that the tot did not have a parachute but still lived, you should be cautious about believing it because your common sense says this feat is highly improbable. Before you put much faith in a story like this, you should get some independent verification. That is, you should get a reliable **second opinion** that supports the story.

What is a reliable second opinion? An expert's opinion would be one. Getting the information from an independent, credible source will help with the reliability. For example, the opinion of an eyewitness interviewed by your local newspaper's reporter, and not by the supermarket tabloid's reporter, should be a good enough second opinion for you to believe the story about the tot's fall. A videotape would also be independent verification. Remember, though, that the more improbable the belief you are considering adopting, the better the evidence has to be. Without the better evidence, then your belief should be lukewarm. A video camera file can be doctored; even three eyewitnesses sometimes can be mistaken about interpreting what they saw. There are videotapes and eyewitnesses who have seen a sea monster in Loch Ness in Scotland, but the experts still believe there is no sea monster there.



Three testimonials of UFOs from members of the UFO Society should be given considerably less credibility than testimonials from three independent people who have no special interest in promoting UFOs.

Beware of interested parties.

Time is also an important factor. Verifying the falling tot story is much easier than verifying whether St. Matthew wrote down the Gospel while visiting Mt. Ararat two thousand years ago. Verifying current events is easier than verifying most historical events, because the trail isn't so cold. There are more traces of current events, more eyewitnesses, more available data, more evidence to find, less need to rely on faith.

Suppose the following were another headline from the *Weekly World News*:

> ***CASHIER FIRED BECAUSE OF HER BIG BUST***
>
> ***WINS BACK PAY***

Is this headline inconsistent with anything you know? No, and it is not especially improbable, only mildly surprising. So you should believe the headline. It is unlikely that the newspaper is wrong about everything. Still, the tabloid is not a sufficiently reliable source for you to believe anything of importance without first checking elsewhere. If it were important to you to get the facts right about the big bust story, you should not rely solely on this paper's report. Try harder to verify it. Get more information from more reliable and independent sources. Would six more copies of the same issue of the *Weekly World News* make the story six times more likely to be true?

In 2016, the Stanford University History Education Group published their study of whether American high school students could assess the strength of the evidence offered in support of a news story. Here is one of their famous examples. The students were informed that on March 11, 2011, there was a large nuclear disaster at the Fukushima Daiichi Nuclear Power Plant in Japan. The students were then told that four years later the following image of misshapen flowers with the accompanying comment was posted on a public photo sharing website:

> *Fukushima Nuclear Flowers*
>
> *Not much more to say, this is what happens when flowers get nuclear birth defects.*

The Stanford Group asked high school students to assess whether the post is strong evidence of Fukushima Daiichi causing an environmental problem. Too many students said it was. Only 20% of the students viewing the picture thought to ask whether the picture was really from that area of Japan or even from Japan at all, how it was determined that nuclear radiation caused the unusual shape, or whether there are flowers like this at places far from nuclear power plants. In short, too many high school students were uncritical thinkers.

Trust Me, I Know It on Good Authority

When a woman says you should believe her because she knows it on good authority, you need to mentally ask yourself these four questions. If you get the right answers, then it is OK to believe her.

- Is her authority, an authority on the proper subject?
- Would she know if the authorities disagreed on this subject?
- Can you trust her to have quoted the authority correctly?
- Can the authority be trusted to have told her the truth?

The Defense Minister of Iran may be the world's best authority on whether his country is stockpiling bio-terror weapons, but he may also be the last person to tell the truth about the weapons.

If you get yes answers to your four questions, then you should believe what she has to say, and you are justified in saying you know it, too. Too often you have to answer one of the questions

with “I don’t know,” and then you should withhold your belief in what she says or else believe it only tentatively until you can get your questions answered.

Suspending Belief

When it comes to improbable claims, the first principle is that the burden of proof in producing the good evidence is on the shoulders of whoever makes the claim or adopts the belief. If you decide to adopt a belief, you should have found enough evidence to justify your doing so. It is not good enough to say, "Well, it's never been proved false, so I believe it." Without the evidence, you should suspend your belief. That is, if you are in a situation in which somebody makes an improbable claim but doesn't supply good evidence to back it up, don't believe it until somebody gives you enough evidence or until you get it for yourself. Don't believe it even if you might like to believe it. I'd like to believe that my sweet Aunt Emma is telling me the truth when she introduces her new friends as aliens from beyond our galaxy, but rationally I should not believe her until they show me some ID.

Just kidding. If someone says, “I saw a green alien from outer space,” you properly should ask for some proof. If the person responds with, “Prove I didn’t,” then they are not accepting their burden of proof and are improperly trying to place it on your shoulders. This kind of error in reasoning is called the “fallacy of misplaced burden of proof.”

———CONCEPT CHECK———

Here are three reports from a friend of yours, Ramone let's say. All are bizarre, but some are more improbable than others. Which report is the most improbable, and why? The focus of these questions is not on whether Ramone is being truthful but on whether what he says is actually true.

a. I saw my uncle die because he threw salt on the ground. He did it when he and I were camping. My grandmother told us never to throw salt away or else something bad would happen soon. The very next day after the camping trip he was hit by that truck on the freeway.

b. Hey, you won't believe this. Less than ten minutes ago, I saw Mary, the one who moved away to Germany last year. Remember she went to be a gymnastics coach in Berlin? Well, she was running into the grocery store as I drove past on the freeway. She's changed a lot. She looks ten years older, and she has a plastic, prosthetic leg.

c. I swear it's true. The president of the United States called at 3 a.m. this morning. He asked me to join the Defense Intelligence Agency and spy on Bulgarian businessmen visiting Toronto. What a surprise; I've never done any spying in my life, and I don't even know where Bulgaria is. I'm just a shoe salesman, but today is my special day. My brother Bill was home when he called. Ask him.

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[122] Answer (a) is the strangest. Although all three stories are unusual, the spy story and the plastic leg story are not as unusual as the salt story because the salt story violates our basic understanding about what can cause what in the world; the spy story and the plastic leg story are merely about unusual human actions. Answer (a) is unlikely because our background knowledge about what causes death tells us that throwing salt isn't the kind of thing that will easily hurt anybody. Regarding (b), Ramone probably didn't get a very good look at Mary if he was zipping by on the freeway and Mary was running, but this event is not as impossible as a death caused by salt thrown down on the ground the day before. Mary's return from Germany would not be that big of a deal; people do change their plans. Losing her leg could have caused her to lose the gymnastics coaching job. The remark about Mary running with a plastic leg is odd. Answer (c) is probably an unreliable report, too. If spy agencies want someone to spy for them, they don't usually call on the phone, they don't give the candidate a specific assignment without first making sure he (or she) can keep his mouth shut, and they don't have the president make the call. So this whole story is very unusual. Ramone is joking, or he takes you for a fool. His brother is probably in on the joke, or else he is naive.

Getting Solid Information about Whom to Vote For

A leaflet shows up in your apartment mailbox a week before the election. It says "David Marr will be the ONE judge accountable to the people, not the politicians." The flyer says Marr will be a "judge for the people" and that "YOU should decide who serves in this courthouse." On the basis of this solid information, you are ready to vote for or against David Marr. Wait, there's more. The leaflet contains two pictures of him smiling. OK, now you are ready to vote. Hmmm.

Suppose an election is coming up and you want to make an informed choice about the ballot measures and candidates. How do you do it? You might ask your parents or friends for advice, then follow their recommendations if they agree. But if you want to think things through for yourself, you should seek out other sources of information. Would it help to reserve one evening before the election and sit down with all the campaign leaflets you have collected during the previous month? If you use these leaflets to figure out who stands where on the issues, you will get frustrated. All candidates sound good, too good, in their own literature. You won't even be able to figure out what the important issues are this way, although you may get some inkling when one candidate's literature attacks the opposition. The government's voter pamphlets that are mailed free to all registered voters can be more helpful. They let the candidates speak to whatever issues they desire, and the statements are fairly informative, given their short length.

Are there better sources of information? Yes. Consider television, TV news, not TV ads. The advantage of TV is that you can see the candidate in action and get some emotional connection. TV information comes in two forms: paid ads and news. The paid TV advertisement is mostly junk food for the eye and mind—fast and appealing, but nutritionally barren. In fact, the techniques used to sell senators are practically the same as those used to sell soft drinks. Any political advertiser worth a sound bite is aiming for your heart strings.

Commenting on this point, President Nixon's advisor William Gavin wrote, "Voters are basically lazy, basically uninterested in making an *effort* to understand what we're talking about." In another memo he said, "Reason requires a higher degree of discipline, of concentration; impression is easier. Reason pushes the viewer back, it assaults him, it demands that he agree or disagree; impression can envelop him, invite him in, without making an intellectual demand…. When we argue with him we demand that he make the effort of replying. We seek to engage his intellect, and for most people this is the most difficult work of all. The emotions are more easily roused, closer to the surface, more malleable."[123]

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[123] From "The Lie Factory" How Politics Became a Business" by Jill Lepore, *The New Yorker*, September 24, 2012, p. 59.

TV news is a better source of political information than TV ads—which is not to say it is a good source. It's more nutritional, but still junk food. The average bloc of uninterrupted speech by presidential candidates in the TV news is only ten seconds. Ten seconds is enough time for a slogan, but not enough for thoughtful argumentation. TV commentators use these ten-second "sound bites" of the candidate to provide flavor, not information. Commentators believe they can say it better than the candidate; they give themselves a good twenty seconds, and the candidate ten. Their primary fear is that the public, with its short attention span, will click the channel changer once the candidate starts going on and on.

> The primary commandment of most TV news directors is that the news has to entertain, not that it has to inform.

The big-budget campaign managers know the territory. For example, they may have crafted an excellent strategy for getting their candidate on TV without the candidate having to answer tough questions. Suppose a TV station has a well-informed reporter who knows just what hard-ball questions to ask, given the chance. When the campaign manager learns that reporter is out in the field covering some event, the campaign manager calls the station manager to say that the candidate is nearby and can be at the station in 15 minutes. The station manager cannot resist the opportunity. He calls over to his news staff and says, "Andy, get ready; you're on in 15 minutes in a one-on-one with the senator." This reporter will be more apt to treat the senator as a visiting dignitary and will throw more softball questions and fewer of the hardball questions than the well-informed reporter would have. In the next news broadcast an hour or so later, the senator probably will look great during those crucial ten seconds. Another victory for the campaign manager and another loss for the viewing public.

TV news is dangerous for the public in other ways. After having watched nightly news stories about a candidate, too many viewers falsely believe they know enough to make a decent choice.

> “People think they are informed, but they are not. They see this very shallow picture of what a race is about, but they actually get very little view of the real candidate. That leaves people worse off because they don’t know that they are uninformed. They are less cautious about their judgments of candidates.”

TV occasionally does provide high-quality reporting, but watch out for the ordinary TV news.

OK, if you can't rely on the ordinary TV news you are most apt to watch, how about the newspaper? There you go. But what part of the newspaper? How about the list of recommendations in the newspaper's editorial page? This list usually appears a day or two before the election. To be safe in adopting your paper's recommendations, you need to know the political ideology of the publisher that drives the recommendation process. Is your ideology the same as his or hers? Can you read a newspaper and figure out its ideology? That takes a great deal of skill. Better to ask someone who knows more about this than you do.

Like computer blogs, the newspaper columns written with a columnist's byline are another source of information. The writer of a newspaper column is like an editorial writer—opinions can be mixed in with the facts. Libel laws are looser for columnists; often they can get away with saying what a regular news story cannot. Columns can be helpful sources of information if the columnist is careful to give reasons for his or her opinions and is careful to distinguish the reasons from the opinions. The problem with editorials and columns that offer advice is that even if they give you reasons for the advice, you always have to worry that they are covering up other reasons that weigh against their advice.

> Selective presentation of which information to withhold is a way to manipulate minds.

New stories, on the other hand, are supposed to be more sanitized, cleansed of opinions, full of facts, and more reliable. Very often they are. The best news stories are usually the ones that appear early in the campaign. In these, the writers interview the candidates and probe for positions on the important campaign issues. Writers of the early stories are the best informed of all the reporters on a newspaper's staff. Early on, the candidate isn't slinging so much mud and is trying to show the highly politicized voters, especially those who give campaign contributions or volunteer in campaigns, that he or she has significant positions on key issues

and is a credible candidate. Later in the campaign, the atmosphere changes. The least politicized voters, those who are undecided as the election nears and those whose decision to vote for a candidate or ballot measure could be easily changed, are the primary target of the bulk of the campaign's media blitz. For these voters, the campaign will create short, memorable slogans plus blasts at the opposition. The newspapers then react and give primary attention to these slogans, to the mudslinging, and to the rise and fall of the polls. The issues take a back-burner.

When Arkansas Governor Bill Clinton was campaigning for the U.S. presidency, much of the early coverage of his campaign was about whether he had slept with a woman who had been paid for her story that appeared on the front page of a supermarket tabloid. The average voter kept thinking, "I want to hear about the issues," but the news reporters kept covering the sex angle. "This is all inane, stupid and insulting, and I hope the American people jam it down you-all's throat," said Bob Slagle, the chairman of the Democratic Party in Texas, when speaking to the press. "The national press corps is acting like a common street gossip in a small town." Meanwhile, the nation's top newspapers were trying to set things straight. On the same day, The *Boston Globe*'s front page headline said, "Poll Shows Clinton's Lead Undiminished," while

across town *The Boston Herald*'s main headline said, "Clinton on the Run." Inconsistent headlines. We voters have a tough time, don't we?

The searching reader will have to look back on page fourteen in the newspaper for any in-depth reporting of the issues, and even then readers need to be aware that story placement can be affected by the paper's editorial policy. Busy readers usually read only the headlines, and a story's favorable treatment of a candidate can be torpedoed by an editor's unfavorable headline, regardless of what the reporter put into the story.

Other significant barriers block the sincere, interested reader who tries to use news stories as a source of information. Reporters too often fail to write stories that take the trouble to explain the issues, and it's not just that those stories aren't viewed by readers and editors as sufficiently entertaining. Explaining the news is harder work than simply stating what is new—the news. Also, there is little reward for writing in-depth reports. The reporter rarely gets a pat on the back from fellow reporters with the accompanying remark, "Beautiful piece of writing." There is no glamour in this part of the business.

In addition, a different factor obscures the public's vision of what is going on. The reporter's notion of objectivity gets in the way. When there are two candidates in an election, reporters believe they must give equal weight and equal column space to both sides. The idea is to present the facts, then back off and let the voters decide for themselves. Unfortunately, this notion of fairness gets in the way when a campaign gets dirty and one candidate starts making false accusations about the opponent. The reporter sees what is going on but rarely will tell the public directly. Instead, when the attacked candidate tries to respond and say that the accusations are not true, the reporter will treat this reaction on a par with the smears themselves and will run the story with a headline "Mud flies," falsely suggesting to the public that both sides are engaging in negative campaigning. Paul Krugman once joked that "if one party declared that the earth was flat, the headlines would read *Views Differ on Shape of Planet*." The reporters are reluctant to tell what is really going on because they believe doing so would be putting their own judgment into a story, which it would be. However, the reporters really are the only experts in touch with the readers, so if the experts won't tell the readers what is really going on, who will? Perhaps that is where the columnists and editors come in. Hmmm.

All in all, though, more good information is available than we are likely to take the trouble to use. The five best sources of information, not ranked in order of importance, are (1) the newspaper stories and magazine articles that profile the candidates and discuss the issues long before election day; (2) government voter pamphlets; (3) extended TV news programs; (4) public debates (but not the thirty-second TV summaries of the debates); and (5) the arguments of editors, columnists, and well-informed friends. All these are better than TV ads, campaign leaflets, blog entries, and sound bites on the ordinary TV news.

Misinformation and Fake News

Too often what looks like news is not news. It has been faked, and we have been misinformed. Someone wants us to believe it even though they know it is not true. We critical thinkers, need to keep up our defenses and not be naïve.

Misinformation goes beyond the occasional hoax. It is a systematic attack on our brains. We critical thinkers seek the honest truth and not the fake news, but it is not always easy for us to tell the difference. The good news is that the more we know about fake news, and the more pro-active we are, the easier it will be for us.

Ordinary persons do not know an expert who can tell the difference between genuine and fake, so they usually look to a person in one of the groups they already identify with for what to believe about a story. They ask, "What are my people saying about this?" or "What do the places I trust say about it?" The ordinary person will not check for themselves. Who has the time? The powers behind the fake news know this, and they exploit it.

The most effective creator of fake news is someone who is able to slip fake news in among the genuine news at news sites. News sites sometimes find the news for themselves, but very often they pick up news from one news site and publish it on their own site, and in this way a fake news story that was embedded into one of those news sits will spread across the news media, and occasionally to news sites we, or "our people," use and trust. Luckily for us critical thinkers, the very best sources of news have their own defenses up and do not re-broadcast the fake news. At the very least they will precede the news item with the phrase, "According to so and so," or "As reported in..."; and they will be clear about when they are offering news and when they are offering advertising and when they are offering more disguised advertising that is usually called "sponsored content." Ads do not come with a tag that says, "Hey, I am an ad," do they? So, it takes some critical thinking to separate them from the news.

Think about that last Twitter message you read. How do you know whether it came from a real human user or from a re-tweeting bot that automatically generates spam to make an issue seem to be more popular than it really is? The bot can turn a minor hashtag into a trending hashtag that catches the eye of journalists who re-mention the issue on more mainstream news sites. The bot-maker thinks, "Create a trend, and you create believers."

Here are some very unreliable sources of information in the United States: the newspaper *National Enquirer*, the newspaper *Weekly World News,* and the website *World News Daily Report*. Here are some very reliable sources of information: peer-reviewed scientific journals, the magazine *The Economist*, and these four daily newspapers: The *Los Angeles Times*, *The Washington Post*, *The Wall Street Journal*, and *The New York Times*. There are, of course, many reliable sources of information that are not American. "Peer reviewed" means that other experts in the relevant field act as referees who must approve in advance the publication of the article.

The best peer reviewing is via blind refereeing, which means that, during the referee process or decision process of whether to publish, the author is never told the names of the referees, and the referees are never told the name of the author.

We critical thinkers always need to be alert to the difference between claims that are backed up by reasons and claims that are not. If we are given reasons, we should ask ourselves whether those reasons are good enough. Also, we should ask ourselves, "Am I forwarding this twitter feed to my friends because it is interesting and I know it to be true, or only because it is interesting?"

Some news stories that we suspect could be fake can be checked by us for accuracy by our visiting the websites Snopes.com or FactCheck.org. They specialize in verifying which interesting news stories are true and which are misleading or totally false. Be alert that some fake news stories will say, "as verified by Snopes.com," even though Snopes.com actually has done no such thing, and the faker is saying this just to discourage any attempt by us to do more checking.

Nobody can check regularly on hundreds of news sources, nor even read or view them. Most people will find one or two news sources they trust, and then put their investigative skills on cruise control and just absorb whatever those news sources say. This procedure can be very efficient time-wise, but it occasionally can be dangerous. We need to do our own checking once in a while, even with the news sites we already trust, especially for the really important news that might cause us to say, "That news means my congressperson is a criminal," or "If that's true, then it was *their* country who provoked our country, not the other way around, so we need to retaliate now," or "That means that what he did is why people like me don't have a better job."

Unfortunately, there are news organizations who have decided that profit is their main goal and that it is more profitable to get their audience to feel informed than to be informed. Acquiring information is expensive. Having their own investigative reporters rather than just writers or "news anchors" is a large, extra expense. It is much cheaper simply to re-broadcast some other organization's news, and to re-shape it so that their audience is told what to believe. The audience leaves feeling informed without being informed. We critical thinkers cannot usually spot this behavior with just a few interactions with the news organization. It takes a great deal of knowledge of how various news organizations work over a period of time, and it takes a great deal of sophisticated critical thinking on our part in order to tell which specific news organizations emphasize cost-effective re-shaping of news and which organizations gather news themselves and broadcast it objectively. Names will not be named here.

If we are checking on a political news item for ourselves, it can be helpful to see whether the item is considered to be news by sources that do not have our own politics. Regarding American TV news organizations, MSNBC is liberal, CNN is middle of the road, and Fox News

is conservative. If all three report it, then it is probably true, but if it appears on MSNBC News, let's say, and not Fox News, then we cannot tell whether it is true or false; it might not be reported on by Fox simply because it is less interesting to them or goes against their politics.

It can be an eye-opening experience to see how the very same story is treated so differently by the above three news organizations. No news source is value-free. Their politics intrudes in the phrasing, in what headline is chosen, and in what information is not mentioned. It is very helpful to us if we are going to rely regularly on a specific news source to double check on it now and then, and to know why we are trusting it instead of another one.

The spread of fake news from fraudulent sources has been a problem ever since civilization began, but it is only a symptom: The larger problem is that too many people will doubt a claim simply because it *does* come from establishment sources—governments, scientists, daily newspapers, TV news programs—when in fact these are reliable authorities. These people are being naïve when they dismiss real news from traditional sources that are trustworthy. Their alienation from "the establishment" makes them easy receptacles for fake news.

On the other hand, in many countries the government is too often involved in promoting propaganda and misinformation. The government in turn pressures the newspapers and TV stations they control. If you are living in this situation, then there is good reason to be alienated from the establishment and to be less trustful of its news. Here is a BuzzFeed link to a video showing the Egyptian Minister of Culture telling a crowd the news that the U.S. Secretary of State Hillary Clinton admitted to creating the terrorist organization ISIS. Lebanese media were spreading the same story. How do *you* know she didn't create ISIS? Were you there to see for yourself?

Well, you can go to FactCheck.org | Search | Clinton ISIS, and read what FactCheck has to say about whether she did.

Let's consider the situation in America. The U.S. has its share of corruption within its establishment, but a smaller share than in the average country. Why should Americans believe that their traditional news organizations are trustworthy? The reporter Steve Inskeep at National Public Radio answered this question:

> Many news organizations produce stories that are checked before publication. Others don't. It's a big deal. Hiring an editorial staff shows the publication's respect for you…. *The New York Times* and the *Wall Street Journal*, for example, have different owners, audiences, stories, perspectives and obsessions. Both have made mistakes and omissions; but both send reporters out into the world and back them up with an editorial process that catches and corrects many errors. This means both can be informative, regardless of your politics or theirs.

When we say a traditional news source backs up its reporters with an editorial process that catches errors, this means that the editors press their reporters to double check the reports and that they recommend the reporter get at least a second, independent source for any unusual claims about situations that the reporter is not a direct witness of. Unlike so many blogs, the mainstream news organizations employ professionals who are devoted to separating fact from fiction.

Critical thinkers should be on the alert for reports containing denunciations of "the right" or "the left" or "Washington" or "the media" or "*their* supporters." These denunciations should be viewed with suspicion and greatly discounted. Good reporters do not appeal to these vague terms and are more specific about who is making a claim about what.

To repeat the point made earlier about double checking, we critical thinkers have a responsibility to occasionally do some checking ourselves on the reporters and their sources. If we check the occasional claim by viewing the reporter's own sources for ourselves and by trying to get an independent source who covered the same issue, then we can assign more trust to this reporter in the future.

Critical thinkers should follow President Ronald Reagan's advice: "trust but verify." That is, do not always mistrust what someone says, but do demand verification of their claim before we buy it hook, line, and sinker—especially if the claim is surprising and, *if* we were to trust it, then we would have to reject many of our other beliefs or have to upset our ideology.

A single fact seems puny compared to our ideology—the large set of our beliefs that helps define our worldview. Unfortunately, too many of us, when confronted with a fact that runs counter to our ideology, will immediately discount that fact as our opponent's partisan opinion. We will not take the trouble to do any of our own fact checking. It is always easier to hunker down secure with our ideology than to take a challenging comment seriously and check on it for ourselves.

What about confronting the person you believe is responsible for promoting fake news? This can be a dangerous thing to do depending on the political situation in which you live. In some countries you could get arrested just for confronting that person. But let's suppose you are in the United States. In the U.S., the powers behind the fake news, the people who employ bloggers and newscasters to push false news at you, never will be able to have you arrested even if they would like to, but they never will confess to what they are doing when confronted. Most likely they will ignore you. However, sometimes they will attack you. They will yell back; or, in a more public setting, instead of yelling back, they will respond in flowery, formal language such as, "It is clear that absurdity is no prohibition on the actions of you and your sources." The counter from the faker is very often to say that your facts are just partisan opinions. The faker will try to turn the tables. If that happens, it is clear that you two are not having a reasoned interchange, and you probably should follow the advice of the American Revolutionary and colonist Thomas Paine:

> To argue with a man who has renounced the use and authority of reason, and whose philosophy consists in holding humanity in contempt, is like administering medicine to the dead.

But if you have no effect on the faker, at least your discoveries will have a positive effect on you, yourself. You will learn better how to separate the genuine news from the fake. You will better understand that facts are something more solid than mere opinions of the people who hold microphones.

You can learn a bit about fake news by looking at the publishing situation from the perspective of the originator of the fake news. Put yourself in the shoes of the faker. Why do you produce fake news? Because you believe the end justifies the means. You believe that achieving your goal justifies using unethical methods to achieve it.

Once you have created your fake news, which is, let's say, an article smearing a political candidate who is opposed by the people who hired you, the best way to get it out there circulating among the news outlets is to send it to a news organization that has low investigative standards and that will see your story as good news, or as the sort of story that entertains their intended audience. They will accept your story without checking on it very much. If your story is left-leaning, then you might post it to a website that regularly bashes the right-wing candidates, and which doesn't look too closely at how accurate the story is, so long as it seems plausible to them. Then, hopefully, other news organizations will pick up your story from that first news organization and use it for their sites. Now your story has momentum. Another successful day for you. If it goes viral, you might get a raise.

However, suppose later that some self-styled critical thinker or some other media people come back at you and demand to know your evidence. You don't have any. So, what do you do? The

only rational response is to stop talking to those people, isn't it? Or you call your doctor—your spin doctor whose primary skill is deflection of criticism and attack on the critic.

OK, step back out of the shoes of the faker, and now ask yourself, "Would I take a high-paying job as the creator of fake news?"

Review of Major Points

Most of what we can legitimately claim to know is based on what other people tell us because we have not verified the information for ourselves. Legitimacy is a matter of degree, as is the continuum from mere opinion to solid knowledge. This chapter explored these points. It clarified the principles of charity and fidelity, and it considered the intricacies of assessing unusual claims. Our judgments of improbability depend on our background knowledge and the evidence available to us. When a claim is inconsistent with our background knowledge, we judge the claim to be improbable. Our most reliable source of information is our own observations, but when these are not available, then we turn to other sources of information, preferably the reliable, traditional news sources. Usually we accept a claim based on the credibility of the sources who tell us to accept the claim. The reliability and credibility of magazines, newspapers, TV programs, and websites differ radically; with the less credible ones, we should get independent verification before accepting any of their unusual claims. We always need to be alert for fake news. The more credible media aim to support their controversial information by getting it from two or more independent sources. The more knowledge we have, and thus the closer our body of background knowledge approaches that of the experts, the better will be our own judgments. Anecdotes of people's experiences are not as good evidence as statistical reports. When we don't have good evidence for a claim, we should suspend belief, or we should continue with our disbelief if we already have some reason to disbelieve it. Getting useful information about whom to vote for is very difficult, but we've seen a few examples that tell us what to be on the lookout for, and we've learned that news about candidates early in an election race is usually more useful than news late in the race. The facts—the objective truths—are our goal, and we critical thinkers need to be on the alert against those people who reject objectivity and see it all as a game of pushing opinions on others in an effort to be influential.

Glossary

anecdote A report of an individual's own experience, a firsthand report.

credibility A person's credibility on some issue is their ability to offer solid grounds for deciding the issue. Credibility is a matter of degree, and it involves both the honesty of the person and how much of an expert they are.

fallacy of misplaced burden of proof Committing the error of trying to get someone else to prove you are wrong, when it is your responsibility to prove you are correct.

fake news: Non-news, especially disinformation presented as if it were news. It is either a lie or a misrepresentation of a situation.

principle of fidelity The principle requiring you to preserve the intended meaning of the speaker's original statements when you are analyzing them.

principle of charity The principle that says to interpret a claim in its best light, so, if it seems obviously false, try to find a re-interpretation that makes it reasonable without violating the principle of fidelity by putting words into the claimant's mouth that the claimant would not accept.

Exercises

1. Create a single sentence that is a rewrite of the following sentence. Your sentence should simultaneously apply both the principles of charity and fidelity:

> The criminal trial of Amy Boycott began yesterday in Illinois and Indiana, making headlines in both states.[124]

■ 2. Consider the following sentence: "I'm not alive today." The sentence is weird. Which of the following sentences would count as being an interpretation that applies both fidelity and charity?

> I'm not alive tomorrow.
>
> I'm alive today but not alive today.
>
> I'm not very animated today.
>
> I'm not under arrest today.[125]

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[124] The criminal trial of Amy Boycott began yesterday on the border of Illinois and Indiana, making headlines in both states. This interpretation applies charity by removing the inconsistency, and it applies fidelity by not interpreting the sentence in a way that could not have been intended (as far as you can tell from the evidence available).

■ 3. If Darryl tells me his father carries a cane, and I tell Samantha that Darryl's father carries a walking stick, have I violated the principle of fidelity?[126]

4. The statement below is apparently contradictory because it suggests that a cheetah is faster than a dog but not faster than a dog. If you wished to remove the greyhound comment while rephrasing the statement, which one of the following is the best way to do it while being charitable and using the principle of fidelity?

> The cheetah is the fastest land animal even faster than a greyhound, but the cheetah in our zoo is sick and cannot run as fast as a dog.

a. All cheetahs run fast, but the cheetah in our zoo is sick and cannot run fast.

b. The average cheetah run fasters than the average of any other kind of land animal, but the cheetah in our zoo is sick and cannot run as fast as a typical dog.

c. The cheetah is the fastest land animal, but not the fastest water animal or flying animal.

d. The cheetah is not the fastest land animal, although some are very fast, and the cheetah in our zoo is sick and cannot run as fast as a dog.

e. Some cheetahs are fast and some are not; for example, the cheetah in our zoo is sick and cannot run as fast as a dog.

5. Create a dialogue in which the speaker clearly fails to properly apply the principle of charity. Don't mention the principle during the dialogue, but at the end identify where the failure occurs and why it occurs.

6. Visit the Internet or a local supermarket's magazine rack, or some other place, and find what you take to be the most preposterous claim you've read or heard this week (outside of this class). State the claim, and identify the source.

7. The more shocking or bizarre the claim, the more apt you should be to demand more and better evidence for it.

a. true b. false[127]

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[125] I'm not very animated today. This gives the sentence a charitable reading without saying something that wasn't meant.

[126] No, because a cane is a walking stick.

[127] Answer (a). The better evidence is required to overcome the initial obstacle of the claim's being so improbable.

9. Which is more improbable, a claim that Martians are attacking Earth, or a claim that Martians are attacking Earth and that the next U.S. president will be a woman? Say why.

10. Suppose the following paragraph had appeared in a news story on the web pages of the *Washington Post*, the major daily newspaper of Washington, D.C. Do you have any comments? What reasons do you have for your comments? (No, you don't get any more precise directions than this. You will be graded on your depth of insight in regard to the course material as it applies here.)

> A man who had been in a coma for six weeks was saved by exorcism from a demon trying to kill him. A doctor and two psychics drove the demon out of the man and into a rat, which began shrieking until it was burned to death, at which point the man stood up and began to talk.

■ 11. As he was standing in the grocery store checkout line, your neighbor read in a magazine (he doesn't remember which one) that farmers in West Virginia reported encountering visitors from outer space. Your neighbor asks you where he can go to find out if anybody has ever really seen extraterrestrials. Which of the following would be the most reliable source of information to recommend to your neighbor?

a. A bestseller called *Space Creatures Terrorized My Baby!*

b. Your uncle who has many friends in West Virginia who are farmers.

c. A U.S. army radar screen operator.

d. A catholic priest who recently wrote an article in *Scientific American* magazine titled "Is There Life beyond Earth?"

e. A scriptwriter for the movie *E. T.*[128]

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[128] Answer (d). The article by the priest promises to provide solid information, unlike the sensational book about terrorizing someone's baby. There is no reason to believe that being a priest would unduly influence the author's opinions on this topic. The source of the priest's article, a reputable scientific journal, adds credibility to the priest's comments on this topic. Regarding (b), West Virginia is a big state, so your uncle is not likely to be able to put your neighbor in contact with the right farmers. Even if your uncle could, the information would be valuable only if the farmers said the whole story was false; but if the farmers said the story was true, your neighbor shouldn't accept the story so easily. Such extraordinary claims require extraordinarily good evidence—better evidence than a few stories from the farmers. If their story were backed up by independent investigators from the military and the universities, the story would be much more likely to be true. Regarding (c), the U.S. Army radar operator is

12. Rank the following three headlines in order from most to least bizarre. Defend your ranking.

a. DEAD CAPTAIN STEERS GHOST SHIP TO PORT!
She'd been missing since 1715

b. SCIENTIST FINDS EVIDENCE OF VISITOR FROM 2081 A.D.

We have found a coin with that date on it, a coin which is yet to be made—delivered here by a man who has yet to be born.

c. U.S. MILITARY LANDS AND SEIZES MARS; U.S. BOUNDARIES ARE ENLARGED TO OUTER SPACE

■ 13. Explain the point of this famous quotation by the philosopher George Santayana: "Skepticism is the chastity of the intellect."[129]

14. Rank the following sources of information in terms of their believability or credibility in regard to whether the U.S. banking system is becoming less stable. You may need to go to outside sources to learn more about them.

a. *Weekly World News* (weekly supermarket tabloid)

b. Radio Baghdad (radio station in Iraq run by the Iraqi government)

c. The San Francisco Chronicle (daily newspaper)

d. *The Nation* (magazine of political analysis)

e. Huffington Post (political news website)

Put the letter of the most credible source first or highest on your list.

15. Scientists generally believe that (i) there are no fire-breathing dragons or abominable snowmen and that (ii) there are no ghosts.

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likely to have heard stories about other radar operators encountering unidentified objects on their radar screens, but nobody can look at a blip on a radar screen and tell whether it is coming from E.T. So, the best bet is the priest.

[129] You can keep your body of beliefs from getting penetrated by a lot of false ideas if you are skeptical and demand decent evidence before accepting the belief.

a drawing of a ghost

Scientists believe this despite many reports by people claiming to have seen these unusual beings. Scientists believe one of the two much more strongly. Which one, i or ii? Why? Write a short essay explaining and defending your answer. The terms can use some clarification. Make the following assumptions. The abominable snowman is called "Bigfoot" or "Yeti" in other parts of the world. A dragon is an exotic flesh-and-blood animal that looks somewhat like a dinosaur but has special physical abilities such as the ability to fly and the ability to direct a stream of flame outward from its mouth. By the word *ghost* we mean the soul of a dead person that appears to the rest of us in bodily form except that it cannot be photographed and can be semitransparent.

16. Which is more improbable? (1) a claim that Martians will attack Earth somewhere someday next year, or (2) a claim that Martians will attack Earth somewhere someday next year, and that the next U.S. president will be a man.

17. You receive a telephone call on your answering machine. The speaker says he is from the online fraud department of your bank's credit card division and that there has been some trouble with your account. You are instructed to call the bank toll-free at 888-278-6424. When you phone that number you are told that someone has charged your card for $18,550 for a new motorcycle, and you are asked if you accept this charge. When you say you do not, you are told that because of this suspicious activity you will need to be assigned a new credit card number and will be given new cards free of charge. In order to verify your identity, you are asked to supply your home address, your social security number, your card number, and your online

password. But for an extra $6 per month you can purchase insurance against identity fraud. At this point, what should a critical thinker do?

18. You are trying to decide which computer would be best for your church to buy for keeping all its records. Rank all of the following that you might go to for advice in terms of their credibility, and include a few sentences defending your ranking.

a. A computer column that appears in an online computer magazine.

b. Your sister who has been a bookkeeper for her local church in Miami for four years.

c. Your next door neighbor who has built two computers so far as a hobby.

d. A salesperson at a computer store.

19. On which issues below is James Shoch more or less credible as a source for you in your decisions on these issues? That is, if he were to give you his advice, how trustworthy and knowledgeable do you guess it would it be? Give a 200 word or less defense of your ranking of Shoch's advice on these issues.

> James Shoch is a professor in the Government Department at a state university in Northern California. His specialty is contemporary American political parties. He has a Ph.D. degree from the Massachusetts Institute of Technology and taught previously at Dartmouth College. He is the author of the books *Trading Blows: Party Competition and U.S. Trade Policy in a Globalizing Era* (University of North Carolina Press, 2000) and is a co-editor of *What's Left of the Left: Democrats and Social Democrats in Challenging Times* (Duke University Press, 2011). He has published eleven articles in academic journals on American economic, trade, and industrial policy. Over twenty-five years ago he was a political director of the activist organization *Democratic Socialists of America*. He has spent parts of summers in France, Italy, Sweden, Denmark, Turkey, China, and Thailand. His food column in the online culinary page *Eating without Guilt* has over a thousand readers per month. Last year he was awarded the Distinguished Teaching Award at his university, an award given to only one person per year.

a. Whether Americans prefer Swedish-style food to Greek-style food.

b. The extent to which the Walmart Corporation influences the balance of trade in the U. S.

c. Whether the twenty-first century's global climate change will have more effect on the climate of North America or South America.

d. Has the Democratic Party moved to the left since the election of Barack Obama?

e. What is a good, cheap Italian restaurant to eat at near M.I.T. next week?

f. Whether a syllabus in a French History course should require weekly testing of the previously assigned readings.

g. Which candidate should you vote for in your congressional district in Los Angeles?

20. After moving into a new apartment, you notice that on weekends occasionally your electric lights flicker or slowly dim and then get brighter. You check very carefully for wiring problems and find no problems. Why wouldn't it be OK then to conclude that your apartment is haunted?

■ 21. Discuss the quality of this argument:[130]

> The prostitute said she enjoyed having sex with Mayor Smith, so Mayor Smith did have sex with the prostitute.

22. Which of these is least likely to be fake news?

a. Non-news.

b. A mistake made accidentally by the *New York Times* newspaper.

c. Disinformation presented in the blog "Challenge to the Right" as if it were news.

d. An intentional misrepresentation of a situation.

e. A known falsehood about a situation that is presented by a blog in order to seem to be an objective truth.

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130 It would be a mistake to say that on the basis of the information in the premises the Mayor did have sex with the prostitute. It would also be a mistake to say that on the basis of the information in the premises the Mayor did not have sex with the prostitute. A better answer would be that the premises give some evidence that the Mayor had sex with the prostitute, but it's not strong evidence because the prostitute might be lying. Better evidence would be some independent evidence such as a witness having seen the Mayor coming out of the prostitute's home at 3:00 pm when he claimed to be elsewhere. Other useful evidence would be that the prostitute has been caught lying about some of her other statements.

CHAPTER 5 Obstacles to Better Communication

This chapter is designed to reveal some of the major pitfalls in normal communication. Usually your goal is to communicate well. You want to be clear, to be precise, and to get the message across with the proper tone. But not always. There are many reasons for not wanting to directly say what you mean. That birthday present from Aunt Bessie deserves a thank you, but you don't want to tell her that the present itself is useless to you. And when you insert into your history essay the famous remark "History is a pack of tricks played on the dead," you don't intend to be taken literally. However, this chapter explores the logical aspects of good communication when you do want to say what you mean and mean what you say. This goal is not always easy to achieve, as we will see.

Not Realizing What You Are Saying

All of us sometimes say things that aren't quite what we mean, but those whose native language is not English have special troubles in this regard. Here are some examples of items written in English by non-native speakers:

- Sign outside a doctor's office in Rome: "Specialist in women and other diseases."
- Bucharest hotel lobby: "The lift is being fixed for the next day. During that time we regret that you will be unbearable."

- In a Serbian hotel: "The flattening of underwear with pleasure is the job of the chambermaid."
- On the menu of a Swiss restaurant: "Our wines leave you nothing to hope for."
- In a Norwegian cocktail lounge: "Ladies are requested not to have babies at the bar."
- In an Acapulco hotel: "The manager has personally passed all the water served here."[131]

You wouldn't make errors like these, would you?

———CONCEPT CHECK———

You've been hired by a Tokyo car rental firm to revise the following paragraph of its brochure in order to improve the English. How would you rewrite it?

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131 These errors and many others have been circulating widely, but the above list is part of a longer list reported on by Jon Carroll in the *San Francisco Chronicle*, July 30, 1990.

> When passenger of foot heave in sight, tootle the horn. Trumpet him melodiously at first, but if he still obstacles your passage then tootle him with vigor.

132

Abusing Rules of Grammar

Bad spelling is a source of communication problems, though not an especially subtle one. The great individualist from Tennessee, Davy Crockett (1786-1836), was a frontiersman who had little respect for book learning; he spelled words any way he wanted and said that the rules of English spelling are contrary to nature."

He had a point, because English spelling isn't designed for easy learning—ask a foreigner. But none of us can change that situation. Crockett couldn't, and you can't. So if we're to communicate effectively, we've all got to spell words the way most everybody else does.

One of the first rules of good communication is to use grammar and semantics correctly. For example, the sentence "She is a person lovely" is bad grammatically, but the semantics is OK. The sentence "She is a negative square root" uses good grammar but bad semantics, although people will know what you mean if you say the sentence is grammatically weird. In this book we won't worry about the fine difference between grammar and semantics and will stick to the big picture: your primary goal as a communicator is to communicate your meaning clearly. Don't make your audience do extra work to figure out what you mean when they encounter bad grammar or bad semantics.

A common error is to make phrases modify unintended parts of a sentence. The reader can get the wrong idea. Here is an example from a newspaper article:

> Coach Pucci offered his resignation effective at the end of the current school year, on Christmas.

This report puzzles the reader because the school year ends in the spring, not at Christmastime. It would have been better to put the words *on Christmas* closer to the part of the sentence they relate to, as in the following rewrite:

> Coach Pucci offered his resignation on Christmas, to be effective at the end of the current school year.

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132 You did get rid of "tootle," didn't you? There are many ways to rewrite the statement more clearly. Here is one: "Lightly honk your horn if a pedestrian blocks your path. If he continues to block your path, honk more vigorously."

The original sentence was odd—odd enough that the reader had to stop and do extra work to figure out what you meant. In doing this, we readers apply a special principle of logical reasoning:

> The reader applies the principle of charity by taking the writer to mean something sensible when the writer could easily be interpreted as unintentionally having said something silly or obviously false.

According to the **principle of charity**, you should give the benefit of the doubt to writers or speakers whose odd statements you are trying to understand; if the statements appear to be silly, then look for a less silly, but still likely, interpretation. In a conversation, when a new speaker makes a comment, we listeners apply the principle of charity by assuming that what they said is intended to be a relevant contribution to the conversation. In fact, it's a sign of mental illness if a person too often makes a comment that is irrelevant to the conversation. We mentally healthy people try to make contributions that can be easily understood to be relevant.

The lesson the principle of charity offers to speakers rather than listeners is that we should clearly say what we mean so that our listeners or readers won't be put through unnecessary mental gymnastics trying to figure out what we really intended to say.

Communication is often hampered when people are sloppy and don't realize what they are saying. Here are some humorous but authentic examples. Imagine being a teacher at an elementary school and receiving these two excuses from Anne's parents:[133]

- Anne didn't come to school. She was in bed under the doctor and could not get up.
- Please excuse Anne. She was sick and I had her shot.

With a little charity and empathy, you can figure out what the parent meant.

What would you think if you were a welfare department employee and you received this letter from a woman applying for financial assistance?

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133 From *The Sacramento Bee* newspaper, February 24,1988.

- I am forwarding my marriage certificate and six children. I had seven, but one died which was baptized on a half sheet of paper.

If you take her literally, you might wonder when the six kids will be arriving. Can you imagine the scene as that seventh child was baptized while it sat balanced on a half sheet of soggy paper? There are effective ways to clear up such writing problems. Here is one way:

> I am mailing you my marriage certificate and the birth certificates of my six children. I had a seventh child, but he died. That child's baptismal certificate is on the enclosed half sheet of paper.

Writers need to take some care in expressing themselves or run the risk of saying something they don't mean; conversely, readers must be continually aware of not taking writers too literally.

———CONCEPT CHECK———

The person receiving the following letter at the welfare department knew not to take it too literally:

> "I want money quick as I can get it. I have been in bed with the doctor for two weeks, and he doesn't do me any good."

Select one of the following choices as the better rewrite of the welfare letter:

> a. "I am in urgent need of funds. For two weeks I have been in bed with the doctor, but I am still ill."
>
> b. "I want money quick as I can get it. At my doctor's request, I have been in bed for the last two weeks, but I am still ill."

———[134]

Using and Over-Using Euphemisms

When you replace a harsh-sounding phrase with one that means more or less the same but is more gentle, you are using a euphemism. Taking a brick from King Tilt's tomb during a visit to

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134 Answer (b). The point is to eliminate the sexual allusion.

the Egyptian pyramids is really stealing, but the person who does so is likely to cover it up with the euphemism "souvenir hunting." If the mortician mentions your "dearly departed" grandmother, that's a euphemism for your dead grandmother. The term *dead* is a more accurate though harsher one. If you're the type of person who tells it like it is, you will have a hard time being a successful mortician or politician.

The connotations of a term are what it suggests to the reader or hearer. Euphemisms have fewer negative connotations; they have fewer associations that are unpleasant to think about or that might offend the hearer's morality or sensitivities. Euphemisms include genteelisms such as "disrobed" for naked and "bosom" for you know what. A "Rocky Mountain oyster" is not an oyster at all, is it? The Bowlers' Association has resolved to use euphemisms to make bowling a more upscale sport. They plan to get bowling out of the bowling "alleys" and into the bowling "centers." They also plan to get the balls out of the "gutters" and into the "channels."

———CONCEPT CHECK———

What is a euphemism for "armpit sweat-stopper"?

———135

Using a euphemism in place of a negatively charged term can keep a discussion going past sensitive points that might otherwise end the discussion or escalate hostilities. However, euphemisms have their down side. They can be used for very serious deception. In the 1930s and 1940s, the German bureaucratic memos called their Nazi mass murder of the Jews by the euphemism "the final solution to the Jewish problem."

———CONCEPT CHECK———

Which terms are euphemisms for "American"?

a. Yankee

b. Capitalist pig

c. Imperialist

d. all of the above

e. none of the above

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135 Underarm antiperspirant.

136

Sometimes we pay insufficient attention to the connotations of what we say. Suppose you were asked one of the following questions.

1. Is the government spending too much for welfare?
2. Is the government spending too much for assistance to the poor?

In a public opinion poll, it was found that twice as many Americans said "yes" to question 1 than to question 2. Can you see how connotations accounted for the difference? Pollsters, poets, and advertisers are the three groups in our society who need to be the most sensitive to connotations.

Two words that are synonymous according to a dictionary or a thesaurus can often have radically different connotations. Some public relations people make their fortunes by trading on their appreciation of these subtleties. Others achieve success by finding synonyms that disguise what is meant. The U.S. Department of Defense purchasers have paid a lot more money for a hammer when it was called a "manually powered fastener-driving impact device." The phrase isn't a euphemism for *hammer*, but it does serve to obscure what is really meant. Such cover-up phrases are called **doubletalk**. One D.O.D. purchase order called a steel nut a "hexiform rotatable surface compression unit."

Can you imagine a military officer walking into the local hardware store and whispering a request for a hexiform rotatable surface compression unit? During the 1991 U.S. war in Kuwait

136 Answer (e). Answers (b) and (c) are more negative than "American." Answer (a) is not more negative than "American" in some regions of the world; New Englanders have no problem with being called "Yankee" as long as they aren't called "Yankee dogs." But even in New England "Yankee" isn't a euphemism, just a synonym.

and Iraq, the Navy reported a 90 percent success rate for its Tomahawk missiles. By "success rate" the Navy meant the rate of successfully leaving the launch pad when the fire button was pressed. An even worse cover-up term was "collateral damage," which was what the military called damage to non-military citizens and their homes and vehicles.

Unintended Innuendo

Here is a letter from Anne's parents to her elementary school teacher:

> Anne was late because she was not early. . . . She is too slow to be quick.

If you were Anne's teacher, you would notice the implication that Anne is dimwitted, but you'd discount it as sloppy communication because you would apply the principle of charity and figure out what the parent probably meant instead.

An **innuendo** is a negative suggestion made by disguised references or veiled comments about a person. If your professor were to write a letter of recommendation to graduate school for you that said, "This student always managed to spell his (or her) name correctly," you would be upset by the innuendo. The professor is using innuendo to suggest you have few talents; being able to spell one's own name correctly is such a minor positive feature that the reader is likely to believe the writer cannot find anything more positive to say. This letter is an example of damning with faint praise.

———CONCEPT CHECK———

Identify the innuendo in the following passage.

> The vice-president is a man who projects the image of being honest.

———[137]

If you call your opponent a "possible liar," you are insinuating something. You aren't specifically charging that he is a liar, but you aren't exactly withholding the charge either.

Imagine that you are a university professor who has been asked to write a short letter of recommendation for a student, Juanita Barrena, who wants to be admitted to social work graduate school. Here are two recommendation letters. Notice that they both state the same facts, yet one is positive and one is negative. How could that be?

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137 The innuendo is that the vice-president is not as honest as his public relations image would suggest.

To whom it concerns:

Ms. Juanita Barrena, one of my ex-students, surprise me by asking that I write a letter of recomendation to you. Although she got an A- instead of an A, she was friendly and, if I remember correctly, organized a study group for the tests. Occasionally she spoke in class. I recommend her.

Yours truly,

Washington Carver

To the Graduate School of Social Work:

I am delighted to have been asked by my student Juanita Barrena to write a letter of recommendation to your graduate school of social work. Juanita excelled in my European history course, capturing an A- in a difficult course. In addition to her good grade, she stands out in my mind as being quite exceptional. Not only did her insightful comments capture the attention of the entire class while demonstrating an excellent grasp of the material, but she also showed special initiative by organizing a study group for my tests. Organizing this group demonstrated her special talent for using her social skills to achieve a specific goal that contributed to the group as a whole, an asset that will serve her well in the field of social work. Regarding her personality, I am again happy to be able to add more favorable comments; she is very friendly, an especially appropriate asset for her future career. I know of nothing about her that would reflect unfavorably upon her application. I am convinced that Juanita has demonstrated a high level of academic and social skills and shows promise of succeeding in graduate school. Again I am happy to recommend her wholeheartedly for admission to your graduate program.

Yours truly,
Prof. Washington Carver
History Department
phone: (996) 486-9433

The emotional tone of the second letter is more animated and positive. For example, the second says "capturing an A-," which is more positive than "getting an A- instead of an A." In the second letter, Carver says he is "delighted to have been asked" to write the letter, but in the first letter he says he is "surprised" to have been asked, raising the possibility that the request was an unpleasant surprise. The second letter is longer, showing that the professor gave more attention to the student's request. The typos in the first letter are a sign of Carver's inattention. In the second letter, Carver added his phone number, demonstrating his willingness to talk further if the admissions committee desires; doing so is evidence he believes Barrena is worthy of some extra effort on his part.

Disobeying Rules of Discourse

A cardinal rule of good communication is to imagine yourself in the shoes of the person you are trying to communicate with. Here is another rule: If you don't like what someone has to say, don't let him say it again. That is not a rule of good communication; just a joke. This one is, though: Obey the rules of discourse. The **rules of discourse** are the rules that guide communicators in normal writing and conversation. These rules are the guidelines most everyone follows and expects others to follow. We try, for example, to interpret other people's speech the way they intend it to be interpreted. We try not to be long winded or roundabout. We try to be courteous. We violate a rule of discourse when we praise faintly. If we are going to praise something, we are normally expected not to praise it at a lower level than it deserves.

Some of the rules of discourse are rules of logical reasoning, and some are not. Interpreting someone's speech the right way is a rule of logical reasoning, but being courteous is not.

It's a rule of discourse not to ask someone to do the impossible, and it's a rule not to say something unless you believe it. That is why it is so odd to say, "That is true, but I don't really believe it." It is also a rule of discourse not to give too little information, or too much information, or irrelevant information.

These rules are for normal situations. You don't follow the rules when you want to keep information secret or when you want to distract people by providing them with so much information that they won't think to ask you the questions you don't want asked.

———CONCEPT CHECK———

What rule of discourse are you violating if, when there is a knock on your door, you open it smiling and say, "You're not unwelcome to come in"?

———138

Being **sarcastic** is a technique that intentionally violates the rules or that conveys a pessimistic opinion. Saying in a sarcastic tone "Yes, I believe you" conveys just the opposite. It is an interesting way to say, "No, I do not believe you." Isn't it fascinating to analyze the rules of language? Not that you care.

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138 Don't be roundabout.

Not Sticking to the Issue and Not Treating It Fairly

Let's consider the notions of accepting the burden of proof, identifying the issue in a disagreement, sticking to the issue, fair play in argumentation, and creating a counterargument.

Not Accepting the Burden of Proof

If a neighbor says, "Jeff slit the tires on my son Jeremy's bike," he is expressing his opinion. An opinion is a belief. But is his opinion also a fact? Maybe. He can show it is a fact if he can prove it to be true. If he expects to convince other people of his opinion, it is his duty to prove it. A proof of a statement is an argument for that statement that ought to be convincing; it doesn't need to be the sort of thing you would find in a math book. You prove a statement to other persons if you give them reasons that ought to convince them, even if those reasons don't actually convince them. The important point is that people don't know something if they are not justified in believing it.

Sometimes, it isn't obvious who has the burden of proof. If two people each make a statement disagreeing with the other, who has the heavier burden of proof? You can't tell by asking, "Who spoke first?" Usually the burden is on the shoulders of the person who makes the strangest statement. A statement is considered strange if it would be likely not to be accepted by the majority of experts in the area under discussion. People who make controversial statements have the greater burden of proving their statements.

The claim that an alleged mass murderer is innocent may be unacceptable to people in a community because the community members have been convinced of his guilt by media coverage. Nevertheless, the burden of proof does not rest with those who make the controversial claim of his innocence; it still rests with those who assert his guilt. The legal experts would say that the controversial claim is the claim that he is guilty before the trial has concluded.

There are other problems in determining where the burden lies. In the late twentieth century, an English researcher discovered a poem inserted between two pages of an obscure book in the Bodleian Library of Oxford University in England.[139] The poem was handwritten by a seventeenth-century scribe who attributed it to William Shakespeare. Surprisingly, however, this poem was not part of the currently known works of Shakespeare. Was it really by Shakespeare? That's the question. Examination of the paper and ink verified that the poem was indeed copied in the seventeenth century. Shakespeare himself died in the early seventeenth century. The poem is clearly written in the style of a Shakespearean poem, although it is not an especially good poem. The researcher is convinced the poem is Shakespeare's. At this point, does the researcher have the burden of providing more proof, or does the skeptic have the burden of proving the poem is not Shakespeare's?

The burden of proof has now shifted to the skeptic, not on the person who said it was written by Shakespeare. Unfortunately, it takes expertise to know this. Because of how the poem was

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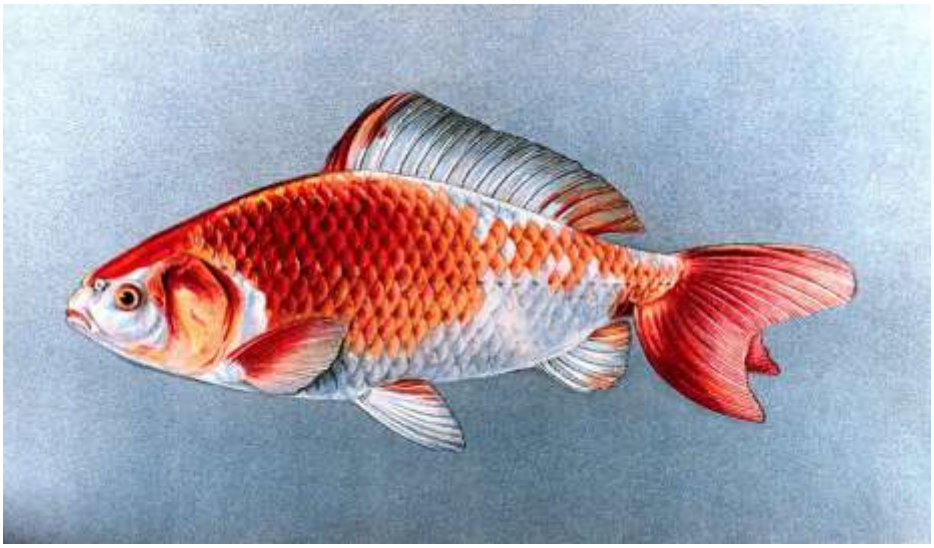
[139] Adapted from remarks made in program 20 of the syndicated TV series "Against All Odds: Inside Statistics," copyright by The Consortium of Mathematics and its Applications, Inc., 1988.

discovered, when it was copied, and the style it is written in, experts on English poetry generally concede that the case has been made in favor of Shakespeare, as author, and the burden is on somebody to show he was not the author. Many skeptical researchers have analyzed the poem, looking at such things as the number of words that aren't in any of Shakespeare's other works, but they have failed to prove their case.

———CONCEPT CHECK———



Jeremy says, "My goldfish are dumb, dumb, dumb. They don't know one-tenth as much about the world as I do." David responds, "You can't say that. Maybe we just can't communicate with your fish." Who has the greater burden of proof in this dispute?

———140

Diverting Attention from the Issue

Besides shouldering one's share of the burden of proof, an equally important duty for a logical reasoner is to stick to the issue during an argument. The issue in a particular piece of reasoning is what the reasoning is specifically about; it's the central question under discussion as opposed to the more general topic or subject. In the example of the neighbor accusing Jeff of slitting the bicycle's tires, suppose another neighbor says, "Quit picking on Jeff. He didn't do it." Now the second neighbor is taking a different position on the issue. The issue is whether Jeff did it. The first

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140 Jeremy doesn't. He is simply making a claim that agrees with common sense. Since David is challenging common sense, he has the greater burden of proving his claim.

neighbor's position is that Jeff did do it; the second neighbor's position is that Jeff didn't. The more general topic is neighborhood crime.

> A good reasoner follows the principles of sticking to the issue and treating it fairly.

The goal is to pursue the truth about the issue, not to sidetrack, confuse, or con one's opponent. Logical reasoners argue in good faith. The purpose is not to win, but to discover the truth. However, political debaters usually don't pursue such a high ideal. Similarly, lawyers fight for their client; they don't try to convince the jury their client is guilty, even when they believe that the client is indeed guilty.

It is possible to learn a lot about good reasoning by examining the major errors in faulty reasoning. Errors in reasoning are called **fallacies**, and in this chapter we will explore some of the major fallacies having to do with getting off the issue. These are often called the fallacies of irrelevance, because when you stray off the issue you make irrelevant remarks.

When trying to spot the issue in an argument, one technique you can use is to search for some conclusion that is being defended. Then try to spot which side of a controversy the conclusion takes. That controversy will be the issue. Figuratively, the technique works like this. Imagine that you are walking along the top of a fence, and someone is giving you reasons to come down on one side. The issue in the argument is whether to come down on one side or on the other. The arguer is not arguing in good faith if he is pulling you off the fence onto his side by some means other than giving good reasons.

———CONCEPT CHECK———

Identify the issue in the following discussion.

> *Jennifer*: You are worrying too much. You should spend less time thinking about the consequences for police officers and more about the consequences for the mayor's office. If the mayor or vice mayor were injured, there would be an outpouring of grief throughout the city.
>
> *James*: Police put their lives on the line for us every day. Each police officer's life is valuable, as valuable as the life of the mayor. Our police deserve our respect.
>
> *Jennifer*: You are thinking of TV shows. Being a farmer is a lot more dangerous than being a cop, but that's a side issue. Look, if some of the police guarding the mayor and her staff get shot during the event we are planning, well, that's life. They know the risk. That's why we politicians pay them so much money.

James: That sounds pretty callous to me. I don't think you should write off police lives the way you write off the latest 2 percent budget cut.

Jennifer: Wake up to the realities. I'm talking political power, and you're just talking sentiment and morality.

The issue is:

a. that police lives are valuable.

b. whether political power is more important than morality.

c. that Jennifer is being callous about police lives and James is being sensitive and showing respect for them.

d. whether the lives of the police are as valuable as those of the mayor and vice mayor.

e. that if the mayor or vice mayor were injured, there would be an outpouring of grief all through the city.

141

141 Answer (d). (a) is not the answer because it makes a statement on James's side of the issue, (b) is not the answer because, although it does give an approximate statement of the topic, the more specific issue is better stated

The normal goal of an arguer is to provide convincing reasons for a conclusion that takes a position on the issue at hand. Arguments that do not achieve that goal are said to be bad, illogical, or fallacious. If the issue is whether a particular Toyota will start in the morning, the following argument doesn't speak to the issue:

> The Toyota is owned by Barack, who is a citizen of the state of Hawaii, and aren't Hawaiians Americans? So, the car is owned by an American citizen.

The argument is fallacious, given the content. Yet the same argument would be fine in another context where the issue is the nationality of the car's owner, but it's not relevant to the issue of whether the car will start. Intentionally diverting someone's attention from one issue to another is called the *Red Herring Fallacy* and the irrelevant issue is called the red herring. The name comes from a prison break in which the prisoners are being chased by prison guards using dogs. The prisoner throws a red herring fish in the direction they want to divert the dogs (who presumably will be attracted more by the smell of the herring than the smell of the prisoners). The bottom line here is that knowing the issue is key to deciding whether an argument is any good.

———CONCEPT CHECK———

What is the specific issue about minority politics referred to in the headline of the following newspaper article? The article's author isn't taking a position on either side of the issue.

Minority Politics at Issue in Merger

> If Johnson County voters approve the merger of city and county governments into one mega-government in the November election, how minorities exercise political power could be dramatically transformed.
>
> At least two current elected officials—both minorities—contend that the transformation means that minority communities will lose what little influence they now have.
> Those minorities who helped write the proposal insist, however, that the local community councils formed under the merger will offer an unprecedented opportunity for minorities to hold office and to sway the debates on issues vital to their communities. There will be no loss of adequate representation, they contend.[142]

a. The issue is the election in Johnson County.

b. The issue is minority politics in Johnson County.

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by answer (d). Answer (c) states James's position on the issue, but it does not state the issue itself, (e) states something that James and Jennifer might agree to, but it is not the specific subject of their controversy.

142 Liberally adapted from an article by Eric Mattson in *The Sacramento Bee*, September 17,1990.

c. The issue is that the local community councils formed under the merger will offer an unprecedented opportunity for minorities to hold office and to sway the debates on issues vital to their communities.

d. The issue is whether the merger in Johnson County will weaken minority influence in government.

a. The issue is whether the result of the election for a merger in Johnson County will hurt minorities.

———143

A discussion is easier to follow if everybody stays on the topic and doesn't stray off on tangents. The duty of the logical reasoner is to avoid getting lost and diverting the attention of others from the topic at hand. Stacey doesn't do her duty in the following conversation:

> *Macey*: Would the Oakland A's be in first place if they were to win tomorrow's baseball game?
>
> *Stacey*: What makes you think they'll ever win tomorrow's game?

Stacey has committed the **fallacy of avoiding the question**. Her answer does not answer the question; it avoids it. This fallacy (error) is one kind of fallacy of avoiding the issue, because answering the question is the issue here. Answering a question with a question is a common way of avoiding an issue.

Like magicians, most politicians are experts at steering our attention away from the real issue. A politician was once asked, "Do you think either the U.S. National Security Council or the Pentagon is actively involved in covert activities in this region of Central America?" The politician responded with, "I think the fact that the president has sent troops into Central America in the past is not necessarily a reason to expect that he will do so now in this region of the world. There has been a lot of pressure by the U.S. banking community to upset the economic situation, but I seriously doubt that we can expect anything as overt as the sending of U.S. troops into the region. On the other hand, neighboring countries may be upset, so there is always a threat of invasion from that direction."

The issue was whether the government was involved in covert (secret) activities in Central America. The politician avoided that issue by directing attention toward overt (public) activities. The politician cleverly and intentionally committed the fallacy of avoiding the issue. Because politicians are so likely to use this avoidance technique, reporters at press conferences are often permitted a follow-up question. A good follow-up here would be, "Thank you, sir, but I asked about the likelihood of covert operations, not overt ones. Can you speak to that issue?"

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143 Answer (d). The issue is whether the merger of the city and county governments of Johnson County will result in loss of adequate political representation for minorities. Answer (e) is not as good because it doesn't say what minorities might lose. Answers (a) and (b) are too imprecise, though they say nothing false. Answer (c) is the worst answer because it comes down on one side of the real issue by using the word *that* instead of *whether*.

———CONCEPT CHECK———

In the following interview, does Pee-Wee Herman answer the question put to him, or does he avoid it?[144]

> *Interviewer*: Did you include the romance in your film as a response to people labeling you as asexual or of indeterminate gender?
>
> *Pee-Wee*: It's just something I wanted to do. I never understand why people say that, though. A lot of the reviews of the show mentioned stuff like "His gender is confusing to children." To me it's clearly male on my TV show. I don't see the confusion. I don't wear wigs or cross-dress. My name is Pee-Wee. There aren't a lot of women named Pee-Wee. Probably from this interview a lot of them will write to me, [gruffly] "Mah name is Pee-Wee and ah'm a woman."

———[145]

A final note about the fallacy of avoiding the question. If somebody asks you a question, you wouldn't automatically be committing the fallacy by refusing to answer the question. Only if you should answer but don't do you commit the fallacy.

An arguer might suggest several issues while addressing another issue. The distinction is important in this conversation:

> *Sanderson*: These Korean video cassettes are a lot cheaper than the ones Sony makes.
>
> *Tamanaka*: Yeah, it's a shame. It's time Congress quit contemplating its navel and created tariffs against Korean electronic imports.
>
> *Sanderson*: I don't see any reason for tariffs. Tariffs just restrict free trade.
>
> *Tamanaka*: There should be more U.S. tariffs against Korean electronic imports because Koreans are getting unfair assistance from their government to subsidize their electronics manufacturing and because Koreans already have too much influence in the American economy.

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144 From *Interview*, July 1987. p. 46.

145 Pee-Wee's comments do answer the question that was asked; they don't sidestep it. When asked whether he included the romance in order to overcome accusations about his sexuality, he directly answered the question by saying he included it just because he wanted to and not because he wanted to overcome accusations about his sexuality. He then went on to address the accusations about his sexuality. You may believe he has a weak answer, or you may believe he didn't say enough. However, a weak answer is still an answer to the question, so Pee-Wee did not commit the fallacy of avoiding the question.

The issue in the conversation is whether there should be more tariffs against Korean electronic imports. The argument in Tamanaka's last remarks addresses this issue. However, his remarks also suggest other issues, such as: Is there anything wrong with having Korean influence on the American economy? If it being right or wrong depends on how *much* Korean influence, then how much is too much? Are Korean electronics manufacturers really getting a government subsidy? If so, is that unfair? These side issues get suggested, but they don't get addressed in Tamanaka's argument. An argument will normally address one issue at a time. If you create an argument, your reasoning will be easier to follow if you take the issues one at a time and not try to handle everything at once.

Re-defining the Issue

It is one thing to argue about an issue but another to agree on what the issue is. For example, on the twenty-fifth anniversary of the first U.S. government report on smoking, the Surgeon General said that cigarette smoking was responsible for more than one out of every six deaths in the United States. Noting that nearly 30 percent of American adults still smoke, despite the Government's warnings, the Surgeon General said that many publications that carry cigarette advertisements also refuse to run articles on the danger of smoking. In addition, the Surgeon General defended taxes on cigarettes. The issue, said the Surgeon General, is health. Not so, said the cigarette companies; the issue is individual freedom—whether our society should have more or less government interference in private enterprise. The issue is whether the government should be involved, by taxation and by requiring warnings on cigarette packs, in an unconstitutional attempt at censorship. It's time for more people, including the Surgeon General, to wake up to the fact that "smokers and the tobacco industry are productive forces in the economy," said the director of media relations for the Tobacco Institute, which is the lobbying organization for the industry.[146]

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[146] Information about this scenario is available in the article, "Surgeon General Rebukes Tobacco Industry over Combative Ads," by Irvin Molotsky, *The New York Times*, national edition, January 12, 1989, p. A7.

Notice that both parties in this argument are trying to **redefine the issue** or "frame the issue" for their own benefit. In this scenario it is probably a mistake to say that one party has identified the right issue and the other has not. All these issues should be addressed. Bringing them all out into the open gives the public a better appreciation of the situation and the ability to make more informed choices.

Suppose Otis has been trying to convince his sister that doctors and nurses working in federally funded family counseling centers should not be allowed to tell pregnant women about the option of getting an abortion. His reasons are that abortion is immoral and that the federal government should not be in the business of promoting immorality. Suppose Otis's sister reacts to his argument by saying that nurses and doctors should be able to give any medical advice they believe to be in the best interests of their patients, so the federal government should not be interfering in the doctor-patient or nurse-patient relationship by outlawing counseling about abortion. This argument will miss its target because it does not address Otis's point about the morality of abortion. Their dialogue will be especially frustrating for both of them until they realize that they are talking about different issues.

Progress can also be made in some disagreements by focusing on the issue in other ways: by defining the issue more precisely, by narrowing the issue, and by noticing when one issue must be settled before another can be fully addressed. For an example of the dependence of issues, consider the lobbyist for San Francisco who is deciding whether the city should take a position to support or oppose a proposed state law to redefine the formula for distributing state monies to county hospitals. The lobbyist will probably not be able to decide whether to recommend support for or opposition to the bill until another issue is settled—whether the bill will give more or less money to San Francisco County Hospital. Local governments usually don't take a stand for or against a bill based solely on fiscal impact, but they always keep fiscal impact in mind.

Here is an example of progress by narrowing the issue. Suppose a student in a government or political science class is asked to write a four-page essay on a topic of their own choosing. Choosing

the issue of whether capitalism is better than communism would be inadvisable because this issue is so large and the essay is supposed to be so short. That big issue would not be manageable. The essay would have to discuss every country in the world and its economics, political freedom, military, lifestyles, and so forth. The essay would be improved if the student narrowed the issue to, let us say, whether race relations were better under American capitalism or under Soviet communism during World War II.

———CONCEPT CHECK———

State the issue in the following letter to the editor. Then sketch the argument for the other side of the issue—that is, the side that the letter writer is opposed to.

> Regarding "Driver Dies after Chase on 1-5," Oct. 28: The article seemed to be really confused. It stated, "The death was the fifth this year in the Sacramento area resulting from high-speed police chases." In fact it resulted, as most if not all of them do, from some low-life scumbag fleeing officers attempting to apprehend him—in this case for auto theft.
>
> What would you suggest officers do, wave good-bye as soon as someone's speed exceeds the limit? Or would you prefer that police just never arrest anyone who travels at high speeds? I'm sure suspects would like that, but I'm also sure decent, law-abiding citizens wouldn't.

———

Covering Up the Reasons That Favor Your Opponent

The reasoner who is trying to be fair and seek the truth not only stays on the issue but also avoids misrepresenting the views of the opposition. In addition, the logical reasoner doesn't hide the opponent's reasons under the carpet. The reasoner who does so is guilty of a **cover-up**. Take this passage, for instance:

> When you are considering which kind of apartment to live in, you should prefer wooden buildings to brick buildings. Brick buildings are more dangerous during earthquakes because wood will bend during the quake, but brick will crack and crash down on you. Also, and even more important, brick has been discovered to be radioactive. If you put a sensitive Geiger Counter up to a brick, any brick, it will click; and it won't with wood. We already have enough sources of radiation in our lives without living surrounded by hundreds of brick sources. So, next time you are apartment hunting, remember to look for wood.

Did you spot the cover-up? It sounds well-reasoned, but it is covering up the bad aspects of wood while scaring you away from bricks. Although it is true that earthquakes are more of a danger for brick apartments than for wood apartments, earthquakes are rare, while fire is a much greater danger everywhere, and bricks don't burn. Second, although it is true that bricks are radioactive, the radioactivity is so trivial that it is not worth bothering about. The danger of wood fires is far more serious. The moral is:

> Critical thinkers give opponents a fair hearing, and do not misrepresent what they say or do.

Very often we all selectively use information in order to help or hurt another person. The Reverend Jesse Jackson tells this story. One cold February afternoon, the newly inaugurated Republican President of the U.S. was on the Presidential Yacht off the coast of Maine. He had some engine trouble, but nobody on board could fix it. Being in a hurry, he got out of the boat and walked across the water to get help on shore. The newspaper reporters on shore who saw him were astonished. Off they raced to compose and call in stories to their editors. All the reporters phoned in essentially the same story, but the next day's headlines in the Republican newspapers said, "President Walks On Water." The headlines in the Democratic newspapers said, "President Cannot Swim." We all tend to process new evidence through the lens of what we already believe.

Review of Major Points

This chapter examined a variety of ways that writers and speakers communicate less well than we and they expect. Sometimes a writer will unwittingly make statements with low information content, will mask the true meaning with euphemism, doubletalk, or innuendo, will use sloppy sentence construction, or will violate the rules of discourse. The chapter also introduced the principle of charity, which readers use to help interpret materials by writers who do not say what they mean nor mean what they say.

People who make statements have the burden of proving their statements. Their goals should be to stick to the issue, to pursue the truth about the issue, and not to sidetrack, confuse, or con the opponent. Progress can sometimes be made when issues are identified, or are identified more clearly. It is important to distinguish between the issue that is addressed and the side issues that are suggested. Some disagreements can be settled by drawing attention to the issue, by more precisely defining the issue, by narrowing the issue, and by noticing when one issue must be settled before another one can be fully addressed.

In this chapter we briefly distinguished fact from opinion, introduced the notions of taking a position on an issue, shifting the burden of proof, making a fallacy, and offering a counterargument.

Glossary

burden of proof The duty to prove some statement you've advocated. The burden is usually on the shoulders of the person who wants others to accept his or her statement. When two people make statements that disagree, the burden falls on the shoulders of the person making the more controversial statement.

counterargument An argument that attempts to undermine another argument.

euphemism A gentler word or phrase used to replace a harsh-sounding one.

fallacies Reasoning errors.

fallacy of avoiding the issue Failing to address the issue at hand by going off on tangents. However, the fallacy isn't committed by a reasoner who says that some other issue must first be settled before the original issue can be adequately addressed.

fallacy of avoiding the question A type of fallacy of avoiding the issue that occurs when the issue is how to answer some question. The fallacy would be committed if someone's answer were to avoid the question rather than answer it.

innuendo A negative suggestion made by disguised references or veiled comments about a person.

issue The specific topic, subject, or central question under discussion, as opposed to the general topic, subject or question.

knowledge Truths you are justified in believing.

principle of charity Giving the benefit of the doubt to writers and speakers who have said something silly or obviously false, and not taking them too literally.

position on an issue Your belief about how an issue should be settled.

proof An argument that ought to be convincing. It doesn't need to be the sort of thing you would find in a math book. You prove a statement to other persons if you give them reasons that ought to convince them, even if those reasons don't actually convince them.

red herring fallacy The error of intentionally distracting someone with a side issue or irrelevant issue.

shifting the burden of proof By making a reasonable case for your position on an issue, you thereby shift the responsibility of proof to the shoulders of your opponent who disagrees with your position.

Exercises

■ 1. What is wrong with the following headline, which appeared in an American daily newspaper?[147]

Religion Plays Major Part in the Message of Easter

2. Write a realistic 10-second TV commercial for Goldstar perfume in which you say too little with too many words.

3. Match the harsh words in the first column with their euphemisms in the following column:

retreat

mad

drop

murder

son of a bitch

bite the dust

_____

adjust downward

neutralize

strategic movement to the rear

pass away

s.o.b.

mentally deranged

---

147 The headline makes a trivially true claim. It conveys essentially no new information to the reader. However, you can imagine the creator of the headline probably intended to make the point that, unlike Christmas with its commercialism, Easter is a less commercialized and more religiously oriented holiday.

4. Find a more euphemistic equivalent of these terms: disaster, spying, fired (from a job), old person, (tell a) lie

■ 5. Give a euphemism for *urination*, and use it in a sentence.[148]

6. The best euphemism for his "death" is his

being butchered

living

Passing away

inspiration to us all

treachery

■ 7. A boy named Stephen gets the nickname "Steve" and a girl named Sarah gets the nickname "Sue," but a girl named Helen has a connotation problem. Explain.[149]

8. Which one of these synonyms has the greatest negative connotation?

inform

squeal

apprise

notify

9. Rewrite these excuses more clearly[150]

a. Stanley had to miss some school. He had an attack of whooping cranes in his chest.

b. Please excuse Jane on Monday, Tuesday, and Wednesday. She had an absent tooth.

c. Please excuse Jim Friday. He had loose vowels.

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148 "Passing water is a natural bodily act." Other euphemisms are "relieving" oneself, "using the facilities," "going to the little girl's room," and so on. Pissing is a synonym but not a euphemism.

149 The connotation Hell is too negative.

150 From *CT Flea Market*, Spring 1988, vol. 2, no. 1, Mayfield Publishing Co., Belmont, California, p. 2.

d. The basement of our house got flooded where the children slept so they had to be evaporated.

e. Please excuse Connie from gym class today, as she has difficulty breeding.

f. Anne did not do her homework because I couldn't understand it.

10. Imagine that Sarah Waltham is a receptionist in the laser printer division of your corporation, and you are her direct supervisor. Write two letters of recommendation for her, one very positive and the other much less so, although it is still a recommendation, not an attack. Both your letters should contain the same facts: (a) she gets to work on time, (b) she is courteous and helpful both on the phone and with employees and clients who contact her, and (c) she is as good a receptionist as the last three you've employed. Don't add other significant facts.

■ 11. Create a euphemism for the term "lobbyist."[151]

12. For each of the following sentences, guess what the author meant to say, then rewrite it more clearly.[152]

a. I had been driving for forty-five years when I fell asleep at the wheel and had an accident.

b. The guy was all over the road. I had to swerve a number of times before I hit him.

c. The telephone pole was approaching. I was attempting to swerve out of its way, when it struck my front end.

d. An invisible car came out of nowhere, struck my vehicle, and vanished.

13. Select some controversial topic about which you have an opinion (i.e., a belief).

14. Write a one- or two-page argument giving reasons to support your opinion. The reasons should not merely be a history of your thinking in arriving at your opinion but instead should be reasons that are likely to convince other people to adopt it. That is, deemphasize the *genesis* of your opinion and emphasize the *justification* of your opinion.

■ 15. What did Mrs. Malaprop probably mean in Sheridan's play *The Rivals* when she said, "He is the very pineapple of politeness"?[153]

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151 Legislative advocate.

152 These examples were collected by James Hollinseed at California State University, Sacramento.

16. Suppose you are only trying to make a case for your position. You don't want to create some knock-down, drag-out, absolute proof; you just want to persuade the person you are talking to. Do you have the burden of *proof* in such a situation?[154]

17. What is the main issue in the following argument?

> Several lines of biological evidence have now fixed the time at which humans and chimpanzees descended from a common, primitive African apelike species. It must have been less than 20 million but more than 5 million years ago. This is because Homo sapiens (humans) and Pan troglodytes (chimpanzees) are so similar in details of anatomy, physiology, chromosome structure, and enzyme chemistry. Admittedly the clocks of anatomy, physiology, chromosome structure, and enzyme chemistry do disagree slightly, but they all agree that the evolutionary tree must have branched during this time.

18. Where in the following dialogue does one of the participants not accept his burden of proof? Justify your answer. The scene: Mr. Harris is walking up to a group of people that includes you, several of your neighbors, Jeremy (the twelve-year-old son of Mr. Harris), and Jeff (a fifteen-year-old son of one of the neighbors who isn't present).

> *Mr. Harris*: There you are! Jeff, did you slit the tires on my son Jeremy's bike?
>
> *Jeff*: What? What are you talking about?
>
> *Mr. Harris*: Thursday afternoon. (Pointing to the bike) Look at those slits, one in the front tire, one in the back.
>
> *Jeff*: I didn't do it.
>
> *Mr. Harris*: Maria saw you on Thursday showing somebody a red knife.
>
> *Jeff*: It was new so I showed people. I'm sorry about the tires, but I didn't cut them.
>
> *Mr. Harris*: Maria said you were arguing with Jeremy. Jeremy's spray paint cans are missing from our garage. So are some boards. I hear that boards in your garage have new spray paint all over them. Black and green. Jeremy's black and green cans are missing.

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153 He is the very pinnacle of politeness or he is the epitome of politeness. This paradigm example is why a funny misuse of words is called a malapropism.

154 Yes, you still have a burden of proof. A proof doesn't have to be 100 percent; that standard is required only in mathematics. Informally, a proof is what ought to convince anyone who can follow the steps in the argument. So, if you want to be convincing, you have the burden of proving your case.

Jeff: I was just taking back some boards that were mine. Jeremy owed me boards. He said he would pay me back, but he never did. I didn't take any more than what was due me. I didn't do the tires.

Mr. Harris: Are you denying you had a knife on Thursday afternoon?

Jeff: My grandfather gave me his Swiss army knife. I showed it to everybody. Jeremy was jealous. He wanted the knife. Those tires could have been slit with any knife.

Mr. Harris: OK, you're right that any knife could have been used, but the person who used the knife was probably mad at Jeremy, mad enough to steal his paint cans and boards, too. Where'd you get the paint for those boards you took?

Jeff: Why did you talk to Maria?

Mr. Harris: Where did you get the paint? Let's see those cans.

Jeff: Maria had no business butting in.

Mr. Harris: She didn't do anything wrong. You did.

Jeff: I was going to pay Jeremy for his paint cans. Jeremy, what do you want for the paint? Here's two dollars. The cans were practically empty. You were done with them. You said so.

19. Write a 100 to 300-word essay defending your own rational belief about how likely it is that Jeff (in the previous exercise) is guilty.

■ 20. What is wrong with this reasoning?

I believe that there can be time travel back to the time of the Egyptian pyramids and the pharaohs because nobody has ever proved that there can't be.[155]

■ 21. State the issue of the following argument:

I know you are thinking of not going to the film with Emilio, but remember that you promised him you would go with him. You now seem to be saying to me that you might go with Juanita instead and might tell Emilio you are sick and won't be going with him. Don't. One consequence of doing this is that you will be breaking your promise to Emilio. That would be morally wrong, wouldn't it? In addition, if Emilio finds out the truth, you could lose your friend. Aren't those reasons enough?[156]

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[155] Here, the speaker does not realize that, because of the oddity of the claim that there can be time travel, he or she has the burden of proof. It is not sufficient to say the claim has never been disproved; it must instead be proved.

[156] The issue is whether you should break your promise to Emilio, not that you should break your promise to Emilio.

22. Create a dialogue in which (a) one speaker shows insight when he or she says, "That's fine, but the real issue is . . . ," (b) the second speaker disagrees with the first speaker, and (c) the first speaker makes a convincing case for being correct.

23. Create a dialogue in which progress is made by narrowing the issue.

24. Find an editorial or letter to the editor in one of your local newspapers and create a short (75-100 words) argument for why the author is mistaken about something. Begin by stating the issue. Assume that your audience is the other students in your class. In your answer, include a copy of the editorial or letter.

25. Create a dialogue between two people in which progress is made in their dispute because they agree to redefine the issue.

26. What is the central issue of the following dialogue?

> *Mother*: My fifteen-year-old daughter failed two courses at school. The worst part is, she didn't even try. She just said, "Oh well, it's not important." If she had tried and failed, that wouldn't be so bad.
>
> *Friend*: Are you sure it wouldn't be so bad? Maybe it would be worse if she tried and failed.
>
> *Mother*: No, it wouldn't, because if she tried she wouldn't fail the courses.
>
> *Friend*: Oh, I think I see what you mean. Do you mean that anybody who tries will succeed at least in the sense that they did try and didn't just give up?
>
> *Mother*: No, I just mean that if my daughter tries, she will get a grade higher than an F.[157]

27. What is the issue or question that the author is concerned with in the following letter to the editor? Choose from the options listed.

> No one says that the death penalty is the only answer to brutal murder. But it is a sure way to stop repeat offenses, and it's far cheaper than keeping a killer in jail 30 or 40 years. While it may not deter a hard-core killer or a psychotic, it probably would deter

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[157] The issue is whether it would be better for the daughter to have tried and also failed rather than not to have tried at all. It would have been unclear to have answered the question as follows: "The issue is that the friend believes it wouldn't have been better for the daughter to have tried and yet failed." This is true, but it would have been an incorrect answer. It would also have been incorrect simply to make the true statement, "The mother does not really listen to what the friend is saying."

the Bernard Goetzes and the kind of youths accused of assaulting the jogger in Central Park.[158]

a. What will stop repeat cases of crime?

b. Whether brutal murders will increase or decrease, given current trends.

c. Should brutal murderers be killed by the government?

d. Whether the death penalty deters hard-core killers or psychotic killers.

■ 28. Identify the issue in the following conversation:

Saghit: Take a look at Jane Fonda and her ex-husband Tom Hayden. There's a couple of typical Democrats for you. Those two radicals are self-admitted organizers of anti-war protests against our sons who were laying down their lives during the Vietnam War. Nowadays, Democratic State Assemblyman Hayden is corrupting the California Legislature. That's the story with the whole party. The California Democratic Party has done a few good things now and then, but basically it is corrupt. It's even corrupt financially. You know the saying, "California has the best legislature that money can buy."

Jorgen: Ja. Ja. Funny joke, but get serious. Not everybody in the California Legislature is a Democrat. Just most of them.

Saghit: You are making my case. The leaders of the State Assembly and the State Senate are Democrats, and everyone knows that these two men are interested only in getting enough money for their reelection campaigns; whether their votes help or hurt the citizens is not their major concern.

Jorgen: Look. The ex-Imperial Wizard of the Ku Klux Klan was elected as a Republican to the Louisiana Legislature. Can the Republicans be proud of that? Are you going to stand there and defend the Ku Klux Klan and the rest of those bigots? So, let's not hear so much from you about Democrats in California.

What is the principal issue in the above conversation?

a. Are California Democrats corrupt?

b. Are Jane Fonda and Tom Hayden corrupting the legislature?

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158 Adapted from a letter to the editor by Edward Peizer, *The New York Times*, national edition, June 6, 1989, p. A18.

c. Are the majority of Democrats too interested in getting money?

d. Whether a member of the Klan was ever elected to the Louisiana Legislature.[159]

29. Regarding the previous question, comment on all the other possible answers that you did not pick. Do the possible answers contain some sub issues or smaller issues surrounding the main issues?

■ 30. If we analyze Saghit's argument in the earlier question about Tom Hayden and the California Legislature, we see that one of the following statements is not a reason he uses to back up his conclusion. That one statement is

a. Tom Hayden is a California Democrat who is corrupting the California Legislature.

b. Jane Fonda and Tom Hayden are typical of California Democrats.

c. At least two, and maybe a lot more, California Democrats are too interested in getting enough money for their reelection campaigns.

d. California has the best legislature that money can buy.

e. Corruption is bad for America.[160]

31. During the next week, pay attention to the occurrence of any argumentation that you find outside your school—argumentation you take part in or observe. Describe one of those arguments. More specifically, describe one person's argument by restating the reasons and the conclusion as full, declarative sentences. Label each sentence as being a reason or a conclusion. State the issue that is in dispute. Remember that when we say informally that two people are in an argument, from a logical perspective there are at least two arguments, not one. Each person in "the" argument has his or her own argument. When answering the question, give only the argument of one person for one side of one issue.

32. (i) Create a list of three beliefs you have. Each belief must be sufficiently controversial that you can imagine there being reasonable people who hold the opposite opinion and disagree with you. Hand the list in to your instructor, (ii) Create arguments in defense of your beliefs, but do not yet hand them in unless requested to do so by your instructor. From your list, your instructor later will arbitrarily pick one of your three beliefs and ask you to give a convincing argument for why other people should accept your belief, (iii) Create arguments against your beliefs. Your instructor will also pick one belief from your list and ask you to give an argument

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159 Answer (a).

160 Answer (e).

against it. Each argument should be a short essay of a page or two, typed double-spaced, if possible.

■ 33. Arnold Haypole is a member of a state legislature. His ex-lawyer, David Kunsinger, has complained that Arnold Haypole is no longer in favor of banning the death penalty in all situations. Kunsinger says Haypole used to be against the death penalty with no exceptions. Here is a newspaper report of Haypole's response to Kunsinger's charge. Explain why the stated issue by Haypole is not the real issue.

> After Kunsinger's charge that Haypole switched positions on the death penalty in order to advance his career, Haypole replied that Kunsinger "should start looking at some of his own clients before he criticizes other people. The issue is whether Kunsinger has a record of honesty. A good look at the record will reveal a forked tongue."

Labeling Kunsinger's criticism of him "very offensive," Haypole added a charge of his own as to why his former defender spoke out. "I think he's just trying to promote a book."[161]

34. Suppose someone argues that since murder is wrong, and that, since capital punishment is murder by the state, it follows that capital punishment is wrong, too. The main issue here is

a. that murder is wrong.

b. whether murder is wrong.

c. that capital punishment is murder.

d. whether capital punishment is murder.

e. is capital punishment wrong?

f. why capital punishment is wrong.

35. What is the issue in the following passage?

> The inside of this portable computer's box is not the standard fare. Mounted on the system board are a 33-Mhz 80386SX chip, a socket for an 80387SX math coprocessor, a VGA video chip set, and an AMI BIOS. As tested, the system had 2MB of 33-nanosecond

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161 Haypole says that the issue is whether Kunsinger is an honest person, but the real issue is whether Haypole changed his position on the death penalty to advance his career or instead changed it because of a good-faith reassessment of the evidence. Haypole doesn't answer Kunsinger's charges that Haypole switched positions to advance his career. Instead, he avoids the issue by launching an attack on Kunsinger himself.

DIP RAM, using 1-megabite chips. Do you find these items as standard fare on a portable?

36. For each of the following disagreements, explain why it is or isn't merely a semantic disagreement.

a. *Jose*: Scientists have proved that there is no such thing as telepathy. Apparent cases of direct mind-to-mind communication, when investigated and tested, cannot be repeated under carefully controlled conditions required for scientific experiments.

Sarah: They may have done good science, but they proved no such thing. A proof that there is no telepathy requires axioms and inferences from axioms, but no scientist has yet produced the axioms of telepathy. So they surely have not established the theorem that telepathy does not exist.

b. *Leon*: Christopher Columbus was a Jew. I read it in the *Jewish Chronicle*.

Washington: He was no Jew. If he had been a Jew, I would have heard about it. I'm a Jew.

c. *Munitions expert*: Fifty percent of the missiles in the U.S. arsenal would fail if they were fired. Maintenance is too haphazard.

Missile expert: Ninety percent of those missiles will work perfectly fine. I have looked at ten of them, and nine worked during a simulated firing.

d. *Daryl*: My candidate is no fool. She is well educated because she has lots of common sense and is well read and could carry on a coherent, interesting conversation on any of a wide variety of subjects from politics to science to sports.

Mary: Your candidate is not well educated. She doesn't even have a college degree.

■ 37. Explain why this passage commits the red herring fallacy:

Will the new tax in Senate Bill 47 unfairly hurt business? I notice that the main provision of the bill is that the tax is higher for large employers (fifty or more employees) as opposed to small employers (six to forty-nine employees). To decide on the fairness of the bill, we must first determine whether employees who work for large employers have better working conditions than employees who work for small employers. I am ready to volunteer for a new committee to study this question. How do you suppose the committee should go about collecting the data we need? [162]

[162] Bringing up the issue of working conditions and the committee is the red herring diverting us from the main issue of whether Senate Bill 47 unfairly hurts business.

CHAPTER 6 Writing to Convince Others

Writing clearly in a straightforward style is the usual goal when composing a written product, but not always. Sometimes you may want to stand your language on its head to shock or amuse your readers. Or you may want to tell an interesting story, and then you'll need effective narrative devices such as plot, character development, and setting. However, you will have a different focus when you write a business report, a newspaper editorial, or a position paper. It is especially important that your writing be clear and exact and well-structured. It doesn't mean that it should be boring. Writing logically does require paying attention to the style as well as to the structure of the written piece. This chapter offers suggestions about how to improve this kind of writing. These suggestions are rules of thumb, not rules to be obeyed to the letter.

OK, first things first, but not necessarily in that order. Here is the list of rules that all good writers follow:

1. Be more or less specific.
2. Use not bad grammars.
3. Proofread carefully to see if you any words out.
4. Don't use no double negatives.
5. Avoid tumbling off the cliff of triteness into the dark abyss of overused metaphors.
6. Take care that your verb and your subject is in agreement.
7. No sentence fragments.
8. Placing a comma between subject and predicate, is not correct.
9. Who needs rhetorical questions?

10. Use the apostrophe in it's proper place.
11. Avoid colloquial stuff, like totally.
12. Avoid those run-on sentences you know the ones they stop and then start again they should be separated with semicolons.
13. The passive voice should be used infrequently.
14. And don't start sentences with a conjunction.
15. Excessive use of exclamation points can be disastrous!!!!
16. Exaggeration is a million times worse than understatement.
17. Stamp out and eliminate redundancy because, if you reread your work, you will find on rereading that a great deal of repetition can be avoided by rereading and editing, so reread your work and improve it by editing out the repetition you noticed during the rereading.
18. Tis incumbent upon one to employ the vernacular and eschew archaisms.
19. It's not O.K. to use ampersands & abbreviations.
20. Parenthetical remarks (however relevant) are usually (but not always) an obstacle for readers (and make it harder on readers even if you're being careful) who have the task of understanding your work (article, passage, document, and so forth).

This chapter emphasizes how to create a successful argumentative essay. An argumentative essay is a work of nonfiction prose stating and defending a position on some issue. It is a certain kind of persuasive writing.

But persuasive writing is, well, not always persuasive to a critical thinker. As writers and as critical readers, we need to remind ourselves that it is unnatural for people to reach the truth by finding good reasons. What is natural is making up our mind using our gut instincts, then going out to find reasons with which we can bombard our opponents while covering up any reasons that appear to threaten our own beliefs.

Writing with Precision and to Your Audience

One suggestion for promoting effective writing is to be precise. But how do you follow a suggestion like that? When should you be precise? Where? How? Unfortunately, there is no recipe to follow. About all that can be said is that you should be precise "where appropriate,"

but you should not be pseudoprecise. Nevertheless, after seeing an example or two below of how to be precise and comparing it with examples of failing to be precise, you will get the point.

Here is a question that is answered precisely and then imprecisely: "How do you get to Bill's house from here?"

RELATIVELY PRECISE ANSWER: Go six blocks up this street to the first traffic light. Turn right, and it will be the red house with white trim—about in the middle of the next block. It's on your left. Or maybe it's on your right; I can't remember.

RELATIVELY IMPRECISE ANSWER: You can't miss it. He lives in the house next to my friend Ted. Ted lives on Braithwaite Street. Ted's is the most beautiful house on the block; Bill and Ted practice their electric guitars there in the garage every night. Keep an eye on their phone booth when you're there.

Even though it contains the imprecise terms *about* and *maybe*, the first answer is more precise.

Another suggestion is to write to your audience. How do you do so? Well, first you have to decide who your audience is. Don't write as if you might be read by any human being either now or in the future. That's too big an audience. For example, if you are writing a description of Theodore Roosevelt and your audience is all professional historians, you wouldn't bother to mention that he was president before that other Roosevelt, Franklin. However, if your audience is junior high school students, you would make a mistake if you failed to mention this fact about Franklin Roosevelt. When you write a college term paper, assume that your audience is your instructor. With that in mind, you do not need to make elementary points that you might need to make if your audience were your fellow students. You can assume that the instructor is aware of the topic you are writing about but may not have had the specific new ideas you have had. Only by writing for a specific audience can you answer the question "Should I argue [explain, describe] this point, or can I presume it and leave it unsaid?" In answering that question, ask yourself this: "If my audience were right here in front of me and I were talking to them, should I say this now in order to get my idea across?" There is no formula for tailoring your writing product to your audience. Good tailoring is affected by the subject matter, by the characteristics of the audience, and by the purpose of the writing. It's hard to be more precise than this.

Part of what makes writing precise is helpful structure. The structure provides a framework. In the example of directions to Bill's house, the structure in the precise answer is a sequence of steps the reader can follow to get there. The only helpful direction offered in the imprecise answer is to go to somewhere on Braithwaite Street.

Writing should have a specific structure, an overall plan of development, a method of organization. Although there are many acceptable structures, not everything is acceptable.

Good readers can readily distinguish an ice sculpture from a puddle. Bad writing leaves these readers with a sense that the writing is all wet and messy.

One usually effective rule of thumb is to mentally divide your own piece of writing into three parts—an introduction, a middle, and an ending. In the introduction you announce your intentions or briefly describe what you are going to say and maybe the motivation for saying it. There you usually present a sketch of your main argument to help guide the reader in what follows. In the middle you provide the details; and in the ending you summarize what you've said and perhaps speculate about its implications or what might follow next. This common structure can be thought of this way: you tell them what you're going to say; then you say it; then you tell them what you've said. This rule gets to be more important the longer the document.

The Introduction

The title or headline is often the first element of an introduction. It gives the audience some idea of what the writing is about and perhaps suggests the main point. The book title *The Chocolate Bible* immediately tells the reader that what is inside will probably have nothing to do with religion but a lot to do with eating and preparing chocolate.

If the same book had been given an overly cute but less precise title such as *Your Face or Mine?* the reader wouldn't have gotten as much information. That information would have to come later, such as in this first sentence of the book:

> Almost all of us love chocolate, but how much do you really know about this elixir of the gods?

Such a simple introductory sentence sets the stage by outlining the rough boundaries of the discussion to follow.

Usually a title alone or a single introductory sentence is not sufficient to introduce the reader to the material that will follow. For example, if we want to make clear that *The Chocolate Bible* is a book for manufacturers and marketers of chocolate, not consumers, then the following additional sentences can go a long way toward introducing the book:

> You know the subtleties of its taste, and how to manufacture and market it in your area, but what about southern Japan? Northern Japan? What manufacturing techniques and marketing strategies would you change if you wanted to reach the Egyptian market with a similar chocolate product? There is considerable room around the world to create or expand the chocolate market. Will you profit in these new markets, or will your competitor? This book will show you how to successfully produce medium-quality and high-quality cost-effective chocolate for the mass market in a variety of countries on several continents.

Thanks to this introduction we readers now know this is a book about the chocolate business, with emphasis on international marketing and manufacturing. It is not a book intended for consumers.

The introduction limits the scope of the discussion to follow. That is, it provides a context for the writing. It should also give some hint of why it's worth reading. Unless the writer has a captive audience, it is the writer's duty to capture the reader's interest and indicate why the writing should not be ignored. The chocolate book's introduction captures the reader's attention by suggesting that there is money to be made by reading on.

The type of introduction appropriate for one kind of writing might not be appropriate for another. If you are writing a newspaper article, you need to provide a summary of the whole article at the beginning so that editors can cut from the end and not have to cut out material in the middle or beginning. So your intro should contain the who, what, where, when, and how. That way, if the ending of the piece is snipped off, the article won't be hurt substantially; it will still make sense and communicate a lot of information. This same structure is appropriate for many business reports, in which the summary of the costs and the recommendations for changes in the business are made up front for the busy manager who wants to know the bottom line first and the details later.

So, one helpful rule in informative writing is to give the reader the overall picture of the article by clearly announcing your intentions. But don't write this way if you are creating a novel. Here is an introduction to informative writing in the computer business:

> This report argues that it is time to divest our interests in peripherals for large computers and concentrate instead on developing peripherals for desktop, laptop, and tablet computers.

This sentence sets up the reader's expectations for what is to follow. When facts and figures are presented later, the reader will have a context to fit them into. Imagine yourself as the reader of a similar report with the same content but without this introduction; the facts and figures are just thrown at you without any explanation of why you should know them. Such an illogical structure would destroy the effectiveness of the report.

In scholarly writing, the introduction should also mention to what other scholars have said on the issue you are writing about. Give credit where credit is due, so that the reader can more readily evaluate how your own work fits in or how it challenges other work in the field.

The Middle

The body of the text is where you provide the details and do what you said you would be doing. If you were planning to describe, this is where you place the details of the description. If you were planning to argue, this is where you provide convincing reasons for your claim and perhaps clarify just what the claim is that you are trying to establish. However, when arguing logically, you should concentrate on what ought to convince, not what will convince. Even if you know your audience's prejudices and how to exploit them to get them to do what you want, don't follow this path if you want to be a logical reasoner rather than a propagandist or con artist.

The most common error in creating an argumentative essay is to leave out, or not to adequately develop, the assessment of objections. You'll look narrow-minded to the knowledgeable reader if you plunge ahead with your reasons and show no appreciation for what reasons your opponent might offer.

When you write your essay and argue for some conclusion, be sure you use assumptions that your audience will agree with, or else you ought to do one of two things: (1) defend those assumptions, or (2) mention that they won't be defended even though you realize that in a fuller work they should be.

Suppose your goal is to create an essay that establishes a specific point. How should you structure the essay? The first thing to keep in mind is that you need a fairly clear idea of the content before you can bother with the structure. Once you have that clear idea, then focus on structure. One helpful rule of thumb is that the middle can be structured so the reader is moved by understandable steps from the more obvious to the less obvious. You can establish your essay's important reasons by carefully taking the reader from points of ready agreement to

points that are more controversial. At the same time, the flow of argument should usually be from the simple points to the complex points. Without this structure, many of your readers will fall by the side of your road. Your structure is your road, and if readers cannot see where they are going, they will become confused and lose interest in what you have to say. In long or complex pieces it doesn't hurt to occasionally remind readers of what the road is, how far you've gone, and what lies ahead.

Although it is important for your writing to have a clear structure, remember to do first things first: Write first, organize later. Brainstorm first; get your ideas onto paper or into your computer. Later you can go back and tie them together effectively by adding the proper organization.

The Ending

By beginning a paragraph with a phrase such as "To summarize," you signal that all the main points you intended to make have now been made. At this point in your writing you should review and summarize those main ideas, especially if the piece is longer than two pages. Now the reader is ready to stop looking at the trees and refocus on the forest—that is, on whether you've succeeded with the grand program you promised in your introduction. But there is no formula for good writing. An argumentative essay isn't always imperfect if it lacks a summary.

Actually the phrase "to summarize" is trite; so you might try to think of an alternative phrase for the transition to the ending.

Digressions

Regarding digression, suppose you are writing a business letter to a supplier explaining how the five generators their company sent you were not the quality you had agreed to purchase. In the middle of this letter, you shouldn't take a weird turn to tell a story about how you were fascinated with generators when you were fourteen years old and how you took one apart and got your first electrical shock. That would be an unreasonable digression because it would be irrelevant. It doesn't speak to the issue even if your digression is interesting.

Digressions take you down some side road and away from the main road. Normally, a digression is a fault in any writing. The reader's mental response to a digression that doesn't give strong hints of its relevance is usually something like "Enough already; now let's get back on track and make some progress."

———CONCEPT CHECK———

If you were going to remove the digression in the following business letter, what would you take out?

> **Dear Mr. Harris:**
>
> **You recently wrote our company regarding a problem with the transistors we supplied to you for your FC-7D circuit boards. I am sure we can solve your problem.**
>
> **Our quality control engineers do try to fill orders correctly. Not only do we use the familiar testing via the Z-bar procedure, but we also have added the Z-bar supplement procedure which is recommended by the American Association of Quality Control Engineers. Our quality control engineers are not new employees, and they have a great deal of experience in filling order such as yours. If you would like to learn more about our quality control procedures, please contact our Quality Control Engineer Office and ask for Jeremy Bohm at (919) 278-7384.**
>
> **We were quite surprised to learn that your own checking of our FC-7D boards indicates there is a ten percent failure rate. We will be happy to refill your order at no expense to you. Today we have begun the procedure of sending you another 77,000 meeting the specifications as indicated in your purchase order #33-Dcl. Meanwhile, it would be helpful for us if you would return the remaining boards that we sent to you. We will pay shipping costs. Please feel free to call me at (919) 278-6424 if you have any further questions.**
>
> **Very truly yours,**
>
> **Dwayne W. Edwards**

Assistant Manager

———163

Let's summarize this section's points about structure. A piece of writing without structure is chaotic. Every piece of writing needs some sort of method of organization, even though different kinds of writing can use different methods. Write the piece first—get your meaning out onto the paper. Then go back and organize. When doing so, mentally consider how you are going to introduce the topic. What way will you organize the main body? How do you intend to end your piece? Can the reader always see the road you are on? Will making a particular point just cause a detour from the main road?

Improving Your Writing Style

The manner of presentation of a piece of writing is its style. You'll need an effective style. How do you get it? Here are some suggestions.

Be brief. One mark of good writing style is brevity but with sufficient detail. There are exceptions, however. Brevity is not a virtue when writing letters appealing for contributions to your organization. Fund raisers have learned that a simple, clear, and concise request does not bring in the money. What works is a long letter that provides more information about the organization and that goes into great detail about how the money will be spent. The letter makes the recipient feel like he or she is part of the inner workings of the organization. Another exception to the rule of brevity is that a complicated point sometimes requires repeating. Just don't repeat it with the same words, and don't do it more than once.

Be straightforward. Another mark of good style is "saying it straight," as Emily Dickinson would say. You should say that Mary had a little lamb whose fleece was white as snow. Only a lawyer could get away with "Mary was the legal owner of a diminutive, potential sheep, whose fleece was as innocent of coloring as congealed atmospheric vapor." Avoid jargon or technical-ese. Also, remember that it is easier to follow a group of sentences, each expressing one idea, than a single sentence that strings several ideas together. Break up those long, rambling strings.

Let's elaborate on these two suggestions. William Faulkner could have made his point briefly and simply by saying:

> Five miles farther down the river from Major de Spain's camp there is an Indian mound, which we children fear. A small Chickasaw Indian reservation is nearby.

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163 Jettison the second paragraph of the letter.

But saying it that way is less interesting and less memorable than the way Faulkner wrote it:

> Five miles farther down the river from Major de Spain's camp, and in an even wilder part of the river's jungle of cane and gum and pin oak, there is an Indian mound. Aboriginal, it rises profoundly and darkly enigmatic, the only elevation of any kind in the wild, flat jungle of river bottom. Even to some of us—children though we were, yet we were descended of literate, town-bred people—it possessed inferences of secret and violent blood, of savage and sudden destruction, as though the yells and hatchets which we associated with Indians through the hidden and secret dime novels which we passed among ourselves were but trivial and momentary manifestations of what dark power still dwelled or lurked there, sinister, a little sardonic, like a dark and nameless beast lightly and lazily slumbering with bloody jaws—this, perhaps, due to the fact that a remnant of a once powerful clan of the Chickasaw tribe still lived beside it under Government protection.[164]

Yes, you usually want to rid your writing of excess vegetation, but a tree can be pruned so much that it dies. There are five-page plot summaries of Faulkner novels, but the only people who buy them are students in English courses who hope the test will not cover anything subtle. The people who read for their own pleasure and interest prefer less brevity and more complexity.

The suggestion above that you adopt a style that is straightforward means, among other things, avoiding the abstract when you can just as well be specific and concrete. For example, a student who misunderstands Heidegger may say too abstractly, "IBM faces Microsoft, not with the nothingness of Being, but with the nothingness of dread." You should say, more concretely, "IBM executives fear their stock will be less valuable if they merge with the Microsoft Corporation."

Give examples; get to the point. That advice is good, but it is a little superficial. If the audience will immediately catch on to your general claim, skip the examples. Some of your textbooks have no doubt moved too quickly through the subject matter and have not given enough examples, while other textbooks have plodded along wasting your time by giving example after example of a simple idea that you caught on to right away.

———CONCEPT CHECK———

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164 From William Faulkner, "A Bear Hunt," *Collected Stories of William Faulkner*, (New York: Vintage Books, 1977), p. 65.

Which response below is the most straightforward answer to the request "Give a specific description of the Indian mound in Faulkner's short story above"?

> a. The mound rises significantly above the plain of the surrounding river bottom.
>
> b. Even to some of us—children though we were, yet we were descended of literate, town-bred people—the mound possessed inferences of secret and violent blood, of savage and sudden destruction, as though the yells and hatchets which we associated with Indians through the hidden and secret dime novels which we passed among ourselves were but trivial and momentary manifestations of what dark power still dwelled or lurked there, sinister, a little sardonic, like a dark and nameless beast lightly and lazily slumbering with bloody jaws—this, perhaps, due to the fact that a remnant of a once powerful clan of the Chickasaw tribe still lived beside it under Government protection.
>
> c. The mound is an earthen cone with a base of about 100 feet and an altitude of 30 feet. The mound sits on a plain that contains a river bottom.

———[165]

Here is a final suggestion that is perhaps the most important of all in producing logical writing: Reread what you've written. After you have written what you set out to write, let it cool. Forget about it for a while; the longer the better. Then go back and reread it with an open mind, as if you were a member of your intended audience seeing it for the first time. Or ask a helpful friend to read it and give you a reaction. You are likely to gain valuable information about what you may need to clarify.

The rest of this chapter explores the process of creating arguments.

Proving Your Conclusion

When the reasons do establish the conclusion, the argument is called a **proof**. Because the line between when the reasons establish the conclusion and when they don't can be a fuzzy one, the term *proof* is vague, except in the case of mathematical proofs. Mathematical proofs are not a matter of degree; they are either correct or incorrect, but the kind of proofs we have in ordinary life and in science are a matter of degree; they make their case more or less strongly.

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[165] Answer (a). Answer (b) is not correct because it is not a description of the mound but instead is a description of the children's reaction to the mound. Answer (c) is not correct because there is no basis for claiming that the mound had those specific measurements. Answer (c) would be a better answer than (a), however, if (c) were true.

Some things are harder to prove than others, as we all know. You may have heard someone say, "It's impossible to prove a negative." This statement is an exaggeration, but it contains a valuable kernel of truth. It is an exaggeration, because it is easy to prove this negative: my car keys are not in my pocket. But it is very difficult to prove the following negative: There is no telepathy.

Unlike a search of my pocket, the place to be searched for telepathy is not well defined because a psychic could say that just because you haven't found any telepathy so far doesn't mean you won't find telepathy in other situations you haven't yet investigated. Also, there is so much uncertainty about what counts as being an actual case of telepathy; for example, a psychic says that some event is a sign of telepathy, but a skeptic disagrees and says the psychic is jumping to conclusions.

Even though it is difficult to prove that there is no telepathy, it has been proved. First, given what else we know about nature, especially what else we know about brain physiology, telepathy is highly improbable, so not only is the burden of proof on anyone who says telepathy does exist, but the burden is a heavy one in the sense that it will have to be an extraordinarily good proof. Systematic searches for telepathy by qualified scientists have turned up no solid evidence. These two reasons prove there is no telepathy. They do not make it 100% certain there is no telepathy, but still it is enough to feel confident.

The above reasoning applies a special method of reasoning: hold off believing that something exists until you get the evidence in favor of it. Science is both a body of knowledge and a way of getting knowledge. Science involves a skeptical attitude that says, "I won't believe you until you show me the solid evidence."

When is evidence solid evidence? For most of us, the most solid form of evidence we have are the reports of experts we trust plus our knowledge that the experts agree with each other. But among the experts themselves, it often does take an expert to decide what counts as solid evidence. Usually, though, solid evidence must be reproducible. For example, if one researcher says, "I tested the subject and found her to be a psychic," other researchers will need to be satisfied that she can actually perform as well when the testing is repeated by themselves or by some other researcher they trust. The truth will be able to stand up to repeated tests, but falsehood will eventually be exposed.

People sometimes ask, "Why can't scientists give poorly supported suggestions the benefit of the doubt and simply accept them? Why the obsessional preoccupation with matters of validation?" The answer is that this liberal attitude leads to a contradiction. Suppose you have poor support for some suggestion S, and you also have poor support for its negation, Not-S. The liberal attitude above would have us accept both S and Not-S, which is absurd. Besides, the track record of accepting unsupported hypotheses is quite poor; they turn out to be unhelpful

for creating good explanations and making accurate predictions, which are the two main goals of science.

When you argue that some conclusion should be drawn from the evidence you present, be careful not to defend a stronger conclusion than what the evidence justifies. Here is an example that illustrates the point. Two Italian-speaking men suffered strokes that damaged their brains, but not in the usual ways. According to a report in the well-respected British science journal *Nature*, examination of the first man two weeks after his stroke revealed that he omitted all vowels when writing about himself, his town, or common objects. He would leave blank spaces for the vowels. For example, he spelled the name of his town, Bologna, as "B lgn ." He was aware of the fact that he had misspelled the words, but he could not correct his errors. The second man also had a vowel-specific disturbance. He could write vowels, but he misspelled many words, and most of the misspellings involved errors with vowels and not consonants. Both men had no such difficulties before their strokes. The experimental psychologist who reported these two astonishing cases said that they may indicate the brain contains two different mechanisms, one for identifying and generating vowels and one for identifying and generating consonants. But notice that the evidence of these two cases is not a proof of this; it does no more than "indicate" this, as the researcher was careful to note. If, instead, the researcher had said that the evidence of these two cases "proves" there is a cerebral vowel organizer, then the researcher would have drawn too strong a conclusion and likely would have been told by the journal editor to tone down the conclusion before the article would be published.

———CONCEPT CHECK———

What is the error in the following sentence?

> In good scientific reasoning, the scientific reasoner should be cautious and never claim that something is known or proved unless it can be shown that from the evidence acquired that it would be absolutely impossible for the claim to be false.

———166

166 This statement is making it too difficult for scientific reasoning to establish its claims. A proof of a claim is simply a strong, convincing argument; it need not be an argument so strong that "it would be absolutely impossible for the claim to be false."

Creating Counterarguments

When we argue, we must be alert to our own errors. We need to become competent critics-in-advance of our own argument, spot any errors, and patch up the argument before expressing it. In creating our own argument, we need to make sure that it can stand on its own two feet.

Sometimes we argue to make a simple point. At other times we argue for the purpose of finding fault in another person's argument. At still other times, we argue for the opposite point that someone else has argued for. In this latter case we are involved in **counterargument**. All those things happen in the following dialogue about what caused armored knights to disappear from the scene of battle:

> *Diana*: You may know that in Medieval Europe the knights wore armor all over their body, but do you know why European armies stopped using these armored knights? It was because of the Battle of Agincourt in France.
>
> *Antonio*: How do you know?
>
> *Diana*: Well, the battle was in 1415 during the Hundred Years War. It was a really big battle between the French and English. The French were defeated by the English, who were led by King Henry V. Both sides' knights wore thick metal all over their bodies; they even put it on their horses. The horses had to be powerful enough to hold up the heavy knights. The French lost about 7,000 soldiers, but the English lost only a few hundred because the English used their new weapons—the big, powerful Welsh longbows; the French knights were slaughtered. After that the European armies began phasing out armored knights.
>
> *Antonio*: That is very interesting. I suppose you are probably right about what caused armored knights to go out of fashion in warfare, but when I asked you for an argument, I thought you were going to convince me that this battle caused armies to stop using armored knights. You've said nothing to convince me if I weren't already convinced. That is, you've presented a possible, even plausible explanation, but you have not argued for why your explanation is the correct one. Where is the historical evidence that the battle caused a change? You've mostly just described the battle and explained what happened rather than argued that the battle was decisive. Your argument is a non sequitur.
>
> *Diana*: Oh, I see what you mean. OK. Well, the evidence is here in my world history book. It says right here on this page that the English army's use of the Welsh longbow was what really defeated the armored French knights, and after other armies learned what happened, they stopped using the armored knights in battles.
>
> *Antonio*: Okay, I'm convinced.

> *Ed*: Hey, I'm not. I read a book about warfare. They had knights in Spain at the time of Christopher Columbus. I remember the book saying that armies stopped using armored knights in 1600 when some Italian general—I think it was Galileo—convinced everyone that guns could penetrate the knights' armor. That made the heavy armor a disadvantage, not an advantage. Armored knights went out when guns replaced bows and arrows. Tougher armor could stop bullets, but the knights weren't strong enough to carry the weight of that kind of armor. So, bullets stopped the armored knights; the Battle of Agincourt didn't.
>
> *Laura*: No, I disagree with all three of you. What caused the European armies to stop using armor was the fact that all the iron ore mines were in the Near East and were seized by the Muslims. They refused to sell the iron to the Christians, and without the iron, the knights couldn't have armor.

Let's analyze this dialogue. These four people are arguing about the correct explanation of the disappearance of armored knights. Diana starts off by claiming, and then weakly arguing, that the Battle of Agincourt caused their disappearance. Antonio attacks her argument, saying that it didn't make the case. Notice that Antonio does not offer a counterargument. In fact, he does not disagree with Diana about her conclusion; he merely doesn't like how she tried to prove it. Then Diana revises her argument to make her case to Antonio's satisfaction. Ed, on the other hand, does create a counterargument. He attempts to prove that the Battle of Agincourt did not cause the cessation of armored knights. He offers an elaborate explanation, but the argument part is simply his appeal to "a book about warfare." He gives a long explanation, but a short argument. Laura, on the other hand, gives an explanation, but no argument in defense of her explanation.

———CONCEPT CHECK———

A counterargument to argument S is always an argument for why the conclusion of S is not true.

a. true b. false

———[167]

When it comes to issues that cannot be settled by scientific investigation, the proofs or arguments take on a different character from the sort we've been examining. The reasons for you to favor a social policy, for example, will more often appeal to the values you hold than to the facts about the world. Values cannot be detected with voltmeters, nor measured with meter

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[167] Answer (a).

sticks. The rest of this chapter will consider arguments that appeal to the values held by the participants in the argument.

Sometimes when we respond to an argument that attacks our own position we try to expose weaknesses; for example, we might point out that the reasons given are not true, or that the reasons don't make the case even if they are true, and so forth. At other times we don't directly attack the argument but rather create a new argument for the opposite conclusion. This indirect response is called "creating a counterargument." By successfully using the techniques of argument criticism or of creating a counterargument, our position lives on to bury our enemy, the undertaker. In courts of law, these techniques are called **rebuttal**. The point of rebuttal is to turn our vaguely felt objections into convincing arguments.

What follows in the next few pages is an example of the give-and-take in argumentation. The exchange contains arguments, counterarguments, criticisms of arguments, criticisms of criticisms, and revisions of criticisms. The issue is whether utilitarianism is the proper way to decide right from wrong. Utilitarianism is the ethical viewpoint based on the following claim:

> UTILITARIAN CLAIM: Among the possible actions a person can take in a situation, the right action is that which produces the most overall happiness for everyone.

John Stuart Mill, a nineteenth-century English philosopher, argued for utilitarianism. He wanted an antidote to the practice of English judges and legislators making social and ethical decisions on the basis of how the decision "felt" to them. Mill wanted the decision method to be more scientific. He hoped that in principle the decision could be the result of a process of calculation of the positive and negative consequences for each possible choice. The alternative that produced the maximum number would be the one to choose. His utilitarianism is a kind of cost-benefit analysis that focuses not on the benefits to a company or special group but to society as a whole, to all people.

> ARGUMENT FOR UTILITARIANISM: We all have or should have feelings of generalized benevolence, of caring in general for our fellow human beings. Utilitarianism expresses these feelings. In addition, most all of the actions that utilitarianism says are immoral are in fact believed to be immoral by most people; and most of the actions that utilitarianism says are moral are generally believed to be moral, so utilitarianism coincides with most of what we already believe. In fact, utilitarianism agrees so well that it provides the most coherence to our chaotic ethical beliefs. Because we want this coherence, we should adopt utilitarianism and accept the consequences of adopting it—namely, that if utilitarian reasoning declares some action to be immoral, then even though we intuitively believe the action to be moral, we must revise our intuitions to be in agreement with what utilitarianism says.

The American philosopher William James did not accept this line of reasoning. He argued against utilitarianism. James's objection arose from his belief that it would be immoral to demand that a single individual suffer even if that suffering were to promote the overall happiness of everyone else. He based his reason on the immediate moral feeling of revulsion we'd have if we thought about the special situation he had in mind. He said:

> COUNTERARGUMENT: Utilitarianism implies that trading off someone's pain to achieve the greater good of everyone else is acceptable. Yet it is really unacceptable, because of our moral feelings of revulsion at running roughshod over the dignity of that one individual.

Here is a simpler version of James's counterargument. Imagine yourself on a wagon train of settlers moving westward in the U.S. in 1850. You are attacked by a gang of outlaws. Circling your wagons, you prepare to defend yourself against an overwhelming force. You count your few guns and bullets and realize you are in a desperate situation. Just then the outlaw leader makes an offer. He promises to let the wagon train pass through to Oregon provided you will hand over the daughter of your wagon master. Otherwise, he says, his gang will attack and kill you all. You happen to know that this gang of outlaws has a tradition of keeping its promises. So if they get the daughter, the rest of you will likely make it through unharmed. You also know that the daughter will likely face unspeakable horrors. What do you do? The utilitarian will say to give her up. She has just one life, but the rest of the wagon train has many more lives to be saved; it's a matter of cost-benefit analysis. In this imaginary scenario, William James would argue that trading the girl for the greater good of the wagon train would be morally abhorrent. It wouldn't be right to do this to her, regardless of the consequences to the wagon train. Therefore, utilitarianism leads to immorality, and it cannot be the proper basis of moral reasoning. End of counterargument.

When faced with an argument against one's own position, a person often strikes back, getting defensive. The utilitarian John Stuart Mill might have responded with, "Well, it's easy for *you* to criticize; you don't have to face the consequences of these important decisions on a day-to-day basis." This remark is the kind of thing we say when we want to discount the force of someone else's argument. Empress Catherine the Great used the same tactic against eighteenth-century Enlightenment philosophers who were criticizing her social policies toward the Russian peasants; she said, "It's easy for you to talk. You write on paper, but I write on human flesh."

In the following passage, the defender doesn't get defensive; instead the utilitarian offers a more substantial criticism that tries to undermine the main points made in James's counterargument. This new argument is based on two reasons: (1) there is no need for us to pay much attention to James's feelings of revulsion, and (2) we do make trade-offs of people's lives all the time without calling it immoral.

> CRITICISM OF THE COUNTERARGUMENT: Moral feelings are very strong, but this does not prevent them from appearing as irrational taboos to those who do not share our conventions. This should warn us against the tendency to make ethical philosophy an apology or justification of the conventional customs that happen to be established. Suppose that someone were to offer our country a wonderfully convenient mechanism, but demand in return the privilege of killing thousands of our people every year. How many of those who would indignantly refuse such a request will condemn the use of the automobile now that it is already with us?[168]

The point of the criticism is to say that if you accept the trade-off for the automobile, then you should accept the trade-off of a lonely soul's pain for the greater good of everyone else. If so, then utilitarianism has not been shown to lead to absurdity, as James mistakenly supposed. Therefore, the counterargument fails, and the argument for utilitarianism stands.

Let's review the flow of the discussion so far. The issue is the truth or falsity of utilitarianism. James's position is that utilitarianism is incorrect. His counterargument depends on his evaluation of the example of the lost soul on the far-off edge of things. The criticism of James's counterargument goes like this. James's situation with the lost soul is analogous to the situation of people being killed by the automobile, and just as it would have been OK to proceed with automobile construction, so it would be okay to send that lost soul to the far-off edge of things. So, utilitarianism is correct.

At this point, James could counterattack by criticizing the analogy between torturing individuals and killing them in car accidents. He might say this:

> CRITICISM OF THE CRITICISM OF THE COUNTERARGUMENT: The analogy between the torture and the automobile situation isn't any good. The two situations differ in a crucial respect. My situation with the far-off lost soul requires intentional harm. The lost soul did not voluntarily give up his right not to be tortured; if he did, that would have been praiseworthy on his part, but he didn't. Instead he was seized against his will. But automobiles were introduced into our society voluntarily with no intention to harm anybody. The car manufacturers didn't build cars with the goal of "killing thousands of our people every year." They set out to make money and provide society with efficient transportation. In my situation, one person is singled out for harm. In the automobile situation, each person runs an approximately equal risk of accidental harm. The lost soul is not free to refuse, and his pain is foreseen. But any particular automobile

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[168] These first sentences of the paragraph are from comments by the American philosopher Morris R. Cohen, but they are taken out of context because they were not originally given as a criticism of William James' views.

> driver is free not to drive, and his pain is unpredictable. So the analogy breaks down. My point stands.

The person who originally criticized the counterargument now makes a change in light of the criticism of his criticism.

> REVISION OF THE CRITICISM OF THE COUNTERARGUMENT: Maybe the analogy with automobiles does break down, but the motivation behind it is still correct and can show what is wrong with James's counterargument against utilitarianism. We often consider it moral to trade off some people's pain against the greater good of everyone else even when the pain is intentionally inflicted and even when those who receive it are not free to refuse it. U.S. Immigration and Naturalization requires people coming into this country to suffer the pain of certain vaccinations for the good of the rest of us who don't want to catch foreign diseases. There is no universal sense of revulsion about such situations. Most people think it is the right thing to do, being the lesser of two evils. It is understandable why individuals look out for themselves and don't choose to do what is in the interest of all society, but that doesn't make what they do morally right, does it? So, utilitarianism is the proper viewpoint on ethics after all.

Well, we won't crown a victor in this dispute about utilitarianism. There are many more moves and countermoves that might occur before the issue is settled. The issue is still an open one in the field of philosophy. However, the discussion does demonstrate the give-and-take that occurs in a serious dispute.

———CONCEPT CHECK———

Briefly state a counterargument to the following argument:

> Communism is better than capitalism because communism is designed to promote cooperation among equals whereas capitalism is designed to promote competition, greed, and the domination of one person by another.

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Let's now try to handle all at once many of the points made about argumentation.

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169 An answer to this question might distinguish goals from actual practice and point out the specific results of twentieth-century communist economies and capitalist economies.

———CONCEPT CHECK———

Consider the following debate, which contains a series of arguments, criticisms of arguments, counterarguments, revisions, clarifications, arguments in defense of previous assumptions, and so forth. The main issue is whether robots could someday think, (a) Where does the first clarification occur? (b) Where does the first criticism occur? (c) Where is the first counterargument? (d) Which side should win this debate? (e) What is the most convincing point made for the winning side?

A.

First Person: A robot could never think. You can tell that right away, just by thinking about what the words mean.

Second Person: Are you suggesting that a robot cannot think because thinking and robot are conflicting terms the way *round* and *triangular* are?

B.

First Person: No, I mean even if some future robot appeared to think, the real thinking would belong to its programmer. A robot couldn't think on its own.

Second Person: When the robot walks, you don't say it's really the programmer who is doing the walking, do you?

C.

First Person: No, of course not.

Second Person: Robots can think because they do all sorts of things that we used to say required thinking. They play chess, for example, though not the way we do.

D.

First Person: They play chess, but they don't think when they play it. Robots cannot think on their own because robots can only do what they are programmed to do.

Second Person: OK, program it to think.

E.

First Person: But you can't do that.

Second Person: Why not? I hope you don't answer by saying, "because robots can only do what they are programmed to do." That would be circular reasoning.

F.

First Person: Thinking requires flexibility in the sense that one can change one's thoughts. But since robots can't change the thoughts that are programmed into them, they cannot really think either.

Second Person: A robot could change its thought without changing its programming, just as a chess-playing computer changes its moves without changing its programming.

G.

First Person: My point about change is that a thinking being must be capable of original thought, but a robot can do only what it is programmed to do.

Second Person: Couldn't a chess-playing computer come up with a chess move that had never been played before and that would surprise even its programmer? That move would be as original for it as our thoughts are for us. Besides, isn't an original human thought just a surprising thought that is actually only the product of the person's genetic code plus his or her life's conditioning?

H.

First Person: No, an original thought is uncaused.

Second Person: If it's uncaused, then it is just random. Surely, good thinking isn't just random mumbling, is it? If you tell me it is uncaused physically but instead caused by our intent, I don't understand that.

I.

First Person: I wouldn't be so quick to write off intentions, but look, a thinking being must be able to handle itself in new situations. There are too many new situations for them to be explicitly handled in advance by the programmer; the task is just too large. So a robot couldn't ever really think.

Second Person: There are an endless number of new addition and multiplication problems, yet a small machine can handle them, can't it?

J.

First Person: Because of individual growth as well as the growth of our species itself, we're all the end products of our entire history, but human history cannot be written down and programmed into a computer. We all know a lot that we can't say, or can't write down in notation. We know it implicitly in our flesh and blood, so to speak. A computer knows only what can be written down.

Second Person: I disagree. Ok, so you know something you can't write down. You know how to ride a bicycle but can't write down the details. It doesn't follow that the details can't be written down just because you can't write them down. Someone else can write them down and use them to permit a robot to ride a bicycle, too. Besides, why are you making such a big point about being made of flesh and blood? You can add, and you are made of hydrocarbon; a calculator can add, and it's made of copper and silicon. The stuff can't be that important.9

K.

First Person: We carbon-based beings really know what we are doing when we add; the calculator doesn't.

Second Person: I agree, but you're overestimating "stuff?' If living organisms are composed of molecules that are intrinsically inanimate and unintelligent, why is it that living, conscious matter differs so radically from unconscious nonliving matter? They both are made of molecules. The answer must be the ways those molecules are put together, because the essence of life and thinking is not substance but instead complex patterns of information. Life and thinking are properties of the way stuff is organized. If you organized the stuff correctly, then life and thought might exist in most any substance, whether it be flesh or silicon chips.

L.

First Person: It isn't really a question of “stuff" nor of programming. It is more a question of essence. We are essentially of a different nature. Thinking beings have souls, but robot computers do not.

Second Person: If a machine were built with sufficient ingenuity, couldn't God give it a soul?

M.

First Person: Yes, God could, but God wouldn't.

Second Person: How do you know what God would do?

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170 (a) B (by first person), (b) B (by the second person), (c) C (by the second person), (d) It is not at all clear who has won this debate, (e) nor even who has made the best point. The points made in this debate have appeared in the literature of philosophy and computer science from some of the greatest minds of the second half of the twentieth century. The debate occurs at a

Review of Major Points

We learned about how to improve writing, especially argumentative writing. 2Be sure your writing is clearly organized, or else you can lose your reader in the details. Here is the best way to structure argumentative writing: a) add your main point, the thesis statement, into the introductory paragraph; b) give an argument for your thesis; c) give counter-arguments and respond to them; (d) end with a conclusion paragraph that summarizes what you've done and perhaps suggests additional issues that need investigation. Whether writing to describe, argue, or explain, by providing a clear and precise structure you can dramatically improve the writing's effectiveness. Longer pieces are more effective when they are divided into three parts in this order:

- Introduction (This is your opening, and it usually includes a statement of your thesis or conclusion.)
- Middle (Your support for the thesis plus an assessment of objections to it.)
- Conclusion (Summarize what you've done and what still needs doing.)

This isn't the only order that might be successful in persuading your audience to accept your conclusion. Essays can be effective even though they leave their conclusion until the end and deal early on with discounting possible objections. The most common error in creating an argumentative essay is not to adequately develop, the assessment of objections.

Getting the main points down on paper or in a word processor file should come before worrying about the organizational details. Write first; then worry about how to structure the ideas effectively. Sometimes when we respond to an argument we try to expose weaknesses in it. We might show that the reasons given are not true, or the reasons don't make the case even if they are true, and so forth. At other times we don't directly attack the argument but rather create a new argument for the opposite conclusion, and doing this is called creating a counterargument.

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high intellectual level; it does not degenerate into name calling or confused circles. The main problem, however, is that many of the excellent points are not developed in enough detail but instead are drifted away from as the debaters continue to launch the missiles stored in their intellectual arsenals.

Glossary

argumentative essay A work of nonfiction prose stating and defending a position on some issue. It's a certain kind of persuasive writing.

counterargument An argument for the conclusion opposite to that taken by another arguer.

Exercises

1. Create a four-page argumentative essay, typed double-spaced, that analyzes the following argument and that attacks the main points of the argument below and then creates a counterargument.

> Animals may appear to have minds, but in fact they don't. Do you seriously believe that a one-celled animal has a mind? Besides, to have a mind it has to have a soul. Yet if every gnat had a soul, there would be a population explosion in the domains of the spirit, that is, in heaven. Heaven surely has no such room. So, gnats and other beasts are mindless.
>
> There are several other reasons I can offer in defense of my point. I have recently been reading the works of Louis Racine, who wrote in 1700 in France. Here is Louis's argument. He is commenting on Rene Descartes's claim that animals are automata. "If beasts had souls and were capable of feelings, would they show themselves insensible to the affront and injustice done them by Descartes? Would they not rather have risen up in wrath against [Descartes who] so degraded them?" That sounds right to me.

> God is good, and we can see "how much more humane is the doctrine that animals suffer no pain." What Cardinal Melchior de Polignac meant by saying this is that it takes a mind to feel pain, but animals feel no pain—they just flinch when pricked—and this attitude that animals feel no pain is correct because the attitude is the most humane approach to animals.
>
> Everyone knows animals are just creatures of instinct. Essentially all animal behavior is unsophisticated by our standards. A lion sees an antelope and lunges for it. The antelope sees the lion, and lurches away.

You will be graded on the clarity and organization of your essay, on the lack of incorrect and silly comments, and on the depth of your insight into the topic.

2. Write a letter in which you weigh the pros and cons involved in hiring either Roth or Toomey as a legislative advocate (that is, lobbyist) for the City of Newark, New Jersey. In this fictitious case, you are an independent consultant, making a recommendation to the city council, and you have interviewed and eliminated all other candidates except these two. The council is voting on this personnel matter at its next meeting in three days. Your report should be written as a confidential letter to the council. Begin with your recommendation, then give an argument

justifying your recommendation by weighing the pros and cons. Here is the description of the job that the two candidates are applying for.

> The Legislative Advocate will represent the interests of the City of Newark before the state government of New Jersey, including but not limited to the legislature, the office of the governor, and the state's various departments, staff, offices, and committees. This position requires writing legislation, recommending legislation, providing information to the City and its staff about the activities of the State Government, representing the city before the State Government in the capitol, providing testimony at hearings, lobbying for passage or defeat of bills before the Legislature, encouraging the Governor to sign or veto bills that have passed the legislature, and other related activities.
>
> The Legislative Advocate reports directly to the president of the city council and supplies monthly reports to the entire council. Salary $162,000 per year plus medical, dental, and optical benefits. The city will supply one full-time secretary, office space, two telephone land lines, one cell phone with unlimited calling, a desktop computer or laptop computer, a fax machine, copy machine, and at least 400 square feet office space in a City building.
>
> *Background on the City Council*: 3 Republicans, 6 Democrats; president is a Republican; 6 men, 3 women; 5 white, 3 black; 1 Hispanic.
>
> *Background on New Jersey*: Democratic governor. Republicans hold a two-thirds majority in the two houses of the Legislature.
>
> *Confidential analysis of personnel matters*:
>
> ROTH: Has previously been a legislative advocate for an Illinois public employee labor union and also for Planned Parenthood in Illinois. Eighteen years ago she and another black female were fired from their positions as county social workers for continuing to picket the county during a strike in violation of a court injunction declaring the strike illegal. The case reached the Illinois Supreme Court and was overturned, winning public employees in Illinois the right to strike. She is currently one of two lobbyists for the City of Chicago, representing the city before the Illinois state government. Her specialties are lobbying for issues concerning health care, labor relations, and urban planning. Holds a master's degree in public health from the University of Pennsylvania. Has letters of support from two Democratic and two Republican city council members in Chicago. Has never lived in New Jersey. No convictions. Age 43. Registered Democrat. Main new idea offered during interview: Lobby for a state bill enabling Newark to legally offer free hypodermic needles to drug addicts in exchange for their used needles.
>
> TOOMEY: Lawyer. Served for two years as a researcher on a taxation committee in the New York legislature. Toomey was an administrative aide for the current lieutenant

> governor of New Jersey, a Republican, but was fired from that position after serving four months. Ran for city council of Princeton eight years ago, receiving thirty-one percent of the vote. Presently is a legislative advocate representing the U.S. Steel Corporation and the Association of Airports of New Jersey before the State. Toomey has worked actively on the election campaign of the speaker of the state senate of New Jersey, who is a personal friend of two Republican members of the Newark city council. Drivers license suspended for six months for drunk driving two years ago. White. Age 63. Registered Republican. Main new idea offered during interview: Newark should make the homeless and the panhandlers less visible to other citizens.

3. This is a three-week assignment. Your instructor will give you a description of a controversial issue. Pick one side of the issue and write an essay defending your opinion. Make it about four pages long, typed double-spaced. It is due one week after it is assigned. The class's essays will then be randomly redistributed to the class. Make sure you don't get your own essay back. For the essay you receive, write a three-page analysis of the quality of the essay. Can you think of better points the writer could have made? Can you think of counterarguments the writer failed to notice? This analysis is due in one week. Put your name on it, and staple it to the back of the first essay. The essay-analysis pairs will then be randomly redistributed to the class. Make sure you don't get any of your own work back. For the pair that you receive, write a three-page critique of both the original essay and the analysis given of it. Put your name on your critique, and staple it to the back of the pair. Turn in the trio within one week.

4. Describe to a sixth-grade science class the similarities and differences between a shadow and a reflection.

5. *Common Sense* was published anonymously on January 10, 1776. The American radical, Thomas Paine, wrote this fifty-page argumentative essay for a variety of reasons, the main one being to convince readers that the colonies should pursue revolution rather than reconciliation. In 400 to 700 words, summarize the argument against reconciliation. To get some flavor of the arguing, consider Paine's reaction below to the assertion that Great Britain is America's parent, the implication being that after some bad times the child should reconcile with the parent rather than revolt and drive away the parent:

> Even brutes do not devour their young, nor savages make war upon their families; wherefore, the assertion, if true, turns to her reproach; but it happens not to be true, or only partly so, and the phrase parent or mother country hath been jesuitically adopted by the king and his parasites, with a low papistical design of gaining an unfair bias on the credulous weakness of our minds. Europe, and not England, is the parent country of America.

6. Research the history of California in the 1930s, then create an argumentative essay making a police officer's case for Okies not settling there.

7. View the film *The Grapes of Wrath* in your college library or elsewhere, then write an essay speculating on the explanation of why the film treated its Chapter 3 the way it did.

8. Write an argumentative essay about utilitarianism in which you conclude either for or against it. Predict the criticisms that might be offered by your opponent and deal with them in your essay.

9. Create an argumentative essay on one of the following topics.

a. Should Columbus Day celebrations be promoted or downplayed?

b. Is a fetus a person with rights?

c. Should our country's defense budget be increased, decreased, or kept the same?

d. If you drop your new toothbrush in the toilet, should you throw it away, should you wash it in hot water and continue using it, or should you do something else?

e. How sure can you be that you are not now dreaming?

f. What is wrong with the following reasoning?

> It is impossible for the instructor to leave this room through the door. In order to get out, he (or she) must move from where he is now and walk across the room to the door. But before that, he must reach the halfway point from where he is to the door. But before that, he must reach the one-quarter point from where he is to the door. But before that, he must reach the one-eighth point, and so forth. He has an infinite number of places to go before leaving the room, and nobody has enough time to visit an infinite number of places.

g. Is the punishment for using crack cocaine too lenient?

h. Are numbers real objects, or are they just in our heads?

i. In what ways is the system of taxes unfair—that is, who or what is not taxed the proper amount?

j. Should a judge ever be able to require a reporter to reveal the identity of her sources (informants)?

k. When is it ever proper to steal?

l. Should there be a death penalty for any crimes?

m. Should flag burning ever be illegal?

n. Property owned by organized religions or by insurance companies does not and should not pay property taxes, right?

o. Should the border between the U.S. and Mexico be made more open like that between the U.S. and Canada, or should it be made more difficult to cross?

p. Discuss this position: Environmentalists do not work from facts. They use tainted theory to scare Americans into believing their lies. Trust me. The Earth will be here for our great-grandchildren to enjoy, even if you do use disposable diapers.

q. Is it OK to pay a worker below the minimum wage if the worker voluntarily agrees to work for less?

r. Should the federal and state governments create more regulations and red tape for companies involved in producing or selling the food we all eat?

s. Who was the best U.S. president?

t. What country has the worst foreign policy?

u. Are any college sports programs overfunded or underfunded?

v. Should county health departments have the right to give out free, clean needles to drug addicts as a means of curbing the spread of AIDS?

w. Should employers be able to refuse to hire people who have AIDS, and should insurers be able to refuse to sell them insurance for this reason?

x. If (you believe) the amount spent on public welfare is too high, where should the money be spent instead? If (you believe) the amount spent on public welfare is too low, where should the government get the money for the increase?

y. Is it OK for the federal government to use our tax monies to bail out failed businesses such as savings and loans?

z. Who will probably do more to improve the United States in the future, the Republicans or the Democrats?

CHAPTER 7 Defending Against Deception

Chapter 1 mentioned several of the most important principles of logical reasoning, and it briefly analyzed examples of good reasoning. Learning from examples of good reasoning and applying the principles of logic are defenses against the forces of irrationality. However, the path to the truth and to the best decision is easier to follow if you've been there before. That is why this chapter explores deceptive techniques used to get people off the path. You'll learn about the techniques of deception used by those who are after your mind or your money. The more you know about the techniques of deception, the better you'll be able to defend yourself. Hopefully you won't use what you learn here to victimize other people.

Deception Is All Around Us

The tuition for our university is less than for schools costing twice as much. Why do you suppose that is? I suspect it's because our university saves money by paying low salaries to their instructors who teach logic and critical thinking.

Now then, let's slow down here. That comment about tuition was a joke, and the remark about low salaries was an intentional smokescreen designed to get you to miss the joke.

Deception has been practiced in so many ways, and new ways are being created so fast by so many creative people, that we readers, consumers, voters, and potential converts have a tough time keeping our defenses up. Nevertheless, we can do it. Once we've studied some of the known techniques, it becomes much easier to spot new ones. Sometimes deception takes the form of outright lying; at other times it is practiced by telling only part of the truth; and sometimes the whole truth is presented but the problem is in how it is presented. This chapter will explore obvious and subtle examples of each.

> The primary purpose of ads and sales presentations is not to provide you with helpful information but to encourage you to buy a product.

When you are considering whether to buy a product, you usually want solid information. You want to know the product's features, what is wrong with the competition's product, new ways to use the product, the real cost for you, and so forth. Not always, though. For example, don't you already have enough information about Pepsi? If you have to watch a Pepsi commercial, wouldn't you rather be entertained than informed? Do you want to know Pepsi's ratio of corn syrup to sucrose, or whatever; or would you rather have music, humor, and dancing? However, except for these special cases where you already know enough, what you do want is solid, objective, significant information. This chapter focuses on techniques of deception that are obstacles to your obtaining this information.

———CONCEPT CHECK———

Suppose you have a gmail account and you receive an email from “Your IT Department” at “IT@gmail.com” saying you should reset your email password – and supplying you a link to the site to change it. The best response is to

a. do this because you are a nice person who wants to cooperate with the email managers even if you changed your password two days ago.

b. refuse to do this because it's likely to be phishing, but do it if this is the second email they've sent you.

c. do this if you have not changed your password for over a year.

d. do nothing and move on to your next email.

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Exaggeration and Lying

A lie is a false statement made with the intent to deceive. What are salespersons doing when they say that "$15,000 is absolutely the best price" they can sell you the car for, and then after ten more minutes of negotiating drop the price another $500? The statement about the $15,000 was false—just another sales pitch. We consumers are so used to this sort of behavior that we hardly notice that it's an outright lie.

Here is a short ad: "Wiler's Whiskey; it's on everyone's lips." If it is, then you won't be safe driving on any road. But it isn't. The ad's exaggerated claim is literally a lie.

People at home, hoping to make some money in their spare time, are often exploited by scams. Scams are systematic techniques of deception. They are also called cons. Here is an example called the craft con. In a magazine ad, a company agrees to sell you instructions and materials for making some specialty items at home, such as baby booties, aprons, table decorations, and so on. You're told you will get paid if your work is up to the company's standards. After you've bought their package deal, knitted a few hundred baby booties, and mailed them, you may be surprised to learn that your work is not up to company standards. No work ever is; the company is only in the business of selling instructions and materials.

What can you do in self-defense? If you are considering buying a product or service from a local person, you can first check with your local Better Business Bureau about the company's reliability. If you have already been victimized, and if the ad came to you through the U.S. mail, you can send the ad plus your story to U.S. postal inspectors.

Here's another example of the craft con. If you have ever written a humorous story, you might be attracted by this advertisement in a daily newspaper:

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171 Answer (d). It is too likely this is phishing.

Mail me your personal funny story and $5—perhaps win $10 if I use. Write Howard, 601 Willow Glen, Apt. 14, Westbury, N.D.

Howard has no intention of your winning $10. Have you ever seen ads suggesting that if you don't buy a certain brand of tire you will be endangering your family? This is a *scare tactic*, and it is unethical if it exaggerates the danger of not buying those particular tires. Here is a sleazy use of the tactic. It is the cover of an envelope advertising something. Are you detective enough to spot what it is advertising?

This Is an Important Notification

Regarding Your ZIP Code

OFFICIAL NOTICE: Contact us at once regarding checks being delivered to your ZIP code.
WARNING: This ZIP Code Notification may not be legally delivered by anyone except U.S. Government employees.

Attention Postmaster

Postal customer shown below is the only person eligible to receive this mailing.
from: Auditing Department
Box 22341
Washington, DC 11821

to: John Doe 11 Elm Street Columbus, OH 43210_____
_____
_____

So, what are they selling? Did you figure out that this is a perfume ad? You didn't? You weren't supposed to. The page is supposed to intimidate you—make you fear that your ZIP code is about to change, that checks are being delivered incorrectly, that you are being audited, or that you are about to receive vital government information. When you open the booklet you find out that everyone in your ZIP code is being offered the chance to buy a new brand of perfume. The sentence "This ZIP Code Notification may not be legally delivered by anyone except U.S. Government employees" merely means that only postal workers may deliver the mail from the post office.

Telling Only Half the Truth

Although some advertisements contain lies and exaggerations, the more sophisticated ones walk the narrow line between truth and falsehood. You get a little truth, but not enough. A sophisticated ad doesn't lie outright and say, "Our toothpaste is 25 percent more effective than all other brands." Instead, it says "Our toothpaste is 25 percent more effective." When we see

this ad, we should ask ourselves: "More effective than what?" The advertiser counts on the fact that we will falsely believe it is more effective than all the competing toothpastes. Yet when the Federal Trade Commission demands to know what the company means by "more effective," the answer will perhaps be that it is 25 percent more effective than no brushing at all. When ads make comparisons, we readers need to be sensitive about what is being compared to what.

Besides watching out for comparisons, we should ask ourselves how the claimed effectiveness is measured and just who has determined that it is 25 percent. Are we supposed to take the advertisers' word for it, or can they instead cite a better authority? Suppose the ad had said, "Our toothpaste is 25 percent more effective, doctors say."

That is better, we might think. Doctors should know, right? But which doctors are doing the saying? Let's hope it is not witch doctors. Were the doctors offered money to agree to a company statement prepared in advance for them to sign? Unless we can rule out these possibilities, we should be cautious about believing that this toothpaste ad is giving us a good reason to buy a product.

Before you say that you know ads cannot be trusted and that you aren't fooled by ads that fail to give good reasons to buy a product, ask yourself why advertisers bother to spend millions of dollars each year using the same advertising techniques in ad after ad. Advertisers know that the techniques do work on almost all people. Do you have a non-brand-name toothpaste in your bathroom? Probably not. Must have been the effect of advertising.

"Lozengine fights bad breath," says an ad. So it does, but do not jump to the conclusion that it eliminates bad breath, or that it is more effective in fighting bad breath than Coke. In fact, Lozengine and Coke both "kill germs on contact." The ad has told you only *part* of the truth. That's not enough.

Using select information to sway someone's opinion is called the *technique of selective representation*. It is also called *telling a half-truth*. Logical reasoners should look for the full story, not just the select information in an ad. A logical reasoner's duty is to consider both sides, not merely the good side. It is the propagandist who pushes one side no matter what.

Newspapers often use the technique of selective representation. Here is a rather subtle example, a carefully selected headline that pushes a stereotype on the readers:

Former Mental Patients Suspected in 14 Killings in County

So, what's wrong with this headline? In the middle of the article, the newspaper chose to emphasize this sentence: "At least five people with a history of mental illness have been accused of killing up to 14 people and injuring 12 in the County." Without any other information, many readers will go on to the next page with the thought embedded in their minds that mental patients are especially violent. However, the logical reasoner will ask the crucial question, "Are the former mental patients killing more than their fair share?" That is, if former mental patients constitute one percent of the population, are they guilty of more than one percent of the murders? Neither the headline nor the article contains an answer to this crucial question, so the reasonable thing to do is to suspend judgment about whether mental patients are "getting out of hand." The more general conclusion we should draw here about logical reasoning is that when we need more information we should

suspend judgment rather than leap to a conclusion with insufficient evidence.

The **stereotype** (general image) of the crazed mental patient lunging with a bloody knife is an inaccurate characterization of the class of mental patients. Even severely ill mental patients are no more violent than the general population. The following is a more humorous use of stereotypes:

> Heaven is where the police are British, the chefs Italian, the mechanics German, the lovers French, and it's all organized by the Swiss. Hell is where the police are German,

> the chefs British, the mechanics French, the lovers Swiss, and it's all organized by the Italians.

There is almost always a grain of truth behind stereotypes, the grain being that the stereotype does accurately describe some members of the social group, maybe many of them. The problem is that the stereotype too often does not accurately describe *most* members of that social group. Almost all of us carry a stereotypical idea around in our heads, and we need to be alert to the likelihood that it does not apply in the situation we happen to be thinking about at the moment. Many of us, when asked directly if some stereotype really applies to a social group, will consciously answer, "No, of course not," but then we will continue to be unconsciously influenced by that same stereotype. That is the more insidious influence of stereotypes.

All of us have some degree of implicit bias which leads to our stereotyping others by the way they dress, their accent, their race, class, sex, and political persuasion. By becoming more aware of this, and by learning more about what disrespect looks like, we can become a fairer person.

———CONCEPT CHECK———

Explain where the stereotype occurs in the following dialogue:

> James: I'm glad you could come over for dinner this evening. We've been friends for so long, and we hadn't met anybody in each other's families.
>
> Sheila: Yes, it was great. Your sister, well, we like each other, I think. Your grandmother was lucid.
>
> James: Everybody is healthy. Aunt May liked your jokes.
>
> Sheila: Great! You never know when a joke will make someone laugh and someone else be offended. I sort of beat up on lawyers, and, as it turned you're your little sister is thinking of maybe being a lawyer someday. She wasn't bothered, was she?
>
> James: No, not at all. She might have said the same thing herself.

———[172]

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[172] By saying the grandmother was lucid, Sheila thought she was giving the grandmother a complement, but it was a mild insult because of the stereotype that older people are not lucid but are losing it mentally. Would you like a friend to end a conversation with you by calling you "lucid"?

The **hedge** is another common but devious tactic used by the enemies of critical thinkers. It is based on selectively presenting information so that what the speaker appears to be saying can later be denied. An ad on a webpage might say, "You could make $100,000 this year if you …. " The word "could" is the hedge. Whether you could *reasonably expect* to make $100,000 is something else again. At first the ad appears to be saying you will make a $100,000, but on careful reading, you realize that the advertiser could claim, "Hey, we never actually promised a $100,000." Hedge words are also called **weasel words**. The phrases "up to," "maybe" and "it is possible" can serve as weasel words. If I say my political opponent "might be" a liar, then I suggest the opponent is a liar without explicitly saying so. What a weasel I am. The critical thinker will always apply this principle:

> Be on the lookout for hedges.

———CONCEPT CHECK———

Identify the hedge in the following passage:

> If you have ever participated in a public event of any sort and then watched the news report of it, you are already aware that the news report barely resembles what you experienced. You are aware of this because you were there. Other viewers are not aware. When television describes events that happened at some other historical time, no one can know what is true.
>
> The best article I ever read on the inevitable distortions resulting from television's inherent need to condense time was written in *TV Guide* by Bill Davidson…. Writing about the new spurt of "docudramas," which represent themselves as true versions of historical events, he said, "Truth may be the first victim when television 'docudramas' re-write history."

———173

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173 Reminder: Try to resist quickly looking down to the footnote for the answer to the Concept Check until after you've thought about the question. The hedge word is capitalized in the following sentence:

> Truth MAY be the first victim when television 'docudramas' rewrite history.

The passage is from *Four Arguments for the Elimination of Television* by Jerry Mander.

Advertisers too often use the **technique of selectively emphasizing the trivial**. Their goal is to take advantage of your ignorance about what is trivial. A Freedom shampoo advertisement might say that Freedom shampoo "adjusts precisely to your hair, taking away the oil and dirt just where it needs to." Great, but so does any shampoo. When it needs to, it cleans; when it doesn't need to, it doesn't. So what? If you didn't know this about shampoos, you might believe the ad is giving you a good reason to buy Freedom shampoo. The moral: advertisers love to make a big deal out of no big deal.

Product advertisers face the problem of promoting their product over that of the competition. Often, as is the case with shampoos, shaving cream, and toothpaste, there are many competing products but not much of a difference among them. So, the advertiser's goal is to create the *illusion* of important differences among brands when in fact the most significant difference for the consumer is price.

The logical reasoner's best defense against the tactic of selective presentation of information is to become well informed. Well informed persons know what is trivial and what is not and know what is likely to be left out or covered up. All other things being equal, the more you know, the less apt you are to be convinced by bad reasoning.

Advertisers have more influence on the content of magazines and TV programs than most of us realize. In women's magazines, almost every issue contains ads that glamorize smoking. Ironically, these ads are sprinkled among articles about women's health and fitness. Yet the magazines rarely carry articles mentioning that cigarette smoking is a growing problem among women and that it is known to cause lung cancer, heart disease, and miscarriages. These deaths are preventable, and the U.S. government has been trying to publicize this fact. You'd expect women's magazines to take a leading role in alerting women. Yet an analysis of articles that appeared during a five-year period in the 1980s in *Cosmopolitan*, *Good Housekeeping*, *Mademoiselle*, *McCall's*, *Woman's Day*, and *Ms.* magazines by a University of Oregon researcher, as reported in *Journalism Quarterly,* showed just the opposite. Not a single article, review, or editorial on any aspect of the dangers of smoking was published. The researcher found thirty-four articles about breast cancer, but none about lung cancer, yet smokers are twenty times more likely to get lung cancer than nonsmokers.[174] Cigarette makers normally cancel ads in magazines that do run articles on the health hazards of smoking, but the financial risks for the magazines are even greater. Tobacco companies have invested their profits by buying up other large corporations, such as Nabisco and General Foods. Thus, when the tobacco ads are withdrawn, so are many of the ads for the food products. It is understandable why magazine publishers don't want to offend tobacco advertisers.

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174 From the University of California, *Berkeley Wellness Letter (The Newsletter of Nutrition, Fitness, and Stress Management)*, December 1990, p. 7.

This example of the high frequency of cigarette ads in women's magazines, coupled with the low frequency of articles attacking cigarettes, is meant to be suggestive. It does not make a definitive case for the influence of advertisers on magazines, newspapers, and TV programs. Maybe women's magazines don't run articles on lung cancer for the same reason they don't run articles on the dangers of fast driving; neither lung cancer nor fast driving is a danger specific to women. Breast cancer is specific to women; so perhaps that is why the women's magazines have articles on breast cancer but not lung cancer. However, cigarette smoking during pregnancy does cause low infant birth weights, which can be considered a problem of special interest to women, so it is odd that the women's magazines carry no articles about the dangers of smoking. Nevertheless, one research paper is not enough to make the case against women's magazines. To make a better case about the influence of advertisers, it would help to have testimonials from editors and publishers saying that they were in fact intimidated by the advertisers. Until you get that evidence, you should suspend belief about the influence of advertisers.

———CONCEPT CHECK———

Evaluate the reasons this ad gives for buying the product:

Recommended by doctors

Wackerli's Hair Spray

The choice of Hollywood's stars

The only hair spray with Formycin

———[175]

[175] The careless reader could leave this ad believing that the hair spray is somehow medically better, and that it is the hair spray used by most of the people in Hollywood who especially care about the beauty and health of their hair and who have made their decision on the basis of careful examination. However, the reader is reading all this in; the information is not really there in the ad. How many Hollywood stars actually chose Wackerli's hair spray out of the many who were sent free samples? On what basis did the stars choose the hair spray? The doctor part sounds good, but on careful reading we see that the ad does not say how many doctors recommended the hair spray or what kinds of doctors they are. Maybe Formycin is what we call “H20." Besides, Wackerli hair spray is probably the only hair spray containing Formycin simply because the Wackerli Company has a copyright on the name so that no other company is allowed to use it. It might be a fine hair spray, but this ad doesn’t give you any good reasons to believe it.

Telling the Truth, While Still Misleading

Even when you get all the relevant facts, there can be serious problems. It depends on how the facts are presented. Consider Grandpa's Granola Bars—pressed bars of breakfast cereal. The primary ingredient in Grandpa's Granola Bars is sugar. The manufacturer of this "health food bar" does not want to broadcast this fact, yet he must obey federal law and list the ingredients in the order of their weight. (The U.S. Food and Drug Administration requires the main ingredient to be listed first.) The corporate management that is pushing Grandpa's Granola Bars has found a clever way to tell the sugar story: List each of the seven kinds of sugar separately. In this case, at the top of the list goes "rolled oats," followed by "sucrose, dextrose, fructose, honey, chocolate chips, invert sugar, and corn syrup." Many consumers won't recognize some of these sugars. Clever of the manufacturer, but deceitful. The unwary reader might conclude, "Ah, the bar is mostly rolled oats." It is mostly sugar.

———CONCEPT CHECK———

Analyze the following offer to determine whether you should join. This ad exploits people whose minds fog over when they see numbers.

> **BINGO! We've finally uncovered the secret, and we will share it with you for a small part of your profits. Here's how to claim your winnings from Las Vegas. The entry fee is only $19.95. The secret is that you play as a group. We arrange for you to play with 99 other players. That way, you can buy so many more bingo cards, and your chances of winning go up astronomically. In fact, we guarantee that your group will win at least $1,000, or double your money back. Act now. Send your entry fee to Dr. Dardanelles, 3381 Magdalen Ave., New York, NY 10009. Add $2 for our expenses.**

This guy is going to give your group $1,000. Guaranteed! How could any logical reasoner walk away from such a good deal?

———176

Saying Little with Lots of Words

When a politician pounds her fist on the podium and yells, "A tax is a tax!" she tells us she does not want more taxes, but literally what she is saying is trivial. We know to look beyond the

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176 Your group is going to give this guy approximately $2,000, and he is guaranteeing your group will get half of it back. No thanks.

literal triviality. Unfortunately, some speakers and writers have no depth; there is nothing beyond the triviality. This newspaper headline is an example:

Heat Wave Blamed for Record High

Temperatures Across U.S.

What else would you blame? This headline has low information content. It contains no information that isn't already known by everybody. Similarly, you receive little information when you hear a politician mention that she supports her country, that she wants schools to teach the children better, that she believes it is now time to cut the fat from government, that she believes it is the government's responsibility to protect the people, and so on. The problem with what the politician says is not that the speech selectively emphasizes the trivial; it wouldn't be trivial to create better schools or cut the fat from government. But it is trivial to say you want to do these things, because so does everyone else—what's new?

———CONCEPT CHECK———

What is wrong with the following comment?

> If we don't change direction soon, we'll end up where we're going.
>
> —Professor Irwin Corey.

———[177]

Persuading Without Using Reasons

Suppose you see a billboard with a picture of a smiling doughnut and the phrase "Mmmmm, DOUBLE DONUTS." The advertiser hopes to trigger a gut-level response so you will buy the product. What information are you getting from that billboard? You are not being given a reason to buy those donuts. This ad is designed merely to create a mood and to provide name recognition for the product.

If I'm trying to sell my house and I bake chocolate chip cookies one hour before prospective buyers will arrive for an open house, is the aroma a reason for them to buy the house? No, but it might cause them to buy it, or it might help a little. If they stop and think about it, they will realize I won't be baking those cookies for them after I move out, and they will realize they

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177 Too obviously true. Low information content. But a great joke from the notorious professor.

should worry that the cookie aroma might be covering up some problem, perhaps the odor of cat urine in my rugs.

We open a magazine and notice a beautiful woman wearing Gentleman Jim jeans saying, "I like to be close to my Gentleman Jims."

I like to be close to my Gentleman Jims.

The advertiser is hoping readers will identify with the woman and they will want to do what she would like them to do. The ad lures us readers unconsciously into buying Gentleman Jims for this "reason," but the ad is giving us no good reason.

People who are out to persuade often have style without content. A used-car salesperson with a dynamic, friendly style is more effective than one with a snarling style or a blah style. When the enthusiastic salesperson conveys real excitement about the car, the listener often unconsciously assumes that this is a good reason to buy. It is not a good reason at all.

The point of these examples is to show that *causes are different from reasons*. Propagandists use reasons only if they believe they will help cause you to do what they want. You, on the other hand, should be on the lookout for solid reasons. You don't want to be pushed around by causes.

———CONCEPT CHECK———

What technique of deception is used in the following beer commercial?

"Schultz Beer: It's as real as it gets!"

———[178]

Most commercials are aimed at your emotions, not your intellect. The goal of the commercial is to give you a feeling, not to pass on useful data. The logical reasoner's goal is to see past the fluff and extract the information, if it's there. Too often it isn't. Most ads take the time only to reinforce the product's name and make you feel good. The advertiser hopes you will unthinkingly associate the product with your good feelings. Market research probably tells the advertiser that doing this is more effective than broadcasting facts about the product's merits.

Deceiving with Loaded Language

Early one morning many years ago, the Libyans were yawning when United States bombers streaked out of the clouds and bombed the President's palace. The next day, Russian newspapers objected to this attack by the United States. In reporting that fact, one U.S. news story said "As expected, the Russian Bear kicked up a fuss about Libya." The use of the phrase "kicked up a fuss" is a propagandistic slap at the Russians; it is an example of loaded language. So is the phrase "as expected," which tends to discount or dismiss the complaint. An unloaded way to present the information would have been for the newspaper to say, "The Russians strongly objected to the Libyan incident." Saying it that way is sticking to the facts.

Loaded language is a major way of persuading you without giving you good reasons. Look for loaded language in the following headline:

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[178] What does this comment have to do with the quality of the beer or with why you should buy it? Does an unreal beer exist? All beers could make the same claim. Thus, this ad persuades without giving reasons by using the technique of selectively emphasizing the trivial.

Big Oil Asks Senator Roberts

for a "No" Vote

Calling the major oil companies "Big Oil" evokes negative images for most people. Can't you just see the fat-cat oil executive in the smoke-filled room with his cigar and pinky ring? Most people root for the little guy and against the big guy. If you were the newspaper editor, you could have written an unloaded headline this way:

Major Oil Companies Ask Senator

Roberts for a "No" Vote

The term *major oil companies* is associated with more neutral images in people's minds. The mental images and evaluations that people associate with a word or phrase are called *connotations*. The negative connotation of "Big Oil" slants the headline against the major oil companies.

The news story complaining about the Russian response to the American bombing of Libya exploited the connotations of the phrase "Russian Bear." A bear is an aggressive animal, so labeling the Russians as "bears" connotes aggressiveness rather than fairness. Slanting a description by using loaded words is not giving an objective description. Using loaded language is a way for writers and speakers to slip their opinions into what would otherwise be an objective description. With slanting, they do not give just the factual description; instead, they add their values.

> Logical reasoners must be on the alert to sort out the facts from the values.

For example, if I tell you that I like La Toya Jackson, I've given her a positive evaluation. I've not stated a single descriptive fact about her. But if I say that she is a great singer, then I've described her by calling her a "singer," and I've evaluated her singing. On the other hand, if I tell you that La Toya Jackson is short and has a high-paying job, then I've stated two descriptive facts about her but have not offered any evaluation of her. Some readers might read this description and respond with a negative evaluation because they dislike short persons, but my original statement did not express this evaluation. It's their evaluation, not mine.

Using Rhetorical Devices

Terms used to slant a passage and influence the reader to accept the writer's attitudes are called **slanters** or **rhetorical devices**. The name "slanter" comes from the metaphor of tilting an otherwise level playing field. The most common rhetorical devices have names. We've already mentioned euphemism, exaggeration, half-truths, innuendo, lying, sarcasm, and smokescreen.

A **dysphemism** is the opposite of a euphemism. It is a term used in order to produce a negative effect. If you call his freedom fighter a *terrorist*, or her grandfather's cemetery a *boneyard*, you've chosen a dysphemism.

Writers also deceive their readers (and speakers deceive their listeners) by using **downplayers**. What is going on when I say, "French President Sarkozy says France will support the policy, but he's just another politician, isn't he?" I am downplaying his claim to support the policy. That phrase "just another" is loaded; it downplays or denigrates the claim. The words "so-called" and "merely" are commonly used as downplayers.

A **proof surrogate** is a less well known rhetorical device, but we've all seen it. When a politician says, "Everyone knows there should not be this kind of tax increase," this remark is claiming there's a proof, but not giving the proof. That phrase, "Everyone knows" is a substitute for the proof, a "surrogate" for it. When your neighbor says, "Studies show that two to three alien spaceships land on Earth every year," you spot the phrase "Studies show" as being a proof surrogate and realize that you shouldn't accept the claim about alien spaceship until you get the proof itself.

Selectively presenting the facts is an even more subtle way to deceive another person. Republicans complain that when Democrats describe a Republican program, they usually choose to mention the unpleasant consequences of the program and never the positive consequences. Republicans are correct in this complaint, although they often do the same thing to Democrats.

Consider the loaded language in italics in this newsletter from Peter Morrison, treasurer of the Hardin County Republican Party in Texas. He is expressing his post-election thoughts about President Barack Obama and other Democrats having won the election a few days earlier.

> We must contest every single inch of ground and delay the *baby-murdering, tax-raising socialists* at every opportunity. But in due time, the *maggots* will have *eaten every morsel of flesh off of the rotting corpse* of the Republic, and therein lies our opportunity.
>
> Texas was once its own country, and many Texans already think in nationalist terms about their state. We need to do everything possible to encourage a long-term shift in thinking on this issue. Why should Vermont and Texas live under the same government? Let each [state] go her own way in peace, sign a free trade agreement

> among the states, and we can avoid this *gut-wrenching spectacle* every four years. [reported by Jillian Rayfield, *Salon.com*, November 10, 2012]

Morrison's lively images make his writing more interesting but more inflammatory. He was picked by the State Board of Education Chairman to screen the public-school textbooks for the State of Texas.

———CONCEPT CHECK———

In the following passage, replace the loaded expressions with wording that slants in the opposite direction. That is, replace a positively loaded term with a negatively loaded term (not with an unloaded term).

> During the most recent artillery and tank battles, the freedom fighters have been able to liberate one more square mile of the Beirut suburbs.

———[179]

Political campaigns usually do not target politically aware voters; they target undecided voters, especially those who pay little attention to politics and know little about the issues. Campaign material is aimed at the target person's emotions. Being remarkably candid when asked about this topic, Joel Bradshaw, a political consultant from Washington, D.C., answered that in the 1980 presidential election one candidate "talked about issues," whereas the other candidate addressed the voters differently and "made them feel good. It is always more powerful to be emotional in a campaign message." Ideas about how to do this come mostly from campaign consultants, not from the candidate. The consultant's relationship to the candidate boils down to "We fool 'em and you rule 'em."

Calling that piece of cloth "Old Glory" instead of "the national flag" can make a difference. People don't think straight when their emotions are all charged up, and it takes just a little emotional arousal to affect the brain. It can alter the chemical balances and reduce logical reasoning ability. Although nobody can or should live without emotion, still,

> people reason better when they are in control of their emotions.

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179 The loaded term *freedom fighters* (positive) can be replaced with *terrorists* (negative). Also, *liberate* (positive) can be replaced with *extend their grip on* (negative). Replacing *freedom fighters* with *soldiers* would remove the positive emotional charge but would not add negative charge.

Your Aunt Mary is grieving over her husband's accidental death when in steps her lawyer saying, "I know this is an especially hard time for you, and we all want to help you, so if you'll just sign these papers giving me the power to make all the financial decisions, your life will be so much easier." The lawyer's terminology is not loaded, but the whole remark is.

One of the more effective ways to use loaded language is in conjunction with body language: a subtle smile here, an awkward glance there. Loaded language isn't all bad; it can be effectively used to enliven dull discourse. But employing it to slant a supposedly objective description is a technique of deception.

A subtler use of loaded language is in **push polls**. Too often when a pollster asks you whether you prefer A or B, the poll is designed not to learn your answer but to influence your answer. The question might be phrased this way, "If you were to learn that candidate A was accused of a homosexual rape in New Orleans two years ago, would you prefer candidate A to candidate B." This kind of poll question is a push poll if it is not true that candidate A was accused of any homosexual rape. The goal of the person who designed the poll is to push a thought into your head. That's why it is called a *push poll*.

Review of Major Points

To defend yourself against the bombardment of propaganda, con games, political hype, and sales pitches, you should demand good reasons before you act and before you change your beliefs. This is easier said than done. One problem is to get a reason, any reason. A second problem is to determine whether an offered reason is any good. In this chapter, we examined deceptive techniques that rely on lying, exaggerating, and selectively withholding information. We also considered how we can be manipulated even when all the relevant information is available to us; the problem in this case is in how that information is presented. Finally, we examined loaded language, rhetorical devices, and the difference between facts and values. Loaded language isn't all bad; it can be effectively used to enliven dull discourse. But using it to slant a supposedly objective description is a technique of deception.

The chapter presented three more principles of logical reasoning: (1) Suspend judgment rather than leap to a conclusion with insufficient evidence, (2) be alert to loaded language, and (3) sort out the facts from the values. We aren't yet done exploring the means of deception. Almost every chapter to follow will add to what we've already discussed.

Glossary

connotations The mental images and evaluations that many people associate with a word or phrase.

dysphemism The opposite of a euphemism. Choosing a word that will intentionally produce a negative effect on the reader or listener.

half-truth A deceptive technique that uses half or some other portion of the available information in order to sway your opinion. It is also called the technique of selective representation.

hedge A deceptive technique based on carefully selecting the information in order to be able later to deny what one at first appeared to have said. For example, your future employer could hedge on saying "You will make $20 per hour" by instead saying, "You will make up to $20 per hour." Then when you are hired for $13 per hour, you can't say you were promised $20 per hour.

lie Not just a false statement. A lie is a false statement made with the intent to deceive.

loaded language Language that unnecessarily uses a word that has emotional overtones or evaluative connotations. It is language that can masquerade as objective description but in fact is slanted to introduce the speaker's own values.

push poll A poll designed to push an idea into the head of the person being polled by a careful design of the questions.

rhetorical device A technique designed to influence another person's attitudes or behavior. The phrase is usually reserved for loaded language or slanters rather than for more legitimate methods, namely offering the person good reasons while not covering up the negative evidence.

scam Systematic techniques of deception usually aimed at making money off the unwary. They are also called *cons*.

scare tactic A technique of deception that uses fear to cause a particular action. An example would be an ad suggesting that you will be endangering your family if you don't buy a certain brand of tires.

selectively emphasizing the trivial Making a big deal of no big deal. The point would be to target a group who did not realize that it was no big deal. For example, you would be using this technique if you advertised that your shampoo contains the hydrogen hydroxide recommended by leading doctors and didn't mention that this is just a fancy name for water.

slanter Loaded language.

stereotype A commonly held mental image, usually of some social group.

weasel words Words that hedge.

Exercises

1. Examine some advertisements and commercials, and find examples of three different techniques of deception mentioned in this chapter. Clip, copy, or describe each one, and then say what it is an example of and how you made this determination.

2. Consider the deceptive advertising technique in this letter that says, "You've just won a free vacation for two in Hawaii or Puerto Rico. Three days, two nights, in a lovely island paradise. Call 666-7733 to claim your prize." Sounds pretty good, no? If you were to call, you would eventually learn the rest of the story. Yes, you will be given two nights for free in a hotel, but you have to agree to attend a three-hour lecture each day about purchasing land on the island. There are other strings attached to the trip. You must agree to pay for a high-priced flight to the hotel on the advertiser's chartered planes. You must also stay in their hotel and pay for at least two meals a day in the hotel restaurant.

The letter's deceptive advertising technique can best be described as

- failing to appreciate that extraordinary statements require extraordinarily good evidence to back them up.
- inconsistency in the reasoning.
- using a half-truth.
- stereotyping.

3. Prepare a six-minute debate between yourself and someone in your class who disagrees with you about whether some person made the right choice.

■ 4. Create a five-second radio commercial that advertises some product. Use the technique of persuading without giving any reasons. Make the commercial seem realistic, not silly.[180]

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180 Here are two commercials:

Mycene Shampoo! It's here. It's now. It's Mycene, and it's for you.

If you want him to be more of a man, you need to be more of a woman. Bushwhack Perfume. For the man in your life.

[Reminder: Exercises that begin with the ■ symbol are answered in the accompanying footnote.]

5. Choose a recent news story and compare the pros and cons of how it is treated on the nightly TV news with how it is treated the next day in the newspaper.

6. Compose an original paragraph that uses some means of deceiving the reader yet still gives the whole truth.

7. When you receive a chain letter, you receive a letter with a message you are likely to agree with plus a short list of people and their addresses. You are asked to (a) send money to the person at the top of the list, (b) copy the letter, placing your own name and address at the bottom of the list and removing the name and address of the person at the top of the list, and (c) send copies of the revised letter on to several new people you know. Why does creating a chain letter qualify as being a technique of deception?

■ 8. Here is a news report that is not objective because it contains loaded terminology. Rewrite it to be more objective.

> The spokeswoman for the pro-abortion group blatantly admitted today that the mother of the unborn child can murder the child if she "chooses."[181]

9. This news report that is not objective because it contains loaded terminology. Edit it to be more objective.

> The "female" leader of the anti-choice group said today that a pregnant woman is "guilty of murder" if she exercises her right to control her own body by aborting the fetus.[182]

Creating a commercial of the form "Famous people use it, so you should, too" is giving a reason and so is an inappropriate answer.

[181] The loaded language is capitalized: The spokeswoman for the PRO-ABORTION group BLATANTLY ADMITTED today that the mother of the UNBORN CHILD can MURDER the CHILD if she "chooses." Calling the fetus a "child" loads the description because a central point of disagreement is whether the fetus is or is not morally equivalent to a child. The label pro-abortion is a term with negative connotations. Members of the group would not agree that they are pro-abortion; they say they are pro-choice, not pro-abortion. A more objective (that is, fair) way of reporting would be: The spokeswoman for the group said today that the woman who carries a fetus should have the option of an abortion if she chooses.

[182] The loaded terms are capitalized: The "female" leader of the ANTI-CHOICE group said today that a pregnant woman is "guilty of murder" if she EXERCISES HER RIGHT TO CONTROL HER OWN BODY by aborting the fetus. Here is a better edited version: The spokeswoman for the group said today that a pregnant woman is "guilty of murder" if she aborts her fetus. Replacing “anti-choice” with “anti-

■ 10. Find the loaded language, if any, that is used to slant the following description of the event positively or negatively. The speaker is Jewish writer Annette Rubenstein, author of the two-volume work *The Great Tradition in English Literature: From Shakespeare to Shaw*. She is describing an event that occurred right after her graduation.

> When I left Columbia [University] with a doctorate in philosophy I graduated into the Depression [of the 1930s]. I wanted very badly to teach philosophy, but it was difficult for a woman to find such employment. The head of the philosophy department got me an offer at Bryn Mawr University on condition I would change my name. At that time there were very few Jewish professors and those that were there were teaching German and foreign languages mostly. Of course I wouldn't change my name, and he said, "Well, they know it; it's not deceiving anybody. It's just that they thought it wouldn't look good in the catalogue. Why don't you translate it to *Redstone*?"

Which word is loaded and used to slant the description positively or negatively?

a. Jewish b. Redstone c. offer d. foreign e. none of the above[183]

■ 11. What do you notice that is odd, from a critical thinking perspective, about this poll question?

> If you were to learn that people from Germany generally have more bacteria on their skin than people from France, would you prefer to buy Schmidt's apple jelly from Germany or Lyon's apple jelly from France?[184]
>
> a. Why am I being asked about only two kinds of apple jelly? Aren't there other kinds?
>
> b. Sounds like a push poll.
>
> c. Isn't the cost relevant here?
>
> d. Shouldn't I have been asked first if I ever use apple jelly?

■ 12. Find an example of exaggeration that has occurred in print, on the Internet, on the radio, or on TV. (a) State the exaggerated claim, (b) explain why it is correct to call it "exaggerated,"

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abortion" is acceptable, as is giving the explicit name of the group; but choosing the term "pro-life" would just replace a negatively loaded term with a positively loaded term.

[183] Answer (e).

[184] Answer (b).

and (c) give the source of the claim (date, page number, program, channel, or other information needed to pinpoint the source).[185]

[185] Here is one answer: (a) "Safari [perfume] by Ralph Lauren. A world without boundaries. A world of romance and elegance. A personal adventure and a way of life." (b) They are overstating what this perfume will do for you. It's just a chemical that smells good. You cannot reasonably expect to use it as a principal path to romance, elegance, adventure, and a way of life, (c) Source: *Glamour Magazine*, May 1991, p. 79. An exaggeration is an overstatement that contains a kernel of truth. An exaggerated claim is false, but not all false claims are exaggerations. For example, a headline that says, "World War II bomber found intact on moon" is false; it is not exaggerated.

CHAPTER 8 Detecting Fallacies

In earlier chapters we examined several techniques of deception: exaggeration, telling only half the truth, and using loaded language. Fallacies are errors in reasoning, and they can be used to deceive, as we saw in the discussion of the fallacy of avoiding the issue, the red herring, and misplacing the burden of proof. In this chapter, we explore other important fallacies. Knowing the main ways that people are lured into these errors will improve your chances for logical self-defense in the future.

Ad Hominem Fallacy

If you venture to disagree with some people about any matter of religion or politics, they will be on your back like a rooster on a tater bug. They'll scratch at you any way they can; call you names; humiliate you; and attack you with an ad hominem fallacy.

Suppose a soccer player is trying to convince somebody that black-and-white soccer balls are easier to see at dusk than red-and-yellow balls, when a third person butts in and says, "Who are you to talk about good and bad soccer balls? You've been thrown out of more soccer games for rules violations than anyone else on the team, and you still owe me five bucks for last season's team trophy." The person who is butting in commits the ad hominem fallacy: attacking an argument by pointing out some *irrelevant* characteristic of the reasoner rather than by pointing out some error in the reasoning itself. Purposefully using the ad hominem fallacy is a kind of smear tactic. The way to avoid committing this fallacy is to concentrate on the reasons, not on the reasoner.

The ad hominem fallacy has 3the logical form "The argument is made by a person who has a bad trait, so the argument is faulty." Most arguments of this ad hominem form are faulty, but some are fine provided having the mentioned trait is relevant to the argument quality. For example, if the trait is that the arguer is well known to have lied several times on this very topic, then the trait is relevant and the person's conclusion isn't to be trusted for the reasons given. Relevance is not about logical form, but about the content or details of the argument.

———CONCEPT CHECK———

Which of the following brief arguments are examples of the ad hominem fallacy?

a. Buy Cheerios; it's the breakfast of champions.

b. Don't buy Cheerios. They're too expensive.

c. Don't listen to Andy's argument for buying Cheerios. He's admitted the reasons behind his concluding that they aren't worth buying or eating, and those reasons really do not support his conclusion.

d. I believe that Cheerios cost less, and all Emilio's numbers and figures about how relatively expensive the cereal is are not convincing, because he's some sort of politician.

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Ad hominems are not always so obvious. Frustrated by a doctor's warnings against smoking, a patient might strike back by saying, "Who are you to talk? You smoke." Has the patient committed an ad hominem fallacy? This is a difficult question. At first sight, you might be apt to say something like this: "Yes, the doctor might be a hypocrite, or a victim of weakness of the will, but the patient's complaint is irrelevant to whether or not the doctor's reasons against smoking are good reasons. “Do as I say, not as I do,” is what the doctor is suggesting. Therefore, the patient has committed an ad hominem fallacy. But on second thought, the patient has a point. It is well known that you often can learn more about what people really believe by observing how they act than by listening to what they spout off about. It could be argued reasonably that if the doctor really believed what he says about smoking, he would follow his own advice. Because he doesn't follow his own advice, it is reasonable to conclude that the advice should not be followed unless other authorities can be found to back up the advice. If the patient had never heard anything negative about smoking except for what this doctor has said, the patient would be acting properly in hesitating to follow the advice. So, the reasoning does not commit the ad hominem fallacy.

Fallacy of Circular Reasoning

If you justify A by appeal to B, then justify B by appeal to C, and then justify C by appeal to A, you are reasoning in a circular. Earlier we saw example of giving circular definitions. Here is another example. By definition, the Bialystok fallacy occurs when there is an instance of either circular reasoning or a Bialystok fallacy. Because the Bialystok fallacy is the most significant of all the fallacies, you can be sure that it is a fallacy of the highest significance. Circular reasoning

186 Answer (d). Only in (d) does the reasoner reject someone's argument by pointing out irrelevant characteristics of the arguer. Answer (c) gives an argument that might appear to attack the arguer, but notice that the attack is on the arguer's reasons and really not on the arguer.

is also called “begging the question” when there is a circular of justification rather than a circle of definitions. Here’s an example with a very small circle: Smoking is bad for your health because it’s so hard on your health when you smoke.

Straw Man Fallacy

When you are arguing with someone, your goal is usually to create an argument that successfully shows the other person's position to be false. Your argument is then called a refutation of your opponent's position. From a logical reasoning perspective, which is one of fairness to the opposition, you ought not mistreat your opponent, nor should you misrepresent your opponent's position. Here is an example of someone misrepresenting a position:

> Lobbyist for the logging company: I'm asking you to help encourage Congress to pass that bill to provide subsidies to Western logging companies for selective cutting of 10,000 acres of federal timber land.
>
> Environmentalist: I don't see how you can seriously ask any of us for our help. You are asking our grandchildren to live in a world in which they will never see a tree, never spot a deer, never smell the sweet scent of pine needles. Do you have any idea how bad it would be to live this way? No trees means bad air. No trees means muddy rivers. No trees means no wildlife. How can you defend the rape of the land? Land is precious; forests are precious; our grandchildren are precious. I don't understand how you can ask us to pick up the banner of desolation.

What an exaggeration! The environmentalist offers all sorts of reasons why there shouldn't be land rape or deforestation of the planet. The lobbyist was asking for logging subsidies, not land rape. The environmentalist has misrepresented the lobbyist's position and then begun to beat up on the misrepresentation. This unfair approach is called the straw man fallacy.

A speaker commits the straw man fallacy whenever she falsely attributes an especially weak position to her opponent that he wouldn't have proposed himself and then proceeds to attack the weak position. The opponent is a real man with a real argument; the weak position is an artificial one held by an artificial person—the "straw man" or scarecrow the speaker has created. It's easier to attack a straw man; nevertheless, the attack is irrelevant. It is a diversion from the main issue.

You are not committing the straw man fallacy simply by drawing a consequence from what the man savs that is not what he himself would draw. It must be clear that you are also misinterpreting what he did say. Here is another example of the straw man fallacy, committed by Bob:

> *Andy*: We should liberalize the laws on crack.
>
> *Bob*: No. Any society with unrestricted access to drugs loses its work ethic and goes only for immediate gratification. We don't want that, do we?
>
> *Andy*: Hey, I didn't say anything about unrestricted access to drugs. That's not the liberalization I want.

Bob has attacked a position that Andy doesn't hold. So, Bob's attack is an irrelevant **smokescreen** that commits the straw man fallacy. Bob's argument is ineffective logically,

although it may still be effective psychologically, especially when Bob goes on to make other points against Andy and doesn't give him time to come back and defend himself.

To avoid committing the fallacy, Bob could, instead, have said to Andy something like the following:

> *Bob*: What do you mean by liberalize? If you mean unrestricted access to drugs, then society will lose its work ethic and go only for immediate gratification, which we don't want, do we? But if you mean some other kind of liberalization, let's hear it. However, what we need is more crackdown on crack, not more liberalization, because. . .

When someone criticizes you by using the straw man fallacy, your natural reaction is to say, "Hey, wait a minute, I didn't say that." Unfortunately, you usually receive the criticism at the last second. Your opponent misrepresents your position while you are not around to defend yourself. In politics, this fallacy frequently occurs in leaflets and ads a day or two before the election.

False Dilemma Fallacy

Reflect on your own work experience, then respond to this item from a questionnaire.

> On average, each week your present employer (or your previous employer if you are not now employed) is drunk on the job
>
> a. occasionally
>
> b. usually
>
> c. always

Suppose your employer is never drunk on the job. What answer could you choose? You don't have one to pick, so you are in a dilemma. Because it is false to say that the three given choices are all that exist, the dilemma is a false one, and the error of reasoning committed by the creator of the question is called the **false dilemma fallacy**. To remove the fallacy, the question could be revised to add a fourth choice, "never." False dilemma reasoning is an example of slanting by unfairly presenting too few choices. It loads the set of choices unfairly by not offering a fair range of choices.

The **black-white fallacy** is a false dilemma fallacy that limits you unfairly to only two choices, as if you were made to choose between black and white. Real life is often not so black and white. What about part black and part white? What about the gray? Saying "You are either for our proposal or you are against it" is the most common example of the fallacy. Dick Gregory put it this way: "Either you are part of the solution or you are part of the problem." If you rightly

complain that the dilemma you face is unfair and that there is another choice you should be offered, then you are finding a way to *escape between the horns* of the dilemma. That is, you escape being gored by the choices offered. For three-horned false dilemmas you may escape *among* the horns instead of between the horns.

Not all dilemmas are false ones. If your employer's drinking problem does occasionally interfere with the quality of his (or her) work, you have to consider whether you will ignore it or instead report it to someone. Now you face a true dilemma. If you do nothing, the problem may not get solved. But if you blow the whistle by reporting the problem to another superior, you might have to deal with your employer's reaction when he finds out. He could start assigning you the more unpleasant assignments and you may suddenly find letters in your personnel file describing your poor work performance.

———CONCEPT CHECK———

Which of the following passages, if any, contain a false dilemma fallacy?

α. Would you vote for the president if he were to run again, provided that code section D of article 20 were repealed, and supposing that under provision 60B the president were to declare his assets and swear not to have been involved in lobbying for a foreign power in the interim?

β. How many alcoholic beverages have you drunk in the last 24 hours?

χ. Is the president doing about the same quality job as he was doing last year or is he doing better this year?

δ. Please suggest improvements, if any, you would make in Einstein's theory of relativity.

ε. Is Einstein's theory of relativity better than Isaac Newton's for predicting orbits of planets.

———187

Here is a false dilemma fallacy you can commit on purpose if you want to trick a toddler into doing something:

> Do you want to go to bed now or after you've had a glass of apple juice?

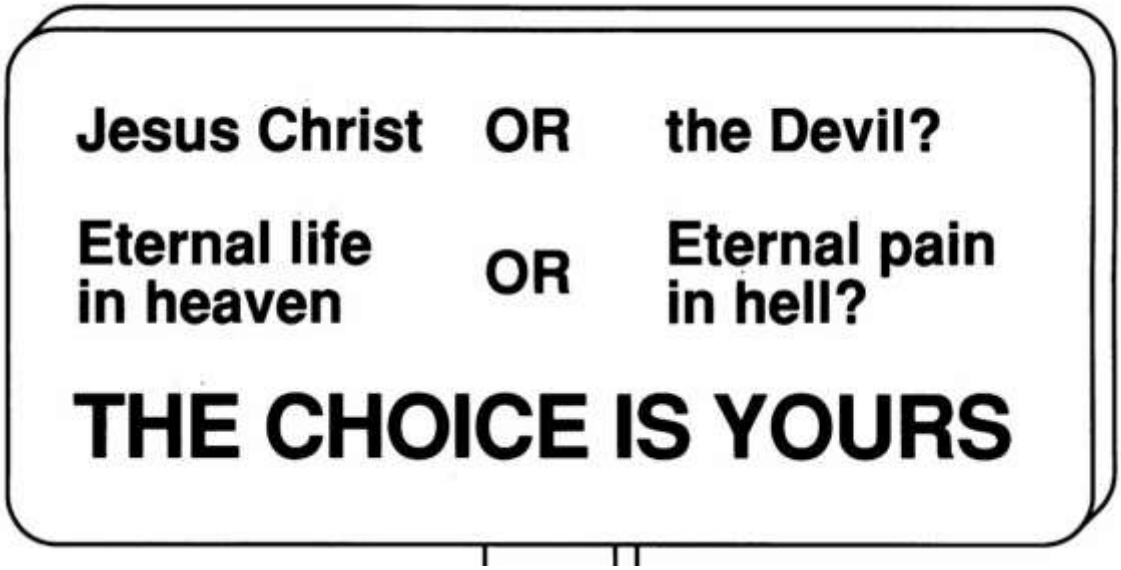
The child who doesn't want to go to bed at all might be tricked into choosing the apple juice. After the child is done with the juice you can say, "OK, remember you agreed to go to bed after

187 Answer (c). Maybe the president is doing worse.

the juice." The child who can see his or her way through the horns of this petty manipulation has reached a definite step up in logical reasoning ability.

A politically significant example of the false dilemma fallacy occurs in this resolution adopted by a major political party in Arizona. It states that the United States is "a republic based on the absolute laws of the Bible, not a democracy based on the changing whims of people."[188] A logical reasoner should ask, "Must it be one or the other?" One of the two choices offered by the resolution is that democracy is based on whims; the readers are offered no choice of a democracy based on something else, such as on reasoned opinion hammered out in the marketplace of competing ideas. By slanting the list of acceptable choices, the resolution guides the reader to making the favored choice. Successful stacking of the deck has to be somewhat subtle. If the resolution had said "a republic based on the Bible, not a democracy based on the changing whims of the stupid voters," it would not have passed because it would not have been subtle enough to pass.

Does the sign below commit the false dilemma fallacy?



This is not an easy question. Whether it commits the fallacy depends on whether there are really only two choices. Are there? How you answer this question may depend on your ideology or world-view. People with certain ideologies would say that ultimately there are just these two choices—Jesus Christ or Satan. Those with a different ideology—Christian Scientists or Muslims or atheists, for example—will say that there are other choices. So, to decide whether the fallacy has been committed here, we first need to settle the issue of the correctness of the religious ideology that says there are just these two choices. That is a large task, not one well suited to

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188 From "Justice O'Connor Regrets 'Christian Nation' Letter," James H. Rubin, *The Sacramento Bee*, March 16,1989, p. A28.

this book. However, it would be incorrect to answer the question of whether the sign commits the false dilemma fallacy by saying, "Yes, it's a false dilemma if you have one ideology; but it's not a false dilemma if you have another ideology." This would be incorrect because the sign either does or doesn't commit the fallacy. Whether it does depends on whether the religious assumption behind the sign is correct. Thus, what it would be correct to say is that people who hold one sort of ideology will say, "Yes, it's a false dilemma, "whereas those who hold another ideology are apt to say, "No, it's not a false dilemma." In short, the issue of whether the sign commits a false dilemma fallacy depends in turn on resolving another issue, the correctness of the religious assumptions behind it.

To summarize, by using the false dilemma fallacy, a speaker withholds important choices. The choices presented divert the reader's or hearer's attention away from the other choices. Pointing out one of those other choices is called escaping between the horns of the dilemma.

Fallacy of Faulty Comparison

Suppose a TV commercial shows a woman wearing Jones & Jones gardening gloves. She is finishing her Saturday rose gardening without scratched hands, while her neighbor who gardens without gloves eventually quits because of the wear and tear on her hands. The commercial ends with the comment, "Don't you wish you had Jones & Jones gardening gloves?" This commercial tries to lure you into doing some faulty reasoning. The commercial creator wants you to compare having no gloves with having Jones & Jones gloves and then to conclude that you should buy Jones & Jones gloves rather than other brands. The logical reasoner will draw another conclusion. The commercial gives some reason to believe that, for gardening, wearing gloves is better than not wearing gloves, but it gives no reason to believe that Jones & Jones gloves are better than any other brand of gloves. This commercial offers a faulty comparison. The comparison should have been between Jones & Jones gloves and competing brands of gloves, not between Jones & Jones gloves and no gloves at all. The advertising agency that created the commercial intentionally used the fallacy of faulty comparison to deceive viewers. What was compared wasn't what should have been compared.

———CONCEPT CHECK———

Explain why the fallacy of faulty comparison occurs in the following advertisement for Flox mouthwash, and explain how to revise the ad to remove the problem:

> Flox removes 300 percent more plaque than simple rinsing. Isn't that reason enough for your family to buy Flox?

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Consider this ad: "Enzine detergent motor oil causes less exhaust emission than the leading seller. Buy Enzine." The faulty comparison problem can be useful for understanding this ad. Even if the ad is correct in what it says, you still need to worry before you decide to buy Enzine. For consumers to make an informed decision about which product to buy, shouldn't the Enzine oil be compared with *all* the other motor oils, not merely the leading seller? The best seller might be best merely because it is the most highly advertised or least expensive, not because it is a high-quality product. The second major difficulty with the ad is that Enzine might be better than all the other products in terms of exhaust emission, but what about other considerations, such as price and constancy of viscosity, that are important for motor oils? When all these factors are considered, the leading seller might be better for your engine than Enzine, even if what the ad says is true. By selectively presenting the comparison information and by not giving you the other relevant information, the ad is presenting a **half-truth**.

Fallacious Appeal to Authority

You know that the moon is a big, hard rock, don't you? It looks that way. But wait! How do you know? How do you know it's not made out of soft plastic? You've never been to the moon. You could be wrong, couldn't you?

Don't let that last question intimidate you. You don't have to go to the moon to know about it. You know the moon is a big, hard rock because you have probably read that fact in a science book or heard it from a science teacher. Science teachers can speak with authority on this matter. If you believe that the moon is a big rock for a reason like this, then you *know* it. Much of what you know you have learned this way. You don't find out for yourself; you believe what authorities say, at least when you can be reasonably sure they are in agreement with each other. You are right to do so. It is not firsthand knowledge, but it is still knowledge.

Suppose you came to believe that the moon is a rock only on the basis of what your sister told you. Then you wouldn't know the truth about the moon, assuming that she is no authority. You would believe the truth about the moon, but you wouldn't know the truth. To have knowledge you need more than true belief. To know something, you have to have solid justification for it. Knowledge is justified true belief; your knowledge is your true beliefs that you could back up by good reasons. The reasons are crucial; without them you just have opinion, not knowledge.

Knowledge is justified true belief.

189 The advertisement encourages you to buy Flox instead of competing mouthwashes by luring you into comparing Flox with no brushing at all. To remove the fallacy and make the point the advertiser wants to make, the Flox mouthwash should be compared with other mouthwashes. For example, the ad could say, "When compared to all other mouthwashes, Flox removes 15 percent more plaque. Isn't that reason enough for your family to buy Flox?"

If you were to learn that some person's supposed knowledge turned out not to be true, then you would say the person never really knew it after all. For example, in Medieval times many people thought they knew the Earth to be flat, but they were mistaken and didn't really know it. They did have a justification for believing what they believed: they could climb a hill, look out, and see that the world appeared to be flat. That was good evidence for the time. Yet their belief was not knowledge, even though it was reasonable for them to hold the belief. In other words, they had a good reason to believe something false, but because it was false it was not knowledge.

———CONCEPT CHECK———

Without having a justification, a person's claim to have knowledge is unsuccessful, but with the justification the person's claim

a. will never be mistaken and will really know.

b. might be mistaken.

a. will always be mistaken, and thus the person will not know.

———190

If you answered that concept check correctly, then you'll have no problem with this one.

———CONCEPT CHECK———

Explain the error in the following sentence, then rewrite it to make the point correctly:

> In Medieval times, people knew that the world is flat, but we now know that it's not flat.

———191

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190 Answer (b). With the justification, the claim could still fail to be knowledge; it must also be true.

191 It is a mistake to say that the people knew the world is flat. People never knew this because people cannot know something that is false. Here is a way to make the point correctly:

> In Medieval times, people believed they knew that the world is flat, but we now know that the world is not.

More about Assessing Credibility

Suppose your next-door neighbor says you shouldn't marry your sweetheart. When you ask her why, she says it's because her older brother thinks so. "So what?" you say. She responds by pointing out that he is an expert psychologist. At this point are you going to call up your true love and say it's all over? No. Being an expert on psychology doesn't make your neighbor's brother an expert on your love life. You know that your neighbor picked an inappropriate authority to back up her claim. The neighbor has made a famous error of reasoning, the fallacious appeal to authority. When it comes to your love life, there probably isn't any authority.

There is an appeal to authority in this article from a college newspaper. Does it commit the fallacy?[192]

The Lottery—The Odds to Beat

> Just what are the chances of winning the state lottery? Statistician Peter Bennett says there is one chance in 25 million of winning the $2 million grand prize The odds are pretty slim, but remember, a $1 ticket could turn into $2 million!

Did the newspaper reporter commit a fallacious appeal to authority by citing statistician Peter Bennett? No. Statisticians are just the right sort of people to appeal to about such a matter. So, unless you have a good reason to doubt Bennett's statistics, you should accept them. This acceptance is based on the following principle of logical reasoning: If a person is especially knowledgeable about a subject, then that person's views on the subject should be trusted more.

A fallacious appeal to authority can occur when an appeal is to someone who really is not an authority in the area. Don't ask a chemist when you want an expert opinion about hockey rules.

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192 From *The New York Times*, June 14, 1988.

The fallacy can also occur when a claim is backed up by an appeal to an authority in the appropriate area yet the authorities themselves are in significant disagreement with each other. When authorities disagree, none of them can "speak with authority." If I find ten authorities who say to vote Republican in the next U.S. presidential election, you can probably find ten authorities who say to vote Democratic. So if I appeal to my ten authorities as the reason why you should vote Republican, I've committed a fallacious appeal to authority. Sometimes, however, political experts should be trusted. If they say who won last year's election, you should trust what they say unless you have a good reason not to. You have background knowledge that the experts won't disagree on this topic.

Here is a more difficult question along this line. Does the following passage commit a fallacious appeal to authority?

> According to psychologists, telepathy (that is, mind reading) occurs more often between friends. The closer the friend, the more frequent the telepathy and the stronger the connection. Only the most gifted of people can read the thoughts of total strangers.

What should you think about all this? First, ask yourself whether psychologists are the right authorities. Shouldn't the speaker appeal instead to brain surgeons? No, psychologists are the appropriate authorities. The fallacy occurs because the speaker has twisted what the authorities really do say about telepathy. Only a small percentage of psychologists believe in telepathy, and they are not the experimental psychologists (the scientists). Almost all scientific experts agree that telepathy is impossible. Therefore, the rest of us are justified in saying so, too.

How could the position of the psychological authorities be changed to favor telepathy? Here is one way. Have a purported mind reader pass a test. The mind reader could agree in advance to tell some of those psychologists what they are thinking about—say, at 2 p.m. each day for the next three days. If the mind reader is correct in even only two out of the three days, the psychologists would kneel down and kiss the mind reader's feet. Claims to be able to read minds on demand are at least testable, and passing the tests should make the case in favor of the existence of telepathic powers. Unfortunately, nobody has ever been able to pass such a test.

You should critically examine such phrases as "According to psychologists . . ." and "Science has shown that. . ." These phrases are occasionally misleading.

You also need to be on the alert that experts won't always tell you the truth. Of course you can always trust me, the author of this book. After all, who are you going to believe? Me or your lying eyes?

When people cite an authority to you, you have to worry that they might not understand what the authorities do say, might not realize that the authorities disagree with each other, or, worse yet, might not be telling the truth about what an authority says.

Most of us, not being scientists ourselves, cannot evaluate the scientific details. We have to rely on what others tell us the scientists say. Those others are usually reporters for newspapers, magazines, radio, and TV. Sometimes in their rush to get the story done, reporters will not bother to examine the quality of the science they are reporting on. They won't be careful to evaluate the reputation of the scientist or to check whether other scientists dispute the quality of that scientist's work. For example, suppose the issue is whether the state legislature should pass a bill favoring cloth diapers over disposable diapers. The relevant scientific issue is the impact of both kinds of diapers on the environment. One reporter may incorporate into his news article some paragraphs from a press release crafted by the cloth diaper company that financed the research. The press statements might say, "Independent research shows cloth diapers to be environmentally sound, while disposable diapers clog our nations landfills without decomposing." The reporter might not have taken the time to determine whether the scientific research really was done by an "independent" researcher. Perhaps it was done by a scientist specifically paid to do the research because the company suspected he or she would come up with the "right" results about the product. Meanwhile, perhaps unknown to the first reporter, some other reporter is incorporating into her own article the key paragraphs from the press release of the disposable diaper company. It has financed its own scientific research showing that "disposable diapers are environment-friendly while cloth diapers must be washed with suds that foul our rivers." We consumers need to be wary of these possibilities of sloppy reporting.

One thing we can do as readers is to be alert for a sentence saying that the scientist was not financed by the company whose product is being reported on. We should also be alert for a sentence indicating that other researchers support the scientist's work. When such helpful sentences are absent, do we conclude that the reporter didn't check all this out, or do we conclude that he or she did but just didn't bother to tell us? We really are stuck in a dilemma. And there is a second dilemma. Do we accept the reported conclusion of the scientific research, or do we remain skeptical? We are too busy to check up on the report ourselves—we barely have enough time to read the entire article from just one reporter. Most reports we receive are not personally important enough for us to engage in a massive reading project to determine just what to believe. Ideally, we might want to withhold our judgment about cloth versus disposable diapers until we get better information, but realistically we will probably never get that information. Nor will we get definitive information about the thousands of other large and small issues facing us throughout our life, and we cannot go through life never having an opinion on anything. The philosopher George Santayana may have been correct when he said that skepticism is the chastity of the intellect, but our intellects can't be skeptical all the time; we have to embrace most of the beliefs of the reporters. It is for this very reason that the information media are so powerful; they inevitably shape our minds even when we are trying to be logical reasoners and careful about what beliefs we adopt. The defense against this situation is to try and get information from a wide variety of sources.

———CONCEPT CHECK———

Identify the appeal to authority in the following piece of reasoning. Why should you be convinced by the speaker's reasoning?

> Our government is standing in the way of progress. What the government should be doing is solving our problems. Yet the government is not doing this because it is not funding a request for what it needs most of all, a universal answering machine. This machine would give an answer to nearly all factual questions that were fed into it. For example, if you want to know if a piece of reasoning is fallacious, you input the reasoning into the machine and then check the output for an answer. If you want to know the cure for AIDS or for some other disease that has no known cure, then just feed in the question, and the universal answering machine will give the correct answer. The machine would do all this without the programmer first feeding it the answers. We don't have such a machine yet, but we should get one right away because having it would be so helpful. Scientific reports show that its creation is not far off; there just needs to be a major increase in funding. There should be a lot of money offered for the best grant applications. That grant money will draw in the best scientific minds to work on this most important project.
>
> The government knows about the universal answering machine project. I wrote Congress and the president two years ago about it. Their inaction shows that the government is standing in the way of progress. Either they are stupid, or there is a cover-up.

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Spotting an Authority's Bias

There is an additional element you have to worry about when someone appeals to authority: bias on the authority's part. Suppose a British politician claims that there is no significant corruption in Venezuela's oil ministry. The politician's evidence is that the chief oil minister of Venezuela was quoted in last week's *Newsweek* magazine as saying his ministry is free of corruption. Should you accept the British politician's argument? Well, since you probably don't know anything about Venezuelan oil, isn't the oil minister in a better position to know whether

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193 The speaker is wrong when he appeals to authorities by saying "Scientific reports show." The reports show no such thing, at least so far. The reasoning is based on the assumption that such a machine is feasible. There is good evidence that it isn't feasible; the government recognizes this, which is why it has not acted. In short, the speaker is a crackpot. Nevertheless, the possibility of getting significant help with most all our decisions from artificially intelligent beings is not ridiculous, but when it occurs we'll all know about it right away.

there is corruption in his oil ministry? Yes, and he is the right authority on the matter. Also, you don't have any reason to believe that he was misquoted. So shouldn't you accept the British politician's claim that there is no corruption? No. It is doubtful that this particular authority will tell the truth. Wouldn't he be likely to cover up corruption if it existed?

When someone wants you to accept a claim because a certain authority says it is so, you should ask yourself a few questions:

1. Is the authority an authority on this subject?

2. Do the authorities agree with each other (except for the occasional lone wolf) ?

3. Can the person who appeals to the authority be trusted to report honestly and accurately what the authority said?

4. Can the authority be trusted to tell the truth on this topic?

Only if you get "yes" answers to these questions should you go ahead and accept what the authority says. Still, look before you leap. For example, all of us trust doctors to be authorities. They have expert knowledge that we do not have. What would you do, though, if you ventured into a doctor's office with symptoms of flu and the doctor said, "I'm sorry, but your leg has to come off right away; sign this release form, and we will get you straight into the hospital"? The principle of logical reasoning that you apply at this moment is the following: When the stakes are higher, it is more important to get better evidence before making the decision. Besides, you might learn that the authorities disagree among themselves about whether your leg needs to be removed.

Appeals to expert opinion will sometimes lead you to error. Even experts make mistakes. However, occasional slip-ups by the experts are no reason to quit using authorities as sources of knowledge.

———CONCEPT CHECK———

You've been asked to research living conditions in two large American cities, Kansas City and Baltimore, especially whether the cost of living of the average person is greater in one city or the other. The cost of living encompasses the cost of food, housing, car insurance, and other regular expenses. Which person below would be most likely to give you the best answer or the best suggestion on where to go to get the answer?

a. A local building contractor who owns land in Baltimore and who has recently built homes and apartments in both Baltimore and Kansas City.

b. Your college's urban studies professor.

c. Your uncle who lived in Baltimore for five years before moving to Kansas City last year.

d. The personnel director of the company that offered you a new job this week in Kansas City.

———194

Here is a more difficult question about how to assess whether someone is an authority.

———CONCEPT CHECK———

Below is a brief biography of a person, followed by a list of topics. Rank the topics according to her expertise in them, beginning with those on which she would be able to speak with the most authority.

> Judy Wilson is currently the director of government documents for the Library of Congress in Washington, D.C. Ten years ago she took a three-year leave from the library to co-direct the census for the Chinese government in Beijing. In 2001 she received a Ph.D. from the Food Research Institute at Stanford University, where she wrote her dissertation on current food consumption patterns throughout China. She published a book four years later on mathematical methods in geography and has published several scholarly articles on the wages and working conditions of women in Asia and Africa.

How can interested members of the public obtain classified research documents as they are declassified and released by the Pentagon and the National Archives?

a. Are Chinese and Indian foods as popular in the U.S. as they were five years ago?

b. Are more women raped in Japan than in China?

c. Are the disabled people in China currently as well fed as those elsewhere in Eastern Asia?

d. Would an accurate census be more difficult to carry out in Ecuador or in Egypt?

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194 Answer (b). Who is going to know more about the cost of living in a city—somebody who lives there or somebody who studies the city? The urban studies professor is supposed to be an expert who studies cities in all their aspects, and the professor would not have a reason to give a biased answer. If the professor didn't know the answer, he or she would definitely know how to get it. The personnel director might well be biased. Your uncle can speak only from personal experience, as far as you know, and probably doesn't know the statistics; yet the statistics would be a more reliable source of information than firsthand stories even from someone you trust. The building contractor could well know about the cost of housing, but there is little reason to suspect he would know about the cost of other aspects of living in the two cities.

Slippery Slope Fallacy

Watch out starting down a slippery slope. You might fall to the bottom and hurt yourself. That's the idea behind the slippery slope fallacy. Arguments of this form are fallacious if there is no good reason to believe you will fall to the bottom after that first step. For example, someone might argue that you shouldn't smoke cigarettes because, if you do, then you'll soon be smoking cigars, and then smoking marijuana, and then cocaine and heroin, and pretty soon you'll be lying under the bridge unconscious with an infected needle sticking out of your arm. Fallacious reasoning, right? There are perfectly good reasons for not smoking cigarettes, but this isn't one of them.

The logical form of a slippery slope fallacy looks like this:

> A leads to B.
> B leads to C.
> C leads to D.
> D leads to ...
> ... which leads to HELL.
> We don't want to go to HELL.
> So, we should not take that first step A.

If A leads to B with a probability of 80 percent, and B leads to C with a probability of 80 percent, and C leads to D with a probability of 80 percent, is it likely that A will eventually lead to D? No, not at all; there is about a 50 percent chance. The proper examination of a slippery slope argument depends on sensitivity to such probabilistic calculations. If the probability of reaching

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195 She could speak with the most authority on (a) and the least on (b). She must know when and where classified documents get released by government agencies because her section of the library would most probably be the first to get them of any library in the country. There is no reason to suppose she knows anything special about rape. She might know how to count the disabled people in China, if this were a question on the Chinese census that the government wanted answered (and you don't know whether it is), but there is little reason to suppose she would be interested in how well they eat today, even though she did study food consumption patterns. Regarding (e), she has expert knowledge about how to do a census, but there is no good reason to suppose she could give a decent answer about the problems of conducting one in Egypt versus Ecuador. Regarding (b), she is unlikely to have solid information about the popularity of Chinese and Indian food with U.S. consumers. There is no reason to suspect her degree in food research would provide her with expertise on the current popularity of such foods. So, on this topic she is likely to speak from her own experiences rather than from reliable statistical data. Therefore, the ranking should have (a) on top. Then ranked equally, you'd have (c), (d), (e). Place (b) at the bottom of the ranking.

that last step is too low, then that slippery slope argument is an instance of the slippery slope fallacy.

Genetic Fallacy

A critic commits the genetic fallacy by attempting to discredit a claim because of its origin (genesis) when such a criticism is irrelevant to the claim. Suppose a friend of yours is reading the newspaper and mentions a report about Senator Friedman's bill to redraw the boundaries of the political districts in your state. Your friend is describing the senator's reasons for the new boundaries when he surprises you by mentioning that, according to the article, the senator got the idea for the new boundaries from a dream she had one night. You say to your friend, "Hey, stop right there. There's got to be something wrong with Senator Friedman's reasons, because she got the idea from a dream." When you say this, you are committing the **genetic fallacy** because you are paying too much attention to the genesis of the idea rather than to the content of the idea and the justification offered for it.

Similarly, if Sigmund Freud, the father of psychiatry, had said that a patient's reasons for believing in God must be faulty because she arrived at her belief as a product of needing a strong father figure who would protect her and answer her prayers, Freud would have been committing the fallacy.

Sometimes more than fallacy label can be assigned to the same error. For example, suppose you were asked to evaluate the reasoning in the following passage:

> In a recent American presidential campaign, a U.S. senator was running against the president for the party's nomination. The senator argued in a speech that the president should be held responsible for an international crisis that hurt American influence in the world because the president had advance signals of the coming crisis but had not acted effectively to prevent the crisis. How did the president reply? By dismissing the senator's argument on the grounds that it was "politically motivated."

Clearly the president, and not the senator, made the error in reasoning here. What error, though? There are several ways to correctly label the mistake:

a. Ad hominem, because the president attacked the senator's character as being that of a politically motivated person.

b. Fallacy of avoiding the issue, because the president did not address the senator's question of who is responsible for the crisis but instead chose to change the issue to whether the senator's charges were politically motivated.

c. Genetic fallacy, because the president attacked the genesis or origin of the senator's complaint rather than the complaint itself.

Non Sequitur

Suppose you've been shopping for a TV set and I tell you not to buy a television set today because it is Tuesday. "Why Tuesday?" you might ask. "Because Tuesdays are so boring," I answer. I have a reason for your not buying the TV set, so I have an argument. But what sort of argument? The reason is so weak that many people are apt to say, "That's no reason at all." My reason may not be totally irrelevant to the issue, but it does not provide significant support for my position on the issue. It would only convince somebody who already was anti-Tuesday or opposed to your purchase, and even if this did convince them it should not convince them. When a conclusion is supported only by weak reasons or by irrelevant reasons, the argument is fallacious and is said to be a **non sequitur**. This Latin term means "does not follow." Any fallacious argument is one whose conclusion doesn't follow from its supporting reasons, so any fallacious argument is appropriately called a "non sequitur." However, we usually apply the term only when we cannot think of how to label the argument with a more specific fallacy name and when it is fairly easy to show that the reasons are weak.

Sometimes when we say, "That's no reason at all," we do expect to be taken literally, because there really is no reason there. If so, there is no argument, and thus no non sequitur fallacy either. Although there is a fuzzy line between a radically weak argument and no argument at all, there is a difference between the two. The weak one has at least some reasons; the other does not. Here is an example of a disagreement in which a person thinks he is giving an argument but in fact is giving no argument at all:

> NON-ARGUMENT: Rafael, you really ought to vote for the Democrat. I just don't understand how you can think of voting for that Republican. I mean, where's your head? The Democrat is so obviously the one to vote for, you should do it and get it over with. Don't sit there and even think about that Republican.

If there were an argument here, the conclusion would be for Rafael to vote for the Democrat. But there is no argument because there is no reason given for the conclusion. Sometimes the term *non sequitur* is defined more broadly to include a non-argument that is mistakenly put forward as an argument. On that definition, the above non-argument would count as a non sequitur, but we won't use the term that way.

Here is another example of a passage that you are apt to react to by saying, "That's no argument at all":

> NON SEQUITUR ARGUMENT: Nuclear disarmament is a risk, but everything in life involves a risk. Every time you drive in a car you are taking a risk. If you're willing to drive in a car, you should be willing to have disarmament.

At this point you might think, "Hey, that's no reason for disarmament," by which you really mean that it's not a good reason. All it is saying is that the risks of disarmament are OK because some other risks are OK. Well, some other risks are OK, but some are not OK. So the reason given is extremely weak.

In summary, whenever you react to a piece of reasoning with a comment such as "Hey, that's no sensible reason for that," you've probably detected a non sequitur fallacy.

———CONCEPT CHECK———

Is the following argument a non sequitur? If it is, explain why.

> Your information shows part of Canada is south of part of California. Therefore, we can be sure that John was right when he said, "Some of Canada is south of part of either California or Nevada."

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196 It is not a non sequitur because the supposed information would give a good reason to believe the conclusion if it were true. As a matter of fact, the information *is* true.

Review of Major Points

The logical reasoner sticks to the issue, makes only relevant remarks, doesn't withhold relevant information, and accurately represents the position of the opposition. Failing to do some of these things is the source of the following fallacies: ad hominem, straw man, false dilemma, faulty comparison, fallacious appeal to authority, genetic fallacy, and non sequitur. In this chapter we saw how to identify these fallacies and how to revise passages containing them. We noted that if an argument has the logical form of a fallacy it still might not be a fallacy. 4 For example, the ad hominem fallacy has the logical form "The argument is made by a person who has a bad trait, so the argument is faulty." Some arguments of this ad hominem form are fine provided having that trait is relevant to the argument quality. Relevance is not about logical form. A more comprehensive list of the fallacies is presented in the *Internet Encyclopedia of Philosophy* at: http://www.iep.utm.edu/fallacy.htm

The world is full of con artists, many of whom are out there right now thinking of new ways to con you into doing things for the wrong reasons. You, the logical reasoner, need eternal vigilance.

Glossary

ad hominem fallacy Attacking an argument by pointing out some irrelevant characteristic of the reasoner rather than by pointing out some error in the reasoning itself.

black-white fallacy A false dilemma fallacy that limits you to only two choices.

escape between the horns of a dilemma Rightly complaining that the dilemma you face is unfair and that there is another choice that you should be offered.

fallacy A kind of error in reasoning.

fallacious appeal to authority An appeal to authority in which the authority is not really an expert in this subject or cannot be trusted to tell the truth, or in which authorities disagree on this subject (except for the occasional lone wolf), or in which the reasoner misquotes the authority.

fallacy of faulty comparison Arguing by comparison but comparing the wrong things.

false dilemma fallacy Unfairly presenting too few choices and implying that a choice must be made only between the offered choices.

genetic fallacy Attempting to discredit a claim because of its origin (genesis) when such a criticism is irrelevant to the claim.

non sequitur "Does not follow"; an argument in which the reasons given are irrelevant or very weak. All fallacies of argumentation are non sequiturs.

refutation A disproof. A refutation of another person's position is an argument that successfully shows the other person's position to be false. You don't refute someone merely by contradicting them.

straw man fallacy Falsely attributing an easily refuted position to one's opponent that the opponent wouldn't have proposed himself and then proceeding to attack the easily refuted position. The opponent is a real man (or woman) with a real argument; the easily refuted position is an artificial position held by an artificial person—the "straw man." It's easier to attack a straw man; nevertheless, the attack is irrelevant. It is a diversion from the main issue.

Exercises

■ 1. Label the fallacy committed by the district attorney in the following passage, and rewrite it to remove the fallacy.

> Will you tell the jury where you bought the gun used to shoot the liquor store clerk? Just a simple "yes" or "no" please.[197]

■ 2. Create an ad hominem fallacy in your response to the following:

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[197] This is a black-white fallacy. An innocent person would have a tough time finding an answer if the question were taken literally. The defendant could escape the two unpleasant choices by saying, "Hey, I never bought any gun, and I never shot the clerk." This defense via pointing out a third possibility besides the two unpleasant ones is called "escaping between the horns of the dilemma." The D.A. should not have required a simple yes or no answer.

To remove the fallacy, you could make a variety of changes; the easiest is to say, "Did you shoot the clerk?" followed by "Did you buy a gun?" An acceptable question would be "Just a simple yes or no: did you buy the gun used to shoot the liquor store clerk?" It is not really sufficient to rewrite the question as: "Will you tell us where you bought your gun?" Assuming this is still a yes-no question, the question does not permit the option of "I never bought any gun."

I don't think it's appropriate at all to celebrate Columbus Day. The holiday honors a man who was responsible for the destruction of millions of Indians. People think Christopher Columbus was a good man, but he wasn't. We opened our arms to welcome him, but he took the land from us.[198]

3. Create a believable dialogue between two people in which the first person uses a non sequitur. Make the non sequitur be a serious argument, not a silly one. Have the second person point out the fallacy, and have the first person agree and correct the error in a way that now does make the point that was originally intended. Begin with a helpful description of the situation by giving background information to aid the reader in understanding the issue involved.

4. Suppose I decide not to buy a television set today because my horoscope says it is a bad day for buying anything. I have a reason for not buying the TV set, but is my reasoning a non sequitur?

5. Does the following argument use a fallacious appeal to authority? Why?

Glass is mostly silicon atoms that slow the speed of light down to 122,000 miles per second. I know this because I overheard one of the employees at the science museum say so. I think it was the Assistant Director.

■ 6. Suppose you notice a webpage containing a news article headlined "SCIENTIFIC RESEARCHER CLAIMS LITTLE GIRL CAN CONTROL DICE WITH HER MIND." The article reports on an investigation performed by a parapsychologist who examined a ten-year-old girl who said she could predict the outcome of rolling two dice, provided she rolled the dice. In response to that article, a friend of yours says, "I am not going to be influenced by that silliness. The parapsychologist is a well-known member of a far right political organization, and she once posed nude for *Playboy* magazine." This response from your friend is an example of

a. an ad hominem fallacy
b. a fallacious appeal to authority
c. a false dilemma
d. a slippery slope[199]

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198 "Hey, you are wrong about Columbus Day; you're some sort of bleeding heart liberal, so your word cannot be trusted." The personal attack alone isn't enough to make the fallacy; you must also suggest that this attack somehow shows that the person's reasoning is unreliable. Here is a different sort of ad hominem fallacy: "What do you know about Columbus Day? You and everyone else in your radical organization are out to smear the good name of white people." This latter kind of ad hominem fallacy is called the **fallacy of guilt by association,** because the reasoner is said to be guilty of error because of groups he or she associates with.

199 Answer (a). This is an attack on the reasoner rather than on the reasoner's reasoning.

7. Is a fallacious appeal to authority committed in the following argument for the conclusion that men are naturally better at basketball and weightlifting?

   John: Men make better basketball players than women do. I would say the same about weightlifting, too.
   Sarah: Yes, I agree. You rarely see women competing in these sports. However, someday, when interests change, women will be as good as men.
   John: Oh, no, I wasn't clear. I mean that men will always be better, because men are just naturally better at these sports. Average men will be better than average women, and the best men will be better than the best women.
   Sarah: What makes you say this?
   John: I've consulted an expert, that's why.
   Sarah: Oh yeah, who?
   John: My mother.
   Sarah: Ha! Your mother. Who's your mother?
   John: She was a coach.
   Sarah: So?
   John: She's athletic director at a women's college; she once was hired by a state university to scout high school basketball players, men and women, for potential athletic scholarships; she is a specialist in sports physiology; and she has carefully followed basketball and weightlifting at all levels of the sports. She even wrote an article about all this for Sports Illustrated magazine.
   Sarah: Well, that may be true about her, but I still think that women could be as good as men if they just had an equal chance.
   John: No way. Women are hopeless. They should not even be allowed to try out.

8. Create an original paragraph that uses a believable but fallacious appeal to authority.

■ 9. Create an original example of the straw man fallacy in response to the following argument:

   I urge you to join the campaign for the proposal. This initiative proposal is in circulation under the tide "Law Invalidation." It is an initiative constitutional amendment, sponsored by two private citizens, that seeks to abolish the California State Bar Association. This leaflet shows you that ten prominent attorneys support the proposal.[200]

10. Suppose Jones argues for some point x. Suppose x is attacked by Smith for two reasons: x implies y, and y is incorrect. If Smith is correct about both reasons, his argument is

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200 Here is one of many ways to create the straw man fallacy:

> The arguer is asking you to join in holding up our lawyers and judges to public ridicule. This is a simple witch hunt, like that in Puritan New England hundreds of years ago. Do you really want to engage in this sort of disgraceful behavior? Hasn't our society lifted itself above the narrow intolerance of the past?

a. a straw man
b. an ad hominem
c. avoiding the question
d. not fallacious
e. irrelevant to the issue of whether x is so.

11. State how to go between the horns of the following dilemma. Ignore the loaded language.

I understand what you are saying about business ethics, but you need to see it from the businessperson's perspective. The choice in business is simple: either I adopt a vow of poverty and go for sainthood, or I take the more sensible path of maximizing personal income no matter what.

12. Create a straw man fallacy in your response to the passage in Exercise 2 about Columbus Day, and then explain why your response deserves to be called an example of that fallacy.

■ 13. Which choice below is a single horn of the false dilemma created by the speaker?

There are no black women conductors of major American symphony orchestras. I can guess why. Either black women aren't musical, or else God wanted no black women conducting those orchestras. But we all know there are some black women who are musical, so I guess it's all part of God's plan.

a. God wanted there to be no black women conductors of major American symphony orchestras.
b. There are no black women conductors of major American symphony orchestras.
c. Black women are musical.
d. Either black women aren't musical, or else God wanted no black women conducting those orchestras.[201]

14. You will commit the fallacy of faulty comparison if you

a. compare apples with tangerines and then say that the cost per pound of one is outrageously high in comparison with the cost per pound of the other.

b. fail to compare apples that you are offering for sale with apples that are rotten.

c. compare apples with oranges and fail to consider that at current prices, two apples equal one orange in California but not in New York.

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[201] Answer (a). The two horns of this dilemma are stated in choice (d). Choice (a) expresses just one horn of that dilemma.

d. promote the health value of your own apples over the competition's apples by comparing the health of eaters of your apples with people who eat no fruit at all.

e. say that Jones & Jones gloves are best for protecting gardener's hands on the basis of a comparison between those gloves and other means of hand protection, including the competition's gloves.

15. Is the fallacy of faulty comparison committed in the text of this 1950s magazine advertisement?

MORE DOCTORS SMOKE OUR CIGARETTE. Check for yourself-smoke our cigarette and see if you don't get less throat irritation.

■ 16. What fallacy, if any, is committed here?

Physicist Jones won the Nobel Prize for his advances in astronomy. Physicist Jones says Republicans are ruining the economy. So, Republicans are probably ruining the economy.[202]

17. Which fallacy, if any, occurs in the following piece of reasoning?

I left my car keys in the house. I've looked carefully all over the bedroom for my car keys and failed to find them. Therefore, I left them in some other room.

a. fallacious appeal to authority

b. ad hominem

c. avoiding the question

d. straw man

e. false dilemma

f. none of the above

18. What is the best characterization of the following passage?

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[202] Appeal to inappropriate authority. In this argument, *so* is a conclusion indicator term, and the conclusion is preceded by two almost irrelevant reasons.

As of January 23, 1977, 88 percent of all U.S. homes had at least one TV set. As of January 23, 1987, 77 percent of all U.S. homes had at least one color TV set. So, as of January 23, 1997 nearly 66 percent of all U.S. homes will have a cell phone.

a. straw man

b. fallacious appeal to authority

c. ad hominem

d. non sequitur

e. no fallacy occurs here; it's fine reasoning

19. During a heated battle in an earlier century, a Prussian emperor, whose troops were displaying fear, urged his men forward with "Onward! What do you want? Do you want to live forever?" Identify a false dilemma here. What is a reasonable way for a Prussian soldier to escape between the horns of this dilemma? First, explicitly define the dilemma. (Hint: The dilemma is not between living and dying, nor between obeying and disobeying.)

■ 20. The verb *go* is conjugated in the present tense as I go, you go, he goes. Bertrand Russell once said that something can be learned from the correct conjugation of words. For example, he conjugates the word *firm* this way: I am firm; you are obstinate; he is a pig-headed fool. What point is Russell really making?[203]

■ 21. Comment on the quality of this argument:

Microorganisms are small living creatures that can be seen only through a microscope. Bacteria, yeast, and molds are the three most important microorganisms in food fermentation. Therefore, the most important microorganisms in food fermentation are bacteria, yeast, and molds.[204]

22. Comment on the quality of the following reasoning and give a justification for your comment.

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[203] First, notice that Russell is making a joke. He is not committing the ad hominem fallacy, nor is he making a point about conjugation. The serious point behind the joke is that we don't judge others by the same standards that we judge ourselves. The more distant the actor is from us, the more likely we are to see the fault in the action. Therefore, this passage offers an example of how reasoners (other than Russell) often do not treat the issue fairly.

[204] The conclusion, which is signaled by the conclusion indicator term *therefore*, is just a restatement of the reason for the conclusion. The conclusion does not "go anywhere." Logicians call this kind of fallacy **circular reasoning**.

Listen, Jerry. You've been convicted twice of molesting children, so your reasons for why the new child-care center should be built near your house aren't going to be acceptable to this committee.

23. What fallacy or fallacies, if any, are committed in the following passage?2

> The scientific method simply sets a rigorous yet easily communicated standard for communicating information. . . . Before a scientist can accept a phenomenon as conclusively proven, several things must happen: First, the experiment must be designed so that no other factors can account for the result. A psychic may correctly identify all the cards in a Zener deck [a set of symbols used for testing telepathy]—but if the cards were so thin they could be read through their backs (as has happened), the experiment doesn't prove anything. The scientist also demands that findings should be repeatable by other scientists in other locations following the same methods. If not repeatable, the result is not conclusive. Now apply these standards to the case of the paranormal. Scientific tests going back more than a century have shown a resounding inability to provide solid evidence for the existence of telepathy, clairvoyance, psychokinesis [moving things by mind power], precognition [seeing the future], levitation, reincarnation, transmigration [of souls], or miraculous healing.

■ 24. Juan argued that bluegrass is the best food for cattle in the Midwest. Sammy objected by citing how the authorities at the U.S. Department of Agriculture recommended alfalfa over bluegrass for Midwestern cattle. If Juan counters this objection by arguing that the U.S. Department of Agriculture is a bloated bureaucracy with too much fat that deserves to be cut in the next federal budget bill, then Juan has

a. committed a fallacious appeal to authority.
b. committed a false dilemma fallacy.
c. committed the fallacy of avoiding the issue.
d. refuted Sammy's position.[205]

25. Imagine what somebody might say who sincerely disagrees with one of your own beliefs. Construct a 300 to 500-word argument that gives reasons for why your belief is incorrect. That is, argue for the other side of the issue. Begin by stating the issue. The new argument must contain no fallacies and no loaded language.

26. Revise the sentence below to correct the errors:

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[205] Answer (c). Choice (b) is incorrect because Juan's attack on the U.S. Department of Agriculture is not an attack on the arguer.

In the Dark Ages, people lived in a world free of diseases from microorganisms, because the germ theory of disease wasn't discovered yet.

■ 27. Examine the following conversation and look for a fallacy in the reasoning:

Mother: My fifteen-year-old daughter failed two courses at school. The worst part is, she didn't even try. She just said, "Oh well, it's not important." If she had tried and failed, that wouldn't be so bad.

Friend: Are you sure it wouldn't be so bad? Maybe it would be worse if she tried and failed.

Mother: No, it wouldn't, because if she tried she probably wouldn't fail the two courses.

Friend: Oh, I think I see what you mean. Do you mean that anybody who tries will succeed at least in the sense that they did try and didn't just give up?

Mother: No, I just mean that if my daughter tries, she most likely will get a grade higher than an E.

Who made the error, the mother or the friend? What error?[206]

28. Revise the dialogue above between the mother and her friend so that it no longer commits the fallacy.

29. Create an ad hominem fallacy in your response to the following argument:

Our department could use the new MouseMan mouse. Since it doesn't use a wire connected to the computer, buying it won't cause more desk clutter. Also, it doesn't have the annoying electrical interference problems that plague other infrared cordless mice. And new MouseMan "sleeps" when you're not working, so a common battery lasts up to a year inside of it. Sounds perfect to me. Let's order a batch of these mice.

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[206] The error was made by the mother. She did not respond to her friend's question about whether it would be worse for the daughter to try yet get an F than not to try at all. Therefore, the mother committed the fallacy of avoiding the question, regardless of whether she avoided it on purpose or simply didn't get the point of the question.

CHAPTER 9 Consistency and Inconsistency

Your goal is to maintain the consistency of your beliefs as you add new beliefs. This chapter is devoted to exploring how to achieve this goal. All of us want to remove any inconsistent beliefs we have, because if we don't then we are accepting something impossible. We aren't like the red queen in *Alice in Wonderland* who said she could believe six impossible things before breakfast.

by Ice Vision

Recognizing Inconsistency and Contradiction

The topic of inconsistency is at the heart of logic. If you say, "Everyone left the room," and I say, "She is someone who is still in the room," then I've said something inconsistent with what you've said. Noticing an inconsistency is a wake-up call to resolve the conflict. One or both of the conflicting claims must fail to be true.

Because the study of inconsistency requires you to know what the words "true" and "truth" mean, it might help you to have a definition. Here it is: The truth is a lie that hasn't been found out. I got that definition from my favorite intelligence service (spy organization).

Just kidding. A truth is a statement of fact, but it is too basic to define.

A group of statements is **inconsistent** if it's not *possible* for them all be true. What does the word *possible* mean here? It means something like conceivable or imaginable, assuming words mean what they normally mean.[207] A group of sentences (even a group the size of one) that is not inconsistent is **consistent**. There is no middle ground between consistent and inconsistent.

Even two false statements can be consistent with each other. These are consistent:

> Abraham Lincoln is my mother.
> Abraham Lincoln is your mother.

The two are consistent with each other, but not with the facts, such as the fact that Lincoln isn't the mother of either of us.

Resolving an inconsistency can be at the heart of deep issues. Theologians recognize that they have a burden of resolving the apparent inconsistency between divine foreknowledge and human free will. Some philosophers of religion argue that the two are inconsistent because God knows what you are going to do, so you are not free to do otherwise than the way God has foreseen. Yet presumably the ability to do otherwise than you do is the essence of your free will. If there's an inconsistency, then you can't have it both ways. Other philosophers of religion say there is no inconsistency, but we won't go further into this thicket of dispute.

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[207] When we say it's not imaginable, we mean we cannot imagine it unless we allow words to change their meanings in mid-sentence or mid-passage—which we do not allow for purposes of assessing possibility. If we were to permit language to go on holiday this way with no restrictions on equivocation, there would never be any inconsistency.

Inconsistency between what we expect and what we get is at the heart of many jokes. Here are some examples:

> "I didn't attend the funeral, but I sent a nice letter saying I approved of it." -- Mark Twain

> "I feel so miserable without you, it's almost like having you here." -- Stephen Bishop

Let me tell you a story. It is about the second time Candace lost her virginity. While she was on a bridge crossing the stream, walking up the lane toward her was a tall man with a dog.... By now you are suspicious of what I am saying because you were alert to the fact that this remark is inconsistent with our common sense knowledge that people can lose their virginity only once.

We have now discussed some different kinds of inconsistencies. They can be put into categories (intellectual boxes). There are **logical inconsistencies** in which the very meaning of the words requires one of the claims to be false. Example: {Everyone left the room. She is someone who is still in the room.}

There are **inconsistencies with our expectations** as in Mark Twain's joke about approving of the funeral.

There are **inconsistencies with facts** as when we say she lost her virginity twice. Any false statement is logically inconsistent with the facts.

A factual inconsistency is a logical inconsistency with the facts.

Are these two sentences (or statements) logically inconsistent?

> Almost everyone in the room is an Arab.

> He's in the room, but he's no Arab.

No, they are consistent. If you were to change "Almost everyone" to "Everyone," then they'd be inconsistent.

The notion of logical inconsistency can get more complicated. These two statements can be said to both logically consistent and logically inconsistent:

> Everybody left the room.

> John is still in the room.

They are inconsistent with the assumption that John is a person, but they aren't consistent as presented, because John could be a teddy bear in the room. However, if you made these two statements to people without them knowing John was a teddy bear, then you'd be tricking them and violating the normal rules of conversation which say that ordinary names of people refer to people and not to other objects unless you say otherwise.

So, the moral about the complication is that consistency questions can depend crucially on what else you are assuming. To explore this complication a bit more, consider the relationship between these two statements.

> Abraham Lincoln is currently the president of the United States.
>
> Abraham Lincoln is a Sumo wrestler.

Would you say the two are

> a. consistent
> b. inconsistent
> c. none of the above

You can't tell whether the answer is a or b. Neither of the two sentences are true. Each one alone is factually inconsistent or inconsistent with the facts, but they are not logically inconsistent with each other and so are logically consistent. If "b" means "factually inconsistent," then the

answer is b. If "b" means "logically inconsistent," then the answer is not b. People are notoriously ambiguous when they ask about inconsistency.

Another way to describe inconsistency is to say that two or more statements are inconsistent with each other if they couldn't all be true. Now the ambiguity is embedded in what the word "could" means. Does it mean "could" as far as the meaning of the words are concerned, or "could" where it is assumed that we are comparing them to all the facts and are not allowed to change any of the current facts of the world? Here's a way to make the point.

Could eggs grow naturally on trees? They couldn't if they have to obey the laws of biology, but they could so far as what those words mean. That is, the sentence "Eggs could grow naturally on trees" violates biology but not grammar. So, we say the sentence is factually inconsistent but not logically inconsistent.

The statement that Abraham Lincoln is your mother could be true but in fact is false. Here we are using "could" in the sense of possible so far as grammar and meaning are concerned.

More on that word "could." Most false statements (sentences) could be true, as far as grammar or meaning is concerned. Similarly, most true statements could be false. But there are exceptions. Here's one. The statement "If it's raining and cold, then it's cold" is true, but it could *not* be false. Statements like this that can't be false without violating what words mean are said to be **analytically true**. The statement, "7 + 5 = 13" is analytically false. The statement that there are more than 13 chickens on Earth is true but not analytically true.

As you deal with problems of consistency in real life, you want to be alert to what people mean rather than just to what they say. For example, suppose Jack says, "Nobody got an A on that test, but she did. Wow, is she smart." What Jack said literally was self-contradictory. If you called him on it, Jack would probably say not to take him so literally because what he really meant was "Nobody (other than her) got an A on that test." What he meant is not self-contradictory. So, to get what Jack intends, you need to overlook his inconsistency.

Are these three sentences consistent?

> Lincoln is taller than Jones.
>
> Jones is taller than Shorty.
>
> Shorty is taller than Lincoln

The three are logically inconsistent with each other. Understanding this inconsistency is all part of understanding the term "taller than." If a person couldn't see that the three sentences were inconsistent, we'd have to wonder whether they really understood what "taller than" meant.

Very often, people will use the terms "inconsistency" and "contradiction" as synonyms, but technically they aren't synonyms. A contradiction between two statements is a stronger kind of inconsistency between them. If two sentences are contradictory, then one must be true and one must be false, but if they are inconsistent, then both could be false. Do the following two statements contradict each other?

> The house is all green.
>
> The house is not all green.

Yes, these two contradict each other; one of the two must be true and the other must be false. This is so for any house. Do the following two statements contradict each other?

> The house is all green.
>
> The house is all blue.

No, both could be false; the house might be white. So, the two statements do not contradict each other, although they are logically inconsistent with each other. This inconsistency is the weaker kind of inconsistency that we call being **contrary**.

When you leave the logic classroom and go out onto the street, you'll find that people use our technical terms "contradiction," "inconsistent," and "contrary" in a sloppy manner; sometimes the three terms are meant to be synonyms. Few people are careful to distinguish factual inconsistency from logical inconsistency. So, you have to be alert to this and try to get at what they mean rather than just what they say.

———CONCEPT CHECK———

Are these two sentences consistent or inconsistent with each other?

> Serena is not taller than Carlos.
>
> Carlos is not taller than Serena.

———[208]

Here is a more difficult question to answer. Are the following two statements inconsistent?

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[208] This pair is consistent because it is possible that they are both true. They are true in a situation where Samantha and Carlos are the same height. Even if you know that Carlos really is four inches taller we still call the pair *logically* consistent because it is possible, as far as the meanings of the words are concerned, that there is a situation in which they are the same height.

Venice was running in the Boston Marathon at 8 a.m. today.
Venice was having breakfast at Bob's Restaurant at 8 a.m. today.

Not quite. Maybe she stopped for breakfast during the marathon.

———CONCEPT CHECK———

Consider this consistent list of statements:

i. The president admires the first lady.

ii. The first lady also admires the president.

iii. Everybody else admires the president, too.

These statements are logically consistent. Label the following sentences as being consistent or inconsistent with the above list:

a. Everybody but the admiral admires the first lady.

b. The admiral admires the first lady but not the president.

c. The president admires other people besides the first lady.

d. The vice-president does not admire the first lady.

e. The first lady does not admire the vice-president.

———209

Statements can even be made with body language. A man could say, "Sure, sure, I believe you" as he lifts his eyebrows and rolls his eyes. In doing so, his actions contradict what he says.

———CONCEPT CHECK———

Are these two sentences inconsistent?

All real televisions are appliances.

Some real televisions are appliances.

———210

Identifying Self-Contradictions and Oxymorons

Self-contradiction is logical inconsistency within a single statement; one part of the statement is inconsistent with another part. An example would be "This replica of a coin manufactured by the Continental Congress in 1776 is authentic in every respect." Here is a slightly more complicated example: "Sharks were on Earth millions of years before any of the dinosaurs, but a few of the early, small dinosaurs lived before the first sharks." You can just look at that statement and see that the author is confused about sharks; you need not be an expert on sharks.

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209 (b) is inconsistent with the original three on the list. Each of the others, separately, is consistent with the original three.

210 There might or might not be an inconsistency here because “some” is ambiguous in English. If “some” is meant in the sense of "at least one but definitely not all,” there is a logical inconsistency. But if “some” means "at least one and possibly more," then there is no inconsistency. Because “some” could be meant either way here, you cannot tell whether an inconsistency exists. Speakers who intend to imply with their word “some” that some are and some aren't should stick in the word “only” and say "Only some of the real televisions are appliances." From now on in this book we will make the assumption that “some” means simply “at least one but possibly more.”

Self-contradictory statements are false, but false statements need not self-contradictory.

> "False" is another way of saying "inconsistent with the facts."

When George Bush was campaigning for the U.S. presidency, he said the following about the resignation of eight campaign aides accused of anti-Semitism: "I hope I stand for anti-bigotry, anti-Semitism, anti-racism. This is what drives me . . . ." A slip-up. If you are for anti-Semitism, then you must be for bigotry, so Bush contradicted himself. Anti-Bush folks got a big laugh out of this one; many pro-Bush folks believed the press shouldn't have bothered to make such a fuss about it.

———CONCEPT CHECK———

Explain the self-contradiction that occurs in this dialogue. Notice that if you take the colonel literally, his hormones are staging a *coup d'etat* on his brain.

> Colonel: (angry at the soldier he is speaking to): Are you on our side or theirs, soldier?
>
> Private: On our side, sir.
>
> Colonel: Soldier, I don't demand very much from my men . . . just that they obey me like they would the word of God.

———[211]

I wish I could show you a round square; I cannot because *round square* is a contradiction in terms. The very meanings of the terms *round* and *square* conflict with each other, so there can be no round squares. "Jumbo shrimp" is not a contradiction in terms; it doesn't mean "large and not large"; it means "large for a shrimp." A contradiction in terms is called an **oxymoron**. Debates are often started by asking whether a term is an oxymoron. For example, is *artificial intelligence* an oxymoron? Jokes are often based in oxymorons, as when someone asks whether *military intelligence* an oxymoron. Military officers do not believe this is a joke.

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[211] In demanding that the private obey his word like the word of God, he is demanding very much—too much. This is inconsistent with his saying that he isn't demanding very much. What the colonel says is amusing because he is so obvious about being inconsistent. We in the audience are charitable and do not take him literally; instead we note the irony and reinterpret him to mean simply that he is very demanding. The dialogue is from the film *Full Metal Jacket*.

When a communicator unintentionally uses an oxymoron, the mistake doesn't usually destroy the main point being made. It does, however, cause the audience to lose respect for the communicator. The mistake is a sign of carelessness or lack of sophistication.

A theologian once said that capital punishment is inconsistent with forgiveness. The theologian meant that if the government kills a criminal, then it cannot later forgive the criminal for the crimes.

———CONCEPT CHECK———

The Health-o-Meter personal scale says "100 percent electronic spring-free strain gauge technology. Consistent accuracy... up to 300 pounds or 136 kilograms.″ This ad

a. contains an oxymoron.

b. does not use *consistent* in the sense of logically consistent.

c. makes a mathematical error.

a. says the personal scale is logically consistent with its description.

———[212]

Inconsistency with Presuppositions

You may have seen cars bearing this threatening bumper sticker: "If you don't like the way I drive, then stay off the sidewalk." The statement taken literally presupposes that the driver drives on the sidewalk.

Definition Statement A *presupposes* statement B if a speaker wouldn't state A unless he or she were taking the truth of B for granted.

The *presuppositions* of a statement are background assumptions. The presuppositions are other, unsaid, relevant statements that would normally be taken for granted if you believed or

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[212] Answer (b). It means "unchanging," not "logically inconsistent" or "factually inconsistent."

asserted the statement. A isn't going to be even true or false without B being true. For example, referring to U.S. arms shipments to Iran being made in exchange for the release of U.S. hostages, comedian Mark Russell, impersonating the U.S. president, said, "We sold no weapons to Iran, and we won't do it anymore." The joke here turns on inconsistency. A speaker probably wouldn't say "We won't do it anymore" unless the speaker was presupposing that we did it once. But the first part of this joke explicitly says we didn't do it, even once.

———CONCEPT CHECK———

Gandhi led India to independence from Britain in 1947, a few years after World War II. British soldiers killed, injured, or jailed many Indians in an attempt to suppress this revolution. When asked by a reporter what he thought of Western civilization, Gandhi said, "I think it would be a good idea." Gandhi's joke turns on a presupposition. Identify the presupposition.

α. The British are still there in spirit and were never expelled.

β. The Western world is not civilized.

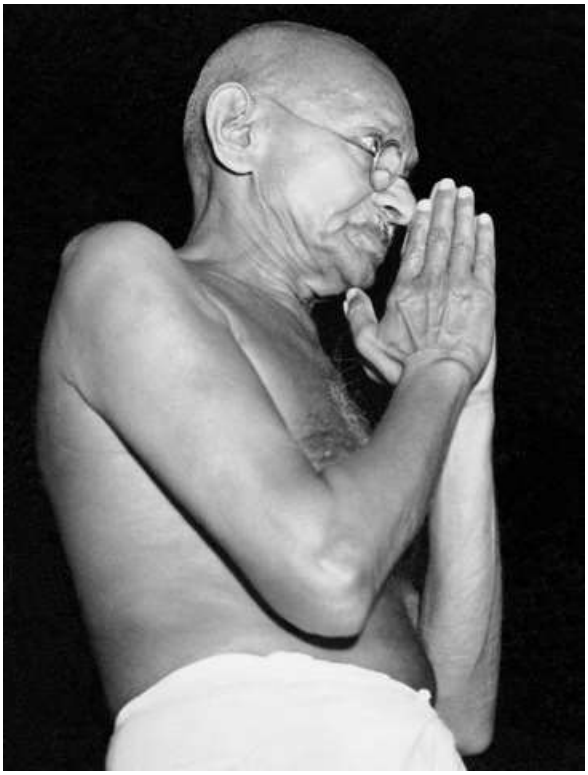
χ. Western civilization is a good idea.

δ. He had a good idea.

ε. It would be a good idea for the British to be expelled.

———[213]

[213] Answer (b). He assumed that the Western world is not civilized and was remarking that it would be a good idea for it to become civilized. Because his assumption is not the questioner's assumption, the comment is humorous.



CONCEPT CHECK

The United States and Iran were the two parties involved in a 1980s scandal about trading U.S. weapons in return for the U.S. hostages who had been seized by Muslim fundamentalists. Impersonating the president, a comedian referred to the trade and said, “There was no third party involved, and we want to thank Israel for all their help." What is the presupposition that is being contradicted?

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Well, we’ve been talking a lot about jokes. Now it's time to get serious. Let's examine astrology—the ancient study of how the stars and planets affect earthly events. My reason for not believing in astrology is that I'm a Scorpio.

That completes our examination of astrology. It also demonstrates something about how jokes turn on self-contradiction.

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214 If you thank Israel for their help, you presuppose that Israel did help and thus that there was a third party involved after all.

You may enjoy trying to detect the inconsistency that makes you doubt Harpy's excuse in the following story.

> Harpy lived with his grandmother next to the freeway in Cleveland, Ohio. He and his grandmother, Mrs. Harker, were on welfare because his father had disappeared and his mother drank so much every day that she was in no condition to raise her children. Harpy didn't like going to middle school, but he did like model airplane glue. Fortunately, he wasn't old enough to buy it himself. In Ohio you have to be eighteen or have a note from your parents. One morning he asked his welfare worker to buy him some glue. A friend had promised to give him a kit for a small airplane, he said. He wanted to start with fifteen tubes.
>
> Although he never got the glue from her, Harpy did enjoy talking to the welfare worker whenever she came for a visit. A few months after the glue incident, between Christmas and New Year's, she arrived for one of her scheduled morning visits. She was surprised to find Harpy's grandmother alone and crying about the Christmas they had just had. Mrs. Harker was crying because her grandson had given her such wonderful presents for Christmas. She wasn't crying for joy. She was crying for another reason.
>
> The next time the welfare worker had a chance, she asked Harpy about those presents. He responded very seriously, “I talked to God in my dream just before Christmas. God said my grandmother loved me very much, and I hadn't done nothin' for her. She worked real hard all her life, and she deserved somethin' real good. We didn't have no money, so God said to me, 'Harpy, you go to Sears' I went to Sears."

Harpy's claim that God told him to shoplift is inconsistent with most people's beliefs about what God would really sav.[215]

Refuting General Statements by Finding Counterexamples

Here is a universal generalization about cows: "All cows are brown." You can refute it by pointing out a cow that isn’t brown.

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215 Unfortunately, this is a true story in the author’s experience, although all the names of the people and the city have been changed.

When you say, "Most of the cows are brown," you are also making a generalization, but not a universal generalization, and you cannot refute it by pointing out a cow that isn't brown.

When you say, "My cow is all brown," you are not generalizing but are making a more specific statement. A **generalization** about a group is a statement about the group that says some, all, or a percentage of them have some property. The property we have been talking about is brown color.

Here is a list of different kinds of generalizations:

All A are B

No A are B

Most A are B

Many A are B

44% of A are B

Two-thirds of A are B

Some A are B

The letters "A" and "B" stand for groups or things, not whole statements. Only the first item on the list is a universal generalization, but when most people use the term "generalization," they mean a universal generalization, and they don't realize that other items on the list are also generalizations. You'll have to be alert to this.

Generalizations saying that some percent or fraction of A are B are called "**statistical generalizations.**"

One version of the straw man fallacy is called **quibbling about a generalization**. The mother tells her little girl, "Drinking poison will kill you; put that down!" Our quibbler responds, "Wait! It might not kill her. I once heard that someone drank a half teaspoon of some poison and lived to tell about it because the emergency crew arrived in time, and the person was fed intravenously for a week." OK, the quibbler is correct that there is a counterexample to the mother's generalization IF you take her generalization too literally. However, the mother really meant to tell her little girl that drinking poison will *very probably* kill her. The quibbler didn't pay attention to the spirit of the remark and took it too literally. Critical thinkers are charitable and don't quibble. When quibblers confront us and our generalizations, we recognize their mistake and we point out that we didn't mean for them to take us so literally.

Your opponent's statement has been **refuted** when you have made a totally convincing case that the statement is false. A refutation is a successful disproof. If you make a statement that is inconsistent with your opponent's statement, you don't have to be correct, but if you refute them, you do. Presenting a **counterexample** is one way to refute a universal generalization. The counterexample will be an exception to the claim.

> A true statement cannot be refuted, so a true generalization will have no counterexamples.

———CONCEPT CHECK———

Fill in the blank. Suppose Chandra Morrison says every U.S. president has been a man, and Stephanie says the third president was female. Stephanie has _____Chandra.

a. refuted

b. given a counterexample to

c. done both a and b to

d. done none of the above to

———[216]

If someone makes the general claim that all As are Bs, one good way to test the claim is to sample some of the As and check to see whether they are also Bs. If you find even one exception, the generalization is refuted.

Refutation is the engine driving science forward. Science progresses by trying to refute statements that are precise enough to be tested. Scientists attempt to refute predictions, conjectures, claims, hypotheses, laws, and theories, provided they are formulated precisely enough that a scientist can figure out how to run a test or experiment which, if failed, would refute them. Statements that fail the tests because they are inconsistent with the observations are

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[216] Answer (d). Stephanie has said something inconsistent with what Chandra said, but not refuted her, so (a) is incorrect. If you refute someone, you must be correct, but Stephanie was not correct, was she? Now about (b). Stephanie has not given a counterexample to Chandra's statement, because a counterexample must be correct, yet what Stephanie says is incorrect. So (b) is also the wrong answer.

declared to have been refuted. The scientific community holds on only to that which it has not yet refuted. The truth is what can stand up to this procedure of attempted refutation.

For an everyday example of this procedure, suppose you flip the switch to turn on the light in your bedroom and nothing happens. Then you try to figure out why nothing happened. Can you think of any explanations? How about "The laws of electricity were just repealed"? No, that is not a likely explanation. Here are four better ones:

- The bulb is burned out.
- A fuse is blown.
- The switch is broken.
- A wire in the circuit is broken.

Which one of these hypotheses is correct? Any of the four could be correct. Well, suppose you screw in a new light bulb and it lights up. That settles it. Your scientific experiment has supported the first hypothesis and refuted the other three.

———CONCEPT CHECK———

The following passage describes a scientific test designed to confirm or refute some hypothesis, (i) State the hypothesis to be tested. Hint: It had to do with both Uranus and something beyond Uranus. (ii) Describe the test—that is, state how the hypothesis was tested. (iii) What possible test result would have been consistent with the hypothesis? (iv) What possible test result would have been inconsistent with the hypothesis? (v) Did the test results refute the hypothesis? That's a lot of questions. OK, here's the passage.

> The success of the English astronomer Edmund Halley in using Newton's laws of mechanics and gravitation to predict the orbits of recurring comets and the success of other astronomers in predicting the positions of the planets convinced almost all astronomers in the Western world that the heavenly bodies are not supernatural beings but are in fact physical objects obeying Newton's laws. In the early 1800s, the outermost planet known to exist in our solar system was Uranus. Unfortunately, the positions of Uranus that were predicted from using Newton's laws did not quite agree with the observed positions, and the deviation was too much to attribute to errors made with the astronomical instruments. Astronomers at the time offered two suggestions for the fact that the predicted positions did not agree with the observations. One hypothesis was that Newton had made some mistake with his laws of mechanics and that the laws should be revised. The other conjecture was that Uranus wasn't the outermost planet after all—that some other unknown planet was attracting Uranus. To check this latter conjecture, the English astronomer J. C. Adams, in 1843, and the French astronomer Leverrier, in 1845, calculated that the positions of Uranus could be explained by

Newton's laws if there were another planet nearby of a specific size and orbit. They suggested that astronomers begin looking in a certain place in the night sky for this planet, a place where the planet must be in order to account for Uranus's orbit. The planet was in fact observed there in 1846 by astronomers from several different observatories. That planet is now called Neptune.

217

Resolving Inconsistencies

In a Peanuts comic strip, Charlie Brown says, "I tell you, Lucy, birds do fly south during the winter." Lucy responds with what she takes to be a counterexample: "Chickens are birds, aren't they? You never see a chicken flying south for the winter, do you?"

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217 (i) Another planet beyond Uranus was attracting it sufficiently to account for the actually observed positions of Uranus in the sky according to an accounting using Newton's laws. (The hypothesis is not simply that there is another planet.) (ii) It was tested by using Newton's laws to predict where the new planet should be located. (iii) Test results that would consistent with the hypothesis: finding a new planet in the predicted location after a careful search. (iv) Test results that would be inconsistent with the hypothesis: not finding a new planet in the predicted location after a careful search. (v) No, the actual test results were consistent with the hypothesis.

"Good grief," says Charlie Brown. This exchange contains a good example of misinterpretation resulting from ambiguity. Lucy takes Charlie Brown's claim one way, but he means it another way. In the way Lucy takes it (all birds fly south) there is a counterexample involving chickens; in the way Charlie Brown means it (many birds fly south), there is no counterexample. To avoid the misunderstanding, Charlie should revise his statement by saying what he means. The moral is that clearing up ambiguity can resolve an inconsistency.

> Clearing up ambiguity can resolve an inconsistency.

When you are given inconsistent information, you should reject some of the information to resolve the problem and achieve consistency among the remaining pieces of information. Because you also want to find the truth, you should always reject the information that is the least well supported or the most likely to be false. However, in cases where it isn't clear what to revise, you need to search for more information (and hope that in the meantime you will not have to act on the information you have).

———CONCEPT CHECK———

This apparently inconsistent sentence was published in a U.S. newspaper. Can you clear up the problem?

> Instead of being arrested, as we stated, for kicking his wife down a flight of stairs and hurling a lighted kerosene lamp after her, the Reverend James P. Wellman died unmarried four years ago.

———218

Sometimes a person has inconsistent moral principles that don't appear to be inconsistent. For example, suppose you, like most people, believe the moral principle that

> (1) People ought to keep their promises to their family,

and also the moral principle that

> (2) You shouldn't do anything that is likely to hurt innocent persons.

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218 The newspaper was apologizing for the false report about the Reverend's violent behavior when in fact he had not behaved this way but had died four years before the report.

These don't appear to be inconsistent. Now suppose that your father insists you keep your promise to help him with his summer project. His project is, you later learn, to stop the burglaries on your family farm by booby-trapping the windows and doors of the barn. An infrared beam of light will pass by the inside of each window. If anyone forces open the window and sticks his head through, they will get a blast of birdshot in the side of the head.

Think of the innocent but curious eight-year-old girl next door who finds the window unlocked on a day when the alarm is activated. She could be hurt. This would violate principle (2) above. The very possibility of this tragic event, even if it never happens, shows that moral principle (1) is inconsistent with moral principle (2). Moral principles are supposed to cover possible situations as well as actual ones. Therefore, you are caught in an ethical dilemma. Which moral principle should be revised? One reasonable change would be to revise principle (1) in favor of (1'):

> (1') People ought to keep their promises to their family unless doing so is likely to hurt innocent people.

Principles (1') and (2) are consistent. This process of resolving moral dilemmas by thinking in advance about potential situations is an important way to make moral progress, and it is the kind of thing that gets talked about in ethics classes. Attention to logical inconsistency can promote moral growth.

The notion of resolving contradictions also plays a central role in adding new information into your store of knowledge. Your goal in adopting new beliefs is always to add more while maintaining consistency. We all try to do this, but there are good ways and not so good ways to do so. Suppose, for example, that your problem is to decide whether George can swim well. If you knew that he was a lifeguard, that would be significant supporting evidence. Almost every lifeguard in the world is a good swimmer—let's say 99 out of 100 lifeguards are good swimmers. Here is a fine argument using this evidence:

George is a lifeguard.
99 out of 100 of the world's lifeguards can swim well.
So, George can swim well.

You cannot be absolutely sure of the conclusion on the basis of those two pieces of information, but you can be about 99 percent sure. It would be illogical to conclude that he *cannot* swim well. Now, compare that argument with this one:

> Fred is a Frisian.
> Frisians are poor swimmers; in fact, 8 out of 10 Frisians cannot swim well.
> So, Fred cannot swim well.

You could be about 80 percent sure that Fred cannot swim well, given these two pieces of information. Both arguments are good arguments because they provide good reasons to believe their respective conclusions. You should add both conclusions into your store of information if you happen to know that the premises are true.

Now for the surprise. Suppose you acquire some new information: Fred is George. If you hold onto the conclusions from the two previous arguments, you will conclude that Fred can swim well and also can't. You can't have that. It is time to go back and revise your store of information. How are you going to resolve your contradiction?

You should retract your belief that Fred cannot swim well. Fred is an exceptional Frisian. The best conclusion on the total evidence is that he *can* swim well, but now you can no longer be 99 percent sure. You need to reduce your estimate of the probability. We won't try to figure out the new probability number.

An important moral can be drawn from our swimming story: Do not cover up counterevidence. The more evidence you pay attention to, the better position you are in to draw the best conclusions. A second moral is that belief is a matter of degree; it is not an all or nothing affair.

> We hold beliefs more or less strongly. It's not simply that we believe something or we don't.

Review of Major Points

In this chapter we examined the notion of inconsistency, which plays such an important role in judgments of improbability. We considered how one sentence can be inconsistent with another, as well as how a sentence can be self-contradictory and can be inconsistent with its presuppositions. A verbal statement can even be inconsistent with the speaker's body language or tone of voice. Finding an example that is inconsistent with a general claim of the form "All

As are Bs" will serve as a counterexample that refutes this general claim. Finding a counterexample is not, however, the only way to refute a claim.

When you are given inconsistent information, you should reject some of the information to resolve the problem and achieve consistency among the remaining pieces of information. Because you also want to find the truth, you should always reject the information that is the least well supported or the most likely to be false. However, in cases where it isn't clear what to revise, you need to search for more information (and hope that in the meantime you will not have to act on the information you have). One important lesson from this discussion is that, when trying to assess a belief, you should not cover up counterevidence, and you should pay attention to the strength, or degree of certainty, with which you should hold a belief.

Glossary

contradiction in terms Applying two or more terms to give a logically inconsistent description. Calling a farmer's field a *round square* would be to use a contradiction in terms. Contradictions in terms are also called *oxymorons*.

contrary A pair of statements are contrary if they are inconsistent but both might be false. "It is less than 10" and "It is greater than 77" are contrary statements.

counterexample to a statement A true statement that is inconsistent with a previous statement and that is about some specific item in a category mentioned in the previous statement. "Spud Webb is a short basketball player" is a counterexample to "All basketball players are tall." We also can say Spud Webb is a counterexample.

generalization A generalization about a group is a statement about the group that says some, all, or a percentage of them have some property.

hypothesis An hypothesis is a claim that is proposed. If someone were to offer a possible explanation of some phenomenon, then that explanation would be an hypothesis.

logically inconsistent statements A group of statements that could not all be true together, in virtue of their meaning. Normally we drop the word "logically" during discussions of inconsistency.

oxymoron A contradiction in terms. Inconsistent phrases such as *the living dead* and *exceptionally ordinary* are oxymorons.

presuppositions A statement's presuppositions are unsaid, relevant statements that would normally be taken for granted in making the statement. Saying, "I like your car" presupposes you do have a car. It doesn't presuppose that 1 + 1 is 2.

refutation A successful disproof. Refuting a statement requires more than merely contradicting it.

self-contradiction Logical inconsistency within a single statement. Example: "Ahmed is taller than Steve, and Steve is taller than Ahmed."

Exercises

Inconsistency

■ 1. Which of these signs, if any, gets its humor from an appeal to inconsistency?

a. On a California freeway: "Fine for Littering."
b. On the wall of a Canadian cleaning service: "Able to Do the Worst Possible Job."
c. In a Boston fast-food parking lot: "Parking for Drive-Through Customers Only."
d. At a Florida bookstore: "Rare, out-of-print, and nonexistent books."
e. Posted at a New Hampshire library honoring the poet Robert Frost: "Frost Free Library."[219]

■ 2. If somebody says to you that it is raining and it is not, then by applying the principle of charity you can reasonably assume that the person intends to say something logically inconsistent—something that is really so and not so in the same sense at the same time.

a. true b. false[220]

3. The principle of charity for inconsistency

a. is a technique of thought for revealing or uncovering a contradiction in one's own thinking.
b. says to be charitable to your principles regardless of the inconsistency in other people's principles.
c. is applied to consistent sets of statements to turn them into inconsistent sets.

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[219] All of them. For example in the first sign, there is an inconsistency between one interpretation of the ambiguous sign and your expectation. The one interpretation is that the littering is fine in the sense of OK, but that's inconsistent with your expectation that the littering is not OK and thus deserving of a financial fine.

[220] Answer (b). Perhaps the person means that it is raining in some place but not raining in some other place. That could be true. Using the principle of charity, you would assume that the person intends to say something true; logically inconsistent statements cannot all be true.

d. says to try to find a consistent interpretation.

■ 4. If Sarah says, "Andre Agassi from Las Vegas once won the French Open Tennis Tournament," and if you reply with, "No, he didn't," then you've contradicted Sarah

a. true b. false[221]

5. Read the following newspaper editorial.

> Tfiineo Sakai won't be attending classes at the University of Rochester's William E. Simon School of Business this fall. He was admitted all right, but that was before the Eastman Kodak Company found out he worked for Fuji Photo Film in Japan and would actually be associating right there in the same classroom with some of its own employees in a two-year master's degree program for middle-level businessmen. Kodak doesn't approve of that kind of fraternization with its business rivals, and Sakai has been sent packing.
>
> When Kodak barks, Rochester jumps. The film and camera company isn't just the city's leading industry; it's also the reason why the university has one of the ten largest endowments in the country. Other American universities have run into criticism for undertaking research under proprietary contracts with private companies or for accepting funds from foreign countries or other sources of beneficence with strings attached specifying what's going to be taught with that money. But only in Rochester, so far as anyone knows, can a corporate benefactor actually reach right down into the admissions process to determine who's fit to be educated.
>
> Japanese companies like to send their employees to study here so that they can learn more about American business principles and practices. Sakai certainly obtained a terrific object lesson at the Simon school, which has heretofore loudly proclaimed its commitment to free markets and an absence of regulatory oversight. Kodak, for its part, says it was only concerned that some of its people might have felt constrained from talking in school while Sakai was around for fear that they might give away some company trade secrets. Meanwhile, Kodak has announced that it's giving the Simon school another $36,000 a year to train business executives in how to take creative risks. Obviously, there's no connection between the two events.222

In the above passage, is the following remark true? The writer reports that Kodak's contributions to the university are the real reason why the university has one of the ten largest endowments in the country, yet the article itself contradicts this claim by suggesting between

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221 Answer (a). Your remark contradicts her statement, but doesn't refute it until you go on to show you are correct and she is not.

222 From *The Sacramento Bee*, September 9, 1987, p. B6.

the lines that this is not the real reason why the university has one of the ten largest endowments in the country.

a. true b. false

6. The writer of the editorial in the previous question explicitly says there's no connection between the two events (requesting the student rejection and donating $36,000) but implies between the lines that there really is a connection, so the writer accuses Kodak of committing a contradiction between what they say is so and what is really so.

a. true b. false

7. Given your common knowledge, and paying attention to the source of the information in the above editorial, it is reasonable to be skeptical and say it is fairly improbable that Kodak really intends to give $36,000 more a year to the University of Rochester.

a. true b. false

8. The writer of the editorial about Kodak says the Simon business school at the University of Rochester has publicly proclaimed a commitment to free markets and an absence of regulatory oversight, yet the writer suggests that the school's actions show they don't actually have that commitment, so the editor indirectly accuses the Simon school of an inconsistency between what they say and what they do.

a. true b. false

9. Notice in the following dialogue how Emilio slowly uncovers Washington's inconsistent set of moral beliefs.

Emilio: Listen to what it says here in the paper. "David Jones was especially bitter after the experience. After commenting on the incident, he said I don't see why having sex with your mother is wrong. If it feels good, then it's OK. Of course, I would never do it; I wouldn't want to go to jail. Besides, in my own case I never really liked my mother, God rest her soul, but I don't believe it's unethical.'" Damn. Can you believe Jones really said that? I think he ought to get what he deserves.

Washington: What's that?

Emilio: About twenty years making license plates in the prison factory.

Washington: Who's to judge?

Emilio: What do you mean by that? I'm to judge, that's who!

Washington: I doubt it. It's not your place. Are you planning on playing God here? It's for God to decide these things.

Emilio: Are you saying that no ordinary person is supposed ever to make any moral judgments of right and wrong about anybody else's behavior?

Washington: You got it.

Emilio: You don't really believe that. I know what you've done.

Washington: What are you talking about? Done what, when?

Emilio: Remember the little boy you found in the psychology building when we were on our way to class?

Washington: Yes.

Emilio: Well, you made a moral decision right there. You could tell he was lost, and you helped him find his way back to his family. He had gotten off the elevator on the wrong floor. You were fifteen minutes late to your psych class.

Washington: Just because I helped him doesn't mean I made any moral judgment of him.

Emilio: Right, you didn't judge him, but you did judge your own action. You acted to help, but you could have acted by doing nothing. A decision not to get involved is a moral decision, too. You chose. You weren't playing God. You just judged between the two ways for you to act.

Washington: OK, but I judged my *own* actions, I didn't judge anyone else's.

Emilio: Suppose I'd been alone and had found the same boy.

Washington: Then it would have been your problem.

Emilio: Wouldn't you have expected me to do the same thing you did?

Washington: Yeah, I'd have predicted that. I know you're apt to do that kind of thing just because you're you. It comes natural.

Emilio: But wouldn't you have thought badly of me if I'd *not* done what you expected? You do believe I have the free will to do something you don't expect, right?

Washington: Uh, yes. OK, I'd approve if you did help the kid. Which reminds me, you never paid back the money I gave you when we both had turkey sandwiches at lunch the day before Thanksgiving.

Emilio: Oh. Well, your memory is as good as any elephant in your herd.

Washington: Why is it easier to remember who owes you money than who you owe money to?

Emilio: Maybe because it's easier to judge than to be judged.

Identify the inconsistent set of Washington's moral beliefs that Emilio uncovered with his questioning.

10. If a set of statements is inconsistent, then any addition to the set that doesn't revise the original statements will preserve inconsistency.

a. true b. false

11. Create a sentence that contains an oxymoron that was not used or mentioned in this chapter.

■ 12. Is this group of three statements logically inconsistent? (In this problem, interpret the word *some* to mean "at least one and possibly all.")

Every dog chases some cat.
Some cats chase no dogs.
Some dogs chase all the cats.[223]

■ 13. The following statement is false:

A rose is not a rose.

a. true b. false[224]

■ 14. The following statement is self-contradictory:

A rose is not a rose.

a. true b. false[225]

■ 15. If a person is being inconsistent, as we have been using this term, then the person has irregular patterns of behavior or frequently changes his or her beliefs.

a. true b. false[226]

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223 The three could all be true, so they are consistent.

224 Answer (a).

225 Answer (a).

226 Answer (b).

16. Are these four statements logically consistent?

- Only bears sleep in this house.
- Goldilocks is not a bear.
- Smokey is a bear.
- Goldilocks and Smokey both sleep in this house although Smokey sleeps downstairs and Goldilocks sleeps upstairs.

17. Consider this list of three statements:

i. $x + 1 = 10$

ii. x is unequal to 7

iii. $x < 3$

If the following statement is added to the above three, will the resultant set of four statements be consistent?

$x = 9$

18. Consider this list of three statements:

i. Modern works of art are not romantic.

ii. But they are occasionally erotic.

iii. However, an erotic work of art could be romantic.

Which statement(s) below, if added separately to the above list, would cause the list to be inconsistent?

a. More than one romantic work of art is erotic.
b. Only one romantic work of art is erotic.
c. Two romantic works of art are modern works.
d. Romantic works of art are not modern.
e. All of the above.

■ 19. Is this set of statements inconsistent, provided there is no equivocation?

The human body is totally a material thing.
The human mind is totally a spiritual thing.
Mind and body can interact.

Spirit and matter cannot interact.[227]

20. Which of the following statements, if added to the four statements in the previous question, would make the new list of five statements be consistent?

a. Spirit and matter do interact.

b. The human body is both a material and a spiritual thing.

c. Sometimes the human body is a material thing and sometimes it is not.

d. None of the above.

■ 21. What logical inconsistency, if any, occurs in this hypothetical news story?

The Russian Military says that it sold 150 bear missiles for $3 million to Central American freedom fighters last month. It says the USSR received full payment. The guerrillas say they paid $3 million to a representative of Soviet intelligence last month; they say they were promised they would receive 150 bear missiles, but only 50 missiles were ever delivered.[228]

22. Defend your evaluation of the quality of the following explanation:

Approximately two-thirds of the doctor's patients caught Barre's disease. This fact can be explained by pointing out that the doctor breathed directly on all his patients, that the doctor had Barre's disease, too, and that whenever a person with Barre's disease breathes directly on another person the other person will catch it, too.

23. Is the following sentence self-contradictory?

Voters must be club members, but some club members are nonvoters.

24. Is the following sentence self-contradictory?

Voters must be club members, but no club members are nonvoters.

■ 25. Are these two statements inconsistent? (Assume the term the *senator* refers to the same person in both statements so there is no equivocation.)

a. The wife of the senator is an interesting person.

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[227] Yes, because the statement that spirit and matter cannot interact implies that no spiritual thing can interact with any material thing.

[228] No inconsistency. However, it is likely that either the guerrillas were lying or they were cheated by the representative.

b. The senator has no wife.[229]

■ 26. If two statements are consistent, then they've got to be true.

a. true b. false[230]

27. If a group of two statements is consistent, then at least one of them must be true.

a. true b. false

■ 28. It is impossible for contradictory statements to accurately characterize the physical world, although people could hold contradictory beliefs about the world.

a. true b. false[231]

■ 29. My friend Stan told me that yesterday he had met my wife's friend Kate at a political meeting. He said they were going out to dinner this Saturday. My wife told me that she talked to Kate earlier today and Kate said she had met Stan at a political meeting; Kate told her that she and Stan were going to play tennis together on Saturday. What inconsistency, if any, is there here?[232]

■ 30. The statement that Barack Obama was the first president of the United States of America is false. It is also

a. self-contradictory
b. an oxymoron
c. inconsistent with our background knowledge
d. contrary to the claim that Abraham Lincoln was not the first president of the United States of America.[233]

31. Why is inconsistency at the heart of logical reasoning?

■ 32. Are these two statements logically inconsistent?

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229 Yes; (a) presupposes what (b) denies.

230 Answer (b). All that is required is that they could be true as far as their meanings are concerned. These two sentences are consistent even though both are false: George Washington was assassinated by Benedict Arnold. It has never snowed in the United Kingdom.

231 Answer (a).

232 No inconsistency.

233 Answer (c).

Hell doesn't exist. Yet in a different sense it really does.[234]

■ 33. Suppose Alex says, "Any oxide will melt if heated to at least 2000 degrees," and Linda says "Yttrium barium oxide melts only above 2300 degrees." Has Linda made a claim inconsistent with Alex's?

a. can't tell (briefly say why)

b. yes

c. no[235]

34. Referring to the previous question, explain why you cannot tell whether Linda has refuted Alex.

35. If three statements are inconsistent (with each other), then at least one of them must be false.

a. true b. false

36. If John says something that contradicts what Sandra says, does it follow that either John or Sandra is lying?[236]

37. Is the following sentence, which contains three sub-statements, self-contradictory?

An asterique is an emulator; all emulators can transverse-bilateralize, and an asterique cannot transverse-bilateralize.

■ 38. Which of the following statement pairs are logically inconsistent?

1. That cereal is at least 20 percent sugar.
2. That cereal is at most 20 percent sugar.

3. That soft drink is at least 10 percent sugar.
4. That soft drink is at least 15 percent sugar.

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[234] No, because of that phrase "in a different sense." If *exist* can have different senses, then hell might not exist literally as a place you can go to after you die, but it might exist here on Earth in people's minds. However, if *exist* cannot have this latter sense, then the second statement is simply false, but still not inconsistent with the first.

[235] Answer (b).

[236] It follows that one of them said something false. It doesn't follow that anyone was *intending* to say something false—that is, lying.

5. Some of them are.
6. Some of them aren't.

a. 1 and 2.
b. 3 and 4.
c. 5 and 6.
d. None of the above.[237]

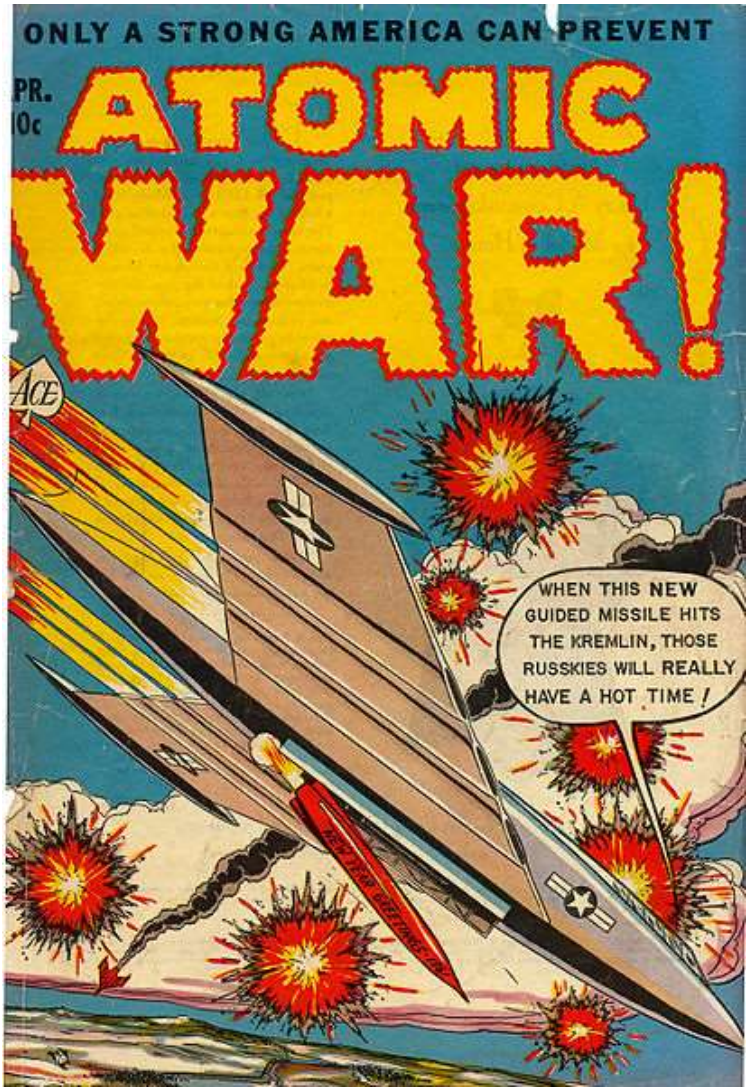
39. You are asked to find out if the following statement is true. What should a good critical thinker do? "A few dinosaurs lived on Earth before the first sharks, and some sharks were on Earth millions of years before any of the dinosaurs, but there are still many other kinds of sharks in today's oceans, although no dinosaurs that we've so far detected." Yes, the instructions are imprecise.

40. If I've contradicted what the manager of the New York Giants says, then I've thereby refuted what the manager says.

a. true b. false

■ 41. Are these four statements inconsistent?

[237] Answer (d).



- Either the U.S. or Russia will start a global thermonuclear war; nobody else can.
- If Russia starts it, then we will all die.
- Yet if the U.S. starts it, then we will all die, too.
- However, God has given us the knowledge that we won't all die, no matter what happens.[238]

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238 Yes, they are inconsistent. From the first three statements, it follows that we will all die. From the fourth, it follows that we won't. This is an inconsistency. If you know something, then it is true; that idea is applied to the fourth statement.

42. Create two graphs—one, a bar graph; the other, a pie chart. Make the two graphs be inconsistent with each other but contain as much of the same information as possible.

43. Write a short essay discussing whether the following two quotations are really inconsistent. Mention why somebody might say they are and why somebody else might say they aren't. Then try to resolve the issue of consistency. Stick to the issue; do not discuss the issue of whether slavery is morally wrong.

"Slavery is morally wrong." (Abraham Lincoln for the Union)

"Slavery is not morally wrong." (Jefferson Davis for the Confederacy)

44. Are these three statements logically consistent with each other?

Only bears sleep in these woods.
Squirrels sleep at night, but not in these woods.
If a thing sleeps in these woods, then it's a bear.
All bears and only bears sleep in these woods.

Counterexamples

1. If statement A is a counterexample to B, then B is a counterexample to A

a. true b. false

■ 2. (a) Create an original generalization about AIDS or about being HIV positive. (b) Give an example that is consistent with it and supports it. (c) Create a successful counterexample that is inconsistent with it and that refutes it.[239]

■ 3. If it is possible, create an original statement that is easily recognized to be a universal generalization with no counterexamples.[240]

4. If it is possible, create an original statement that is easily recog nized to be a universal generalization but that has a counterexample.

5. Create a statement that would be a counterexample to the claim that all things in the universe are cooler than a candle flame.

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[239] (a) All past basketball players were HIV positive, (b) Magic Johnson (a basketball player who played for the Los Angeles Lakers) was HIV positive, (c) Johnny Dawkins (a basketball player who played for the Philadelphia 76ers) was not HIV positive.

[240] All even numbers are integers.

■ 6. Give a counterexample to the claim that all promises should be kept.[241]

7. Identify the claim below that is a generalization but that has no counterexamples.

   a. There is no there there. (Said by Gertrude Stein when she was talking about her home in Oakland, California.)

   b. All professional basketball players in the U.S. like to eat Cheerios.

   c. Every planet around the sun is held in orbit primarily by the force of gravity.

   d. In general, General Abrams has more clout than General Franklin.

8. Here is a refutation of the astrologers' claim that the stars determine every person's destiny. It is from the Confessions of St. Augustine, a Roman, who was a Catholic father born in North Africa and who wrote in about 400 A. D. First, briefly explain why his challenge is a successful refutation. Then revise and weaken the claim by making it less precise so that St. Augustine's remarks won't refute the revised claim.

> Firminus had heard from his father that when his mother had been pregnant with him a slave belonging to a friend of his father's was also about to bear. It happened that since the two women had their babies at the same instant, the men were forced to cast exactly the same horoscope for each newborn child down to the last detail, one for his [father's] son, the other for the little slave. Yet Firminus, born to wealth in his parents' house, had one of the more illustrious careers in life whereas the slave had no alleviation of his life's burden.

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[241] Consider the example of a promise you made to your friend to return the knife you borrowed. In the situation in which he rushes up to you raving mad and saying he wants his knife back so he can kill his mother, you should break your promise. Saying "You should not keep promises that might hurt someone" is a relevant answer. It is in the ballpark, but it is inadequate because it provides no specific example of a promise. A counterexample is always a specific example from the category that the generalization is about.

CHAPTER 10 Deductive Reasoning

In any argument, the arguer intends the reasons to adequately support the conclusion, to *imply* it. For example, if you want people to conclude that your product is the best buy for them, you ought to give them some good reasons. What makes the reasons good enough is that they imply that your product is the best buy for them. This chapter explores how the notion of implication lies at the heart of logical reasoning. There are two kinds of implication that can be involved—deductive or inductive. This chapter focuses on deductive arguments, and the main goal of a deductive argument is to satisfy the standard of being *deductively valid*. We will define "deductive validity" very soon.

Implying with Certainty vs. with Probability

From the supposition that all real moons are made of green cheese, does it follow that the Earth's real moon is made of green cheese?

Yes, it follows with certainty. That is, you can be certain of it on the basis of the reason given. However, the reason is an odd one, isn't it? As you can see from that odd argument, the notion of following-from is about what *would be* true if something else were true, regardless of whether that "something else" is true or not.

> In any good argument, the conclusion follows from the reasons given.

In a successful argument, the conclusion follows from the reasons given. The reasons used in an argument are called its premises. The **basic premises** are those used to establish the conclusion directly rather than by being a premise justifying another premise that supports the conclusion.

Sometimes the inference can make an argument's conclusion follow with certainty, in which case we call the argument **deductively valid**, but in many other arguments the premises are intended only to make the conclusion significantly more probable, in which case we say the argument is **inductively strong**.

The conception of deductive validity was introduced back in chapter 2. Here is how it was defined there:

> An argument is **valid** if the truth of its basic premises force the conclusion to be true.
>
> An argument is **valid** if it would be inconsistent for its basic premises to be true and its conclusion to be false.
>
> An argument is **valid** if its conclusion follows with certainty from its basic premises.

> An argument is **valid** if the conclusion would be true whenever the basic premises were true.
>
> An argument is **valid** if it has no counterexample, that is, a possible situation that makes the premises true and the conclusion false.

Suppose you have talked to ten baseball fans, and nine out of ten of them said the Baltimore Orioles won't win the next pennant. Suppose that on the basis of this information you conclude that the Orioles won't win the next pennant. You've just created an argument whose conclusion is probable, given the premises. Just how probable will be difficult to pin down precisely. If you talked only to fans who have biased views about the Orioles, your information makes your conclusion less probable than if you had talked to a wider variety of baseball fans, including perhaps some baseball experts. But even the experts can't know for sure.

We have just been considering an inductive argument. Now, let's consider a deductively valid argument, an argument whose reasons, if true, force the conclusion to hold. Suppose all vice-presidents of the United States since Martin Van Buren have secretly been the coordinators of U.S. intelligence operations during their terms of office. Also suppose Andrew Johnson was the vice-president of the United States under President Ulysses S. Grant, a president who served after Van Buren. What would this information imply with certainty? It would imply that Andrew Johnson was once the coordinator of U.S. intelligence operations. Another way of saying this is that if you wanted someone to conclude that Andrew Johnson was once the coordinator of U.S. Intelligence operations, you might consider giving the person the following two reasons:

> (1) All vice-presidents of the United States since Van Buren have secretly been the coordinators of U.S. intelligence operations during their terms of office.
>
> (2) Andrew Johnson was the vice-president of the United States under President Ulysses Grant, a president who served after Van Buren.

Reasons 1 and 2 imply with certainty that Johnson once coordinated U.S. intelligence operations.

These notions of implying with certainty and implying with probability can be defined in terms of the notions of inconsistency and improbability:

Definition A statement, or group of statements, P *implies* a statement Q *with certainty* if Q would have to be true if P were true. More formally, P implies Q with certainty if these two conditions hold: (1) it is logically inconsistent for P to be true without Q also being true.

Definition A statement, or group of statements, P *implies* a statement Q *with probability* if Q would probably be true if P were true. More formally, P implies Q if these two conditions hold: (1) it is improbable for P to be true without Q also being true.

Implying with probability is the vaguer notion. Implying with probability admits of degrees. The probability usually cannot be measured with a number (the fancy phrase is "cannot be quantified") but instead can only be measured as high, low, very high, and so forth. However, in those rare cases when the probability can be measured with a number, the probability is always less than 100 percent. If it were equal to 100 percent, then we'd say we have a case of implying with certainty instead of implying with probability.

When someone presents an argument intending to convince us of the conclusion, he or she tries to get us to see that an inconsistency or improbability is involved in accepting the premises but not the conclusion. If the arguer can show this, then the argument's premises really do imply their conclusion. The two definitions above try to codify these ideas. In criticizing an argument whose conclusion is intended to follow with certainty, the critic might try to show that there is no inconsistency in accepting the premises while rejecting the conclusion. If the critic shows this, then the argument's premises do not really imply their conclusion with certainty.

It is much easier to show that an invalid argument is invalid than it is to show that a valid argument is valid. To show that an invalid argument is invalid, you can show that there is a **counterexample**. That is, you can show that there could be a situation in which the premises are all true while the conclusion is false. To show that an argument is valid, you have to show that there couldn't any counterexample, and that is harder to show.

OK, let's go back over some of these points from a different perspective. To ask whether a statement implies another statement is to ask an ambiguous question. This question could mean *implies with certainty* or *implies with probability*. When *implies* occurs alone, it is best to assume that both senses might be intended. For example, suppose a person is arrested by the county sheriff. Does this action imply that the person is guilty of the crime he or she is arrested for? The best answer is "yes and no," depending on what is meant by the word *imply*. It doesn't follow with certainty that the arrested person is guilty, but it does follow with significant probability. This is because it is much more probable that the arrested person is the guilty one than that a typical non-arrested person is.

Even if it is probable that the person is guilty, the mere fact that the person is arrested does not make the probability so high that you as a juror should vote for conviction on the basis of just this fact. You shouldn't vote for conviction until you have been shown that the probability of guilt is high enough to be called "beyond a reasonable doubt." District attorneys try to show that from the evidence of the case it follows with very high probability that the defendant is guilty. The D.A. could never hope to show that the guilt follows with certainty. That would be too high a standard, and no one would ever get convicted.

The following are different, but equivalent, ways of saying that a statement P implies a statement Q with certainty:

- The argument from P to Q has no counterexamples.
- The argument from P to Q is deductively valid.
- Q can be deduced validly from P.
- Q follows with certainty from P.
- Q follows necessarily from P.
- Q is logically implied by P.
- Q follows logically from P.
- Q can be deduced from P.
- P logically implies Q.
- P necessitates Q
- P entails Q.

Let's look at some more examples of "following from" to get a better understanding of what follows from what and whether it certainly follows or just probably follows.

Does the statement "Everybody admires the first lady" imply with certainty that the current secretary of state admires the first lady? Yes, it does. Suppose you then learn that not everybody admires the first lady. Does the conclusion about the secretary of state admiring the first lady still follow with certainty? Yes, it still does. The point can be stated more generally:

> If a statement Q follows from a statement P, then it still does even if you were to learn that P is false.

Implying is a matter of "what if." We all do a lot of logical reasoning about false situations. Politicians, for example, will say, "This bill isn't law, but what if it were law? If it were law, then it would imply that things would be improved. So let's vote for the bill." The ability to do this kind of "what if" reasoning is valuable. At the beginning of this discussion, we did some "what if" reasoning from two statements: that Andrew Johnson was vice-president under Grant, who served after Van Buren, and that all vice-presidents of the United States since Van Buren have secretly been the coordinators of U.S. intelligence activities. Then we investigated what these

statements implied. However, both statements are false. Vice-presidents have not actually been the coordinators of U.S. intelligence activities. Also, Andrew Johnson was not Grant's vice-president; he was Lincoln's vice-president. Many unstated premises are like that: They're controversial and should not be left unexamined.

Consider this argument: All happy people are rich, all beautiful people are happy, so all beautiful people are rich. Although the key terms *happy*, *beautiful*, and *rich* are vague, the conclusion nevertheless follows from the two premises with absolute certainty.

> You can have certainty in your reasoning even if it uses vague concepts.

If I feel certain that a particular person wouldn't have been arrested if the person weren't guilty, that doesn't make it certain that the person *is* guilty. My psychological state of feeling certain does not make it *be* certain; it doesn't make the person's being guilty follow with certainty from the fact about being arrested.

This point is worth repeating. The certainty mentioned in the definition of *follows with certainty* is not a psychological notion; it is a logical notion. That is, certainty is about the logical relationship of support among statements. Someone's feeling certain that Q follows from P is not what makes Q follow from P with certainty. Q follows from P with certainty only if it would be impossible for P to be true while Q is false. Another way of saying this is that Q follows from P with certainty only if P fully supports Q—that is, only if P *entails* Q.

Julius Caesar did conquer Rome. If this claim were in doubt, some historian might point out that it could be concluded with certainty from these two pieces of information:

> The general of the Roman Legions of Gaul crossed the Rubicon River and conquered Rome.
>
> Caesar was the general of the Roman Legions in Gaul at that time.

Notice that if "at that time" were missing from the second piece of information, then the conclusion would not follow with certainty. Here is why. Maybe Caesar was the general at one time, but Tiberius was the general at the time of the river crossing. The more doubt you have that "at that time" is intended if it is not stated explicitly, the less sure you can be in concluding that Caesar conquered Rome.

———CONCEPT CHECK———

If an advertisement promotes a sale of clothes that are 100 percent genuine simulated cotton, then it

a. follows with certainty

b. follows with probability

c. doesn't follow

that this is an offer to sell clothes that are essentially all cotton.

———242

Let's try another concept check about the concept of following with certainty.

———CONCEPT CHECK———

242 Answer (c). Simulated cotton is not cotton.

What follows with certainty from these three sentences?

Only bears sleep in this house. Goldilocks is not a bear. Smokey is a bear.

a. Smokey does not sleep in this house.

b. Smokey does sleep in this house.

c. None of the above.

[243]

Distinguishing Deduction from Induction

When someone says to you, "That's a good argument," you need to figure out what the person means by "good." Arguments are properly evaluated as being good in different ways, most importantly as to whether they are deductively valid, deductively sound, or inductively strong.

Definition An argument is *deductively valid* if its conclusion follows with certainty from the premises.

Definition An argument is *deductively sound* if its conclusion follows with certainty from the premises and all the premises are actually true.

Definition An argument is *inductively strong* if its conclusion follows with high probability from the premises.

An argument can also be evaluated as to whether it is understandable for the audience intended to receive it, or whether it addresses the issue under discussion, and so on. However, this section will focus only on validity, soundness, and inductive strength.

By definition, a **deductive argument** is an argument presented with the intention of being valid or sound. By definition, an **inductive argument** is one intended to be inductively strong. If the arguer's intentions aren't clear, then it's indeterminate whether the argument is deductive or inductive. It will be one or the other, though—there is no other kind. Here is an example that one speaker might give as a deductive argument but that another might give as an inductive argument:

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[243] Answer (c). Answer (b) would be the answer if the first sentence had said "all bears" instead of "only bears."

If she's Brazilian, then she speaks Portuguese. She does speak Portuguese.

So, she is Brazilian.

This would be a deductive argument if its author intended for it to be deductively valid (which it isn't). The argument would be inductive if its author intended that speaking Portuguese be a "sign" or "positive evidence" making it probable that the person is Brazilian, in which case it would have some inductive strength but not a great deal. If you cannot guess the intentions of the arguer, you cannot tell whether you have been given an inductive argument or a deductive one, and you should assess the argument both ways. Then apply the principle of charity for arguments and suppose that the arguer intended the argument to be interpreted in the way in which it gets the best assessment.

Although inductive strength is a matter of degree, deductive validity and deductive soundness are not. In this sense, deductive reasoning is much more cut and dried than inductive reasoning. Nevertheless, inductive strength is not a matter of personal preference; it is a matter of whether the premise *ought* to promote a higher degree of belief in the conclusion.

(Deductively) valid does not mean "legitimate." When somebody is said to have made a valid criticism of somebody's argument, the word *valid* is not being used in our technical sense. Using our book's technical terminology, *valid inductive argument* and *sound inductive argument* are not meaningful phrases.

Declarative sentences are nearly always true or false. At least the ordinary declarative sentences are. For example, "It's noon" is a declarative sentence. "What time is it?" is not. A question is neither true nor false. A command is also neither true nor false.

It does not make sense to say an argument is true. Arguments can be good or poor, valid or invalid, sound or unsound, strong or weak, but never true or false.

Outside the classroom, people are not so careful with their use of these terms, so you have to be alert to what they mean rather than only to what they say. From the barest clues, the detective Sherlock Holmes cleverly "deduced" who murdered whom, but actually he made an educated guess. Strictly speaking, he produced an inductive argument, not a deductive one. Charles Darwin, who discovered the process of evolution, is famous for his "deduction" that circular atolls in the oceans are actually coral growths on the top of barely submerged volcanoes, but he really performed an induction, not a deduction.

Aerial view of a coral atoll in the ocean

———CONCEPT CHECK———

Assess the quality of the following argument:

> Most all wolves are not white. King is a wolf in the San Diego Zoo that we are going to visit tomorrow. So, he is not going to be white.

a) inductively very weak

b) inductively strong

c) deductively valid

———[244]

Are you clear about the difference between being valid and being sound?

———CONCEPT CHECK 4———

Is this argument deductively valid and sound?

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[244] Answer (b). If you had to bet on whether that next wolf is going to be white or not white, the best bet would be that it would not be white. Thus, the conclusion is made probable by the premises, which is a telltale sign of an inductive argument with some strength. Answer (c) would be correct if the word "Most" were "All."

The current president of Russia is an Asian, and all Asians are dope addicts, so the president of Russia is a dope addict.

———245

At the heart of the notion of deductive validity is the notion that, if an argument's conclusion follows with certainty from its premises, you would be violating the cardinal rule to avoid inconsistency if you were to assert the premises while denying the conclusion. So, for reasons of logical consistency,

> In deductively valid reasoning, a false conclusion will never follow from true premises.

———CONCEPT CHECK———

If it can be done, give an example of a valid argument with a false conclusion. If it cannot be done, say why.

———246

Starting from true premises, valid reasoning will never lead you to a false conclusion. The trouble is that invalid reasoning can lead you to a true conclusion and thereby trick you into thinking that the reasoning is really valid. For instance, let's suppose you know my pet is a dog and not a lion. Therefore, you might accept this invalid argument:

A lion is a cat.

My pet is not a lion.

So, my pet is not a cat.

This argument may look good at first, but it is a terrible one. What the arguer has done here is preach to the already converted—you already believe the conclusion. We have a psychological tendency to cheer for any argument that concludes with what we already agree with, but we

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245 Yes, this is a valid argument. One of the premises is false, so it is definitely not a sound argument.

246 Here is an example: George Washington is from Bangladesh, so he is from Asia since anyone from Bangladesh is also from Asia.

lower our standards of logical reasoning when we do. It's an unfortunate tendency that we all need to watch out for.

As we've seen in previous chapters and as we will explore in greater depth in later chapters, deciding whether a conclusion follows with probability from the premises is a matter of high art, deep science, and common sense. However, with deductive arguments, the following-from is cut and dried. Consequently, if an argument is deductively valid and there is something wrong with the conclusion, we can be sure there is something wrong with one of the premises, even if you can't figure out which premise. For example, the following argument seems to be deductively valid:

> If something goes away, there has to be a place where it goes. In the morning, night is gone. So it must have gone somewhere.

Do you agree that this is a deductively valid argument? The conclusion is obviously false, isn't it? It's valid. But if a valid argument has a false conclusion, then it can't have all its premises be true. In valid reasoning, true premises will always take you to a true conclusion. Would you agree that therefore the argument above must have a faulty premise somewhere? The first premise looks OK, because when a dog goes away there is a place where it goes, even if you can't find it. The dog has to go *somewhere*, right?

The same if a cat goes away. Yes, for cats and dogs, but still the first premise is *not* OK. In the morning the night just ceases to be; it doesn't go anywhere. So the whole trouble begins in the argument's first sentence.

You might think this explanation rather obvious, but it hasn't always been so obvious to people. Many ancient Greeks would have accepted the faulty first premise as common sense. Times have changed. A related, enduring philosophical debate concerns whether there is a place where you go when you die. Well, we cannot settle this deep question here, but it is interesting to think about.

Sound deductive arguments are also called **proofs**, but so are strong inductive arguments, although in a different sense of the word 'proof'. All mathematical proofs are deductively sound. Some scientific proofs are, too, but most are merely inductively very strong. When science proves that dinosaurs are extinct, the evidence for this conclusion does not imply the conclusion with certainty, only with very high probability. The scientific proof that Jupiter revolves around the sun doesn't meet the high standard of the mathematical proof that 7 + 5 = 12. Consequently, we can be more sure that 7 + 5 = 12 than that dinosaurs are extinct or that Jupiter revolves around the sun. Nevertheless, the revolution is almost certain because the evidence is overwhelming. Ditto that dinosaurs lived millions of years ago and now are extinct. In the later chapters of this book we will examine in greater detail what it takes to produce a scientific proof.

Mathematical proofs that involve what mathematicians call "induction" are actually deductive and not inductive, by our standards. Similarly, in the field of mathematics called probability theory or statistics, the conclusions of mathematical proofs will be probability statements, but these proofs are deductively sound arguments whose conclusions about probability follow with certainty, not with probability. They are about probability, but they are deductive, not inductive. So, the terminology in these areas requires some attention.

When people say to you, "That may be a strong argument, but it's not really a proof," they are probably using proof in the sense of our "deductive proof" or "deductively sound argument." If this is what they are saying, they are making the good point that just because an argument is inductively strong, it need not be deductively sound, although they may not be familiar with this technical terminology that we use to explain what they mean.

It is worth noting that some dictionaries and texts define "deduction" as *reasoning from the general to specific* and define "induction" as *reasoning from the specific to the general*. However, there are many inductive arguments that do not have that form, e.g., "I saw her kiss him, so I'm sure she's having an affair."

So far we have been concentrating on arguments in which a conclusion has followed either from a single statement or from a small group of statements. However, the logical reasoner also has the ability to decide whether a conclusion follows from everything said in a book or in a long article. For example, does it follow from Herman Melville's most famous book *Moby Dick* that the author believes each person has an inner nature that cannot be changed? Answering this question is much more difficult, and it won't be answered here. We will leave that for your English literature class. An analogous question might be to ask whether, from Albert Einstein's 1916 physics paper introducing the general theory of relativity, it follows that there can be places where gravity is so strong that light could not escape even if there's nothing else blocking the light's path.

Review of Major Points

In exploring the concept of implication, which is at the heart of nearly all reasoning, we divided it into two types: implying with certainty and implying with probability. These two types can be defined in terms of the notions of inconsistency and improbability, respectively. Arguments are evaluated by three standards: as being deductively valid, deductively sound, and inductively strong. The strength of an inductive argument is a matter of degree but not of personal preference. The term *proof* is ambiguous. It can mean the kind of proof that occurs in mathematics; this is a deductively sound argument. Or it can mean the kind of proof that occurs in science; this is a very strong inductive argument.

Glossary

deductive argument An argument presented with the intention of being deductively valid and perhaps deductively sound.

deductively sound An argument that is deductively valid and whose basic premises are all true.

deductively valid An argument whose conclusion follows from its basic premises with certainty.

follows with certainty Statement C follows from statement (or group of statements) P with certainty if C would have to be true if P were.

follows with probability Statement C follows from statement (or group of statements) P with probability if C is probably true if P is true.

implies with certainty A statement (or group of statements) P implies a statement Q with certainty if Q is forced to be true whenever P is true. More formally, P implies Q with certainty if these two conditions hold: (1) it is logically inconsistent for P to be true without Q also being true.

implies with probability A statement (or group of statements) P implies a statement Q with probability if Q is probably true when P is true. More formally, P implies Q with probability if these two conditions hold: (1) it is improbable for P to be true without Q also being true.

inductive argument An argument intended to be inductively strong.

inductively strong An argument is inductively strong if its conclusion follows from its basic premises with high probability. The strengths of inductive arguments are a matter of degree; some are stronger than others.

premises An argument's reasons or assumptions.

proofs Sound deductive arguments or very strong inductive arguments. Generally, mathematical proofs must be sound, and scientific proofs must only be inductively strong.

Exercises

Following-From and Implication

In answering the following questions, go light on applying the principle of charity or you will find yourself being so charitable that you can find no examples of bad reasoning. The concept checks and worked exercises can be helpful guides in deciding when to apply the principle.

■ 1. From the fact that all ice melts when placed in a pan above the lit burner of a gas stove, does it follow *with certainty* that if the president of France places some ice in a pan above the lit burner of a gas stove in Paris next Christmas, his ice will melt?

a. yes b. no[247]

■ 2. Explain why "no" is an incorrect, or less than adequate, answer to the following question:

Suppose a woman is arrested for a crime, and there are two eyewitnesses who say she is guilty. Does it follow that she is guilty?[248]

3. If Senator Fairchild of New Mexico admits his guilt to the charge of breaking and entering, does it follow that he entered after breaking in? Why?

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[247] Answer (a). If all ice melts, then the president's ice melts, too.

[248] The correct answer is "Yes and no." No, it doesn't follow with certainty, but yes, it does follow with significant probability. The mere fact that the person is arrested is some reason to increase your degree of belief in the person's guilt. More often than not, the police arrest the correct persons. However, police do make mistakes, so even if it does follow, from the person's being arrested, that the person is guilty, it doesn't follow with strong enough probability that a member of the jury should vote for conviction on this evidence alone.

■ 4. Explain the error in this reasoning:

If Jeremy Irons says, "All U.S. presidents are American citizens" it follows that the current president is an American citizen. Surely that's a mistake. The current president is an American citizen not because Jeremy Irons says something but because of certain Constitutional requirements.[249]

5. Assuming (with the IRS) that all items from column C are to be listed in column F and that all items from column F are to be listed on form 1040 Schedule SA, then

a. it follows with certainty
b. it follows with probability
c. it does not follow

that all items from column C should be listed on form 1040 Schedule SA.

6. Which of the following arguments are deductively valid? Don't worry about soundness.

a. Whales are mammals, but the biggest living thing in our sea is definitely not a mammal, so it's not a whale either.

b. Potatoes are a kind of produce, and not all of Bob's fattening foods are potatoes, so not all of his fattening foods are produce either.

c. That squirming thing has no backbone, but all fish have backbones. So it's not a fish.

d. All fat fish are good swimmers. No house cat is a fat fish. So no house cats are good swimmers.

7. To ask whether a statement implies another statement is usually to ask an ambiguous question, even if neither statement itself is ambiguous. Briefly explain why.

8. Find a real-life example of a deductively sound argument.

9. Assuming that the following nursery rhyme is an accurate report, which are the only accurate headlines? That is, which can be deduced from the information in the song?

Old MacDonald had a farm. Ee ii ee ii oh.

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[249] It follows from what Jeremy Irons says but it doesn't follow from his saying it. The two need to be distinguished. The reasoning in the paragraph doesn't distinguish them.

And on this farm he had some pigs. Ee ii ee ii oh. With an oink! oink! here. And an oink! oink! there. Here an oink! There an oink! Everywhere an oink! oink! Old MacDonald had a farm. Ee ii ee ii oh.

a. Old Man's Farm Overrun by Wild Pigs
b. Cries of Pigs Indicate Animal Abuse on MacDonald Farm
c. MacDonald Animal Farm Teaches Pigs Vowels
d. MacDonald Has Farm That Had Pigs
e. MacDonald Is Man Who Owned Farm That Had Pigs
f. MacDonald Had Farm That Had Animals
g. MacDonald Had Farm That Has Pigs

■ 10. Referring to the previous exercise, does statement (e) logically imply statement (f)?

a. yes b. no[250]

11. Does statement (e) above logically imply statement (g)?

a. yes b. no

■ 12. Do the statements in the Old MacDonald song imply statement (e)?

a. yes with certainty
b. yes with probability
c. no, not at all[251]

13. Find three examples of reasoning in which the conclusion is intended to follow from the premises but does not. The sources must be from your own experience outside the college and its classrooms and textbooks. Sources might be newspaper or TV ads, Internet web pages, magazine articles, conversations, books, and so on. Cut out, photocopy, or write up each example on a separate (8.5 x 11 inches) page. On that page, or on the next page if you

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[250] Answer (a). This is the correct answer because, if you own it, you certainly have it, and if it's a pig, it's certainly an animal. In questions like this, it is expected that you will use your common knowledge as background assumptions when they are needed; in this case, for example, you are using the assumption that all pigs are animals.

[251] Answer (b). Given when the song was created, and your background knowledge that in those times, unlike in the twenty-first century, most farms were family owned, it is probable that he actually owns the farm rather than is a tenant farmer or leases the land, though you cannot be *sure* that he owns it.

need more room, identify where the example came from and the date of the publication or the broadcast. Then identify and explain what is illogical about the illogical reasoning that occurs. Staple together your examples in the upper left corner, after adding a cover page containing your name. Don't bother using a fancy binder or notebook. You will be graded on the accuracy and clarity of your identification of the illogical reasoning and on the variety of your examples.

14. Let B = "x is an even number" and let C = "x is 8/2." Then does B logically follows from C?

    a. yes b. no

15. For the previous question, if B is true, then C follows from B with certainty.

    a. true b. false

16. Consider the following proposed argument:

    Every man is a potential killer. Everyone who went to the bank is a man. Therefore, everyone who went to the bank is a potential killer.

    As long as the ambiguous term *bank* is referring in both cases to the same financial bank or the same riverbank, does the ambiguity make any difference to whether the conclusion follows from the premises?

17. Assuming that a financial bank is intended in the previous question, does the conclusion follow with certainty from the premises?

18. All cows are mammals and have lanthrobia. All squirrels are mammals and have lanthrobia. All humans are mammals and have lanthrobia. Therefore, all mammals have lanthrobia.

In this argument the conclusion

    a. follows with certainty from the premises.
    b. follows with probability from the premises.
    c. none of the above.

■ 19. All cows are mammals and have lanthrobia. All squirrels are mammals and have lanthrobia. All humans are mammals and have lanthrobia. Therefore, some mammals that are neither cows nor squirrels have lanthrobia.

In this argument the conclusion

    a. follows with certainty from the premises.
    b. follows with probability from the premises.

c. none of the above[252]

20. The argument about lanthrobia in the previous question is deductively valid.

a. true b. false

21. If statement A follows from statement B, does statement B thereby follow from statement A?

■ 22. Either you are no friend of Sarah's or you will let me in to borrow your stereo for her. But since you obviously won't let me borrow your stereo for her, therefore you are no friend of hers. This argument is

a. deductively valid.
b. deductively invalid.
c. none of the above.[253]

23. Write an essay of three pages (typed double-spaced, if possible) that answers the following question. (Background: Many liberals say “no" and many conservatives say "yes," so be sure to consider all sides of the issue).

Does it follow from the Bill of Rights of the U.S. Constitution that individuals have the right to bear arms?

24. If the premises of an argument are true, and if their being true makes it improbable that the conclusion is false, then the argument is inductively strong.

a. true b. false

25. If you knew that all fast swimmers have good lung capacity, and if you knew that some fast swimmers have bad politics, would it follow for certain that every student who has good politics and is a fast swimmer has good lung capacity?

■ 26. Is it possible to have a deductively sound argument that is also deductively valid?[254]

■ 27. Is it possible to have an inductively strong argument that is deductively invalid?[255]

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[252] Answer (a). It is deductively valid because the conclusion is forced to be true whenever the premises are. Of course, we have no way of knowing whether the premises are actually true, so we cannot judge the argument's soundness.

[253] Answer (a).

[254] Yes, every sound argument is valid.

[255] Yes, they all are deductive invalid.

28. "John isn't a good waiter because all good waiters have pleasant smiles, but John doesn't have a pleasant smile." If you were to learn that John really is a good waiter, then you could say that

    a. the argument is deductively invalid and unsound.
    b. the argument is deductively valid and sound.
    c. the argument is deductively invalid and sound.
    d. a premise is false.

29. Create an obviously deductively valid argument for the conclusion that the Bible is the word of God. One of your key premises must be that the Bible was written by one or more Christian prophets.

30. Create an obviously deductively invalid argument for the conclusion that the Bible is the word of God, using the following as one of your key premises: the Bible was written by the Christian prophets.

31. Suppose that a medical team has examined 21 randomly selected children of the Zambezi Desert and discovered that all of them have malaria or else once had it. It follows

    a. with certainty
    b. with probability
    c. neither with probability nor certainty

that the next three randomly selected children of the Zambezi Desert will be found to have malaria or else to have once had it, if they are examined for malaria. You may assume that there are approximately 8,000 children in the Zambezi Desert.

32. Premise: A survey of major corporate executives indicates that 60 percent believe that some American businesses often engage in price fixing.

    Conclusion: If you were to randomly pick five of the surveyed major corporate executives, you could reasonably expect that three of them would believe that all American businesses engage in some form of price fixing.

    The conclusion

    a. follows.
    b. does not follow.

33. President Kennedy was murdered. So if Oswald did not kill Kennedy, then someone else did.

    a. true b. false

34. President Kennedy was murdered. So if Oswald had not killed Kennedy, then someone else would have.

    a. true b. false

35. (a) If only great works of art are owned by the Crocker Gallery, does it follow with certainty that the only great works of art are owned by the Crocker Gallery? (b) How about vice versa? Assume that the gallery does own works of art.

■ 36. Bacteria use only an asexual form of reproduction. So, it

    a. follows with certainty
    b. follows with probability
    c. does not follow

that bacteria do not use a sexual form of reproduction. By the way, you did take the require biology course that is a pre-requisite for this course, didn't you?[256]

37. If the club members are not adults, and only adults have rights, then
    a. it follows with certainty
    b. it follows with probability
    c. it does not follow

that the club members have no rights at all.

38. If a researcher proved that certain bacteria will cause pneumonia in any large animal because 100 percent of the tested animals given the bacteria caught pneumonia whereas none of the animals who weren't given the bacteria caught pneumonia, this proof would be

    a. a deductively sound argument

    b. an inductively strong argument

39. For the following argumentation, you may assume that the meaning of the words *tort* and *sequestration* are taught in every law school, (a) Identify any premise indicators and any conclusion indicators (these terms were defined in an earlier chapter). (b) Is this argument deductively valid? (c) Discuss the question of the argument's soundness, (d) How would you improve the argument if you believe it does need improvement?

    Any lawyer knows what the words *tort* and *sequestration* mean. Surprisingly, this so-called "friend" of yours doesn't know what the words mean. It follows that your friend is not a lawyer.

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256 Answer (a). It's just a matter of what the word *asexual* means.

40. In a recent issue of your daily newspaper, find a letter to the editor that contains an argument, (a) What is the issue? (b) What conclusion is the writer arguing for? (c) Briefly list the main reasons offered, and number them, (d) Which of the reasons can the average reader tell are true? (e) Is the argument probably intended to be inductive or deductive, or isn't there enough information to tell? (f) Briefly discuss the quality of the argument. Are there weak spots in the argument? Where? Why? (g) Attach a copy of the letter to your answer.

CHAPTER 11 Logical Form and Sentential Logic

Abstracting from the content of an argument reveals the logical form of the argument. The initial sections of this chapter show that logical form is the key to the validity of deductively valid arguments. The chapter then explores sentential logic, the logic of sentences. Finally, the chapter investigates the tricky terms *only*, *only if* and *unless*. To understand reasoning that uses these terms—in contracts and legal documents—many persons are forced to hire a lawyer. You, however, will be one step closer to becoming *their* lawyer.

What is Logic?

The field of logic is more prescriptive than descriptive. That is, it is not the study of how persons actually do reason, but rather the study of how they *ought* ideally to reason insofar as they are being "logical," that is, reasoning correctly. The field of logic also explores the errors to which thinking can be prone when it drifts away from the ideals of correct reasoning.

Logic in the narrowest sense of the term is not prescriptive and is only about *logical consequence*, that is, about what has to be true if something else is true. Our book uses a less narrow sense of what the term "logic" means.

Deductive logic explores deductively valid reasoning, the most secure kind of reasoning. The most elemental piece of reasoning is a simple argument that draws one conclusion from one premise or assumption. In any argument, simple or not simple, if the conclusion follows with certainty from the premise we call the argument *deductively valid*. A mathematical proof is an example of a deductively valid argument.

Inductive reasoning, by contrast, is about less secure reasoning. Its conclusion follows from its premises with probability but not with certainty.

The field of logic explores the *structural* properties of reasoning. The field isn't interested in building bigger piles of good arguments, but in understanding their structural features. The structure is called "logical form." In this chapter we will be studying logical forms.

Logical Equivalence

If you were told, "John stepped on the camera by accident," you wouldn't have learned anything different from having been told "The camera was accidentally stepped on by John." These sentences say the same thing—they make the same statements—even though they are grammatically different. Because the two say the same thing logically, they are said to be *equivalent*, or, more technically, *logically equivalent*. Logical equivalence is somewhat like synonymy except that it is for sentences, not words. That phrase *say the same thing* is a bit imprecise, so here is a definition using more precise terminology:

Definition Statement P is **logically equivalent** to statement Q provided P follows from Q with certainty and Q also follows from P with certainty.

The certainty mentioned here is not a psychological notion; it is a logical notion. That is, the certainty is not about feeling sure but instead about the solidity of the logical relationship of support among statements.

Alternative Definition Statement P is **logically equivalent** to statement Q provided P logically implies Q and also Q logically implies P.

Here is a pair of logically equivalent statements:

> Tiffany is so sincere that you can't doubt her.
> The sincerity of Tiffany cannot be doubted.

Yet these two are not logically equivalent:

> Tiffany got married and got pregnant.
> Tiffany got pregnant and got married.

Time order is the problem.

Here is a much less obvious example of logical equivalence. Suppose P is the sentence "Not all mammals are land dwellers," and Q is the sentence "Some mammals are not creatures that live on land." Does Q follow from P with certainty? Yes. How about vice versa? Yes. So P and Q are logically equivalent. This relationship between the two sentences would hold even if the word *mammal* were replaced by the phrase *fish in the Indian Ocean*. Consequently, logical equivalence between two sentences can be a matter of the **form** of the two sentences, not just what they are about.

———CONCEPT CHECK———

Does the definition of logical equivalence permit a true sentence and a false sentence to be logically equivalent to each other?

———[257]

Deciding whether two phrases are logically equivalent[258] can be critical in assessing the quality of an argument. Here is an example involving an argument in which the conclusion follows from the premises with certainty:

1. If the attraction that baseball has will persist in America over the next decade, then our income from concessions will also remain steady over the next decade.

2. I know the attraction that baseball has will in fact persist in America over the next decade.

3. So, our income from concessions will remain steady over the next decade.

Would the conclusion still follow if premise 2 were replaced with the following statement?

2′. Baseball will continue to flourish in America over the next ten years.

It depends. If statement 2' is logically equivalent to statement 2, then the conclusion would still follow with certainty. However, if you cannot be sure they are equivalent, you cannot be sure the conclusion of the argument with 2′ follows with certainty. To decide whether 2 and 2' are equivalent, you should be sensitive to context and use the principle of charity. If, after doing all this, you still cannot tell whether 2 and 2' are equivalent, and if you need to be sure, you will have to ask the speaker or author to be clearer.

———CONCEPT CHECK———

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257 Don't rush to look at the answer before thinking seriously about the question. The answer is in the next footnote.

258 No, if one is true and the other is false in the same circumstances, they must be saying something different from each other and thus cannot be logically equivalent.

Does the conclusion follow with certainty from the premises in this argument? Explain why a simple "yes" or "no" answer is unacceptable because of logical equivalence.

> If the latest version of the word processing program Word is warmly received on presentation, its owners and programmers are going to be happy about what they created. All reports indicate Word did hit the market with a splash and got many good reviews. So we can conclude that WordPerfect's creators felt a sense of accomplishment.

———259

The concept of logical equivalence is useful in other ways. This usefulness arises from the fact that the deductive validity or invalidity of an argument usually depends on the logical forms of its sentences, as we will see later in this chapter. In turn, the ability to identify the logical forms of sentences requires the ability to translate the sentence into a logically equivalent one.

Logical Forms of Statements and Arguments

The logical form of an argument is composed from the logical forms of its component statements or sentences. These logical forms are especially helpful for assessing the validity of *deductive* arguments. For instance, consider the following argument, which is in standard form:

> If all crystals are hard, then diamond crystals are hard.
> Diamond crystals are hard.
> ———————————
> All crystals are hard.

This is a deductively invalid argument, but it can be difficult to see that this is the case. The difficulty arises from the fact that the conclusion is true and all the argument's premises are true. One way to detect the invalidity is to abstract away from the content of the argument and to focus at a more general level on the form of the argument. The argument has this **logical form**:

> If Cryst, then Diam.

---

259 The argument's conclusion follows with certainty from its premises if the principle of charity permits us to say that "warmly received on presentation" means the same as "hit the market with a splash," and if it also permits us to say "happiness" here is the same as "feeling a sense of accomplishment" and if the "owners and programmers" include the "creators." It is likely that these equivalences hold, but you cannot be sure and therefore cannot definitely say, "Yes, the conclusion follows with certainty." If you needed to be sure, you should ask the author to be clearer about all this.

Diam.
———————
Cryst.

The term *Cryst* abbreviates the clause "All crystals are hard." The term *Diam* abbreviates the clause "Diamond crystals are hard." It is easier to see that the form is invalid than it is to see that the original argument is invalid. The form is invalid because other invalid arguments have the same form. For example, suppose Cryst were instead to abbreviate "You are a Nazi" and Diam were to abbreviate "You breathe air." The resulting argument would have the same form as the one about diamonds:

If you are a Nazi, then you breathe air.
You do breathe air.
———————————————
You are a Nazi.

Nobody would accept this Nazi argument. Yet it is just like the argument about diamonds, as far as form is concerned. That is, the two are logically analogous. So if one is bad, both are bad. The two arguments are logically analogous because both have the following logical form:

If P, then Q.
Q.
———————
P.

It is really the logical form of the diamond argument that makes it be invalid not that it is about diamonds. If someone were to say of the argument about diamonds, "Hey, I can't tell whether the argument is valid or not; I'm no expert on diamonds," you could point out that the person doesn't have to know anything about diamonds, but just pay attention to the pattern of the reasoning.

Standard form is not a kind of logical form; it is merely a way of writing down arguments.

Just as valid patterns are a sign of valid arguments, so invalid arguments have invalid patterns, as we shall see. All arguments have patterns (logical forms). The first person to notice that arguments can be deductively valid or invalid because of their pattern or logical form was the ancient Greek philosopher Aristotle. He described several patterns of good reasoning in his book *Organon*, in about 350 B.C. As a result, he is called "the father of logic." He started the whole subject with this first and yet deep insight into the nature of argumentation.

In our example, the terms *Diam* and *Cryst* served as logical symbols that abbreviated sentences. We will be introducing more and more logical symbolism as this chapter progresses. The reason

for paying attention to logical symbols is that when arguments get complicated, a look at the symbolic logical form can show the important heart of the argument. The reason for using symbolism is much like that for translating mathematical word problems into mathematical symbols: the translation makes the mathematics within the statements more visible for those who have a feeling for the symbols. The purpose of introducing symbols and logical forms is to aid in evaluating reasoning that is too complicated to handle directly in the original English.

However, this chapter hasn't yet spelled out how to determine the logical form of a sentence. Unfortunately, determining the logical form of a sentence is tricky because the same sentence can have more than one logical form depending on how one treats it. It can have a sentential form in an area of logic called sentential logic, a class logic form in class logic, or even other forms. This difficulty will be clearer after the following introduction to sentential form and sentential logic.

The argument about diamonds was analyzed using sentential logic. Sentential logic is the branch of logic that focuses on how the logical forms of complex sentences and arguments are composed from the logical forms of their sub-sentences. The sub-sentences must be connected by one of the following sentence connectors or their synonyms: and, or, not, if-then. The technical symbols for these connectors are &, v, ~, → but we will deal with these later.

Strictly speaking, sentential logic is about statements, but this chapter won't be careful about this. Also, it is arguments, not forms, that are invalid. However, that distinction will not be observed in this chapter either. Nor will the distinction between a statement constant and a statement variable; that is, sometimes the letter P will stand for a specific statement, and at other times it will stand for any particular statement.

The Logic of *Not*

In sentential logic, an inconsistent group of sentences is defined via their logical form. By definition, a sentence group is inconsistent if it implies some complex statement whose logical form is "P and not -P." This complex statement is composed of two sub-statements, the statement P and its opposite, not -P. The two sub-statements are joined by the connector *and*. The statement form "P and not-P" is said to be the logical form of a contradiction. Note that the statement form "not-P" does not stand for any statement that isn't P; rather, it stands for any statement that negates P—that says something that must be false when P is true and that must be true when P is false. Not-P is the negation of P. This information about negation can be summarized in the following **truth table for negation**:

P	not-*P*
T	F
F	T

Here the capital letter *T* represents the possibility of the sentence at the top of its column being true, and *F* represents the possibility of being false.

———CONCEPT CHECK———

The negation of "She's moral" is

a. She's immoral.
b. It's not the case that she's immoral.
c. She's amoral.
d. None of the above.

———[260]

In sentential logic, there are two ways a pair of sentences can be inconsistent. They are **contradictory** if they are inconsistent and if, in addition, one sentence must be true while the other must be false. However, two sentences are **contrary** if they are inconsistent yet could both be false. Out on the street you have to be on the alert since so many people use the one word "contradiction" for both terms. But here we will use these technical terms properly.

Sentences A and B below are contradictory, whereas sentences A and C are contrary, and sentences B and C are consistent.

A. The house is all red.

B. The house is not all red.

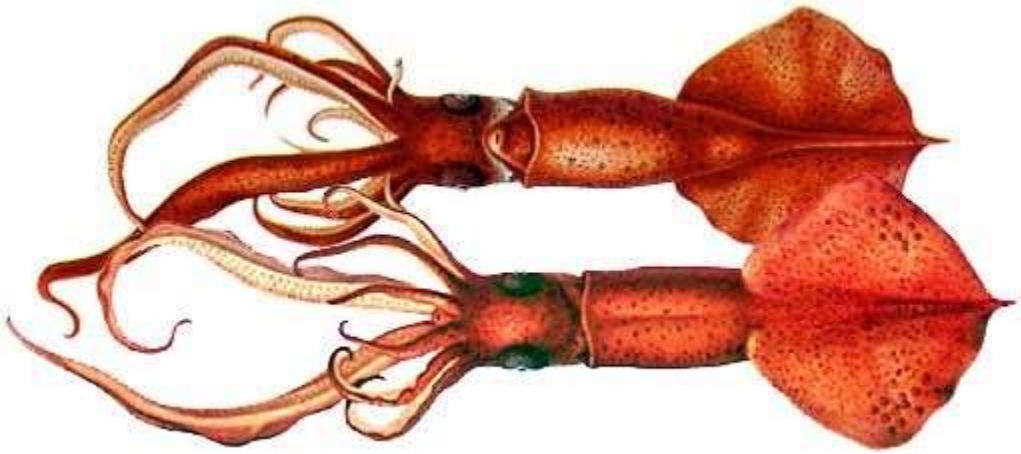
C. The house is all green.

Another term that occurs when people are thinking about inconsistent is "opposite." When a squid is hiding at the bottom of the ocean in camouflage it is not signaling but hiding. A biologist might say that when a squid is in camouflage, that is the *opposite* of the squid's signaling. The kind of opposite meant here, is being contrary, not being contradictory. The squid might be neither signaling nor in camouflage if it is just swimming along peacefully.

---

[260] Answer (d). Here are three, equivalent negations of "She's moral:"

No, she's not.
She's not moral.
It's not the case that she's moral.



———CONCEPT CHECK———

Create a sentence that is contrary to the claim that it's 12:26 p.m. but that does not contradict that claim.

———[261]

[261] "It is noon." Both sentences could be false if it is really 2 p.m., but both cannot be true (in the same sense at the same place and time without equivocating).

———CONCEPT CHECK———

Which statement below serves best as the negation of the statement that Lloyd Connelly is an assemblyman who lives in the capital?

a. Lloyd Connelly lives in the capital and also is an assemblyman.

b. No one from Lloyd Connelly's capital fails to be an assemblyman.

c. It isn't true that Lloyd Connelly is an assemblyman who lives in the capital.

d. Lloyd Connelly doesn't live in the capital.

a. Lloyd Connelly is not an assemblyman.

———[262]

If you were to learn that x = 8, would it be reasonable for you to conclude that it isn't true that x is unequal to 8? Yes. The valid form of your reasoning is

$$\frac{P}{\text{not-not-}P} \quad \text{[deductively valid]}$$

One could infer the other way, too, because any statement is logically equivalent to its **double negation**.

The Logic of *And*

Sentential logic explores not only the patterns of sentences but also the patterns of arguments. In this section we will explore arguments whose validity or invalidity turns crucially on the use of the word *and*. The truth table for "**and**," or "**&**," or **conjunction** as it is called by logicians, has four rows for all the possibilities:

---

[262] Answer (c). Answer (d) is incorrect because both the original statement and (d) could be false together. A statement and its negation cannot both be false; one of them must be true.

P	*Q*	*P* and *Q*
T	T	T
T	F	F
F	T	F
F	F	F

Each row of the truth table represents a possible situation or way the world could be. If you were to learn that x = 5 and that y < 7, would it be valid for you to infer that y < 7? Yes. It would also be trivial. The general point of that example of reasoning is that the following is its deductively valid form:

$$\frac{P \text{ and } Q}{Q} \quad \text{[deductively valid]}$$

If you were to learn that x = 105, would it be valid for you to infer both that x = 105 and that y = 14? No. The general point is this:

$$\frac{P}{P \text{ and } Q} \quad \text{[deductively invalid]}$$

The truth table for conjunction can be used to demonstrate that in the previous argument form there are possibilities in which the premise is true while the conclusion is false. [Just left P be true and Q be false.] There are no such counterexample possibilities for deductively valid forms. In this way, the tables provide a general method of assessing the validity of arguments in sentential logic.

> Any instance of a valid argument form must produce a valid argument.

The Logic of *Or*

In any statement of the form "P or Q" the statement P is called "the left disjunct," and the Q is called "the right disjunct." The operation of "or" or "**v**" is called **disjunction**. Consider the

statement “x = 5 or y < 19." If you were told that either the left or the right disjunct is true, but not which is true, could you be sure that the right one is true? No. The moral is the following:

$$\frac{P \text{ or } Q}{Q}$$ [deductively invalid]

However, if you knew that the left disjunct is not true, you could infer that the right one is. The general form is

$$\begin{array}{l} P \text{ or } Q \\ \underline{\text{not-}P} \\ Q \end{array}$$ [deductively valid]

———CONCEPT CHECK———

State whether the main argument below is a deductively valid inference, then describe the logical form of the inference.

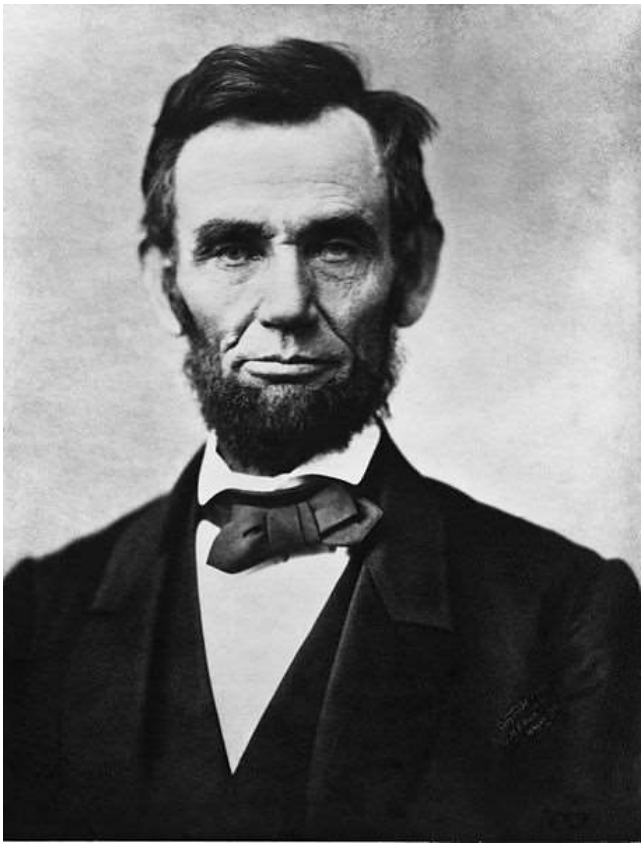
Assuming x = 4 and y < 7, as you have said, then x is not unequal to 4.

———263

263 Yes, it is a deductively valid inference. Its logical form is

$$\frac{P \text{ and } Q}{\text{not-not-}P}$$ [deductively valid]

P is $x = 4$
Q is $y < 7$



———CONCEPT CHECK———

Does this argument have valid logical form?

> Your information establishes that President Abraham Lincoln was assassinated by Ulysses Grant. Now we can be sure that John was right when he said, "Abraham Lincoln was assassinated by Grant or Booth."

In trying to assess whether the argument is deductively valid, you can abstract the main argument to produce the following form:

$$\frac{P}{P \text{ or } Q}$$

where we have defined

P = President Abraham Lincoln was assassinated by Ulysses Grant.

Q = Abraham Lincoln was assassinated either by Grant or else by Booth.

The first premise happens to be false, yet the conclusion is true. The problem, however, is not to decide which sentences are true but to decide whether the logical form is deductively valid.

———264

The truth (and falsehood) possibilities for *or* can be summarized in this truth table:

P	*Q*	*P* or *Q*
T	T	T
T	F	T
F	T	T
F	F	F

The Logic of *If-Then*

Some argument patterns are so common that they have been given names. The most common of all is **modus ponens**:

If *P* then *Q*
P
———— [deductively valid]
Q

The validity of this form can be checked by using the truth table for implication (that is, the conditional) and noticing that there is no possibility of a counterexample, namely a situation where the premises are truth and the conclusion is false.

P | Q | If P then Q

T | T | T
T | F | F
F | T | T
F | F | T

The Greek logician Chrysippus discovered the modus ponens form in 200 B.C.E. Here is an example of an argument whose sentential logical form is modus ponens:

---

264 This is a valid form. Any argument with that form has to be valid no matter declarative sentence you replace 'P' with; and ditto for 'Q'.

> If they bought that much aluminum stock right before Chile had its general strike, then they will be wiped out.
>
> They did buy that much aluminum stock just before Chile had its general strike.
>
> They will be wiped out.

To show that this argument does have the modus ponens logical form, we could use this dictionary of abbreviations:

> P = They bought that much aluminum stock right before Chile had its general strike.
>
> Q = They will be wiped out.

If we symbolize the argument, then we get this logical form:

If *P* then *Q*
P

Q
[deductively valid]

Choosing the letters P and Q was arbitrary. We could have used A and B. The following form is also called *modus ponens*:

> **If A then B**
> **A**
> **So, B**

In addition to modus ponens, there are other forms of deductively valid reasoning in sentential logic. **Modus tollens** is another common one, and it has this form:

If *A* then *B*
not-*B*
---
not-*A*
[deductively valid]

Examples of this form of valid reasoning were examined in earlier chapters without mentioning the Latin term for it. Here is an example:

> If he is a lawyer, then he knows what the word *tort* means. Surprisingly, he doesn't know what the word means. So, he's not a lawyer.

In this example of modus tollens, the letters A and B represent the following:

A = He is a lawyer.
B = He knows what the word tort means.

In daily life, you wouldn't be apt to detect the modus tollens form so clearly because the above argument might be embedded in a passage like this:

> If he were really a lawyer as he claims, he'd know the word *tort*. So, he's some sort of imposter.

This passage contains the same modus tollens argument that was in the previous passage. However, the premise not-B is now implicit. The conclusion of the modus tollens is also implicit. In addition, a second conclusion has been drawn—namely, that he's an imposter. It takes a lot more logical detective work to uncover the modus tollens argument.

Although the modus tollens form is a valid form—that is, any argument with that form is a valid argument—there are apparently similar arguments that are invalid yet are often mistaken for valid ones. Here is an example of a common one:

> If she's Brazilian, then she speaks Portuguese. She's no Brazilian, so she doesn't speak the language.

The reasoning is deductively invalid. In standard form it might be written this way:

> If she's Brazilian, then she speaks Portuguese.
> She is not Brazilian.
> ---
> She does not speak Portuguese.

The conclusion does not follow with certainty. To suppose it does is to commit the **fallacy of denying the antecedent**. The fallacy also occurs more transparently in this argument: "If you are a Nazi, then you breathe air, but you obviously are not a Nazi, so you don't breathe air." This invalid argument is logically analogous to the one about speaking Portuguese.

In sentential logic, the logical form of the fallacy is

If *P* then *Q*
Not-*P*

Not-*Q* [deductively invalid]

The form is what defines the fallacy. The if-part of a conditional, the P, is called its **antecedent**. Then then-part is called the **consequent**. The second premise, "not-P," denies (negates) the antecedent. The arguer asserts the conditional, denies the antecedent, and draws an invalid inference. That is why the fallacy has the name it does.

———CONCEPT CHECK———

The singularity is the moment when artificial intelligence rapidly escalates. "To analyze the argument for a singularity in a more rigorous form, it is helpful to introduce some terminology. Let us say that AI is artificial intelligence of human level or greater (that is, at least as intelligent as an average human). Let us say that AI+ is artificial intelligence of greater than human level (that is, more intelligent than the most intelligent human). Let us say that AI++ (or super-intelligence) is AI of far greater than human level (say, at least as far beyond the most intelligent human as the most intelligent human is beyond a mouse). Then we can put the argument for an intelligence explosion as follows:

1. There will be AI+.
2. If there is AI+, there will be AI++.

———————————————

3. There will be AI++."

Is the indented argument valid?

———265

Here is an invalid argument that is often mistaken for a modus ponens argument.

> If she's Brazilian, then she speaks Portuguese. She does speak Portuguese. So she is Brazilian.

The premises of this argument do give a weak reason to believe the woman is Brazilian. However, if the arguer believes that the premises establish with certainty that she is Brazilian, then the arguer is committing the fallacy of **affirming the consequent**. Rewriting the argument in standard form yields

> If she's Brazilian, then she speaks Portuguese.
> She does speak Portuguese.
> ----------
> She is Brazilian.

The logical form, in sentential logic, of the fallacy is

If *P* then *Q*
Q
———— [deductively invalid]
P

The fallacy has its name because then *then* part of any conditional is called its consequent and because affirming the second premise Q affirms the consequent of the conditional.

---

265 Yes, it is valid. The passage is from "The Singularity: A Philosophical Analysis," by David J. Chalmers, *Journal of Consciousness Studies* 17:7-65, 2010.

———CONCEPT CHECK———

Which passage commits the fallacy of denying the antecedent?

a. If pork prices continued to drop in Japan from 1789 to 1889, then pork would have been eaten regularly by the average citizen of Tokyo in 1890. Pork prices continued to drop in Japan during that time. Consequently, the average citizen of Tokyo in 1890 did eat pork regularly.

b. If pork prices continued to drop in Japan from 1789 to 1889, then pork would have been eaten regularly by the average citizen of Tokyo in 1890. The average citizen of Tokyo in 1890 did not eat pork regularly. So pork prices did not continue to drop in Japan from 1789 to 1889.

c. If pork prices continued to drop in Japan from 1789 to 1889, then pork would have been eaten regularly by the average citizen of Tokyo in 1890. So the average citizen of Tokyo in 1890 did not eat pork regularly, because pork prices did not continue to drop in Japan from 1789 to 1889.

d. If pork prices continued to drop in Japan from 1789 to 1889, then pork would have been eaten regularly by the average citizen of Tokyo in 1890. The average citizen of Tokyo in 1890 did not eat pork regularly. So pork prices did continue to drop in Japan from 1789 to 1889.

e. If pork prices continued to drop in Japan from 1789 to 1889, then pork would have been eaten regularly by the average citizen of Tokyo in 1890. The average citizen of Tokyo in 1890 did eat pork regularly. So pork prices did continue to drop in Japan from 1789 to 1889.

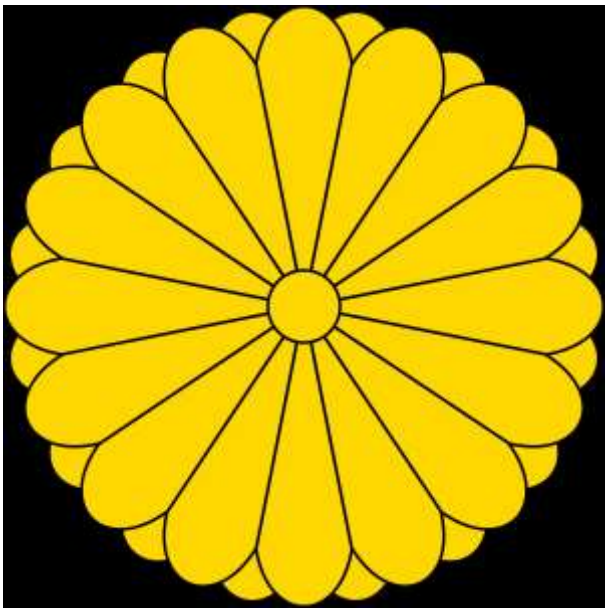
———[266]

[266] Answer (c).

CONCEPT CHECK

In the previous Concept Check, which passage commits the fallacy of affirming the consequent?

267



267 Answer (e).

———CONCEPT CHECK———

In the previous Concept Check, which passage is an example of modus ponens?

———[268]

Logicians working in sentential logic have discovered many other deductively valid and invalid argument forms. For example:

> A conditional statement of the form "If P, then Q" implies with certainty the statement whose form is "If not-Q, then not-P."

In other words, the following argument form is deductively valid:

P implies *Q*
not-*Q* implies not-*P* [deductively valid]

If someone says to you, "If it snows today, you should seek shelter at David's cabin," is the person implying that it is snowing today? No, and the point behind why the person is not is captured by the following invalid argument form:

If *P* then *Q*
P [deductively invalid]

The following inference is also deductively invalid:

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[268] Answer (a).

If *P* then *Q*
Q
[deductively invalid]

The last three argument forms represent points about logical reasoning that were made informally when the notion of a conditional was first introduced. With the tools of logical symbolism, the points can be made more briefly, as we've just seen.

The techniques of sentential logic can often be helpful in analyzing deductive argumentation, but there are many deductive arguments for which sentential methods do not apply. The recognition of this fact has led logicians to create new and more powerful logics to handle these other arguments. These logics are studied in college courses called "symbolic logic" and "deductive logic" and "formal logic."

———CONCEPT CHECK———

Describe the logical form of this reasoning about conditionals, and indicate whether it is or isn't valid reasoning:

John: Are you sure?

Winona: If I wasn't, I wouldn't be here.

———269

The Logic of *Only*, *Only-If*, and *Unless*

The word *only* is an important one for logical purposes. To explore its intricacies, suppose that to get an A grade in Math 101 you need to do two things: get an A- or better average on the homework, and get an A average on the tests. It would then be correct to say, "You get an A

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269 This is valid reasoning. Let P be the implicit assumption that I am here. Let Q be the claim that I am sure. Then the reasoning has this valid logical form:

P

If Not Q, then Not P

Q

grade in Math 101 *only if* you get an A- or better average on all the homework." Now drop *only* from the sentence. Does it make a difference? Yes, because now you are left with the false statement "You get an A grade in Math 101 if you get an A- or better average on the homework." Speaking more generally, dropping the *only* from *only if* usually makes a significant difference to the logic of what is said. Unfortunately, many people are careless about using these terms. Let's display the logical forms of the two phrases in sentential logic, using these abbreviations:

A = You get an A in Math 101.

B = You get an A- or better average on all the homework.

Now, “A only if B” is true but “A if B” is false. So "A only if B" and "A if B" are not equivalent; they must be saying something different. They have a different "logic."

Here is a summary of the different logical behavior of *if* as opposed to *only if*. The following three statement patterns are logically equivalent:

(1) P only if Q

(2) P implies Q

(3) If P, then Q

but none of the above three is equivalent to any of the following three:

(4) P if Q.

(5) Q implies P.

(6) If Q then P.

Yet (4), (5), and (6) are all logically equivalent to each other.

The phrase *if and only if* is a combination of *if* plus *only if*. For example, saying, "You're getting in here if and only if you get the manager's OK" means "You're getting in here if you get the manager's OK, and you're getting in here only if you get the manager's OK."

———CONCEPT CHECK———

Which of the following are true?

For all x, x = 4 only if x is even.
For all x, x is even only if x = 4.

For all x, x is even if and only if x = 4.

———270

———CONCEPT CHECK———

Are all three of these sentences logically equivalent to each other? If not, which two are equivalent to each other? Watch out. This is tricky because your background knowledge about geography is useless here.

α. If you're from the USA, then you're from North Dakota.

β. You're from the USA only if you're from North Dakota.

χ. You're from North Dakota if you're from the USA.

———271

The logical form of sentences containing the word *unless* is important to examine because so many errors and tricks occur with the word. It usually means the same as *or*, although many people, on first hearing this, swear it is wrong. You're going to go to jail unless you pay your taxes, right? So, either you pay your taxes or you go to jail.

Consider a more complicated situation. Suppose you will not get an A in this course unless you are registered. Does it follow with certainty that if you are registered, you will get an A? No.

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270 Just the first one.

271 All three are equivalent to each other, and all three are false.

Does it follow that you will not get an A? No, that doesn't follow either. Does it follow instead that if you do not get an A, you are not registered? No. What would, instead, be valid is this:

> You will not get an A in this course unless you are registered.
>
> So, if you get an A, then you are registered.

The logical form of the reasoning is

> Not-A unless REG.
> So, if A, then REG.

Does this really look valid? It is.

Sentential Logic

When we create logical forms for arguments we sometime abbreviate clauses or simple sentences with words or just capital letters. If we were always to use capital letters and always to use the following special symbols for the connective phrases, such as "or" and "and," then we'd be expressing logical forms in the language of **Sentential Logic.** Sentential Logic is also called *Statement Logic* and *Propositional Logic*. The connective symbol 'v' abbreviates the English connective word 'or' that is used to link together two sentences in order to build a longer sentence. Similarly, the symbol '&' replaces the English conjunction word "and" that also builds bigger sentences from smaller sentences. The '~' symbol represents negation or the phrase "It is not true that..." which can be added to the front of a sentence to produce its negation. The arrow '→' represents 'if-then.'

Here is a list of the connective symbols of Sentential Logic with the English phrases they replace. We will use the symbols with two simple sentences A and B:

~A	not-A (it's not true that A)
A v B	A or B (either A or B or both)
A & B	A and B (A but B)
A → B	if A then B (B if A) (A only if B)
A ↔ B	A if and only if B (A just in case B)

There are grammar rules for forming well-formed formal sentences of greater and greater complexity. For our vocabulary of basic formal sentences we use the capital letters from A to O in the alphabet (and perhaps these capitals with numerical subscripts if we need more basic sentences). Then the complex sentences are built from these sentences by applying the connectives, according to the following rules of grammar:

> If P and Q are variables standing for any symbolic sentences, no matter how complex, then ~P is a well-formed sentence, and so is (P v Q), and (P & Q) and (P → Q) and (P ↔ Q).

'P' and 'Q' might represent or abbreviate any declarative sentence such as A, or A & (B → A), or whatever. Formal sentences can be as complicated as we want, but their length must be finite.

These grammar rules imply that the complex sequence of symbols ((A & B) → C) is well-formed, but (A & B → C) is not. By the way, we customarily drop the outermost pair of parentheses (but only those) when writing well-formed sentences. For example, ((A & B) → C) is the same sentence as (A & B) → C.

———CONCEPT CHECK———

Is this string of symbols grammatically well-formed? (E v F & G)

———[272]

Truth Tables

Let's develop what is called the *formal semantics* of Sentential Logic. Semantics is about, among other things, the way the truth of some sentences affect the truth of other sentences. Truth and falsehood are said to be the two *truth values* that sentences can have. But a sentence can't have both of them at the same time.

Here is the *truth table* that gives a picture of how negation works:

P	~P
T	F
F	T

This table implies, among other things, that (A & B) and ~(A & B) have opposite truth values, as you can see by letting P abbreviate "(A & B)" in the truth table.

Here is a truth table for how 'v' affects a sentence's truth values:

P	Q	P v Q
T	T	T

[272] No, it cannot be built by applying the grammar rules to basic sentences. However, the following two sentences are well-formed: E v (F & G), and (E v G) & G.

T	F	T
F	T	T
F	F	F

The last line of this table implies that if sentence A (when substituted for P) were false and sentence B (substituted for Q) were false, then sentence A v B would have to be false. But the table doesn't apply just to simple sentence letters. The last line also implies that if sentence C & A is false and sentence C & B is false, then sentence (C & A) v (C & B) is false, too.

Here is the truth table for &

P	Q	P & Q
T	T	T
T	F	F
F	T	F
F	F	F

The &-table tells you that the only way for an & sentence to be true is for both of its component sentences to be true. For example, the only way for (A v B) & (C v A) to be true is for (A v B) to be true and (C v A) to be true.

Here is the truth table for →

P	Q	P → Q
T	T	T
T	F	F
F	T	T
F	F	T

You can build larger truth tables to help you figure out the truth values of complicated sentences from knowing the truth values of their component sentence letters. Here is a truth table for (A & (A → B)) → B. The intermediate columns for A → B and for A & (A → B) are our "scratch work" to help us figure out the truth value of the larger sentence.

A	B	A → B	A & (A → B)	(A & (A → B)) → B
T	T	T	T	T
T	F	F	F	T
F	T	T	F	T
F	F	T	F	T

You need a row of a truth table for every way you can assign Ts and Fs to the component sentence letters. If there were a third sentence letter such as C in a formal sentence, then its truth table would need eight rows instead of four. How did we figure out that a T belongs in the last

row in the last column in the above table? We made use of the fact that the sentence (A & (A → B)) → B is basically an → sentence whose if-part is F [as we found by doing the scratch work] and whose then-part is F. Then we noticed that the truth table for P→Q says that, when P has the truth value F and Q has the value F, we should assign T to P→Q. That's why a T belongs in the bottom row in the right column of the table above.

———CONCEPT CHECK———

What is the truth value of E v (F & G) in a row of the truth table where E is false and F and G are both true?

———[273]

For every sentence of Sentential Logic no matter how long the sentence is, we can build its truth table in this manner and figure out the conditions (rows) under which it is true and the conditions under which it is false. This feature of Sentential Logic is called the *truth functionality* of Sentential Logic.

To say a little more about semantics, we can define a *logically true* sentence or a *tautology* in Sentential Logic to be a sentence that is true no matter what the truth values are of its simple letters. For example, A v ~A is a tautology, but A v B is not. A v B might be true or might be false depending what values A and B have. It will come out false if A and B are both false, as you could check by working out the truth table. A sentence that is always false no more what the truth values are of its simple letters is called a *contradiction*. A & ~A is a contradiction. Most sentences of Sentential Logic are neither tautologies nor contradictions. We call such sentences *contingent*. For example, the sentence A v B is contingent. So is C. In some conditions they are true and in other conditions they are false.

Let's go back to English for a moment, and compare what we've just said about contingent sentences of Sentential Logic with contingent sentences of English. 5The sentence “President Eisenhower was a general” is contingent because it might be true and might be false. Yet it is actually true; it's not really false. It might be false, not in the sense that it might become false, but only in the sense that it might have been false if the facts of the world had been different. The sentence "President Eisenhower was a general or he wasn't" is a logical truth, and you could figure out that it was true even if you'd never heard of President Eisenhower. There's no way to change the conditions or facts of the world to make this sentence be anything other than true. You figure this out just be looking at its underlying logical form and knowing how "or" and "negation" work in English. Now, suppose there is a person you've never heard of, say Sen-Chu. Do you know whether the following sentence is true?

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[273] It is true. If F and G are true, then F&G has to be true. But that makes the right side of the 'v' be true, and the truth table for 'v' then requires the full sentence to be true.

Sen-Chu was and wasn't a general.

You can tell this is false just because of its semantic structure, of how the words "and" and "not" work. No matter who this Sen-Chu person is, the sentence must be false. This insight you have about semantic structure is reflected in Sentential Logic when you figure out that the complex sentence A & ~A has to be false even if you don't know the truth value of A.

———CONCEPT CHECK———

One of these sentences is a tautology, one is contingent, and one is a contradiction. Which is which?

F & (~F v G)

~F v (B & (B → F))

(C → D) v ~(C → D)

———274

The *negation* of a sentence p is another sentence q that has the opposite truth value as p in any situation, that is, in any assignment of Ts and Fs to the basic sentence letters. It is easy to see that ~A is the negation of A.

Two statements are said to be *semantically equivalent* (or just equivalent) if they agree in their truth values no matter what the situation, that is, no matter what assignment of Ts and Fs to their basic sentence letters. A is equivalent to ~~A. B is equivalent to B v B. ~A is equivalent to A → (B & ~B).

———CONCEPT CHECK———

The sentence C v ~B is equivalent to one and only one of the following sentences. Which one?

a. C → B
b. B → C
c. ~B → C

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274 contingent, contradiction, tautology.

d. B → ~C
e. ~B → ~C

275

Arguments, Logical Consequences and Counterexamples

Let's turn from the semantics of sentences to the semantics of arguments. An argument in Sentential Logic is said to be *valid* or *logically correct* just in case the conclusion must be true when the premises are true. When this is the case with some argument, we say its conclusion is a *logical consequence* of its premises. Here is a valid argument:

A → D
A

D

Here is a recipe or mechanical method for deciding whether an argument is valid. Check the truth table for all the sentences in the argument (namely all its premises plus its conclusion). If in all situations (that is, all row, or all assignments of truth values to the capital letters) that make the premises be true, the conclusion is also made true, then the declare the argument to be valid. Otherwise, declare it to be invalid. Let's apply the method to this truth table for the above argument:

		prem.	prem.	conclusion
A	D	A → D	A	D
T	T	T	T	T
T	F	F	T	F
F	T	T	F	T
F	F	T	F	F

Any argument written in formal Sentential Logic can be checked for validity by this method of building and inspecting truth tables. An invalid argument will have a row that shows how the premises could all be true while the conclusion is false.

CONCEPT CHECK

275 b.

Use the truth table method to test whether this argument is valid.

~A
C → A

~C

———276

In a valid argument, there is no row of the truth table in which the premises get Ts while the conclusion gets an F. That is, valid arguments have no *counterexamples*. Notice that valid arguments can have false premises.

———CONCEPT CHECK———

Does this argument have a counterexample?

A → B
B

A

———277

3-Valued Logic

Here is an old argument called the paradox of the heap. Start with a single grain of sand. One grain of sand isn't a heap of sand. Adding one grain to that pile won't make a

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276 Yes, it is valid. It has the form of *modus tollens*. There is no way for the premises to be true while the conclusion is false without violating the truth tables.

277 Yes. This argument has the invalid form called *affirming the consequent*. In a situation where A is false and B is true, we have a counterexample because then the argument has true premises and a false conclusion. For example, here is an argument that commits the fallacy of affirming the consequent: If that boy standing over there is your grandfather, then that boy is a male. That boy is a male. So, that boy standing over there is your grandfather. This has true premises and a false conclusion in any situation where there's a boy standing over there. Since there's a situation, even if it's not a situation in real life, that would make the premises be true and the conclusion false, the argument is invalid.

heap either. In fact, adding one grain of sand to anything that's not a heap does not make it a heap. So, there are no heaps of sand.

But of course there *are* heaps of sand, so there must be some problem with the reasoning. In wrestling with the logic of vagueness, a small number of logicians suggest that there must be some precise point where the non-heap becomes a heap. Many others recommend using what we call a 3-valued logic to allow some piles to be heaps, some not to be heaps, and some others to be in between. These logicians recommend saying that in these in-between cases the sentence "That is a heap" is neither true nor false, and should be assigned a third truth value "neither." Let's indicate this third truth-value with the symbol "#" and assign it to the sentence "Adding one grain of sand to anything that's not a heap does not make it a heap" for the reason that the sentence is not quite true but not quite false either. Maybe we can solve the paradox of the heap this way.

Before we say more about heaps, let's develop our formal logic a bit more.

Regarding negation, our intuitions tell us that, if P were to abbreviate any formal statement such as A, B, C, ..., or even more complicated statements containing many capital letters, then

~P is true iff P is false,

and we expect negation's truth table to have these two rows:

P	~P
T	F
F	T

Most philosophers and logicians are happy with this. However, our intuitions are not so clear when it comes to negating a sentence that we believe does not have a classical truth value (a T or F). Here is why. The philosopher and logician Bertrand Russell believed *all* sentences do have a classical truth value, but many advocates of 3-valued logic have the intuition that the following sentence is yet another kind of sentence that is neither true or nor false:

The present king of France is bald.

They say it is neither true nor false because of the failed presupposition, so it should get a third truth value such as #. They say the negation

The present king of France is *not* bald

isn't true or false either.

The king of France

Russell again disagrees and says both these sentences about the king of France are false, and they aren't really negations of each other. Anyway, that is why the advocates of 3-valued logic give the following table for negation, where # is the third truth value that stands for a lack of a classical truth value:

P	~P
T	F
F	T
#	#

The Polish logician Jan Łukasiewicz used that table in 1924, but his motivation for developing 3-valued logic was not to give the third truth value to sentences with failed

presuppositions nor to vague sentences but to give it to sentences about the future, such as "There will be a sea battle tomorrow," which he believed were incapable of being assigned either a T or F because tomorrow hasn't happened. Other logicians want to use 3-valued logic for sentences about unreal entities such as "Superman and Batman are having lunch."

To have a full sentential logic that is 3-valued we need to give truth tables for the connector symbols & and v and →. Logicians have investigated various choices for these tables. Let's use the following tables that were recommended by Łukasiewicz.

&	T	F	#
T	T	F	#
F	F	F	F
#	#	F	#

v	T	F	#
T	T	T	T
F	T	F	#
#	T	#	#

→	T	F	#
T	T	F	#
F	T	T	T
#	T	#	T

The way to read these tables for, say A&B is that A's truth values comes from one of the rows, but B's truth value comes from one of the columns, and the value of A&B is the value where the A row meets the B column. For example, if A is # and B is F, then we look at the # row and the F column and find that A&B is F.

———CONCEPT CHECK———

If the sentence "The present king of France is bald" is given the truth value #, what is the truth value of these three sentences when translated into our 3-valued sentential logic?

> The present king of France is bald or not bald.
> If the present king of France is bald, then the present king of France is bald.
> It's not the case that the king of France is both bald and not bald.

———278

———CONCEPT CHECK———

Let's consider a more general question about how 3-valued logic works. Can you show that Aristotle's law of excluded middle P v ~P holds in classical 2-valued logic but not in our 3-valued logic? The law implies that no matter what truth value the sentence

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278 Let B be the sentence "The present king of France is bald." Then the questions are asking for the truth values of B v ~B and B → B and ~(B & ~B). Their values are required by the truth tables to be # and T and #.

substituted for P has, the complex sentence P v ~P will have the truth value T. Why does this implication hold in 2-valued logic but fail in our 3-valued logic?

———279

The previous Concept Check showed that P v ~P is a tautology in our 2-valued logic but fails to be a tautology in our 3-valued logic, as we'd expect. Łukasiewicz wanted it to fail when P was a sentence lacking a classical truth value such as "There will be a sea battle tomorrow."

Let's now turn from single sentences to arguments. We define an argument to be deductively valid in either 2-valued or 3-valued logic if and only if its conclusion is true whenever its premises are all true. Arguments in 3-valued logic can be assessed with truth tables in a manner similar to the usual 2-valued logic, but now there are more rows because there are more combinations of truth values. For example, if an argument is made of sentences from exactly two sentence letters A and B, then instead of the four rows of classical truth tables there are nine rows. You will need the following nine rows in order to treat all the possible assignments of truth values to the sentence letters A and B:

A	B
T	T
T	F
T	#
F	T
F	F
F	#
#	T
#	F
#	#

Let's use truth tables to decide whether the following argument form is valid in our 3-valued logic. It is valid in 2-valued logic and is said to have the logical form called "modus ponens."

P
P → Q

Q

279 Briefly, the law of excluded middle fails in 3-valued logic because, whenever P gets the value #, the bigger sentence P v ~P is not true; it is #.

Here is the truth table for that argument in our 3-valued logic:

P	Q	prem. P	prem. P → Q	conc. Q
T	T	T	T	T
T	F	T	F	F
T	#	T	#	#
F	T	F	T	T
F	F	F	T	F
F	#	F	T	#
#	T	#	T	T
#	F	#	#	F
#	#	#	T	#

To use this table to assess argument validity, you will look for a row that serves as a counterexample to the argument, namely a row in which the two premises are true but the conclusion is not. There is only one row in which the two premises are true, the first row, so you don't need to look at the other rows. In that first row, Q gets the value T, so the row fails to be a counterexample. Therefore, the argument is valid in 3-valued logic. One moral here is that if you focus in this problem on finding just a counterexample, you don't need to build the whole nine-row truth table; it is sufficient to build just the first row. Usually in treating any argument there will be some way to streamline the hunt for a counterexample and avoid building large tables.

———CONCEPT CHECK———

Show that this classically valid argument is invalid in our 3-valued logic:

A → B so ~A v B

———280

History of Sentential Logic

Sentential Logic was created in 225 B.C.E. by the ancient Greek logician Chrysippus. That knowledge of logic was lost in the Dark Ages but was rediscovered by the French philosopher Abelard in the 12th century. The truth table system for Sentential Logic was invented in 1902 by the American logician Charles Peirce to display how the truth of some sentences will affect the

280 In the row in which A and B both get the truth value #, the premise is true but the conclusion is not, so that row is a counterexample.

truth of others. Truth tables were rediscovered independently by Ludwig Wittgenstein and Emil Post.

We haven't explored a proof system in this book, but a proof system for Sentential Logic was developed in 1879 by the German logician Gottlob Frege to enable us to create proofs analogous to proofs in plane geometry in which *rules of inferenc*e and axioms are used to infer a sentence from previously established sentences without knowing anything about which sentences are true. A proof is a list of sentences, a sequence of steps. A typical rule of inference is *modus ponens*:

> From any two steps of a proof that have the forms P and also P→Q you may add a new step of the form Q.

Sentences P and Q can be complicated; they don't need to be simple sentence letters. When applying this or any other rule of inference, there is no need to know or mention the truth value of the sentences involved. The proof system for Sentential Logic is often called *Sentential Calculus*. If Sentential Logic goes instead by the name Propositional Logic, then its proof system is called *Propositional Calculus*.

Any argument which can be shown to be valid by the method of truth tables is also one whose conclusion can be proved from its premises by using axioms and rules of inference in the proof system. This property of Sentential Logic is called completeness. The completeness of Sentential Calculus was first proved by the American logician Emil Post in 1921.

Sentential Logic also has the reverse property, that any argument that is provable is also valid. So, validity and provability come to the same thing in the sense that the set of arguments that are valid is also the set of arguments whose conclusion can be proved from its premises.

When there is a mechanical method that in principle could answer all questions of a certain kind without ever giving a wrong answer and always giving some answer in a finite time and never relying on probability or creativity, the method is said to *decide the question*. The truth table method can be used to decide the question of which sentences of Sentential Logic are logical truths, that is, tautologies. We also make the point by saying logical truth in Sentential Logic is *decidable*. The question of whether an arbitrary sequence of symbols is a well-formed sentence of Sentential Logic is also decidable. Can you imagine how to design a computer program which, when given the input of any string of symbols, will always correctly tell you whether it is a well-formed sentence in Sentential Logic?

Computers are logic machines in two senses: their electronic design follows basic principles of symbolic logic, and their programs are also based on principles of symbolic logic. The first programming language evolved from a formal language for symbolic logic.

Three-valued logic was invented by the British logician Hugh MacColl in 1906. Jan Łukasiewicz was another early advocate of three-valued logic. He delivered a "farewell lecture" to the University of Warsaw in 1918, in which he announced dramatically, "I have declared a spiritual

war upon all coercion that restricts man's free creative activity." The logical form of this coercion, in Łukasiewicz's view, was Aristotelian logic, which restricted propositions to true or false. His own weapon in this war was three-valued logic.

Review of Major Points

This chapter introduced the concept of a sentence's logical form and the concept of logical equivalence between sentences. Arguments have logical forms composed of the forms of their component sentences. Logical form in turn is the key to assessing whether a deductive argument is valid. Once you have identified the logical form of a deductive argument, the hardest part of assessing validity or invalidity is over, because with the form you can spot logical analogies, and you can use the method of truth tables to determine whether the argument is valid, that is, has no counterexample. In this chapter we concentrated on logical forms in Sentential Logic: forms involving *and*, *or*, *not*, and *if-then* that connect smaller sentences to form bigger sentences. We also examined three terms that are likely to cause logical confusion: *only*, *only if* and *unless*. The chapter ended with an excursion into 3-valued logic and then into the history of the field of logic. You have now developed an arsenal of powerful logical tools to use in attacking some cases of complex reasoning. Unfortunately, there is no single tool that works for all kinds of reasoning.

Glossary

antecedent The if-part of a conditional.

conditional An if-then statement.

consequent The then-part of a conditional.

contradictory A logical inconsistency between two statements in which one must be true while the other is false.

contrary A logical inconsistency between two statements when both could be simultaneously false.

fallacy of affirming the consequent A deductive argument of the form "If P then Q; Q; so, P."

fallacy of denying the antecedent A deductive argument of the form "If P then Q; not-P; so not-Q."

logical form of a contradiction The statement form "P and not-P."

logically analogous Having the same logical form.

logically equivalent Logically implying each other. Alternatively, we can say two statements are logically equivalent if they are true in the same situations and false in the same situations.

modus ponens A deductive argument of the form "If P then Q; P; so Q."

modus tollens A deductive argument of the form "If P then Q; not-Q; so not-P."

negation The negation of statement P is a statement of the form "not-P" that is true when P is false and that is false when P is true.

Sentential Logic The branch of logic that focuses on how the logical forms of complex sentences and arguments are composed from the logical forms of their sub-sentences or clauses. The clauses will be connected by one of the following sentence connectors or their synonyms: *and*, *or*, *not*, or *if-then*. Sentential Logic is also called *Propositional Logic* and *Statement Logic*.

Exercises

Logical Equivalence

■ 1. Is every statement logically equivalent to itself?[281]

■ 2. Does the definition of logical equivalence ever permit false sentences to be logically equivalent to each other?[282]

3. Let A = "x is 4," let B = "x is an even number," and let C = "x is 8/2." Then are A and B logically equivalent?

4. Let A = "x is 4," let B = "x is an even number," and let C = "x is 8/2." Then are A and C logically equivalent?

5. If no items from column C are nondeductible, can we infer with certainty that all items for column C are deductible? How about vice versa?

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281 Yes.

282 Here is an example: "Churchill was the first prime minister" and "The first prime minister was Churchill."

The Logic of Not, And, Or, and If-Then

■ 1. Show, by appeal to its logical form in sentential logic, why the following argument is valid or is invalid, and be sure to say which it is.

> If politicians are corrupt, their friends are also corrupt. Thus, if politicians are not corrupt, they don't have peculiar friends because they have peculiar friends if their friends are corrupt.[283]

■ 2.The following argument is

a. deductively valid
b. deductively invalid.

> I don't know whether polyvinyls are corrosive or not, but I do know that if they are, then ferrophenyls are also corrosive. Therefore, if polyvinyls are not corrosive, they don't have picoferrous properties because they have picoferrous properties if ferrophenyls are corrosive.[284]

Defend your answer by appeal to logical form.

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[283] The argument can be treated in sentential logic using the following definitions of the sentences
(clauses):
PC = politicians are corrupt
FC = the friends of politicians are corrupt
PF = politicians have peculiar friends

Here is the logical form (noticing that the conclusion is not the last statement in English):

If PC, then FC.
If FC, then PF.

If not-PC, Then not-PF.

This form is invalid. If you can't tell whether this form is valid, maybe the invalidity is easier to see by using a logical analogy. Here is an analogous argument that is also invalid:

If it's a house cat, then it's a feline.
If it's a feline, then it's a mammal.
So, if it's not a house cat, then it's not a mammal.

[284] It is invalid. Here is the form: If PVC then FC. If FC then PF. So, If not-PVC then not-PF.

3. The following argument is

   a. deductively valid b. deductively invalid

   I don't know whether polyvinyls are corrosive or not, but I do know that if they are corrosive, then ferrophenyls are also corrosive. Isn't it reasonable, then, to suppose that, if polyvinyls are corrosive, they have picoferrous properties because, as you've already said, they have picoferrous properties if ferrophenyls are corrosive?

Defend your answer by appeal to logical form.

4. Consider this amusing argument: "If God had wanted people to fly, He would not have given us bicycles." Here is its implicit premise: But He has given them to us; so it's clear what God wants.

   a. State the implicit conclusion.

   b. State the logical form of the argument in sentential logic.

   c. Is the argument deductively valid? Why or why not?

   d. Is the arguer assuming that God is not evil?

5. The following passage contains one or more deductive sub-arguments, all of whose premises are stated explicitly. For each one, (a) identify the sub-argument by rewriting it in standard form, (b) give its logical form, and (c) say whether it is valid.

   You've got to give up this sort of behavior. God frowns on homosexuality. Besides, all the community standards oppose it, and this is hurting your father's business. He has to serve the public, remember. If your homosexuality is illegal, you should give it up, and your homosexuality is illegal, as you well know. You say it's OK because it feels right, but there is more to this world than your feelings. I love you, but you must quit this nonsense.

■ 6. Valid or invalid?

$$\frac{\text{If } A\text{, then } B \quad A}{A \text{ and } B}$$ [285]

■ 7. Is this a deductively valid argument pattern?

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285 Valid.

P or not-*P*
If *P*, then *R*
not-*R*
---
not-*P* [286]

■ 8.Is the following argument form deductively valid in sentential logic?[287]

A
If *A*, then *B*

B

9. Here is the logical form of an argument in sentential logic. Is it valid or invalid?

If *A*, then *B*
A

A or *B*

10. Which statement patterns below would be inconsistent with the pattern "P or Q"?

a. not-P b. not-Q

c. not-P and not-Q d. not-P or not-Q

e. If P, then not-Q

11. Which of the following statement forms has the logical form "If A, then B"?

a. A, from which it follows that B.

b. A, which follows from B.

■ 12. Is this argument deductively valid?

The report writing was not difficult. Since report writing is either difficult or pleasant, the report writing must have been pleasant.[288]

13. Identify the lowercase letter preceding any passage below that contains an argument or a sub-argument that has the following logical form:

not -B

---

[286] Yes.

[287] The form is valid, and any specific argument with that form is also valid.

[288] This is an example of valid reasoning, and it remains valid even if you were to learn that one of the premises is false.

A implies B
not-A

a. X is the family of all open-closed intervals together with the null set. If X is the family of all open-closed intervals together with the null set, then X is closed under the operation of intersection. Consequently, X is not closed under the operation of intersection.

b. X is not the family of all open-closed intervals together with the null set. If X is the family of all open-closed intervals together with the null set, then X is closed under the operation of intersection. Consequently, X is not closed under the operation of intersection.

c. X is not the family of all open-closed intervals together with the null set. But X is the family of all open-closed intervals together with the null set if X is closed under the operation of intersection. Consequently, X is not closed under the operation of intersection.

d. If X is the family of all open-closed intervals together with the null set, then X is closed under the operation of intersection. X is the family of all open-closed intervals together with the null set. Consequently, X is closed under the operation of intersection.

e. X is the family of all open-closed intervals together with the null set. If X is the family of all open-closed intervals together with the null set, then X is closed under the operation of intersection. Consequently, X is closed under the operation of intersection.

f. If X is closed under the operation of intersection, then X is the family of all open-closed intervals together with the null set. X is not the family of all open-closed intervals together with the null set. Consequently, X is not closed under the operation of intersection.

14. In regard to the previous question, identify the letters of the passages that are deductively invalid.

15. Is this argument deductively valid? Defend your answer by appeal to sentential logic.

If state senators are corrupt, their staff members are corrupt. The staff members of state senators are indeed corrupt, so state senators are corrupt.

■ 16. Is this argument deductively valid? Defend your answer by appeal to sentential logic.

If Einstein were alive today, the physics department at Princeton University in New Jersey would be affected by his presence. So, if you look at the department you'll see he's one dead duck.[289]

---

[289] Valid because its sentential form is modus tollens. The argument is superficially invalid but is actually valid when the principle of charity is used in these two ways: (1) to say that the

■ 17. Is this a valid sequent in Sentential Logic?

$A \rightarrow B, \sim A \vdash \sim B$

That is, if we obey the rules of the truth tables, can we be confident that there is no way to assign truth values to the simple statement letters that will produce a counterexample?[290]

The Logic of Only, Only If, and Unless

■ 1.You can usually get from the bottom floor to the top floor of a building that has an elevator _____ you walk up the stairs.

a. only if b. if and only if

c. just when d. unless

e. none of the above[291]

2. You are president of the United States _____ you are a U.S. citizen.

a. only if b. if and only if

c. provided that d. if e. unless

■ 3.You are president of the United States _____ you are not president of the United States.

a. only if b. if and only if

c. just when d. if e. unless[292]

---

conclusion is logically equivalent to "Einstein is not alive," and (2) to add the implicit premise that the physics department at Princeton University in New Jersey is not affected by the presence of Einstein.

[290] No. This argument has the invalid form called *denying the antecedent*. In a situation where A is false and B is true, we have a counterexample because then the argument has true premises and a false conclusion.

[291] Answer (e)

[292] Answer (e).

4. For any whole number x, x is even _____ x is odd. (Which ones cannot be used to fill in the blank and still leave a true statement?)

   a. only if b. if and only if
   c. provided that d. if
   e. unless

■ 5. For any whole number x, x is even _____ x is not odd. (Which ones cannot be used to fill in the blank and still leave a true statement?)

   a. only if b. if and only if
   c. provided that d. if
   e. unless[293]

6. If it were the case that only people favoring cost-cutting techniques in the administration are advocates of decreasing the number of administrative positions, would it follow that you have got to be an advocate of decreasing the number of administrative positions to be a person favoring cost-cutting techniques in the administration?

7. A sign says, "Only adults may view this film." Does it follow with certainty that if you're an adult, you may view this film?

8. Joseph will not graduate in cosmetology unless he passes either the developmental cosmetology course or the course in experimental design. So, if Joseph passes experimental design, he will graduate in cosmetology.

   a. deductively valid b. not deductively valid

9. Carlucci calls us only if the war room is in condition orange, but the war room *is* in condition orange. So, Carlucci will call.

   In analyzing this argument, let the word *Orange* stand for the statement "The war room is in condition orange," and let the word *Call* stand for "Carlucci calls us." Rewriting the first premise as a conditional and then generalizing to the argument pattern yields which one of the following?

   a. If Orange, then Call.
      Orange.
      Call.

   b. If Call, then Orange.
      Orange.
      Call.

   c. Call only if Orange.

---

[293] Answer (e). It would be true to say "x is even unless x is odd." Adding the *not* makes (e) not fit in the blank.

Orange.
Call.

10. The argument in the previous question commits the fallacy of denying the antecedent when the first premise is rewritten as a logically equivalent conditional statement and then the argument is translated into its form in sentential logic.

    a. true b. false

11. Consider this memo from an employer:

    Employees must be given the opportunity to give or withhold their consent before the private aspects of their lives are investigated. The firm is justified in inquiring into the employee's life only if the employee has a clear understanding that the inquiry is being made. The means used to gain this information are also important; extraordinary methods would include hidden microphones, lie detector tests, spies, and personality inventory tests.

    ■ i. If the quotation is correct, then if the employee has a clear understanding that the inquiry is being made, the firm is justified in inquiring into the employee's life.

    a. follows b. does not follow[294]

    ii. If the quotation is correct, the firm is justified in inquiring into the employee's life if the employee has a clear understanding that the inquiry is being made.

    a. follows b. does not follow

    iii. If the quotation is correct, then if the firm is justified in inquiring into the employee's life, the employee has a clear understanding that the inquiry is being made.

    a. follows b. does not follow

12. Suppose x = 4 if and only if y < 22. From this fact, which of these follow with certainty?

    a. x = 4 provided that y < 22. b. x = 4 unless y < 22.

    c. y < 22 if x = 4. d. x = 4 or y < 22.

    e. (y = 22 or y > 22) just when x is not equal to 4.

---

[294] Answer (b). The phrase *only if* works like *if-then* in the sense that "Inquiry is justified only if employee has understanding" is logically equivalent to "If inquiry is justified, then employee has understanding." Note that statement (i) is the converse of this—namely, "If employee has understanding, then inquiry is justified." Consequently, (i) does not follow from the statement containing the *only if*, which is why the answer is (b).

13. Are these two arguments logically analogous? Is either of them deductively valid?

Carlucci will call us only if the war room is in condition orange, but the war room is in condition orange. So Carlucci will call.

Carlucci will call us only if he is alive. Carlucci is alive, so he will call.

■ 14. Are these two sentence forms logically equivalent?

Not-A unless B.
A only if B.[295]

Sentential Logic

1. Create a truth table for this argument in (ordinary Sentential Logic): B & (~C → ~B), so C, then say how you can look at the table and tell whether the argument is valid. Is it valid?

2. Create a truth table for this argument: B & (C v ~B), so C, then say how you can look at the table and tell whether the argument is valid. Is it valid?

3. (a) Is this sentence a tautology: (C & B) v (~C v ~B) ?
(b) Show its truth table.
(c) Say how you can look at the truth table and tell whether the sentence is a tautology.
(d) Is this sentence a tautology in 3-valued logic?
(e) Show its truth table in 3-valued logic.
(f) Say how you can look at the 3-valued truth table and tell whether the sentence is a tautology.

4. Do logicians invent logic or discover it?

---

[295] Yes. The first is equivalent to "not-A or B." The second is equivalent to "A implies B." These two are equivalent to each other.

CHAPTER 12 Aristotelian Logic and Venn-Euler Diagrams

Although there is no system of logic that can be used on all deductive arguments to successfully determine whether they are valid, the system of class logic and its method of Venn-Euler diagrams can be used successfully on the arguments that can be interpreted as being about classes, such as sets or collections. Class logic was created by Aristotle in ancient Greece, but it has undergone some development since then, although this chapter will not discuss that development.

Aristotle's Logic of Classes

A class is any collection, group, or set that is thought of as a single object. All the black symbols on your computer screen make a class, and so do all your fingers. You could even mentally collect these two classes into the combination class of both kinds of things, although that would be a very odd class. Surprisingly much ordinary talk that does not seem to be about classes can be interpreted so it is explicitly about classes, and that is why class logic is more useful than it might appear to be at first. For example, saying Obama is a president can be interpreted as saying Obama is in the class of presidents. He's a member of that class.

Class logic focuses on the classes that are mentioned in subjects and predicates of sentences, and it focuses on the occurrence of the key words *all*, *some*, *none* and their synonyms. For example, the word *Greek* refers to the class of Greeks, and the sentence "All Greeks are Europeans" can be interpreted as saying that the class of Greeks is included within the class of Europeans—that is, any member of the class of Greeks is also a member of the class of Europeans. The sentence "Socrates was an ancient Greek" does not seem to be about classes, but it can be interpreted as saying that one object (namely, Socrates) is a member of a class (namely, the class of ancient Greeks). In class logic, the sentence "No Americans are Europeans" would be interpreted as

saying that the class of Americans does not overlap with the class of Europeans—that is, the two classes do not have a member in common.

> The focus in class logic is on class membership and on classes being included within other classes.

Sentences about classes have logical forms. For example, the sentence "Some Europeans are Greek" has the form "Some E are G" where the letter E stands for the class of Europeans and the letter G stands for Greeks. The sentence is interpreted in class logic as asserting that some members of E are members of G. The statement form "All N are B" is a briefer version of "All members of the class N are members of the class B." In sentential logic, the capital letters were used for sentences or clauses, but here in Aristotle's class logic, the capital letters are used for classes.

Just as sentences have logical forms, so do arguments.

> The logic form of an argument is the form of its component premises and conclusion.

Here is an argument that can be paraphrased in English to reveal its class structure:

Nazis are bad.

Nazis like to beat up Catholics.

So, liking to beat up Catholics is bad.

Paraphrase in class logic:

All members of the class of Nazis are members of the class of bad persons.

All members of the class of Nazis are members of the class of persons who like to beat up Catholics.

So, all members of the class of persons who like to beat up Catholics are members of the class of bad persons.

In creating a paraphrase for use in class logic, we search for logically equivalent sentences in which the main verb is some form of *to be* and in which the subject and predicate can be read as being about classes. Using some obvious abbreviations of the classes, we can display the logical form of the above argument as follows:

All N are B

All N are L.

All L are B.

where

N = (the class of) Nazis

B = (the class of) bad persons

L = (the class of) all persons who like to beat up Catholics

The test of whether we have actually found the logical form of the argument is whether we can reproduce the argument by substituting the words back in for the letters.

Two different arguments in English might have the same form in class logic if we can change the definition of the capital letters. For example, if the letter L were to stand for the class of persons who like to breathe air, then on substituting words for letters in the above argument form, we would get an analogous argument about Nazis liking to breathe air.

Nazis are bad.

Nazis like to breathe air.

So, liking to breathe air is bad.

The two arguments rise and fall together in class logic because they are logically analogous—that is, they have the same form in class logic. This particular form is deductively invalid, isn't it?

Our choice of the letter N was arbitrary. We can re-letter formal arguments in class logic and get the same form. If we replaced N with M above, we'd get this analogous form:

> All M are B
>
> All M are L.
>
> All L are B.

In class logic, if we are talking about individual members rather than classes, the custom is to use small case letters. So, if we wanted to treat the sentence "The biggest fish in our sea is not a mammal" in class logic, we might choose the small case letter "b" for "the biggest fish in our sea" and choose "M" for the predicate "is a mammal." Then we'd translate our sentence into class logic as "b is NOT-M."

The "NOT" isn't the negation that was used in sentential logic. Here it means the *complement* of M, that is, the class of all things not in M.

———CONCEPT CHECK———

Which one of the choices below has the logical form of this argument about whales? (Hint: The order in which the premises are presented in an argument is not essential to an argument's validity or to its form.)

> Whales are mammals, but the biggest fish in our sea is definitely not a mammal, so it's not a whale either.
>
> a. Potatoes are produce. Not all fattening foods are potatoes, so not all fattening foods are produce either.
>
> b. That squirming thing has no backbone. However, fish are the kind of things that do have backbones. So it's not a fish.
>
> c. Fat fish are swimmers. No house cat is a fat fish, so no house cats are swimmers.

———296

296 Answer (b). Both arguments have this form: All W are M. b is NOT-M, so b is NOT-W.

You aren't restricted to using single capital letters for a class. If it helps you remember its name better by giving the class a longer name, that is OK. You could have chosen "MAM" as the abbreviation of the class of mammals instead of "M."

———CONCEPT CHECK———

Choose the correct class logic pattern for the following biological argument:

> All insects have exactly six legs. So no spider is an insect because all spiders have exactly eight legs.

Here are four choices for the pattern. SIX stands for the class of things that have six legs.

a. All INS are SIX.
No SPID are INS.
No SIX are EIGHT.

All SPID are EIGHT.

b. All INS are SIX.
No SPID are INS.
No SIX are EIGHT.

No SPID are INS.

c. All INS are SIX.
No SPID are INS.
No INS are SPID.

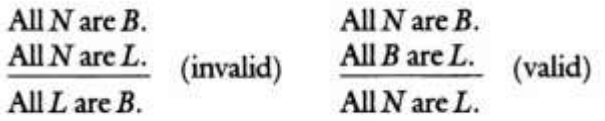
All SPID are EIGHT.

d. All INS are SIX.
All SPID are EIGHT.
No SIX are EIGHT.

No SPID are INS.

———297

The two arguments below have different forms. Any argument with the form on the right is valid:



You should be able to think of a counterexample to the argument form on the left. Think about what definitions you could give to N, B and L that would create an argument with true premises and a false conclusion.

Substituting *Nazis* for N and *bad people* for B and *like to breathe air* for L will produce a counterexample to the form on the left.

———CONCEPT CHECK———

If some A are C and all C are R, then must some R be A?

———298

From the answer to the previous concept check you can see that deductive logic is placing limits on what you can think of.

> You cannot think of counterexamples to valid arguments.

———CONCEPT CHECK———

Is this a deductively valid argument form?

No A are B.

---

297 Answer (d). Only (b) and (d) have the correct conclusion below the line.

298 Yes, this is deductively valid reasoning in class logic. You cannot think of any definitions for the letters that will produce an invalid argument.

Some B are C.

No A are C.

———[299]

Using Venn-Euler Diagrams to Test for Invalidity

In class logic, we can create diagrams to help us test arguments for validity. Before we do this, though, let's improve our skill at reasoning with the complement of classes, that is, the set of all things not in a class. If you're an American, then what's our name for the non-Americans? It's "foreigner." The more Americans travel, the more they meet non-Americans.

Assuming that nobody can be both a Jew and a Christian, it would be true to say that all Jews are non-Christians and true to say that some non-Jews are non-Christians, but it would be false to say that all non-Christians are Jews and false to say all non-Christians are non-Jews. Whew! Congratulations and compliments if you could carefully comprehend the complexities of those complementations about classes. If you could, you can complete this concept check correctly.

———CONCEPT CHECK———

[299] No, it is deductively invalid. You can probably think of some definitions for the letters that will produce an invalid argument. How about A being apples and B being bananas and C being fruit?

Martin (pictured above) is not a white male if Martin is

a. a white non-male. b. a non-white male,

c. a non-white non-male. d. all of the above.

300

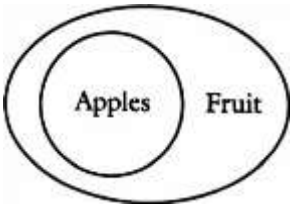
Skill at negating terms is needed for constructing Venn-Euler diagrams. This diagramming method is a helpful way to quickly assess the deductive validity of arguments in class logic. It can guide you to the correct assessment when the argument is too intricate to analyze in your head. In presenting this method, we shall first introduce the diagrams for classes, then generalize the method so that it can be used to display whether sentences about classes are true or false, and then generalize the method again so that it can be used to show whether arguments using these sentences are deductively valid.

The circle below is Euler's diagram of the class of apples.

300 Answer (d). Answering questions like this would be so much easier if we had some sort of picture or diagram method that would show us what is going on. Maybe you can invent one. Euler tried to do this back in the 18th century in Switzerland.

In this two-dimensional diagram, any point within the circle represents an apple and any point outside the circle represents a non-apple such as a Muslim or a pencil. The custom for labeling is to use a capital to start the name of a region (class) and a small case letter to name a specific member of a region (class). The small letter "r" labels the point to the right of the circle that represents a specific non-apple, let's say Thomas Edison, the American inventor and founder of the General Electric Corporation. There is nothing important about the shape of the region. An ellipse or a rectangle would be fine, just as long as it is clear what is in the region and what is out, that is, what is in the class and what is not. The size of the circle isn't important either. Nor do we pay attention to moving the diagram to the left or right or up or down. All those changes would produce the same diagram, as far as class logic is concerned.

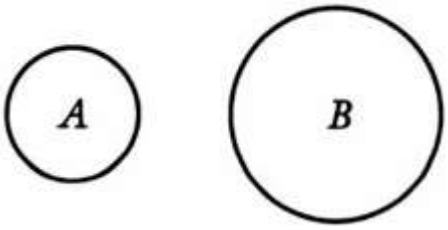
The following is a more complicated diagram that represents both the class of apples and the class of fruit. In the real world, the class of apples is included wholly within the larger class of fruit. The diagram provides a picture of this real-world relationship:



The above diagram represents the truth of the sentence "All apples are fruit," but you are welcome to draw diagrams that don't picture the way the world is.

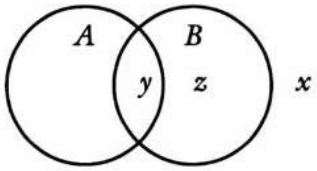
Any label for a region can be inside or outside it, provided there is no ambiguity about which label goes with which region. Sometimes we will call oval regions "circles" since we don't pay any attention to the difference between a circle and an ellipse.

Here is a diagram in which statements of the form "No A are B" are true:



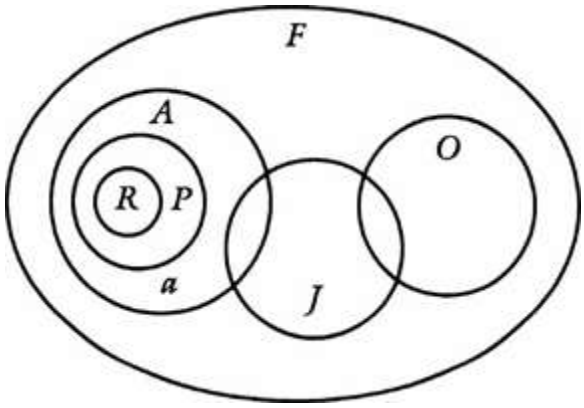
What is important about this diagram is that the two circles do not intersect (overlap). The circles shouldn't be tangent either, because that would make it hard to tell whether the two classes have a common member.

Consider the points x, y, and z in the following diagram. The classes A and B intersect—that is, they have members in common. One of those members is y.



Point x is neither in class A nor in class B. It's in the complement of each. Point y is in both A and B. Point z is in B but not in A. By viewing the diagram, you can see that some members of B are in A and some aren't. However, you cannot tell whether A has more members than B. If region A is larger than B in a diagram, you can't tell whether A has more members than B. For that matter, you can't even tell whether the class has any members at all. However, in all diagrams from now on, we will assume that we are starting with classes that are not empty.

Here is a diagram representing the real-world relationship among apples, fruits, oranges, apples in Paris, apples in restaurants in Paris, and fruit owned by our friend Juan:



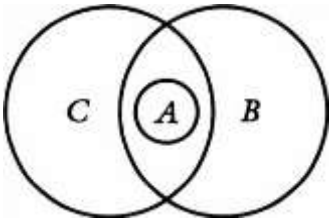
A = things that are apples
F = things that are fruit
O = things that are oranges
P = things that are apples in Paris
R = things that are apples in restaurants in Paris
J = things that are fruit owned by our friend Juan

To be clear, we shall always use capital letters or capitalized words for classes of things. If we want to add the information that some specific object is a member of one of the classes, we will

use a lowercase letter to represent the member. In the previous diagram the lowercase *a* represents the one apple in my refrigerator. You can see that the letter *a* is outside the P circle; this shows that the apple in my refrigerator is not in Paris. Notice that Juan himself is not a member of any of the classes in the above diagram; the information about Juan is embedded in the definition of *J*. By inspecting the diagram you can tell that Juan doesn't own any Parisian apples (because J and P do not overlap), but he does own apples (because J intersects A), does own oranges (because J intersects O), and does own some other unspecified fruit (because J is in F but not all of J is in A or O).

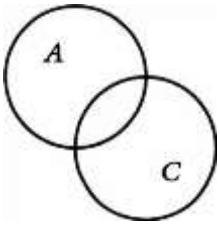
———CONCEPT CHECK———

Find some classes in the real world that have the relationships indicated in the following diagram:



———301

How would you draw a diagram in which the statement that some apples are from Canada and some aren't is true? This will do the trick:



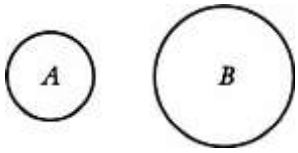
C = the class of things from Canada

A = the class of apples

The sentence pattern "All A are non-B" is true in the following diagram:

---

301 Be sure to think about these concept check before looking at the answer, or you might not have acquired the skills you need to do well on the homework and tests. A = U.S. citizens who live in New York City, B = city dwellers, C = Americans.



Notice that it is the same as the diagram you'd draw for "No A are B." Logically equivalent sentences have the same kinds of diagrams. That's a key idea in class logic.

The above diagram would represent the false sentence "No Texans are Americans" if the following dictionary were used:

A = Texans

B = Americans

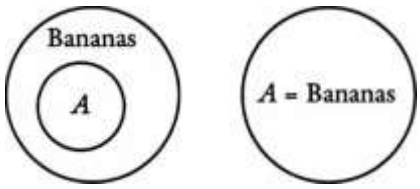
Although that sentence is false in the real world, the diagram shows how the world would be if the sentence were true. The same point is made by saying that the diagram is a picture of what is true in a certain "possible world" that isn't the actual world.

———CONCEPT CHECK———

Make the statement "All Texans are non-Americans" be true in a diagram, using the above dictionary for A and B.

———[302]

Letting A be the class of apples. In the two diagrams below the sentence "All apples are bananas" is true (even though the sentence is false in the real world):



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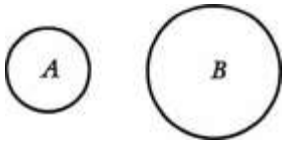
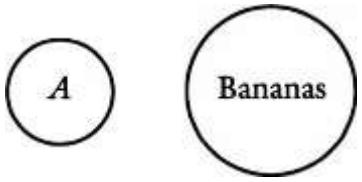
302 Notice that in this diagram every Texan A is outside America B and thus is a non-American. So this possible world isn't the actual world.



But notice the difference in the two diagrams. In the one on the left some bananas fail to be apples. This is not so in the diagram on the right. In the second diagram, the class of apples and the class of bananas are the same class. A diagram of the real-world relationships between apples and bananas would instead look like this:



———CONCEPT CHECK———

Draw a diagram for apples and fruit in which the following sentence *isn't* true in the diagram: "All apples are fruit." The sentence is true in the real world, but it won't be in the possible world represented by your diagram.

———303

With a sentence such as "All apples are fruit," the analyst has the option of treating it in class logic or in sentential logic. In class logic, it is logically equivalent to "All things in the class of apples are also things in the class of fruit." This states a relationship between two classes. In sentential logic, the sentence is logically equivalent to "If it's an apple, then it's a fruit." This states a conditional relationship between two sub-sentences.

We can now generalize the diagram method to a technique for assessing the deductive validity of arguments, provided that the sentences constituting the argument describe how classes of objects are related to each other. **The Venn-Euler diagram method of assessing arguments works only for deductive arguments in class logic**. It shows an argument to be valid if there is no diagram of a counterexample to the argument. By definition, the counterexample to an argument is a possible situation or an interpretation of the argument showing how it could have true premises and a false conclusion.

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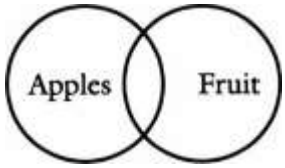
303 There is more than one kind of diagram that will work.



In class logic, an argument is valid if there is no diagram of a counterexample.

More specifically, here is **how to apply the method of checking for validity** in class logic:

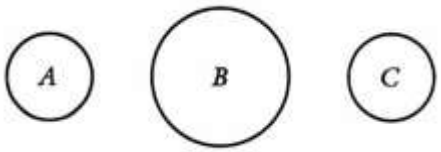
> Translate the premises and conclusion of the argument into appropriate sentences of class logic. Search for a counterexample. That is, try to diagram these sentences in class logic so that the premises come out true in the diagram and the conclusion comes out false in the diagram. If there is a diagram like this, then this counterexample diagram shows that the argument is deductively invalid. However, if all possible diagrams fail to produce a counterexample, then the argument is declared to be deductively valid.

This method never gives an incorrect answer if you have actually correctly examined all possible diagrams. An argument is valid if there *exists* no counterexample, not merely if you can't find one. Maybe you can't find one because you didn't look carefully. So, the application of the method of Venn-Euler diagrams is risky since its answer depends on you being correct when you say you've looked and are confident that no counterexample exists.

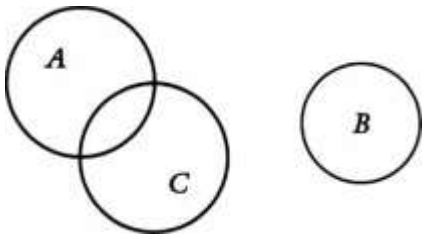
To see the technique in action, let's try it out on this argument pattern:

> No A are B.
>
> No C are B.
>
> So, No A are C.

Here is a diagram that makes all the premises be true:



None of the circles intersect or are contained within another. In this diagram the conclusion is true. Can we conclude that the argument pattern is valid? No, not from this information. We should instead have been searching to make sure that there is no diagram that makes the premises true but the conclusion *false*. In fact, there is such a diagram:



Here the conclusion is false when the premises are true, a telltale sign of invalidity. Therefore, the diagram method declares the argument pattern to be invalid.

———CONCEPT CHECK———

Use the diagram method to show the validity of this argument pattern:

All A are B.

All B are C.

So, All A are C.

———[304]

———CONCEPT CHECK———

Use the diagram technique to assess the validity or invalidity of this argument. Remember to interpret *some* to mean "at least one but not all."

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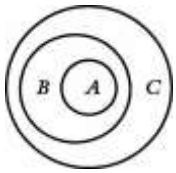
[304] Here is a way to draw a diagram of both the premises being true



There can be other diagrams of the premises: permit circle A to equal circle B, or for B to equal C. However, in all the possible diagrams of the premises, the conclusion comes out true in the diagram. So, no counterexample can be produced. Therefore, the Venn-Euler technique declares this argument pattern to be valid.

Some cats are felines.

Some animals are felines.

So, some animals are cats.

305

When trying to find the logical form of an argument, it is not always possible to tell whether you should look for its form in class logic or in sentential logic. Experiment to see what will work. Some arguments have logical forms that cannot be expressed adequately either way, and then more powerful logics such as predicate logic must be brought to bear on the argument.

In addition, some arguments are deductively valid although their validity is not a matter of logical form using any formal logic. Here is an example:

John is a bachelor.

So, he is not married.

The validity is due not just to form, but to content—in particular, to the fact that the definition of *bachelor* implies that all bachelors are not married. We could force this argument to be valid due to its logical form in class logic if we could encode the idea that all bachelors are not married into class logic, and we can. Just add the premise: All bachelors are not married. Valid arguments that don't need the insertion of definitions are called *formally valid*. All formally valid arguments are deductively valid, but the reverse doesn't hold. However, in our course we won't pay attention to this fine distinction. If you see that a definition is needed to make the argument be valid, go ahead and insert it and don't worry about the fact that this shows your argument is deductively valid but not formally valid.

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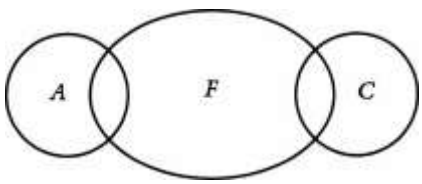
305 The argument is invalid; the following diagram serves as a counterexample:

Some C are F.

Some A are F.

Some A are C.



Venn-Euler diagrams have other uses besides checking for validity. If two sentences can have the same diagram, then they are *logically equivalent* in class logic. The diagrams also can be used to check for consistency. If there is a diagram in which each sentence in a set of sentences comes out true, then the set is *logically consistent*.

The Logic of *Only* in Class Logic

Consider whether these two sentences are logically equivalent:

> Only Americans are Texans.
>
> Only Texans are Americans.

They aren't equivalent. One way to tell is that in the real world one is true and one is false. Logically equivalent sentences are true together or false together. The first sentence is saying, "If you are in the class of Texans, then you are in the class of Americans." The second sentence is saying, "If you are in the class of Americans, then you are in the class of Texans."

Diagrams can be useful for demonstrating the logical relations of sentences containing the tricky word *only*. Let TX be the set or class of Texans, and let USA be the set of Americans. Then "Only Americans are Texans" has this diagram:

and "Only Texans are Americans" has this diagram:

Now it is clear that the two sentences are not saying the same thing and so are not logically equivalent. If they said the same thing, they'd have the same diagram.

Would it be OK to say only Europeans are Greek? Hmm. We will come back to this question in a moment.

———CONCEPT CHECK———

Use the Venn-Euler diagram technique to show the validity or invalidity of the following argument:

Only living things have children.

A computer does not have children.

So, a computer is not a living thing.

———306

To abstract from these examples, the main points about the logic of the word *only* are that the class logic statement

Only A's are B's

is logically equivalent to the class logic statement

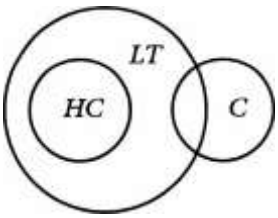
All B's are A's.

Both of those statements are equivalent to the conditional statement

If anything is a B, then it's an A.

---

306 The argument is invalid because in the following diagram the premises come out true but the conclusion doesn't:



HC = the class of things that have children

LT = the living things

C = computers

———CONCEPT CHECK———

Create a counterexample to the following argument by producing a logically analogous argument that is more obviously invalid:

> Only Simbidians are Greek. So, only Greeks are Simbidians.

———[307]

Now let's examine some complicated arguments that depend crucially on the word *only*. Is the following argument deductively valid?

> Only living things can have feelings.
>
> A computer is not a living thing.
>
> So, a computer cannot have feelings.

Also, is the following argument valid?

> Only living things can have feelings.
>
> A computer does not have feelings.
>
> So, a computer is not a living thing.

Both of these arguments appear to be valid to many people who hold certain views about artificial intelligence. Yet these people are being illogical.

———CONCEPT CHECK———

Are *either* of the previous two arguments about computers deductively valid?

———[308]

---

307 Consider the situation in which a "Simbidian" is a European. In this situation, the argument has a true premise and a false conclusion. I made up the word Simbidian; you won't find it in the dictionary.

308 The first argument is valid.

Review of Major Points

This chapter focused on the logical forms of arguments in Aristotle's class logic. For deductive arguments involving class relationships, Venn-Euler diagramming is a useful picture method for assessing validity or invalidity. The method is applied to an argument by attempting to discover a counterexample to the argument. If one is found, the argument is deductively invalid. But if none can be found, then the argument is valid.

Glossary

class logic The logic developed by Aristotle that turns on the relationships among classes of things, especially the classes referred to by the subjects and predicates of sentences whose verb is a form of "to be."

complement The complement of a class is all the things not in the class.

counterexample to an argument A state of affairs, real or imagined, in which the premises of the argument turn out to be true and the conclusion turns out to be false.

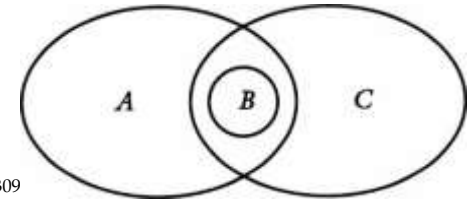
formally valid Deductively valid because of its logical form.

Venn-Euler diagram Diagram representing the class inclusion and class membership relationships.

Venn-Euler diagram method A method of determining the validity of arguments in class logic by using diagrams in order to produce a counterexample to the argument, if one exists.

Exercises

■ 1. Find three classes in the real world that have the relationships indicated in the following diagram:



309

309 A = fruit, B = oranges, C = things that grow on trees.

2. Draw a diagram in which the following statement is true, and draw one in which it is false: "Only non-handheld things are returnable." Be sure to define your labels.

■ 3. Draw a diagram in which it is true that although no Americans are voters, some of them are free and some aren't, yet all of them are rich. In your diagram, are all the voters rich?[310]

4. If all A are C but no C are B, then are some A also B?

■ 5. Finding something that has both properties W and T tends to confirm the statement "All W are T"; for example, finding a black raven tends to confirm the statement "All ravens are black."

a. true b. false[311]

6. If all non-black things are non-ravens, then you can be sure there are no albino ravens.

a. true b. false

7. Assuming that all non-black things are non-ravitious, it follows with certainty that all nonravitious things are non-black.

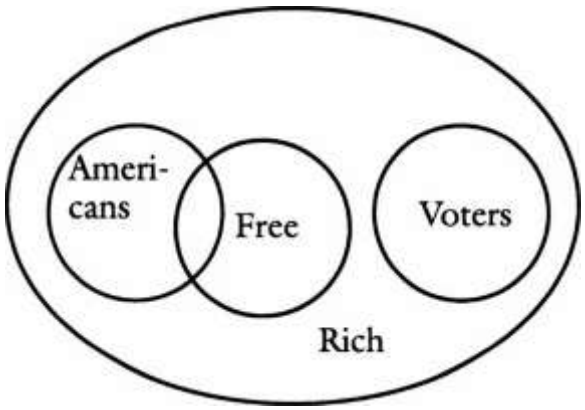
a. true b. false

8. Even if all ravens are black, it would not necessarily be the case that everything that is not black fails to be a raven.

a. true b. false

---

310 There are many acceptable diagrams. The relationship between voters and rich people is not fixed by the sentence. Consequently, you have leeway about where the voters' region can go. It can go outside the rich area, it can intersect it, or it can be wholly within it—provided that the voter area is wholly separate from the American area. In the following diagram all the voters are rich, but this need not be true in other acceptable diagrams.



311 Answer (a).

9. The sentence can be used to express an invalid argument. Turn it into a deductively valid argument by adding the word *only*.

> Children pay no taxes at all, because children are not adults and because adults pay taxes.

■ 10. Give the logical form of the following argument in class logic. Define your new symbols, but let M = the class of modern works of art. Draw the relevant diagrams for assessing the deductive validity of the argument. Assess its validity by referring to your diagram(s): that is, say, "These diagrams show that the argument is valid (or invalid) because . . ."

> Since all modern works of art are profound works of art, but not all profound works of art are modern works of art, and because some religious works of art are modern works of art, even though some aren't, it follows that some religious works of art fail to be profound.[312]

---

[312] Although you weren't asked for the standard form, here it is:

All modern works of art are profound works of art.

Not all profound works of art are modern works of art.

Some religious works of art are modern works of art.

Some religious works of art are not modern works of art.

Some religious works of art fail to be profound.

The logical form of the argument is:

All M are P.

Not all P are M.

Some R are M.

Some R are not M.

Some R are not P.

where we used these definitions:

M = (the class of) modern works of art

P = the profound works of art

■ 11. The Venn-Euler diagram technique is a way of testing whether something is wrong (invalid) with the pattern of arguments that are about classes of things.

a. true b. false[313]

12. Given a class logic argument that is deductively valid but unsound, the diagram technique can show why it is unsound.

a. true b. false

13. Use the method of diagrams to determine the validity or invalidity of the following argument:

There are doctors who aren't rich, because all doctors are professionals yet some professionals are not rich.

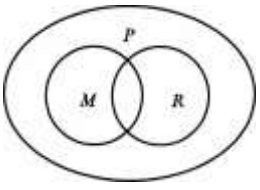
14. If no items from column C are nondeductible, and if column C is not empty of items, then can we infer with certainty that at least one item from column C is deductible?

■ 15. Is this argument deductively valid?

Some anthropoids are surreptitious and some aren't; hence there are brazen things that aren't anthropoids because all surreptitious beings are brazen.[314]

JR. = religious works of art

"Not all P are M" means that not all members of P are members of M.



This diagram shows that the argument is deductively invalid because the diagram makes the premises (of the logical form) true while the conclusion is false.

313 Answer (a).

314 It is invalid because of the possibility of the situation shown in the following diagram:

■16. Is this argument deductively valid? Use the method of diagrams, and show your work.

> There are prize winners who aren't avaricious, because every early entrant is a prize winner and because one or more avaricious beings did enter early, though some didn't.[315]

---

[315] To find the answer, translate it into the kind of English that more obviously talks about classes and that uses the terms all, some, and none in place of their equivalents.

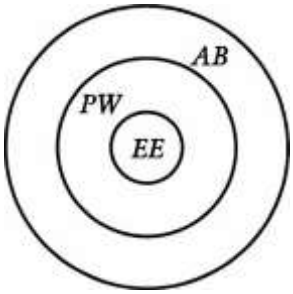
All early entrants are prize winners.
Some avaricious beings are early entrants.
Some avaricious beings are not early entrants.
Some prize winners aren't avaricious.

The logical form of the above is:

All EE are PW.
Some AB are EE.
Some AB are not EE.
Some PW are not AB.
Where

EE = (the class of) early entrants
PW = (the class of) prize winners
AB = (the class of) avaricious beings

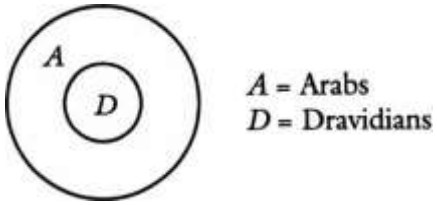
Goal: To draw a diagram showing that the argument can have true premises while having a false conclusion—the sure sign of deductive invalidity. The diagram below achieves this goal:



17. Is this argument deductively valid? Use the method of diagrams, and show your work.

> There are prize winners who aren't avaricious, because all early entrants are prize winners and some avaricious persons entered early and some early entrants aren't avaricious.

18. Is the statement "Some Arabs are Dravidians" true in the following diagram?



a. yes b. no c. depends on the meaning of *same*

19. Is this argument deductively valid? First, consider whether the argument is best handled with sentential logic or class logic.

> The moon maidens don't like Miller Lite. If the Beast controls planet Gorp, then Xenon is in power on that moon. If Xenon is in power on that moon, then the moon maidens like Miller Lite. So the Beast doesn't control planet Gorp.

Give the logical form of the argument. Define your terms.

20. One of the following two arguments is deductively valid, and the other is not. Identify the invalid one, and use the method of Venn-Euler diagramming to defend your answer.

> A = Arabs D = Dravidians

a. There are biopical persons who aren't devious because some devious persons are not surreptitious, and some are, and because a person is surreptitious only if he or she is biopical.

b. There are biopical persons who aren't devious because some surreptitious persons are not devious, and some are, and because any person is biopical if he or she is surreptitious.

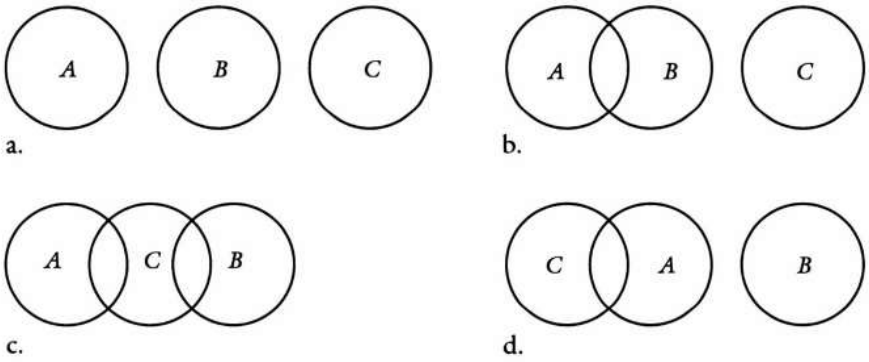
21. Use the technique of diagrams to assess the validity of the following arguments:

> a. If some A are C, and all C are R, then some R must be A
>
> b. No A are B. c. No A are B.
>
> Some B are C. All B are C.

So, no A are C. So, no A are C.

22. Which diagram demonstrates the deductive invalidity of the following argument?

No apes are bears.
No bears are cats.
So, no apes are cats.



23. Draw a diagram that will demonstrate the deductive invalidity of the following argument that might be given by a political liberal who isn't reasoning logically:

> No conservatives in Congress are for helping humanity, because all supporters of legislation to increase welfare programs want to help humanity, yet none of the conservatives support legislation to increase welfare programs.

24. Are the following statements logically consistent with each other? Use diagrams to defend your answer.

> Not only are no bluejays arachnids, but no dialyds are either. Still, some bluejays are catalytic, but not all are. Anything catalytic is a dialyd.

■ 25. To say that all the people who go to this restaurant are kids is to say something logically equivalent to

a. Only the people who go to this restaurant are kids.

b. Only kids (are the people who) go to this restaurant.

c. Neither a nor b.

d. Both a and b.[316]

■ 26. Which pairs of statement forms from the following list are logically equivalent to each other? In answering, use only the lowercase letters, not the statement forms themselves.

a. No Aare B. b. No B are A

c. All are not-B. d. All not-B are A.

e. Only not -A are B.[317]

27. Which pairs of statements from the following list are logically equivalent to each other? In answering, use only the letters, not the statements. Hint: Use Aristotelian logic.

a. Every hand-held thing is nonreturnable.

b. No returnable thing is hand-held.

c. All nonreturnable things are hand-held.

d. Only non-hand-held things are returnable.

e. No hand-held thing is returnable.

■ 28. Are these logically equivalent? If not, why not?

a. Not all profound works of art are modern.

b. Not all profound works of art are modern works of art.[318]

---

316 Answer (b).

317 All pairs from the group {a, b, c, d} are logically equivalent.

318 Yes, they say the same thing, using the principle of charity. They are different grammatically but not logically. It is possible to interpret the first as meaning mean modern in time and the second as meaning modern in style. However, if you make the latter point, you

29. During Ronald Reagan's presidency, the United States Attorney General Edwin Meese III criticized the Supreme Court's Miranda decision that spelled out the legal rights of accused persons that the police must respect. Meese said, "The thing is, you don't have many suspects who are innocent of a crime. ... If a person is innocent of a crime, then he is not a suspect." One of the following statements is logically equivalent to what Meese said in his last sentence. That is, Meese said

a. If a person is not innocent of a crime, he is not a suspect.

b. No suspects in a crime are innocent.

c. No persons who are not innocent of a crime are suspects.

d. All suspects in crimes are innocent.

e. If a person is innocent of a crime, then he is not guilty of the crime.

■ 30. Let's try out some more terminology from everybody's friend, the United States Internal Revenue Service.

---

should also notice that the two could be (better yet, are likely to be) logically equivalent; it is wrong to say they definitely are not equivalent. In fact, if the two sentences were used in a piece of reasoning and they did have different meanings, and if the context didn't make this clear, the reasoner would be accused of committing the fallacy of equivocation.

If no items from column C are deductible, then can we infer with certainty that no deductible items are from column C? How about vice versa? What can you conclude about whether the two statements are logically equivalent?[319]

31. *Sofa* and *couch* are equivalent terms—that is, they are synonymous. Now consider the term *weird*. Is the term closer to being equivalent to *unusual* or instead to *very unusual*? If someone disagreed with you about this, what could you do to prove the person wrong?

32. To say that only the people who go to this restaurant are kids is to say something logically equivalent to

a. All the people who go to this restaurant are kids.

b. All kids go to this restaurant.

c. Neither a nor b.

d. Both a and b.

■ 33. Suppose someone says, "Only kids go to Chuck E. Cheese restaurants."

i. Would the following sentence, if true, be a counterexample?

Some kids in Russia don't go to Chuck E. Cheese restaurants.

ii. How about this as a counterexample instead?

I'm an adult, not a kid, and I go to Chuck E. Cheese restaurants.[320]

34. Consider this argument:

> All cylinders contain petroleum, since each one has a blue top and only petroleum containers have blue tops.
>
> Does it follow from the second premise that some things can have blue tops but not be petroleum containers?

---

319 Yes. Yes. They are equivalent; they are two ways of saying the same thing.

320 i. no ii. yes

photo by Ferenghi

CHAPTER 13 Inductive Reasoning

If it looks like a duck, walks like a duck, and quacks like a duck, then it's a duck. This is usually good reasoning. It's probably a duck. Just don't assume that it *must* be a duck for these reasons. The line of reasoning is not sure-fire. It is strong *inductive reasoning* but it is not strong enough to be deductively valid. Deductive arguments are arguments intended to be judged by the deductive standard of, "Do the premises force the conclusion to be true?" Inductive arguments are arguments intended to be judged by the inductive standard of, "Do the premises make the conclusion probable?" So the strengths of inductive arguments range from very weak to very strong. With inductively strong arguments there is a small probability that the conclusion is false even if the premises are true, unlike with deductively valid arguments. An inductive argument can be affected by acquiring new premises (evidence), but a deductive argument cannot be. This chapter focuses specifically on the nature of the inductive process because inductive arguments play such a central role in our lives. We will begin with a very important and very common kind of inductive argument, generalizing from a sample. Then later we will consider the wide variety of inductive arguments.

Generalizing from a Sample

Scientists collect data not because they are in the business of gathering facts at random but because they hope to establish a generalization that goes beyond the individual facts. The scientist is in the business of sampling a part of nature and then looking for a pattern in the data that holds for nature as a whole. A sociologist collects data about murders in order to draw a general conclusion, such as "Most murders involve guns used on acquaintances." A statistician

would say that the scientist has sampled some cases of murder in order to draw a general conclusion about the whole population of murders. The terms **sample** and **population** are technical terms. The population need not be people; in our example it is the set of all murders. A sample is a subset of the population. The population is the set of things you are interested in generalizing about. The sample is examined to get a clue to what the whole population is like.

The goal in drawing a generalization based on a sample is for the sample to be **representative** of the population, to be just like it. If your method of selecting the sample is likely to be unrepresentative then you are using a **biased method** and that will cause you to commit the **fallacy of biased generalization**. If you draw the conclusion that the vast majority of philosophers write about the meaning of life because the web pages of all the philosophers at your university do, then you've got a biased method of sampling philosophers' writings.

Whenever a generalization is produced by generalizing on a sample, the reasoning process (or the general conclusion itself) is said to be an **inductive generalization**. It is also called an **induction by enumeration** or an **empirical generalization**. Inductive generalizations are a kind of argument by analogy with the implicit assumption that the sample is analogous to the population. The more analogous or representative the sample, the stronger the inductive argument.

Generalizations may be statistical or non-statistical. The generalization, "Most murders involve guns," contains no statistics. Replacing the term *most* with the statistic 80 percent would transform it into a statistical generalization. The statement "80 percent of murders involve guns" is called a **simple statistical claim** because it has the form

> x percent of the group G has characteristic C.

In the example, x = 80, G = murders, and C = involving guns.

A general claim, whether statistical or not, is called an inductive generalization only if it is obtained by a process of generalizing from a sample. If the statistical claim about murders were obtained by looking at police records, it *would* be an inductive generalization, but if it were deduced from a more general principle of social psychology, then it would not be an inductive generalization, although it would still be a generalization.

———CONCEPT CHECK———

> Is the generalization "Most emeralds are green" a statistical generalization? Is it an inductive generalization?

———[321]

[321] It is not statistical, but you cannot tell whether it is an inductive generalization just by looking. It all depends on where it came from. If it was the product of sampling, it's an

Back from the grocery store with your three cans of tomato sauce for tonight's spaghetti dinner, you open the cans and notice that the sauce in two of the cans is spoiled. You generalize and say that two-thirds of all the cans of that brand of tomato sauce on the shelf in the store are bad. Here is the pattern of your inductive generalization:

x percent of sample S has characteristic C.
---
x percent of population P has characteristic C.

In this argument x = 66.7 (for two-thirds), P = all the tomato sauce cans of a particular brand from the shelf of the grocery store, S = three tomato sauce cans of that brand from the shelf of the grocery store, and C = spoiled. Alternatively, this is the pattern:

Sample S has characteristic C. So, population P has characteristic C.

where C is now not the property of being spoiled but instead is the property of being 66.7 percent spoiled. Either form is correct, but be sure you know what the C is.

> The goal in taking samples is for the sample to be representative of the population it is taken from, in regard to the characteristics that are being investigated.

The more the sample represents the population, the more likely the inductive generalization is to be correct. By a **representative sample** we mean a sample that is perfectly analogous to the whole population in regard to the characteristics that are being investigated. If a population of 888 jelly beans in a jar is 50 percent black and 50 percent white, a representative sample could be just two jelly beans, one black and one white. A method of sampling that is likely to produce a non-representative sample is a **biased sampling method**. A biased sample is a non-representative sample.

The fallacy of hasty generalization occurs whenever a generalization is made too quickly, on insufficient evidence. Technically, it occurs whenever an inductive generalization is made with a sample that is unlikely to be representative. For instance, suppose Jessica says that most Americans own an electric hair dryer because most of her friends do. This would be a hasty generalization, since Jessica's friends are unlikely to represent everybody when it comes to owning hair dryers. Her sampling method shows too much bias toward her friends.

---

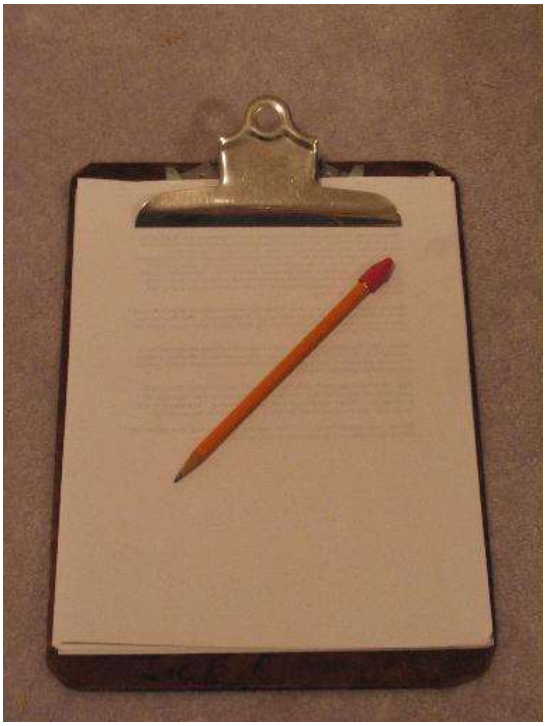
inductive generalization. If not, then it's not an inductive generalization. Either way, however, it is a generalization.

Random Sample

Statisticians have discovered several techniques for avoiding bias. The first is to obtain a random sample. When you sample at random, you don't favor any one member of the population over another. For example, when sampling tomato sauce cans, you don't pick the first three cans you see.

Definition A **random sample** is any sample obtained by using a random sampling method.

Definition A **random sampling method** is taking a sample from a target population in such a way that any member of the population has an equal chance of being chosen.



It is easy to recognize the value of obtaining a random sample, but achieving this goal can be difficult. If you want to poll students for their views on canceling the school's intercollegiate athletics program in the face of the latest school budget crisis, how do you give everybody an equal chance to be polled? Some students are less apt to want to talk with you when you walk up to them with your clipboard. If you ask all your questions in three spots on campus, you may not be giving an equal chance to students who are never at those spots. Then there are problems with the poll questions themselves. The way the questions are constructed might influence the answers you get, and so you won't be getting a random sample of students' views even if you do get a random sample of students.

Purposely not using a random sample is perhaps the main way to lie with statistics. For one example, newspapers occasionally report that students in American middle schools and high schools are especially poor at math and science when compared to students in other countries. This surprising statistical generalization is probably based on a biased sample. It is quite true that those American students taking the international standardized tests of mathematics and science achievement do score worse than foreign students. The problem is that school administrators in other countries try too hard to do well on these tests. "In many countries, to look good is very good for international prestige. Some restrict the students taking the test to elite schools," says Harold Hodgkinson, the director of the Center for Demographic Policy in Washington and a former director of the National Institute of Education. For example, whereas the United States tests almost all of its students, Hong Kong does not. By the 12th grade, Hong Kong has eliminated all but the top 3 percent of its students from taking mathematics and thus from taking the standardized tests. In Japan, only 12 percent of their 12th grade students take any mathematics. Canada has especially good test results for the same reason. According to Hodgkinson, the United States doesn't look so bad when you take the above into account.

The following passage describes a non-statistical generalization from a sample. Try to spot the conclusion, the population, the sample, and any bias.

> David went to the grocery store to get three cartons of strawberries. He briefly looked at the top layer of strawberries in each of the first three cartons in the strawberry section and noticed no fuzz on the berries. Confident that the berries in his three cartons were fuzz-free, he bought all three.

David's conclusion was that the strawberries in his cartons were not fuzzy. His conclusion was about the population of all the strawberries in the three cartons. His sample was the top layer of strawberries in each one. David is a trusting soul, isn't he? Some grocers will hide all the bad berries on the bottom. Because shoppers are aware of this potential deception, they prefer their strawberries in see-through, webbed cartons. If David had wanted to be surer of his conclusion, he should have looked more carefully at the cartons and sampled equally among bottom, middle, and side berries, too. Looking at the top strawberries is better than looking at none, and looking randomly is better than looking non-randomly.

When we sample instances of news reporting in order to draw a conclusion about the accuracy of news reports, we want our sample to be representative in regard to the characteristic of "containing a reporting error." When we sample voters about how they will vote in the next election, we want our sample to be representative in regard to the characteristic of "voting for the candidates." Here is a formal definition of the goal, which is representativeness:

Definition A sample S is a (perfectly) **representative sample** from a population P with respect to characteristic C if the percentage of S that are C is exactly equal to the percentage of P that are C.

A sample S is less representative of P according to the degree to which the percentage of S that are C deviates from the percentage of P that are C.

If you are about to do some sampling, what can you do to improve your chances of getting a representative sample? The answer is to follow these four procedures, if you can:

1. Pick a random sample.
2. Pick a large sample.
3. Pick a diverse sample.
4. Pick a stratified sample.

We've already discussed how to obtain a random sample. After we explore the other three procedures, we'll be in a better position to appreciate why it can sometimes be a mistake to pick a random sample.

———CONCEPT CHECK———

Which is the strongest and which is the weakest argument? The four arguments differ only in their use of the words *random* and *about*.

a. Twenty percent of a random sample of our university's students want library fines to be lower; so, 20 percent of our university's students want library fines to be lower.

b. Twenty percent of a sample of our university's students want library fines to be lower; so, 20 percent of our university's students want library fines to be lower.

c. Twenty percent of a random sample of our university's students want library fines to be lower; so, about 20 percent of our university's students want library fines to be lower.

d. Twenty percent of a sample of our university's students want library fines to be lower; so, about 20 percent of our university's students want library fines to be lower.

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[322] Answer (c) is strongest and (b) is the weakest. The word about in the conclusions of (c) and (d) make their conclusions less precise and thus more likely to be true, all other things being equal. For this reason, arguments (c) and (d) are better than arguments (a) and (b). Within each of these pairs, the argument whose premises speak about a random sample is better than the one whose premises don't speak about this. So (c) is better than (d), and (b) is worse than (a). Answers (d) and (b) are worse because you lack information about whether the samples are random; however, not being told whether they are random does not permit you to conclude that they are not random.

———CONCEPT CHECK———

For the following statistical report, (a) identify the sample, (b) identify the population, (c) discuss the quality of the sampling method, and (d) find other problems either with the study or with your knowledge of the study.

> Voluntary tests of 25,000 drivers throughout the United States showed that 25 percent of them use some drug while driving and that 85 percent use no drugs at all while driving. The conclusion was that 25 percent of U.S. drivers do use drugs while driving. A remarkable conclusion. The tests were taken at random times of the day at randomly selected freeway restaurants.

———[323]

Sample Size

If you hear a TV commercial say that four out of five doctors recommend the pain reliever in the drug being advertised, you might be impressed with the drug. However, if you learn that only five doctors were interviewed, you would be much less impressed. Sample size is important.

Why? The answer has to do with the fact that estimations based on sampling are inductive and thus inherently risky. The larger the sample, the better its chance of being free of distortions from unusually bad luck during the selection of the sample. If you want to predict how

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[323] (a) The sample is 25,000 U.S. Drivers, (b) The population is U.S. drivers, (c) The sample size is large enough, but it is not random, for four reasons: (1) Drivers who do not stop at roadside restaurants did not have a chance of being sampled, (2) the study overemphasized freeway drivers rather than other drivers, (3) it overemphasized volunteers, (4) it overemphasized drivers who drive at 4 a.m. (d) The most obvious error in the survey, or in the report of the survey, is that 25 percent plus 85 percent is greater than 100 percent. Even though the survey said these percentages are approximate, the 110 percent is still too high. Also, the reader would like more information in order to assess the quality of the study. In particular, how did the study decide what counts as a drug, that is, how did it operationalize the concept of a drug? Are these drugs: Aspirin? Caffeine? Vitamins? Alcohol? Only illegal drugs? Did the questionnaire ask whether the driver had ever used drugs while driving, or had ever used drugs period? Did the pollster do the sampling on one day or over many days? Still, lack of information about the survey is not necessarily a sign of error in the survey itself.

California voters will vote in the next election it would be better to have a not-quite random sample of 10,000 future voters than a perfectly random sample of two future voters.

To maximize the information you can get about the population, you will want to increase your sample size. Nevertheless, you usually face practical limits on the size; sampling might be expensive, difficult, or both.

In creating the government census, it is extremely difficult to contact and count those people who live temporarily on the couch at a friend's apartment and those who live in their cars and have no address and those who are moving to a new job in a different state. You can make good estimates about these people, but if you're required to disregard anyone you haven't talked to during your census taking, then you'll under-represent these sorts of people in your census results. People who complain that the government census will make an educated guess about how many people live in a city even if they haven't counted all of the people, never seem to complain when their doctor samples their own blood rather than takes all of it to examine.

So, when is your sample size big enough for your purposes? This is a fascinating and difficult question. To illustrate, suppose you are interested in selling mechanical feeding systems to the farmers in your state. You would like to know what percentage of them do not already own a mechanical feeding system—they will be your potential customers. Knowing that this sort of information has never been collected, you might try to collect it yourself by contacting the farmers. Since it would be both difficult and expensive to contact every single farmer, you would be interested in getting your answer from a sample of small size. If you don't care whether your estimate of the percentage of farmers without a mechanical feeding system is off by plus or minus 10 percent, you can sample many fewer farmers than if you need your answer to be within 1 percent of the (unknown) correct answer. Statisticians would express this same point by saying that a 10 percent **margin of error** requires a smaller sample size than a 1 percent margin of error. All other things being equal, you'd prefer to have a small margin of error than a large one.

Let's suppose you can live with the 10 percent margin of error. Now, how sure do you need to be that your estimate will fall into that interval of plus or minus 10 percent? If you need only to be 90 percent sure, then you will need a much smaller sample size then if you need to be 97 percent sure. Statisticians would express this same point by saying that a 90 percent **confidence level** requires a smaller sample size than a 97 percent confidence level. Just exactly how much smaller is a matter of intricate statistical theory that we won't go into here, although we will explore some specific examples later.

A margin of error is a margin of safety. Sometimes we can be specific and *quantify* this margin, that is, put a number on it such as 6%. We can say that our sampling showed that the percentage of farmers without a mechanical feeding system is 60 percent plus or minus 6 percent. Sometimes we express the idea vaguely by saying that the percentage is about 60

percent. At any rate, whether we can be specific or not, the greater the margin of error we can permit, the smaller the sample size we need.

To appreciate the desirability of a small margin of error, imagine that you are trying to forecast tomorrow's temperatures in cities around the globe and you claim that you have a great model for doing this, whose only side effect is that your model predicts a temperature between absolute zero and the temperature of the sun—a gigantic margin of error. You use your model and predict that tomorrow's temperature in New York City will be three thousand degrees. If you claim that your prediction is within your margin of error, you will be correct, but your model will clearly be useless because we want temperature predictions that have a much smaller margin of error.

Sample Diversity

In addition to selecting a random, large sample, you can also improve your chances of selecting a representative sample by sampling a wide variety of members of the population. That is, aim for diversity—so that diversity in the sample is just like the diversity in the population. If you are interested in how Ohio citizens will vote in the next election, will you trust a pollster who took a random sample and ended up talking only to white, female voters? No. Even though those 50 white women were picked at random, you know you want to throw them out and pick 50 more. You want to force the sample to be diverse. The greater the diversity of relevant characteristics in your sample, the better the inductive generalization, all other things being equal.

Because one purpose of getting a large, random sample is to get one that is sufficiently diverse, if you already know that the population is homogeneous—that is, not especially diverse—then you don't need a big sample, or a particularly random one. For example, in 1906 the Chicago physicist R. A. Millikan measured the electric charge on electrons in his newly invented oil-drop device. His measurements clustered around a precise value for the electron's charge. Referring to this experiment, science teachers tell students that all electrons have this same charge. Yet Millikan did not test all electrons; he tested only a few and then generalized from that sample. His sample was very small and was not selected randomly. Is this grounds for worry about whether untested electrons might have a different charge? Did he commit the fallacy of hasty generalization? No, because physical theory at the time said that all electrons should have the same charge. There was absolutely no reason to worry that Tuesday's electrons would be different from Wednesday's, or that English elections would be different from American ones. However, if this theoretical backup weren't there, Millikan's work with such a small, nonrandom sample would have committed the fallacy of hasty generalization. The moral: Relying on background knowledge about a population's lack of diversity can reduce the sample size needed for the generalization, and it can reduce the need for a random sampling procedure.

When you are sampling electrons or protons, if you've seen one you've seen them all, so to speak. The diversity just isn't there, unlike with, say, Republican voters, who vary greatly from each other. If you want to sample Republican voters' opinions, you can't talk to one and assume

that his or her opinions are those of all the other Republicans. Republicans are heterogeneous—the fancy term for being diverse.

A group having considerable diversity in the relevant factors affecting the outcome of interest is said to be a heterogeneous group. A group with a relatively insignificant amount of diversity is said to be a **homogeneous** group. For example, in predicting the outcome of measuring the average height of two groups, Americans and Japanese, the diversity of American ethnicity makes Americans a heterogeneous group compared to the more homogeneous Japanese group. It is easier to make predictions for homogeneous groups than for heterogeneous groups.

Being homogeneous is relative, however. The Japanese might be more homogeneous than Americans relative to measurements about height, but the Japanese might be more heterogeneous than Americans when it comes to attitudes about socialism and about how to care for infants.

———CONCEPT CHECK———

The most important goal in sampling is

a. randomness
b. representativeness
c. diversity
d. large sample size

———[324]

———CONCEPT CHECK———

Suppose you know the average height of Japanese men and of American men. If you randomly pick a hundred Japanese businessmen, you can be more sure of their average height than you can be if you pick American businessmen. Explain why.

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[324] b

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Stratified Samples

In addition to seeking a large, random, diverse sample, you can improve your chances of getting a representative sample by stratifying the sample. In the example in the Concept Check about taking the drug tests at random times, there was a mistake made because many more drivers are on the road at 5 p.m. than at 5 a.m. Random sampling on times would be biased in favor of the 5 a.m. drivers. To remove this bias, the sampling method should take advantage of this knowledge of who drives when by **stratifying** according to time of day. For example, if you know that 30 percent of drivers are on the road from 5 p.m. to 6 p.m. and 3% are on the road from 5 a.m. to 6 a.m., then make sure that 30 percent of the sampled drivers are randomly picked from 5 p.m. to 6 p.m. and only 3 percent from 5 a.m. to 6 a.m. Do the same for the other driving times if you know the percentages for those other times.

325 The variety of the Japanese data is less than that of the American data because Japan is a more homogeneous society. The American people are more ethnically diverse and so are more genetically diverse, and genes affect human growth. Suppose the average Japanese man is 5' 5", and the average American man is 5' 8". Then the point the message is making is that the average of the 100 Japanese men you pick will be closer to 5'5" than will the average of the 100 American men be to 5'8".

Suppose you are planning a poll to learn how Ohio citizens will vote in the next presidential election. You can use your knowledge of politics to help pick the best sample. You already have specific political information that the race of a voter is apt to affect how he or she will vote. Suppose you also know that, even though Ohio citizens are 65 percent white and 30 percent black, the expected voters will be 70 percent white and 25 percent black.[326] You can use all this information about the voting population to take a better sample by making sure that your random sample contains exactly 70 percent white voters and exactly 25 percent black voters. If your poll actually were to contain 73 percent white voters, you would be well advised to randomly throw away some of the white voters' responses until you get the number down to 70 percent. The resulting stratification on race will improve the chances that your sample is representative. Stratification on the voters' soft drink preference would not help, however.

The definition of stratification uses the helpful concept of a variable. Roughly speaking, a variable is anything that comes in various types or amounts. There are different types of races, so race is a variable; there are different amounts of salaries, so salary is a variable; and so forth. Each type or amount of the variable is called a possible value of the variable. White and black are two values of the race variable. Suppose a population (say, of people) could be divided into different groups or strata, according to some variable characteristic (such as race). Suppose each group's members have the same value for that variable (for example, all the members of one group are black, all the members of another group are white, and so on). Suppose a sample is taken under the requirement that the percentage that has a given value (black) of the variable (race) must be the same as the known percentage of the value for the population as a whole. If so, then a **stratified sample** has been taken from that population, and the sample is said to be stratified on that variable.

Stratification is a key to reducing sample size, thereby saving time and money. If you want to know how people are going to vote for the Republican candidate in the next presidential election, talking to only one randomly selected voter would obviously be too small a sample. However, getting a big enough sample is usually less of a problem than you might expect when you pay careful attention to stratification on groups that are likely to vote similarly. Most nonprofessionals believe that tens of thousands of people would need to be sampled. I asked my next-door neighbor how many he thought would be needed, and he said, "Oh, at least a hundred thousand." Surprisingly, 500 would be enough if the sample were stratified on race, income, employment type, political party, and other important variables. This 500 figure assumes the pollster need only be 95 percent sure that the results aren't off by more than 2 percent. If you can live with a greater margin of error than 2 percent and less confidence than 95%, then you can use a much smaller sample size.

The first great triumph of stratified sampling came in 1936 when one unstratified poll using a sample size of 10,000,000 people predicted that President Roosevelt would not be re-elected. A poll by George Gallup using a small stratified poll of only 3,000 people correctly predicted that Roosevelt would be re-elected.

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326 These numbers are not reliable.

The most important variables affecting voting are the voters' political party, race, sex, income, and age. If the pollster has no idea what these variables are that will influence the results of the voting, then the pollster cannot ensure the sample is diverse in regard to these variables, so a very large sample will be needed to have the same confidence in the results that could be had with a smaller stratified sample.

———CONCEPT CHECK———

Your quality control engineer conducts a weekly inspection of your company's new beverage. He gathers a random sample of 100 bottles produced on Mondays or Tuesdays. Over several weeks, at most he finds one or two sampled bottles each week to be faulty. So you conclude that your manufacturing process is doing well on an average every week, since your goal was to have at least 98 percent of the beverage be OK.

Suppose, however, that the quality control engineer knows that your plant produces an equal amount of the beverage on each weekday and that it produces beverages only on weekdays. Describe the best way for the quality control engineer to improve the sampling by paying attention to stratification.

a. Sample one beverage from each weekday.

b. Pick a larger and more random sample.

c. Take an equal number of samples on Saturdays and Sundays as well.

d. Make sure that 20 percent of the sample comes from each weekday.

α. Sample more of the bottles that will be delivered to your most valued customers.

———[327]

Statistical Significance

Frequently, the conclusions of inductive generalizations are simple statistical claims. Our premise is "x percent of the sample is la-de-da." From this we conclude, "The same percent of the population is, too." When the argument is inductively strong, statisticians say the percent is **statistically significant** because this statistic is one that very probably is not due to chance. The number need not be significant in the sense of being important; that is the non-technical sense of the word *significant*.

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[327] Answer (d). The suggestion in (b) would be good to do, but it has nothing to do with stratification.

Suppose you are interested in determining the percentage of left-handers in the world, and you aren't willing to trust the results of other people who have guessed at this percentage. Unless you have some deep insight into the genetic basis of left-handedness, you will have to obtain your answer from sampling. You will have to take a sample and use the fraction of people in your sample who are left-handed as your guess of the value of the target number. The target number is what statisticians call a **parameter**. The number you use to guess the parameter is called the **statistic**. Your statistic will have to meet higher standards the more confident you must be that it is a reliable estimate of the parameter.

I once told my seven-year-old son Joshua that he was unusual because he was left-handed. That surprised him, so he decided to check out whether I was correct. In the sophisticated terminology of mathematical statistics, we'd say Joshua's goal was to determine whether a certain parameter, the percentage of left-handers in the whole world, is much less than 50 percent. Here is what Joshua did to acquire a statistic to use to estimate the parameter. He said, "You're left-handed, Dad. Mom and my little sister aren't. That is two and two." What Joshua had just done, more or less, was to take a sample of four from the vast population of the Earth, discover that two of the four are left-handed, and then calculate the statistic of 50 percent as his guess of the parameter. A statistician would say that Joshua's statistic is not significant because the sample is too small. If Joshua were to take a larger sample, the resultant statistical claim would be more believable.

So Joshua set out to get a bigger sample. He asked all the children in his class at school whether they were left-handed. Two out of twenty-two. He also went around the neighborhood asking whomever he could. The new result from home, school, and neighborhood was seven left-handers out of thirty-seven. This statistic is more apt to be significant, and it is much less than 50 percent. The moral here is that the bigger the sample size, the more confident you can be that the calculated statistic is statistically significant. The more sampling, the less likely that the result is due to chance. Patterns that appear in small samples might disappear as the sample size grows; they might be shown to be **coincidental**. Significant patterns and significant statistics are those that are likely not to be accidental or coincidental; they are likely to be found to hold true on examination of more of the target population.

We still haven't answered the question of whether Joshua's statistic of 7/37 is statistically significant. Is it? It definitely is a better guess than 2/4, but to compute whether it is significant requires some sophisticated reasoning involving complex formulas about margins of error and levels of confidence, which we won't pursue here. We can, however, sketch three features of the answer.

First, the margin of error: We need to decide just how accurate we want our guess to be. Can we be satisfied with an accuracy of plus or minus 10 percent, or do we need a smaller margin, say plus or minus 1 percent? Second, the confidence level. Are we willing to be only 95 percent sure that we have the right answer, even allowing for the margin of error? Or must we be 99 percent sure? All other things being equal, the more confident we need to be, the less significant will be the statistics we have gathered. Third, how biased was the sampling? Was it random? Was it

diverse? Population size is not normally something that needs to be taken into account if the population is large compared to the sample size.

> In very large populations, the statistic for a relatively small sample will be statistically significant based on the size of the sample, not on the size of the population.

Designing a Paired Comparison Test

Suppose you own a food business and are considering marketing what your researcher/cook says is a better version of one of your old food products say, a vegetarian burrito. The main factor in your decision will be whether your customers will like the taste of the new product better than the taste of the old one. You can make your marketing decision by guessing, by letting your cook choose, by asking advice from your friends, or by some other method. You decide to use another method: ask your own customers which of the two vegetarian burritos they like best. Why not? If the customers in your sample prefer the new product, you will believe that the whole population will, too, and you will replace the old product with the new one.

A good way to do this testing would be to use a procedure called **paired comparison**. In this kind of test, you remove the identifying labels from the old and new burrito products and then give a few tasters the pairs of products in random orders. That is, some tasters get to taste the new burrito first; some, the old one first. In neither case are they told which product they are tasting. Then ask your taster/judges which product they like better. If a great many of them like the new one better than the old one, you can go with the new product.

How many tasters do you need in order to get useful results? And if most of the tasters like the new product but many do not, then how much disagreement can you accept and still be sure your customers generally will like the new product better? If three out of five tasters say the new product is better but two out of five disagree, would a conclusion that over half your customers would prefer the new burrito product be a statistically significant result? These are difficult questions, but they have been studied extensively by statisticians, and the answers are clear.

Before those difficult questions can be answered, you need to settle another issue. How sure do you have to be that your tasters' decision is correct, in the sense of accurately representing the tastes of the general population of your customers? If you need to be 99 percent sure, you will

need more tasters than if you need only to be 95 percent sure. Let's suppose you decide on 95 percent. Then, if you have, say, twenty tasters, how many of them would have to prefer the new product before you can be 95 percent sure that your customers will like the new product better, too? If your taster-judges are picked randomly from among your population of customers and aren't professionals in the tasting business, then statistical theory says you would need at least 75 percent (fifteen) of your twenty judges to prefer the new product. However, if you had more judges, you wouldn't need this much agreement. For example, with sixty judges, you would need only 65 percent (thirty-nine) of your judges to give a positive response in order for you to be confident that your customers will prefer the new product. What this statistic of thirty-nine out of sixty means is that even if twenty-one out of your sixty judges were to say that your new burrito is awful, you could be 95 percent sure that most consumers would disagree with them. Yet many business persons who are not versed in such statistical reasoning would probably worry unnecessarily about their new burrito if twenty-one of sixty testers disliked the product.

Statistical theory also indicates how much agreement among the judges would be required to raise your confidence level from 95 percent to 99 percent. To be 99 percent sure that your customers would prefer the new product to the old, you would need seventeen positive responses from your twenty judges, or forty-one positive responses from sixty judges.

Let’s try another example. You recently purchased a new service station (gas station) and have decided on an advertising campaign both to increase your visibility in the community and to encourage new customers to use the station. You plan to advertise a free gift to every customer purchasing $10 or more of gasoline any time during the next two weeks. The problem now is to select the gift. You have business connections enabling you to make an inexpensive purchase of a large supply of either six-packs of Pepsi or engraved ballpoint pens with the name of a local sports team. You could advertise that you will give away free Pepsi, or else you could advertise that you will give away the pens. The cost to you would be the same. You decide to choose between the two on the basis of what you predict your potential customers would prefer. To do this, you could, and should, use a paired comparison test. You decide you would like to be 95 percent sure of the result before you select the gift. You randomly choose twenty potential customers and offer them their choice of free Pepsi or a free ballpoint pen. Ten are told they can have the Pepsi or the pen; ten are told they can have the pen or the Pepsi. You analyze the results. Three customers say they don't care which gift they get. Five say that they strongly prefer Pepsi to the pen because they don't like the sports team. Six say they would be happy with either gift but would barely prefer the Pepsi. Four customers choose Pepsi because they have enough pens. The rest choose pens with no comment. From this result, can you be confident that it would be a mistake to go with the ballpoint pen?

Yes, you can be sure it would be a mistake. Your paired comparison test shows fifteen of twenty prefer Pepsi. At the 95 percent confidence level, you can be sure that over 50 percent of your customers would prefer the Pepsi. By the way, this information about numbers is for illustrative

purposes. You as a student aren't in a statistics class, so you won't be quizzed on making these calculations. But if you did own that service station you should use a paired comparison test and get some number advice by looking up the info on the Internet or by asking somebody who has taken a statistics class.

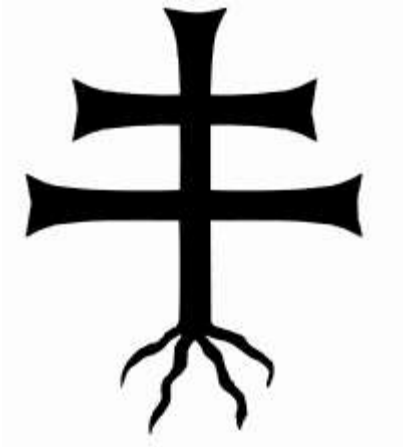
Suppose you learn that your favorite TV program was canceled because the A. C. Nielsen Corporation reported to CBS that only 25 percent of the viewers were tuned to your program last week. CBS wanted a 30 percent program in that time slot. You then learn more about the Nielsen test. Nielsen polled 400 viewers, 100 of whom said they were watching your program. Knowing that the United States has 100 million TV sets, you might be shocked by CBS's making a major financial decision based on the simple statistical claim that 100 out of 400 viewers prefer your program. Can this statistic really tell CBS anything significant about your program? Yes, it can, provided CBS can live with a 2 percent error. Nielsen and CBS can be 95 percent confident that the statistics from a sample of 400 will have an error of only plus or minus 2 percent.

Obstacles to Collecting Reliable Data

So far in our discussion of significant statistics, we have worried about how to make decisions using *reliable* information from a sample of our population. To obtain significant statistics we try to obtain a representative sample by getting one that is diverse, random, and large. A major obstacle to obtaining a representative sample is that **unreliable data** too easily creep into our sample.

If you own a radio station and decide that over 80% of your listeners like that song by singer Katy Perry because over 80% of those who texted your station (about whether they like that song) said they liked it, then you've made a too risky assumption. Those who texted you weren't selected at random from your pool of listeners; they selected themselves. **Self-selection** is a biased selection method that is often a source of unreliable data.

There is the notorious problem of lying to pollsters. The percentage of polled people who say they've voted in the election is usually higher than the percentage of people who actually did. More subtly, people may practice self-deception, honestly responding "yes" to questions such as "Are you sticking to your diet?" when they aren't. Another problem facing us pollsters is that even though we want diversity in our sample, the data from some groups in the population may be easier to obtain than from other groups, and we may be tempted to favor ease over diversity. For example, when counting Christians worldwide, it is easier for us to get data from churches of people who speak some languages rather than others and who are in some countries rather than others and who are in modern cities rather than remote villages.



There are other obstacles to collecting reliable data. Busy and more private people won't find the time to answer our questions. Also, pollsters occasionally fail to notice the difference between asking "Do you favor Jones or Smith?" and "Do you favor Smith or Jones?" The moral is that natural obstacles and sloppy methodology combine to produce unreliable data and so to reduce the significance of our statistics.

Varieties of Inductive Arguments

We have just completed our analysis of one kind of inductive argument, generalizing from a sample. There are other kinds. The study of inductive logic is more complex than deductive logic, and it is not as well developed. It consists merely of several independent topical areas that focus on a particular kind of inductive argument. This section of the chapter briefly introduces some of the different kinds. Some inductive arguments are of more than one kind.

Argument from Authority

Suppose a high school science teacher says to you,

> The scientists I've read agree that Neptune is a cold planet compared to Mars, Earth, and Venus. So, Neptune is definitely a cold planet.

This argument from authority does not jump to conclusions. The high school teacher offers expert testimony although it is secondhand. It might be called *hearsay* in a courtroom, but it is reasonable grounds for accepting the conclusion. So, the conclusion follows with probability.

But with how much probability? Nobody knows, not even the scientists. Nobody can say authoritatively whether the conclusion is 85 percent probable or instead 90 percent probable.

All they can properly say is that the appeal to authority makes the conclusion a safe bet because the proper authorities have been consulted, they have been quoted correctly, and it is well known that the experts do not significantly disagree with each other about this.

The conclusion of the following argument is not such a safe bet:

> The scientists say astral travel is impossible. That is, our spiritual bodies can't temporarily leave our physical bodies and travel to other places. So they say. However, my neighbor and several of her friends told me they separately traveled to Egypt while their physical bodies were asleep last night. They visited the pyramids. These people are sincere and reliable. Therefore, the scientists are wrong about astral travel.

Is this a successful inductive argument? The arguer asks us to accept stories from his neighbor and her friends. These anecdotes are pitted against the claims of the scientists. Which should you believe? Scientists have been wrong many times before; couldn't they be wrong here, too? Yes, they could, but it wouldn't be a good bet. If you had some evidence that could convincingly show the scientists to be wrong, then you, yourself, would likely soon become a famous scientist. You should be cautious about jumping to the conclusion that the scientists are wrong. The stories are so extraordinary that you really need extraordinarily good evidence to believe them. The only evidence in favor of the stories is the fact that the neighbors and friends, who are presumed to be reasonable, agree on their stories and the fact that several times in history other persons also have claimed to be astral travelers.

The neighbor might say that she does have evidence that could convincingly show the scientists to be wrong but that she wouldn't get a fair hearing from the scientists because their minds are closed to these possibilities of expanding their consciousness. Yes, the scientists probably would give her the brush-off, but by and large the scientific community is open to new ideas. She wouldn't get the scientists' attention because they are as busy as the rest of us, and they don't want to spend much time on unproductive projects. However, if the neighbor were to produce some knowledge about the Egyptian pyramids that she probably couldn't have gotten until she did her astral traveling, then the scientists would look more closely at what she is saying. Until then, she will continue to be ignored by the establishment.

Egypt's Giza Pyramid [with author and his daughter]

Most of what we know we have gotten from believing what the experts said, either first hand or, more likely, second hand. Not being experts ourselves, our problem is to be careful about sorting out the claims of experts from the other claims that bombard us, while being aware of the possibility that experts are misinterpreted, that on some topics they disagree, and that occasionally they themselves cannot be trusted to speak straightforwardly. Sensitive to the possibility of misinterpreting experts, we prefer first hand testimony to second hand, and second hand to third hand. Sensitive to disagreement among the experts, we prefer unanimity and believe that the greater the consensus, the stronger the argument from authority.

Also, we are sensitive to when the claim is made and to what else is known about the situation. For example, a man returning from a mountaintop might say to you, "Wow, from there the world looks basically flat." Twenty anecdotes from twenty such people who independently climbed the same mountain do not make it twenty times more likely that the world *is* flat. You can't trust the twenty stories because you know there is much better evidence to be had. However, in the days when the Egyptians were building their pyramids, the twenty anecdotes would actually have made it more reasonable to believe that the world is flat, although even then it wouldn't have been twenty times more.

What is reasonable to believe at any time depends on the evidence available at that time.

It's important to resist the temptation to conclude that in ancient times people lived on a flat world but that now they live on a round one. This is just mumbo jumbo; the world stayed the same—it was people's beliefs about the world that changed. Do not overemphasize the power of the mind to shape the world.

Argument from Analogy

> *Dear sir,*
>
> *A woman's composing of music is like a dog's walking on its hind legs. It is not done well, but you are surprised to find it done at all.*
>
> *Yours truly,*
>
> *Mr. C. Pig*

This joke uses an argument from analogy. The unfamiliar world of electricity can be explained by showing how electricity in a wire behaves analogously to water flowing through a pipe. Analogies help with description, too. We envision a rolling ball when we hear that presidential candidate Roosevelt had momentum going into the New Hampshire primary.

Analogies can be used in arguing. A woman without a man is like a fish without a bicycle. This joke would be making a radical feminist comment, because hidden between the lines is an argument for why women don't need men. The joke is intended to counter the conclusion of someone who would say that a woman without a man is like a fish out of water.

Here is a more serious example of an argument by analogy. Suppose that for several months a scientist gives experimental drug D to a variety of dogs confined to cages. A group of similar caged dogs do not receive the drug. The scientist then tests to see whether the dogs receiving drug D are more cardiovascularly fit than the ones not receiving the drug. The scientist checks blood pressure, stamina, and other physiological measures. The scientist's initial conclusion is that dogs that get the drug are no more cardiovascularly fit than the other dogs. The scientist's final conclusion is that, for humans, taking drug D will be no substitute for getting lots of exercise, as far as cardiovascular fitness is concerned. This argument uses what analogy? Let’s figure it out. Here is the argument in standard form:

> Dogs are like humans in many ways.
> Dogs cannot use drug D as a substitute for exercise.
> ---
> Humans cannot use drug D as a substitute for exercise.

The conclusion follows with probability. However, we could rewrite the first premise so that the conclusion follows with certainty:

Dogs are like humans when it comes to deciding whether drugs can be a substitute for exercise.
Dogs cannot use drug D as a substitute for exercise.

Humans cannot use drug D as a substitute for exercise.

This argument is deductive. Which of the two ways of treating the argument is better? It is hard to tell and doesn't make much difference. The scientist is more likely to have intended inductive standards to apply; at least we shall assume this from now on. But what is more important to see is that both ways of analyzing the argument depend on accepting the analogy between people and dogs. If the analogy is unacceptable, the argument breaks down. Scientists get into serious disputes about whether testing drugs on rats, dogs, and rabbits gives reliable information about how these drugs will affect human beings. These disputes are about analogy.

To generalize, the simplest inductive arguments from analogy have the following form:

As are analogous to Bs in several respects.

As have characteristic C.

_____

Bs have characteristic C.

Characteristics are the same thing as properties or qualities. In the drug-testing example, A = dogs, B = humans, and C = the characteristic of not being able to use drug D as a substitute for exercise. If A's have characteristic C but B's do not, the analogy between A and B is a faulty analogy as far as C is concerned. The phrase "in several respects" is there to remind us that when we are assessing some piece of reasoning that uses an analogy, we always need to keep in mind which aspects of the analogy should be taken seriously and which should be ignored.

Analogies are often stated without using the words *analogous to* and *like*. Persuading a terrorist to defect is supposed to be analogous to converting the child from watching TV to doing her homework. The key to seeing the analogy is in noting the word *akin*. Is this a faulty analogy? The average reader is not in a position to tell. Only people who are familiar both with persuading a terrorist to defect and with raising children would be in a position to say However, notice that in this passage the analogy is not used to draw some conclusion, as it is in the earlier analogies we have discussed. The analogy is used merely to *explain* the process of persuading a terrorist. The passage contains an explanatory analogy but not an argument by analogy. If it were to contain an argument by analogy, it would probably say that because the conversion of the child requires such and such, therefore persuading a terrorist does, too.

———CONCEPT CHECK———

Arguments from analogy have the following logical form: A is analogous to B in important ways. A has property C. So, B has property C, too. What would the letters A, B, and C represent in the following argument by analogy?

> I am a vegetarian, and I believe it's morally wrong to cook live shrimp. After all, it would be wrong for someone to toss you into a pan of boiling water, wouldn't it?

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Advertising that uses testimonials often promotes an argument by analogy. Take the Hollywood beauty who testifies to the TV viewer: "I got a silicone breast implant from Dr. Wrigley, and I got the lead part in a commercial. His plastic surgery can help you, too."[329] You, the female viewer, are being asked implicitly to accept the analogy with your own situation and conclude that the surgery will get you what you want. But as a logical reasoner you will confront the analogy directly by thinking something like this: "That's fine for her, but I'm not trying to get a part in a commercial, so realistically what does her testimony have to do with me in my situation?"

By criticizing the analogy in the argument that the TV program encourages you to create, you are using the technique of pointing out the **disanalogies**. The disanalogies are the differences, the ways in which the two are not analogous. We point out disanalogies when we say, "Yes, they're alike, but not in the important ways." We are apt, also, to use this method in response to

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328 A = people, B = shrimp, C = the characteristic of it being morally incorrect to cook them by tossing them alive into a pan of boiling water.

329 This testimonial commits the post hoc fallacy.

the analogy between people and shrimp by pointing out that we are not like shrimp in terms of sensitivity to pain, or intelligence, or moral worth.

A second method of attacking an argument by analogy is to **extend the analogy**. We do this when we find other ways the two things are similar and then draw obviously unacceptable conclusions from this similarity. For example, we can attack the argument that uses the analogy between people and dogs by saying, "Dogs are like people in other ways, too. For example, we both like to eat meat. Since dogs enjoy their meat raw, you won't mind eating your hamburger raw tonight, will you?" When the original advocate of the cardiovascular argument answers, "No, we aren't that much like dogs," you can respond with "I agree, so how can you be so sure we are like dogs when it comes to taking drug D?"

Let's now analyze a complicated argument by analogy. You might have had the honor of getting involved in the following unpleasant discussion with Mario about white women marrying black men. During the conversation, Mario said:

> A dog breeder wouldn't think of mixing different breeds, so the human race should not be mongrelized by interracial breeding. You accept my argument, or aren't you logical? Of course you accept it; you aren't some kind of pervert. Besides, you are not a dog breeder, so you are in no position to doubt what I say.

Let's cool down and analyze this volcanic eruption. Mario's statement, "The human race should not be mongrelized by interracial breeding," is loaded language filled with negative connotations. A less loaded replacement would be, "The human race should not produce children of parents from different races." The argument is primarily based on an analogy. The analogy is between having puppies of different breeds and having children of different races. There are important disanalogies to notice. Our background knowledge tells us that the purpose of dog breeding is to improve and retain the characteristics of the breed. The purpose of having children is not normally to improve and retain the racial characteristics of each parent. Did your parents have you primarily for design purposes? A second difficulty with the analogy is that even if mixing breeds produces mongrels that are of lesser quality in terms of winning blue ribbons in dog shows, it doesn't follow that mixing races produces children who are of lesser quality. In most societies, the citizens do believe that races shouldn't mix and that when they do they produce children who are "inferior," but this belief is based only on custom; there is no biological reason to believe that such children are physically or mentally inferior to their parents.

Mario was also mistaken in saying that if you lack expert knowledge about dog breeding, you should not doubt his claim. Our criticism of his analogy was based on common sense, not on any expert knowledge. His threatening to label you a "pervert" and not "logical" if you reject his argument is itself just name calling or intimidation. From a logical-reasoning perspective these threats do nothing positive for his position. If Mario were your boss, his attacks might convince you not to say you disagree with him, but his reasons shouldn't actually convince you to agree with him.

———CONCEPT CHECK———

Evaluate this argument by analogy from 1940:

> Armies are like people. If you cut off the head, the body may thrash around a bit, but very soon it quits fighting. So, a good way to win this European war against the Nazis and Fascists would be to concentrate all our energies on killing Hitler and Mussolini.

———330

Induction from Past to Future (Prediction)

As goes the past, so goes the future. That is a common style of inductive argument. Here is an example:

> The record book shows that the American track teams have won more meets than the Australian track teams. So, the Americans can be expected to dominate the Australians in future track meets.

This is an induction by analogy because it depends on the claim that the future will be analogous to the past in certain ways. Not all past patterns can be justifiably projected to hold in the future. The chicken assumes that the hand that has fed it will continue to feed it in the

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330 There is no doubt that if you cut off someone's head, the person will soon stop fighting. The problem is whether there is a message here for how to win World War II against the German and Italian armies led by Hitler and Mussolini, respectively. To some extent armies are like people. They eat, they sleep, they move, they fight. On the other hand, to some extent armies are not like people. They are composed of more than one person, they can be in many places at once, and a new head can easily be appointed, and so forth. The most important disanalogy, however, is that the person without a head has to stop fighting, but an army without a supreme leader does not have to stop fighting. Maybe the two armies would stop fighting if their supreme leaders were killed, but the argument by analogy does not provide a strong reason for this conclusion. In short, a person without a head has no brains; an army without a head still has the brains of its officer corps and individual soldiers. A much better case could be made for killing the supreme leader if it could be shown that, throughout history, armies have stopped fighting when their supreme leaders have been killed.

future, but one day that hand will wring its neck. One of the principal problems of science is to discover which patterns are projectible into the future and which are not. No easy task.

Arguments from past patterns to future patterns depend on a crucial premise: If we are ignorant of any reason that a past pattern should not continue, then it probably will continue.

The principles of reasoning that this section has applied to inductions from the past to the future also apply to inductions from the past to the present and to inductions from the present to the future.

Appeal to a Typical Example

If you like the first pineapple you eat, you don't have to eat forty-seven more pineapples to figure out whether you like pineapples. One example is enough. Similarly, if you are given a meal of lung fish and discover that it tastes awful, you might argue by analogy that you won't like eating any other lung fish if it is prepared the same way. This inference makes use of the assumption that one lung fish is like any other as far as taste is concerned, especially if the preparation is similar. You assume that your one lung fish is a typical example of lung fish. In doing so, do you commit the fallacy of jumping to conclusions? No, but you would do so if you did not implicitly rely on background information. You use your background information that kinds of food don't usually change their taste radically from one meal to another. Without this background information, you really ought to try some more examples of lung fish before concluding that you don't like this seafood.

This example about lung fish is a special kind of argument from analogy; the argument relies on the fact that nearly all the members of a group are analogous to some typical member of the group. We will call this kind of argument by analogy an "induction by appeal to a typical example."

The following argument also tries to make its point by giving only one example, expecting the reader to accept the generalization from that example. What is typical of what here?

> Although it is true that intending to do something usually does not bring about the same consequences as doing it, morally it seems no different. Suppose I intend to kill my rich uncle for my inheritance. I am hiding in his house behind the door, with my axe in my hand, waiting for him to enter, but as he walks up the front porch steps, he has a heart attack and dies. Hey, it's my lucky day! I get the inheritance and I don't even have to clean the blood off my axe. Surely you will say that the fact that I did not carry out my intention to kill my uncle does not absolve me morally, for had he entered the house I would have killed him. Whether or not I actually killed him, I'm still immoral. It seems, therefore, that the intention is always as wrong as the action.[331]

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331 This example was suggested by Angela Scripa.

The main generalization the author wants the reader to accept is that all cases of intending to kill are as wrong as actually killing. The strategy of the argument is to present a single case, suggest that it is an example in which the generalization applies, and then imply that the example is perfectly typical and thus that the generalization holds for all cases. The arguer is counting on the fact that the audience will be reminded from their own experience that the example is typical.

To evaluate the quality of this argument we need to ask ourselves whether this really is an example. Is the case of the potential axe murder really an example in which the person would be just as immoral whether he or she followed through with the crime or not? Second, even if it is an example, is it really typical of all other cases of intention to commit a crime?

———CONCEPT CHECK———

Which of the following arguments is an induction by analogy, using an appeal to a typical example?

a. John is a typical example of a farmer. He doesn't wear a suit to work. He understands about raising animals, planting crops, building fences, and so on. Yet all farmers are going to suffer with this new legislation, so John is, too.

b. We checked it out for ourselves. After drilling the right-size hole in the plastic, we poured the liquid hydrofluoric acid down the hole onto the steel and noticed that a perfectly circular hole in the steel appeared within a minute. So, hydrofluoric acid will always react with steel, at least if the acid is a liquid.

c. All boa constrictors are reptiles, and Matt Rasmussen's pet boa constrictor is a typical one, so it's a reptile, too.

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Argument Based on Signs

Here is an example: There's a railroad crossing sign ahead on the highway, so there's a railroad crossing ahead.

Causal Inference

Here is an example of a causal inference that is not inductive. Drinking a cup of vodka causes people to get drunk within ten minutes. Ten or fifteen minutes ago he drank a cup of vodka. So, he's drunk by now. The conclusion follows with certainty, doesn't it?

Here is an example of a causal inference that *is* inductive. A screwdriver is a mixed drink of vodka and orange juice. I've never noticed anybody walking funny after they've drunk plain orange juice, but everybody I've seen who has drunk two screwdrivers within a half hour has walked sort of wobbly when they've stood up. I think drinking vodka affects a person's ability to walk.

The next chapter is devoted to this type of inductive argument.

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[332] Answer (b). The phrase typical example in answer (a) isn't enough reason to say that the passage is an induction by analogy, using an appeal to a typical example. Only (b) makes use of the example being typical. Arguments (a) and (c) would continue to be strong even if the example were atypical. Also, argument (b) is inductive, whereas arguments (a) and (c) are deductively valid.

Inference to the Best Explanation

The berry pie is missing from the windowsill where it was cooling off this afternoon while it was raining. Now it's evening, and there's mud on the neighbor's shoes and a smirk on her berry-stained face. There's no indication anyone other than the neighbor took the pie. So, the best explanation of all this is that the neighbor took the pie.

That inductive argument was an inference to the best explanation. The next two chapters will explore in more detail this kind of inductive argument, but here is a quick comment about assessing the quality of inferences to the best explanation.

> She's not here, so she's gone to the supermarket.

You could categorize this reasoning as an inference to the best explanation, but if you were asked to assess the quality of this argument, you'd immediately want to know what else you can assume. Did she say before she left that she needed groceries? Does she very often go to the supermarket when she is not here? Without proper answers to these questions, then your background information that people who aren't here might be in zillions of other places would suggest that the quality of this argument is very low.

How New Information Affects an Argument's Strength

An inductive argument should be assessed by looking at all the available, relevant information. (This principle is sometimes called the **Principle of Total Information**.) If relevant information has been covered up, or if it is newly acquired, this can affect the strength of the argument. Let's look at an example argument and then consider how you should change your estimate of its strength when new information becomes available.

> Harold needs to have his rugs cleaned, and his friend Veronica reports that Ajax Carpet Service did an excellent job on her rugs. From this, Harold concludes that Ajax will do an equally good job on his own rugs. He has no other information about Ajax Carpet Service or Veronica's rugs; so he satisfies the Principle of Total Information.

Harold's argument has a certain inductive strength. We are interested in how the following new facts should affect its strength. Should it strengthen the argument, weaken the argument, or

have no effect on the strength of the argument? Assess each new fact assuming it is the only change made to the original argument.

a. Veronica hired Ajax several times, and Ajax always did an excellent job.

> *answer*: This new information strengthens Harold's argument because it's now known that Veronica has an even better "track record" of good results with the Ajax Carpet Service, so it's even more likely that Harold will get the same good results.

b. Veronica's rugs are wool, and Harold's are nylon.

> *answer*: This weakens Harold's original argument. There is new information about a relevant factor that is present for Veronica but missing for Harold, so Harold can be less sure Ajax will work out OK for him. The analogy between their two situations is worse, so relying on the analogy will produce a weaker argument.

c. Veronica's carpets never had any stains on them before they were cleaned, but Harold's have several large stains.

> *answer*: This weakens the argument. There is new information about a relevant factor that is present for Veronica but missing for Harold, so Harold can be less sure Ajax will work out OK for him.

d. Harold knows of six additional people who have had their carpets cleaned by Ajax, and all six have been very pleased.

> *answer*: The inductive strength goes up. The past track record of good jobs by Ajax is even better and since it's with a variety of people it should be more likely to work for Harold whose cleaning situation might be even more like one of those additional situations than it is like Veronica's situation.

e. Harold changes his conclusion to state that Ajax will get his carpets *approximately* as clean as it has gotten Veronica's.

> *answer*: Stronger. The conclusion is now vaguer and thus more likely to be true. It's easier to hit a big target than a small one.

f. One of Ajax's employees published a new novel.

> *answer*: This information is irrelevant, so the strength of Harold's original argument is unchanged.

g. Ajax has recently undergone a change in management.

answer: Weaker. A change in management might mean a change in chemicals, or a change in workers, so now Harold can't be as sure that things will go as they did back at Veronica's.

h. The Environmental Protection Agency recently banned the cleaning solution Ajax has used for many years.

answer: Weaker. The use of the cleaning solution may have been what made Veronica happy with Ajax's work, so a possibly relevant factor has been altered, and this weakens the argument.

Let's work through another set of examples about revising our assessment of the strength of an argument. Here is an example about arguing from the past to the future. Suppose you are trying to decide whether the highway you plan to take to visit your grandparents on Christmas Eve will be covered with snow. You gather the relevant evidence from your memory:

Every Christmas Eve in the past, the highway to my grandparents has been snow-covered.

Nobody has said anything that would suggest the highway conditions this Christmas Eve will be any different than in the past. On the basis of these reasons, you conclude:

This Christmas Eve, the highway to my grandparents will be snow-covered.

This argument is deductively invalid. Nevertheless, it is a moderately strong inductive argument if the premises are true. The argument depends crucially on the premise that on every Christmas Eve in the past the highway has been snow-covered. Suppose you can't be very sure this is true. If so, this doubt about your key premise should also cause some doubt about your conclusion. For that reason alone, you should put less faith in your conclusion. The principle of logical reasoning that this example illustrates is the following:

> Apportion the strength of your belief in the conclusion to the strength of your belief in the premises.

Let's take a closer look at revising potentially good inductive arguments that go from data about the past to a prediction about the future. Suppose you have collected the following data: the San Francisco 49ers football team has won five of its last six games. Here is a conclusion that could be drawn from that data: The San Francisco 49ers will win their next football game. This argument would be strengthened if the conclusion were to hedge a little and state that the 49ers

"might win" their next football game. It would be worsened if the conclusion were that the 49ers will win their next *three* games.

Would the original argument be improved, weakened, or unaffected if you were to add the premise that the last six 49ers games were all against different teams? It would be improved because the premises would then show that the team has the ability to win against a variety of opponents, not just one or two. If you were to learn, however, that the price of rice in China was rising on days when the 49ers played their last six games but will be sinking on the day of their next game, the argument would be unaffected. If you were to learn that their last six games were played outdoors during warm, clear weather but that their next game will be played against the Chicago Bears outdoors in cold, snowy weather, the argument would be weakened because you know that playing conditions can affect the outcome of a game played outdoors.

Logical reasoners who are arguing from the past to the future need to be especially sensitive to the variety of the past data. For example, here are two inductions from past statistics to future performance, yet one is a better induction than the other. Why? Notice the variability in the scores.

> Bob scored 10, 5, and 15 points in his three previous basketball games (an average of 10 points per game). So, he will score about 10 points next game.
>
> Bob scored 10, 9, and 11 points in his three previous basketball games (an average of 10 points per game). So, he will score about 10 points next game.

The first argument is worse. This is because of the variety of Bob's scores. The less variety in the past data, the better.

On the other hand, the more variety in the relevant past conditions affecting the data, the better. That is, the more diversity among the relevant factors, the better. For example, regarding the second argument about Bob, if you learned that he had had a slight cold during the first game and that some of the games were on indoor courts but others were on outdoor courts, you could be surer of the conclusion than if you lacked this information.

However, a relevant factor lacking in the past but existing in the future lowers the quality of the argument. For example, if you were to learn that Bob will play the next game with a sore ankle (and he didn't have a sore ankle during the previous games), you know that he is less likely to score about 10 points.

Past diversity of conditions is a plus; future diversity is a minus.

———CONCEPT CHECK———

Here is an argument from the past to the future:

> The Kings have played the Lakers in basketball three times this year, and each time the difference in their two scores has been under six points. So, their next game against each other should have a point spread of under six points.

The past performance of the Kings is analogous to their future performance. Below you are given various modifications of the above argument. Treating each modification separately from the others, determine whether the alteration produces a stronger argument, produces a weaker argument, or has no effect on its strength.

a. Change "three times" to "thirteen times."

b. Their next game should have a point spread of exactly five points.

c. The Lakers lost to the Pistons yesterday but beat the Knicks last week.

d. Although there is a home court advantage, the three games were alternated between the two teams' home courts.

e. For the last three games against the Lakers, the starting center for the Kings has been Causewell, but he was hurt in a skiing accident today and won't be starting against the Lakers.

f. The Lakers have played the Kings only once.

g. In all previous games between the two, the announcer from the local TV station has drunk a beer during the game, but next time he won't drink.

h. In two of the three previous games between the Kings and the Lakers, the difference in their two scores was under six points, but in one it was over six.

i. In all previous games between the two, the Kings starting center was high on cocaine, but next time the center won't be.

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[333] Here is how the modifications will affect the argument:

a. Stronger. A better track record makes for a more reliable prediction.

b. Weaker. A more precise conclusion is harder to defend.

c. No effect. Those games shouldn't affect how the Lakers will do against a different team, namely the Kings.

d. Stronger. The added diversity (variability) of the relevant conditions in the past makes it more likely that the pattern will hold into the future.

e. Weaker. A relevant condition that held in the past is now known not to be holding in the future, so the conclusion is now more chancy.

f. Weaker. There is not much of a pattern now.

g. No effect. The mental state of the announcer is not relevant.

h. Weaker. There is now more variety in the past data, so the inductive argument will be weaker.

i. Weaker. A relevant past condition no longer will hold, and thus the analogy between past and future is weakened.

Statistics and Probability

Even when we are dealing with statistically significant statistics, we critical thinkers have to be on our guard not to be bamboozled by statistics. Which would you prefer, a drink that is 96% fat-free or one that is 4% fat? Most of us would prefer the first one, but we aren't thinking critically here, because there is no difference in the two.

———CONCEPT CHECK———

If you look at the speed people are driving when they get in auto accidents, you will find that a much higher percentage of accidents occur at speeds below 70 miles per hour than at speeds over 100 miles per hour. Therefore, to be safe you should try to drive over 100 miles per hour.

You do want to be safe, don't you? Or maybe you prefer living on "the edge." Or maybe you saw through my silly recommendation about driving over 100 miles per hour. Can you say what is wrong with the reasoning other than that it is silly?

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Let's turn from statistics to probability. Probability involves putting a number on the chance of an event taking place. The custom is that probability numbers must be on a scale from zero to one, which zero meaning the event definitely won't occur and one meaning it definitely will. Most probabilities we are interested in fall somewhere between these two extremes.

Consider a game involving dice. When we roll a fair die, there are six possible outcomes, all equally likely. Suppose we are interested in the probability of getting a 5. That means that exactly one of the six possible outcomes is classed as a success, giving a probability of 1/6. The fundamental principle here is straightforward. The probability of a successful outcome is always the ratio:

> Number of successful outcomes divided by the total number of outcomes, so long as every outcome is equally likely. If the outcomes are not equally likely, the math gets complicated.

Gamblers who bet on the outcome of the role of a fair die sometimes make the mistake of thinking that if after ten or twenty rolls, a five has come up less than 1/6 of the time, then a five is "due," meaning that on the next roll a five is more likely than 1/6. This mistake in reasoning is called the *gambler's fallacy*. A five has the same probability regardless of the history of the die.

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334 About the speeding, very few people drive that fast, so naturally there are few accidents at that speed; but the chances of having an accident when driving at that speed are astronomical compared to driving within the speed limit.

But all this was on the assumption that the die was "fair." Let's relax that assumption. Suppose someone shows you a coin with a head and a tail on it. You watch him flip it ten times and all ten times it comes up heads. What is the probability that it will come up heads on the eleventh flip? Let's consider what three people would say.

A person who commits the gambler's fallacy would tell you, "Tails is more likely than heads, since things have to even out and tails is due to come up."

A math student would tell you, "We can't predict the future from the past; individual trials are uncorrelated. So, the odds are still even."

A professional gambler would say, "There must be something wrong with the coin or the way it is being flipped. I wouldn't bet with the guy flipping it. However, on an even bet I'd bet someone else who isn't a friend of the guy doing the flipping that heads will come up again."

The professional gambler is the most sensible of these three people.

Notice how we apply our background knowledge to estimates of probability. Suppose you know you are reaching blindly into a container of white and black balls. Let's suppose you sample the container, replacing the ball after each sample. You do this five times and get 4 white and 1 black ball. Then if you were asked whether a white ball or a black ball is likely next time, you'd say a white ball. But if you had background knowledge that the container has one white ball and 99 black balls, then you'd guess a black ball next time, not a white ball.

We make all sorts of probability judgments without putting any numbers on those probabilities. Looking at a woman walking out of a parking garage, we correctly say it's more probable that she's a bank clerk than that she's a bank clerk from Florida even though we have no good idea what the probability number is. But if we noticed that she had just walked away from her car that has Florida license plates, then we'd say it's more probable that she's a bank clerk from Florida than that she's a bank clerk not from Florida.

———CONCEPT CHECK———

Is it more probable that she's a bank clerk from Florida than that she's poor and lives in Florida and works as a clerk in a bank?

———[335]

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335 Yes. It is more probable that she has two characteristics than that she has those two plus another one.

Review of Major Points

Inductive arguments are more common than deductive arguments, and they are more difficult to analyze, but logical reasoners need to be able to handle both kinds of argument. The quality of an inductive argument is always a matter of degree, unlike the quality of deductive arguments. In this chapter we considered the value of anecdotal evidence and reviewed some of the problems with arguments that appeal to the opinions of authorities. We examined several types of inductive argumentation, giving the most attention to generalizing from a sample. Generalizing from a sample is also called inductive generalization. To improve your chances of obtaining a representative sample, you should get a random, large, and diverse sample when you can. Arguments by analogy are attacked by finding disanalogies and by extending the analogy in unexpected directions. Finally, we introduced the problem of re-assessing the strength of an inductive argument when new information becomes available. We took a short foray into the mine field of statistics and noticed some ways people can lie with statistics. We introduced the subject of probability and learned to avoid the gambler's fallacy, and to judge that it is more probable that any two events will occur than that these two plus a third will occur.

Glossary

appeal to a typical example Drawing a conclusion about a population from the characteristics of a single example believed to be typical.

biased sample A non-representative sample.

biased sampling method A method of taking a sample that is likely to be non-representative.

biased generalization A generalization produced by relying on a biased sampling method.

coincidental pattern A pattern in data that appears by accident. A coincidental pattern would not persist if more data were acquired.

confidence level The percentage of confidence we need that the value of our statistic agrees with the target parameter, given the acceptable margin of error. For example, are we willing to be only 95 percent sure that we have the right answer, even allowing for the margin of error? Or must we be 99 percent sure?

disanalogies The ways in which two things are not analogous.

diversity Variety.

extend the analogy To point out additional ways in which two analogous things are alike.

fallacy of hasty generalization Jumping to conclusions when the conclusion is a generalization from the evidence.

fallacy of jumping to conclusions Drawing a conclusion prematurely or with insufficient evidence, even if the conclusion turns out to be true.

faulty analogy Claiming that two things are analogous with respect to some characteristic when in fact they aren't analogous.

gambler's fallacy Assuming that an event is due or has a higher probability of occurring because it has occurred very much in the past, when it is should be known that the probability doesn't change over time.

heterogeneous group A group having considerable diversity in the relevant factors affecting the outcome of interest. For predicting the shape of a randomly picked snowflake, snowflakes are a heterogeneous group.

homogeneous group A group with an insignificant amount of diversity in the relevant factors affecting the outcome of interest. For predicting either the color or the melting point of a randomly picked snowflake, snowflakes are a homogeneous group.

inductive generalization Generalizing on a sample; also called induction by enumeration and empirical generalization.

margin of error A limitation on the accuracy of a measurement; it is the interval around the parameter that the statistic falls within.

parameter The target number in a measurement—that is, the true value of the characteristic being measured.

population The set or group whose characteristics are the focus of the measurement or inductive generalization. The population need not be a group of people; when a quality control engineer samples cereal boxes to measure their freshness, the population is the cereal boxes.

principle of total information When assessing the strength of an argument for a conclusion, use all the information that is relevant and available.

random sample Any sample obtained by using a random sampling method.

random sampling method Taking a sample from a target population in such a way that any member of the population has an equal chance of being chosen.

representative sample Less formally, a sample having the same characteristics as the population. More formally, a sample S is a perfectly representative sample from a population P with respect to characteristic C if the percentage of S that are C is exactly equal to the percentage

of P that are C. A sample S is less representative of P according to the degree to which the percentage of S that are C deviates from the percentage of P that are C.

sample The subset of the population used to estimate the characteristics of the population.

simple statistical claim A claim that has the form "x percent of the group G has characteristic C."

statistic The number used as the estimate of the parameter.

statistically significant A statistic that probably does not occur by chance.

stratified sample A sample that is divided into strata or categories.

typical example A single member that has the same characteristics as the population as a whole, in the sense that if it were the only member in a sample, the sample would be a representative sample of the population.

variable Anything that comes in various types or amounts. There are different types of races, so race is a variable; there are different amounts of salaries, so salary is a variable; and so forth.

value of a variable Each type or amount of a variable. For example, Caucasian is a possible value of the race variable; $30,000 would be the value of the salary variable for a person who makes $32,500 per year if the salary variable indicates annual salary only to the nearest $10,000.

Exercises

Generalizing from a Sample

1. Evaluate the following reasoning. In answering, specify the conclusion, say whether the conclusion follows, and explain why.

> This survey of major corporate executives indicates that 60 percent of those sampled believe that some American businesses often engage in price fixing. Therefore, if you were to pick in the same way five of the surveyed major corporate executives, you could reasonably expect that three of them would believe that some American businesses often engage in price fixing.

2. If some members of the target population did not have an equal chance to be selected into the sample, then the sample *must* be non-representative of the population.

a. true b. false

3. Rank the following three arguments in order of their strength, strongest first:

> (1) Our local newspaper's film reviewer liked the film; so it's a good bet that everyone else will, too.
>
> (2) Everyone else liked the film, so it's a good bet that our local newspaper's film reviewer will, too.
>
> (3) Everyone liked the film, so it's a good bet that our local newspaper's film reviewer did, too.
>
> a. 123
>
> b. 32 1
>
> c. 2 13
>
> d. 3 12
>
> e. 2 3 1

■ 4. Is a large random sample that is stratified on all the relevant characteristics in the population always representative of the population? Why?[336]

■ 5. Why aren't all representative samples random? You may assume that any sample is less than the whole population being sampled.[337]

6. For the following statistical report, (a) identify the sample, (b) identify the population, and (c) discuss bias and the representativeness of the sample, mentioning sample size, stratification, and so on.

> The *State Hornet*, the State University student newspaper, conducted a survey by asking students a series of questions. The survey was conducted at noon in front of the University Union and involved 450 students out of a student body of 26,000. The interviewers were careful to get a sample with a racial, sexual, and age breakdown similar to that of the university as a whole. In the survey, 70 percent of the students interviewed said they opposed mixing sexes on the same floor of the dormitories. The

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[336] No. Such a sampling procedure won't guarantee a correct conclusion. Only a deductive argument will do that. Generalizing from sampling less than 100 percent of the population is always risky.

[337] Getting a random sample is one of several methods that will help get a representative sample, but a representative sample can also be obtained by luck.

> newspaper presented the results of its survey in an article headlined "Majority of Student Body Opposes Mixing Sexes on Same Floor of Dorms."

Suppose that in response to this passage, Smith remarks, "There are several problems with this survey. For instance, the “70” is pseudoprecise, and just how do you tell from a distance what someone's age is?" (d) Discuss this response.

■ 7. After a gun control law was passed in the state of Washington, the murder rate in Washington dropped from 4.3 percent per thousand to 3.4 percent per thousand. If this drop is statistically significant, then

α. the drop is not due to random variation in the population of murders.

β. the difference between 4.3 percent and 3.4 percent is due to chance.

χ. the difference between 4.3 percent and 3.4 percent is too small to be important statistically.

δ. the difference between 4.3 percent and 3.4 percent either is due to chance or is too small to be important statistically, but not both, and you cannot tell which from the information given.[338]

8. For the following statistical report, (a) identify the sample and its size, (b) identify the population, and (c) discuss how the sampling could have been improved by stratifying on time (but don't mention other ways to improve it).

> In an effort to determine U.S. truck driver attitudes about the new requirements, the Council for Population Studies asked U.S. truck drivers whether they thought the same smog requirements that automobile drivers must meet should apply to truck drivers as well. Of the several thousand who responded to the survey, most indicated that they believed trucks should be exempt from the automobile smog regulations. The voluntary survey was taken at random times of the twenty-four hour day at randomly selected truck stops throughout the United States.

■ 9. Hannah is getting sick and tired of following Ricardo’s advice. Every time he has recommended a film for her to see, she has been disappointed in the film. Once she even walked out before the film had ended. She decides that this time she is not going to go see “The Rise of Dracula” which Ricardo’s has just recommended.

In Hannah’s reasoning, what percentage of the items in the past have had the property in question that she is considering projecting into the future?

---

338 Answer (a).

α. 25%
β. 20%
χ. 100%
δ. 0%
ε. can't tell[339]

10. Examine the following dialogue, paying attention to the quality of the reasoning. Then answer the questions that follow.

Lesley: I think little Sam will soon be having dreams of giant needles.

Rico: What? Have you been reading the tabloids again?

Lesley: No, but his school says all elementary and pre-school kids should be vaccinated for measles.

Rico: Who is sick? Do you know anybody with measles?

Lesley: No, but they *might* get sick. Evidently somebody high up thinks there's a chance. The school recommended the shots in a leaflet Sam brought home this afternoon.

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[339] Answer (c). 100% of the times in the past when she has taken his advice, she has been unhappy with the advice. She infers that this pattern will continue into the future and that she will also be unhappy again with the new advice. The property in question is the disappointing character of the film that is recommended by Ricardo.

Rico: What will this latest suggestion of theirs cost us?

Lesley: I don't know. That's a problem. We have to find a clinic, make the appointment, and all that. The leaflet recommended ten clinics in the county.

Rico: It may not be worth all the trouble. I don't know anybody in the last ten years who has ever gotten measles. Besides, can't you still get the disease even if you take the vaccine for protection? Do they say it's perfect? Can't the vaccine itself give you the disease? Shouldn't we consider all this?

Lesley: Well, the leaflet said something about a scientific report in some medical journal. Here it is. It says, "The new vaccine uses a live form of the measles virus that is expected to be the cause of most cases of measles in the U.S. over the next few years. However, the virus is weakened so it is very unlikely to cause a real case of the measles. In order to show that measles can be prevented in children, medical professors Carolyn Owen, Mary Pittman Lindemann, and Linda Bomstad gave injections last year to 1,244 children who had been admitted to Chicago hospitals for non-life-threatening problems. 622 received the vaccine; the rest of the children received an injection that looked identical but was actually a harmless placebo, just salt water. The nurses administering the injections were not told which children were getting which kind of injection. Seven months later, only one of those who received the vaccine had gotten measles, but 45 of the group whose injections contained no vaccine had been diagnosed as having the disease." How does that sound to you?

Rico: OK, the shot will help keep Sam safe, but I'd still like to know what it costs.

Lesley: Well, you go call a clinic and ask them.

Rico: You're better at dealing with bureaucracies. You call.

α. What is the main issue in this conversation?

β. Rico implicitly makes an inductive generalization based on some statistics. What is the target population?

χ. Describe the sample, but do not evaluate the sampling procedure itself.

δ. Any problems with the sampling procedure? Comment on stratification of the sample.

ε. What did this study say or show about how to cure measles in a child once the child has gotten the disease?

ϕ. Is Rico being illogical anywhere in the conversation? If so, where and why?

■ 11. Could this be true? "I was trying to learn about the population, but my totally unbiased sampling method produced what I later learned was a non-representative sample."[340]

12. About 95 percent of the sample of 94 resistors taken from the approximately 1,500 resistors in Tuesday's output at the factory are of good enough quality to be sold. From this information about the 94 resistors, which of the following statements about the 1,500 is most likely to be true?

a. All of Tuesday's total output of resistors work OK.

b. Exactly 95 percent of Tuesday's total output of resistors work OK.

c. Over 90 percent of Tuesday's total output of resistors work OK.

d. 94 to 96 percent of Tuesday's total output of resistors work OK.

13. If some members of the target population did not have an equal chance to be selected into the sample, then the sample must be nonrandom.

a. true b. false

14. What is an important thing to do if you want to be able to trust the answer you get from taking a statistical survey, especially if you are paying people to participate in your survey?

a. Be sure to survey as many of your friends as possible.

b. Be sure to avoid surveying any of your friends.

c. Stratify your sample.

d. Avoid a representative sample in cases where the population is large.

e. Avoid a representative sample in cases where the population is small.

15. Suppose you were interested in whether the customers who buy heavy metal music from your store would like you to carry wall posters of the musicians. You can't ask all the customers, but you can ask a few by taking a poll. You happen to know that about 60 percent of your customers who buy heavy metal music are male. You know that about 50 percent of the people in the world are female. If you were going to stratify your sample on sex, how should you do the stratification?

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340 This could well be true. Being unbiased only promotes the production of a representative sample; it won't guarantee it.

■ 16. After examining the birth records of as many black persons as she could fine who were born between 1850 and 1950 in a Gulf Coast state, Dr. Gale Carswell discovered that 55 percent of those children were female. She then reported the remarkable result that there were significantly more female than male black children born in the Gulf Coast states during that period. In her study, the population was

a. as many black persons as she could find who were born between 1850 and 1950 in a Gulf Coast state.

b. black persons who were born between 1850 and 1950 in a Gulf Coast state.

c. people living in states along the Gulf Coast between 1850 and 1950.

d. 55 percent of the black persons born in a Gulf Coast state between 1850 and 1950.[341]

17. Logical reasoners should not commit the fallacy of covering up counterevidence. In each of the following passages the reasoner is guilty of committing this fallacy, though you aren't told why. What would you guess is the negative evidence that is being suppressed either intentionally or unintentionally?

a. Every day of my life the night has been followed by the sun's coming up. It is reasonable, therefore, to suppose that the sun will always come up in the future.

b. I've tried lungfish at three different restaurants over the last few years. Every time it has tasted awful to me. So, if I order the lungfish on this menu tonight, I won't like it.

c. The creation of the world happened long before anyone was around to witness it, so there can be no support for the theory of evolution from individual testimony. The only real evidence for evolution is in the bones embedded in rocks, but there are so many questions in this area of paleontology that even the paleontologists don't agree. Besides, all the evidence is easily accounted for by the Noah's flood that is mentioned in the Bible. Therefore, if you base your belief in evolution on geology or paleontology you are really being unscientific.

■ 18. If you obtained new theoretical knowledge that the population of objects you are about to study by statistical sampling is not very diverse, then you can make good use of this knowledge by

a. increasing your sample size.

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341 Answer (b).

b. decreasing your sample size.

c. assuming that similar effects are likely to have dissimilar causes.

d. avoiding a representative sample.[342]

Other Types of Inductive Arguments

■ 1. Suppose someone offers the following argument: Amassing a fortune is like winning an election because it takes hard work, new ideas, and charisma. Well, behind every great fortune there is a great crime. So, you know what that means for elections. Explain the analogy by identifying the argument's conclusion and the A, B, and C that appear in the standard form of any argument by analogy.[343]

■ 2. Create a short, serious argument by analogy for the following conclusion even if you don't agree with it:

Abortion clinics deserve to be bombed.[344]

3. Which one of the following three passages argues in a way that relies on an anecdote?

a. Uncle Antonio told me, "Don't bother checking," but I didn't listen to him. Somehow I just didn't believe Sandra when she said Sacajawea was some president's wife. I really wanted to find out more about Sacajawea, so I asked the librarian. She said to check the encyclopedia. It said that Sacajawea was an Indian woman who guided Lewis and Clark's expedition in 1804. She didn't marry any president. But think about that expedition. Knowing what you know now about U.S. history since 1804, do you think things would have turned out better if Sacajawea would have refused to be the guide for Lewis and Clark?

b. Mercy Otis Warren was a black activist who wrote political pamphlets during the American Revolution. I can still remember my grandmother saying to me, "When you grow up, you should read about that revolution. But don't read about it from your high school textbook. Read other books from big libraries." That's why I'm here. I want to

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342 Answer (b).

343 Conclusion: Winning an election depends on a great crime. A = amassing a fortune; B = winning an election; C = depends on a great crime.

344 An abortion clinic is like a nest of wasps in that both harm innocent persons. A nest of wasps deserves to be bombed (with pesticides). So, abortion clinics deserve to be bombed, too.

know if you have any history books about Mercy Otis Warren. There is no listing for his name in the computerized catalog.

c. Paula Abdul and Wynton Marsalis are better singers than Lady Gaga. I went to the same concert that you are talking about, but I was closer to the stage than you were. Trust me; Lady Gaga didn't sing those songs; she just moved her lips to make it look that way. Once, when she tripped while dancing across the stage, she closed her mouth for a second, but the song kept right on going.

4. Identify the analogy that is used or mentioned in the following passage:

Hardly anybody likes to kill people. War is a messy, dirty, godforsaken business. Who wouldn't rather be home eating popcorn on the couch? But let's face it. You can't make an omelet without breaking eggs.

5. Create an original argument about some aspect of warfare. Your argument must be reasonable and nontrivial, and it must rely on an appeal to an analogy.

■ 6. Discuss the strength of the following argument by analogy:

Mercury is like water in that they are both liquids. Water seeks its own level, so the mercury in that thermometer will, too, if you break it open.[345]

7. Discuss the quality of the reasoning in this argument. Is it valid, sound, fair, etc.?

You have to be a lesbian to be a feminist, but the film "Still Killing Us Softly" doesn't promote lesbianism, so the film is antifeminist.

8. Which of the following passages contain arguments that are inductions by appeal to a typical example?

a. This piece of copper is a typical example of copper. All copper conducts electricity. Therefore, this piece of copper does, too.

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[345] That argument is weak. Here is a much better argument:

All liquids seek their own level when not confined. Mercury is a liquid.

So, Mercury will seek its own level, too, when not confined.

The first premise here follows from a scientific theory of liquids. The reason that the original argument is weak as it stands is that it is quite similar to the following inductively weak argument:

Mercury is like water in that they are both liquids. Water is a thirst-quenching liquid, so the mercury in that thermometer is, too.

Mercury is actually poisonous, as are all metals.

b. Let me make this appeal one more time, but it's the last time. If you want to keep your roof from leaking next winter, you've got to buy our Number One roof treatment. It has worked for all our customers, so it will work for you, too.

c. Woody Allen's "Annie Hall" was a comedy, so his films are probably all comedies, don't you think?

d. Our polling indicates that very few black Canadians can name one famous black American who lived in the nineteenth century. Their best guess for an example of a black American was Huey Newton. Newton was black, but he was a Black Panther organizer in Oakland, California in the 1970s, not in the nineteenth century.

9. Do some independent research and then write a short essay explaining to what extent the flow of electricity in a wire is analogous to the flow of water in a pipe.

10. Write a short essay explaining to what extent the operation of a family is and isn't analogous to the workings of a country.

11. After receiving another student's answer to the previous question, write a short essay evaluating the student's answer.

12. State the implicit analogy used in the following argument:

    You wouldn't think it's right to attack your neighbor across the street, so it is immoral for any country to attack its neighbor.

■ 13. State the implicit analogy used in the following argument:

    There's no challenge in defeating Princeton in baseball. Would you take candy from a baby for the challenge of it?[346]

■ 14. Choose the letter of the ranking that goes from strongest argument to weakest:

    (1) Pele scored 10, 9, and 11 goals respectively in his last three games, so he will score 10 goals next game.

    (2) Pele scored 10, 9, and 11 goals respectively in his last three games, so he will score 9 to 11 goals next game.

    (3) Pele scored 10, 9, and 11 goals respectively in his last three games, so he scored an average of 10 goals in his last three games.

    a. 123

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346 Defeating Princeton in baseball would be like taking candy from a baby.

b. 321
c. 213
d. 312
e. 231[347]

15. During this year's soccer season, our team has lost all three of its games against Princeton University. It's a good bet that tomorrow's game against them will also be one big tragedy.

Consider the following changes to the above argument. Would each change (separately) be likely to strengthen, weaken, or not affect the argument?

a. Meredith, who is Princeton's best player, played in all three of the previous games, but she won't be playing tomorrow.

b. Helen, who is our team's best player, played in all three of the previous games, but she won't be playing tomorrow.

c. The last three games against Princeton were played on our field, and the next one will be, too.

d. The last three games against Princeton were played in different places: on our field, Princeton's, and the local community college's.

e. One of the games was played during a high wind, and the other two were played during a cold drizzle, but the weather prediction for tomorrow is warm, sunny, and calm.

f. During the past three games you have bet on the results and won, but this time you are not going to bet.

■ 16. Lady Theresa claims to be a psychic and to have perceptive abilities beyond those of most other people. She was tested in a laboratory once for her ability to guess which queen is missing from an ordinary deck of fifty-two playing cards, each containing four different queens. A friend of Lady Theresa was surprised to learn that she correctly identified the missing card only 50 percent of the time; she expected her to have a 100 percent success rate.

a. If in future card tests the experimenter were to have a professional magician specializing in card tricks observe Lady Theresa and help detect any cheating, should this make a 50% success rate more believable or less believable?

b. If not 50 percent, then what score should you expect the average, nonpsychic person to get on the card tests?

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[347] Answer (b). Argument 3 is deductively valid, unlike the other two arguments.

c. The experimenter says that Lady Theresa's 50 percent is not statistically significant. Why do you suppose it isn't significant, and what do you recommend doing to determine whether her ability on these card tests is significantly better than the average person's ability?[348]

17. Is mathematical induction a particular kind of inductive argument?

18. Comment on the strength of these inductive arguments:

a. Our lunar module landed on Saturn's closest moon and found the surface everywhere to be powdery down to two inches. Therefore, the surface of Saturn itself is covered everywhere with two inches of powder.

b. The chemical 3,4,5-trimethoxylate benzaldehyde killed David and his son when they drank it, so it will kill anybody.

19. Create your own multiple-choice question, with answer, about induction by appeal to a typical example. Make the question realistic, unambiguous, and the appropriate level of difficulty for students in your own class.

20. Create your own essay question, with answer, about induction by appeal to a typical example. Make the question realistic, unambiguous, and the appropriate level of difficulty for students in your own class.

21. For the problem of deciding whether a vaccine manufactured from chicken eggs will be effective against the common cold, would you say that a healthy sixty-two-year-old female designer of anti-tank weapons for the Boeing Corporation in Seattle, Washington would be a sufficiently typical member of the target population such that if the vaccine works on her it would work on anybody? Why? Mention any relevant background knowledge you have about diversity.

■ 22. State the conclusion of the following inductive argument, and then describe the argument's structure:

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[348] Answer (a). This will make it more believable because it will make it more difficult for her to cheat or to get lucky. In short, you will have a better-designed experiment. (b) The answer is 25 percent, which is one queen out of four. (c) It probably wasn't significant, because so few tests were run. Maybe she guessed twice and was correct one of the two times. Do more tests.

David was caught cheating on his history homework when he was in high school, and now you want to hire him to work the cash register in our office? Get serious. A leopard doesn't change its spots.[349]

23. Which of the following is the only one argument that relies on an induction from the past to the future? State the conclusions of all the arguments.

    a. Joey's leopard had spots in the past and it will have spots in the future. So, a leopard doesn't change its spots.

    b. Yesterday there was a full jar of jelly beans on that shelf. This morning there is a half-empty jar. Somebody took some last night, right?

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[349] Conclusion: David will continue to cheat if he is hired to work the cash register in our office. It's an argument from the past to the future passed on the idea that the past pattern of cheating will be likely to continue in the future. The comment about leopards is a common expression used to make the point that old patterns will continue to hold in the future. This passage could be analyzed as containing two arguments. First comes the argument mentioned in the preceding paragraph. The second argument has more implicit elements: its conclusion is that we shouldn't hire David. The argument contains implicit premises about it being unwise to hire people who cheat, especially if the job is to work a cash register. It is unclear, however, whether the second argument actually occurs; perhaps it doesn't and we are just guessing that the second argument is likely to be created or accepted by the arguer.

c. When you bought that goldfish, who ended up taking care of it, me or you? Now you want to buy a guinea pig, and you expect me to believe that you will take care of it. No thanks.

d. You've got to buy either the goldfish or the guinea pig. My older sister told us that the goldfish is cheaper to buy and to feed, although it is also a little less fun to play with. So, let's buy the guinea pig, not the goldfish.

24. The following passage describes a scientific experiment. It then makes an induction from the past to the future.

We showed the person who claimed to be a psychic a deck of regular playing cards in which one card had been removed. The psychic was shown the backs of the cards but was not allowed to touch the cards. During the twenty times we tested the psychic, he correctly guessed which card was missing from the deck over 50 percent of the time. Therefore, he will get it right more than half of the time on the next twenty times we perform the test. Would the above argument be improved, weakened, or unaffected if

a. The phrase *twenty times we tested* is changed to *twenty-four times we tested*.

b. The phrases *missing from* and *half* are replaced by *not in* and *50 percent*, respectively.

c. The word *half* is changed to *three-quarters*.

d. The psychic was quite comfortable in the past tests but will be made uncomfortable in the future tests.

e. In the previous tests a magician trained in card tricks was present to observe the psychic and to help the experimenter discover cheating that would invalidate the experiment, but in future tests the magician will not be present.

f. In the past tests the experimenter knew which card was missing, but in the future even the experimenter won't know the answer at the time the question is asked of the psychic.

g. The past tests and results were duplicated by an independent and trustworthy research organization.

h. Instead of all past twenty tests having been performed on a single day in a single lab, they were spread across fourteen days in seven different labs.

■ 25. John is a part-time cotton farmer in Alabama who has tried for four years to get a decent crop on his small plot. Every year he's had so much damage from pests that he hasn't made a decent profit. He concludes that next year's results will be just as bad. Would the strength

of his argument be improved, weakened, or unaffected if he next year John will be adding alfalfa clippings as a fertilizer to his crop? Why?[350]

26. Consider the character of this passage:

> Medieval war is like a chess game because there are knights battling on horseback, kings at the center of attention, powerful queens, bishops who support the king, and so forth.

In the passage, there is an argument

a. by disanalogy
b. by appeal to a typical example.
c. by analogy that is not an appeal to a typical example.
d. whose conclusion is an analogy.

27. Criticize the following argument by analogy by using the technique of pointing out disanalogies:

> Government budgets are like personal budgets in so many ways. Since you can't last long when your own budget is in the red, you shouldn't permit deficit spending by your government.

■ 28. 6Notice how different those two arguments are. All other things being equal, which is the stronger argument? Choose from one of the four suggested answers.

1. She's not here, so she's gone to the supermarket.
2. She's not here, since she's gone to the supermarket.

a. 1 is stronger because, if she's gone to the supermarket, then she can't be here provided we can assume that we aren't in the supermarket, which is a very good assumption.

b. 2 is stronger because, if she's not here, then she might be in any one of many different places. The supermarket could be one of those places. So, the conclusion follows, and this is a strong argument.

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[350] The argument probably will be weaker, because there is now less similarity between the past and the future in regard to a causally relevant characteristic. In particular, the fertilizer might make the crop more hardy and thus more resistant to the pest. Only if you knew that adding this fertilizer would tend to hurt the crop—say, by promoting pest growth—could you safely say that the argument would be strengthened. If you didn't know whether adding the fertilizer would help or hurt the crop, then just the fact that you know that adding it would be likely to affect the crop is reason enough to say the argument is weaker.

c. 2 is stronger because it is very probably ok to assume the word "here" does not refer to the supermarket, and it is fine to assume that people cannot be in two places at once. With those assumptions, the conclusion follows.

d. 1 is stronger because, if she's not here, then there are many other places where she might be. The supermarket is one of them. So, the conclusion follows, and this is a strong argument.

351

351 c

CHAPTER 14 Reasoning about Causes and Their Effects

An inductive argument can establish its conclusion with probability but not certainty. A previous chapter examined many types of inductive argumentation and introduced some of the methods of statistical reasoning. This chapter begins a systematic study of causal reasoning. Causal arguments are arguments in support of a causal explanation or causal claim. You know what a causal claim is. If I say it's raining, then my claim is not a causal claim. If I say God made it rain, then I'm making the causal claim that God caused the rain. A causal claim is a claim that an effect has a cause. All of us are interested in finding causes; without finding them we'd never understand why anything happens. In the beginning of the chapter, we will explore reasoning about correlations and conclude with reasoning about causes and effects. We will investigate how to recognize, create, justify, and improve these arguments. Cause-effect reasoning often involves arguing by analogy from the past to the present, but it also can involve appealing to scientific theories and to other aspects of logical reasoning, as we shall see in this and the next chapter.

Correlations

A correlation is a connection or association between two kinds of things. For example, scientists are interested not only in statistics about who has lung cancer, but also in how smoking is

related to lung cancer. This relationship is one of apparent connection, and it is described mathematically by saying that the values of the variable "number of smokers in a group" and the variable "number of lung cancer cases in that group" are **correlated**. The word *correlated* is a technical term. Finding a correlation in your data between two variables A and B is a clue that there may be some causal story for you to uncover, such as that A is causing B, or vice versa.

> One's heart leaps up when one beholds an unexplained correlation between familiar phenomena.—W. V. Quine

Suppose that a scientific article reports that smoking is positively correlated with lung cancer. What this means or implies is that groups of people with a high percentage of smokers usually also have a high percentage of lung cancer cases, and groups with a low percentage of smokers usually also have a low percentage of lung cancer cases.

Here is another way to make the same point. The two percentages tend to rise and fall together across many groups. If A = percent of smokers in any group and B = percent of lung cancer cases in the same group, then the scientific article is reporting that values of the variable A tend to go up and down as values of the variable B also go up and down.

Definition: If the values of the variable A tend to increase and decrease in synchrony (parallel) with the values of the variable B, then there is a *positive correlation* between the values of A and the values of B.

When the values of A and the values of B are positively correlated, we also say that the variables themselves are positively correlated.

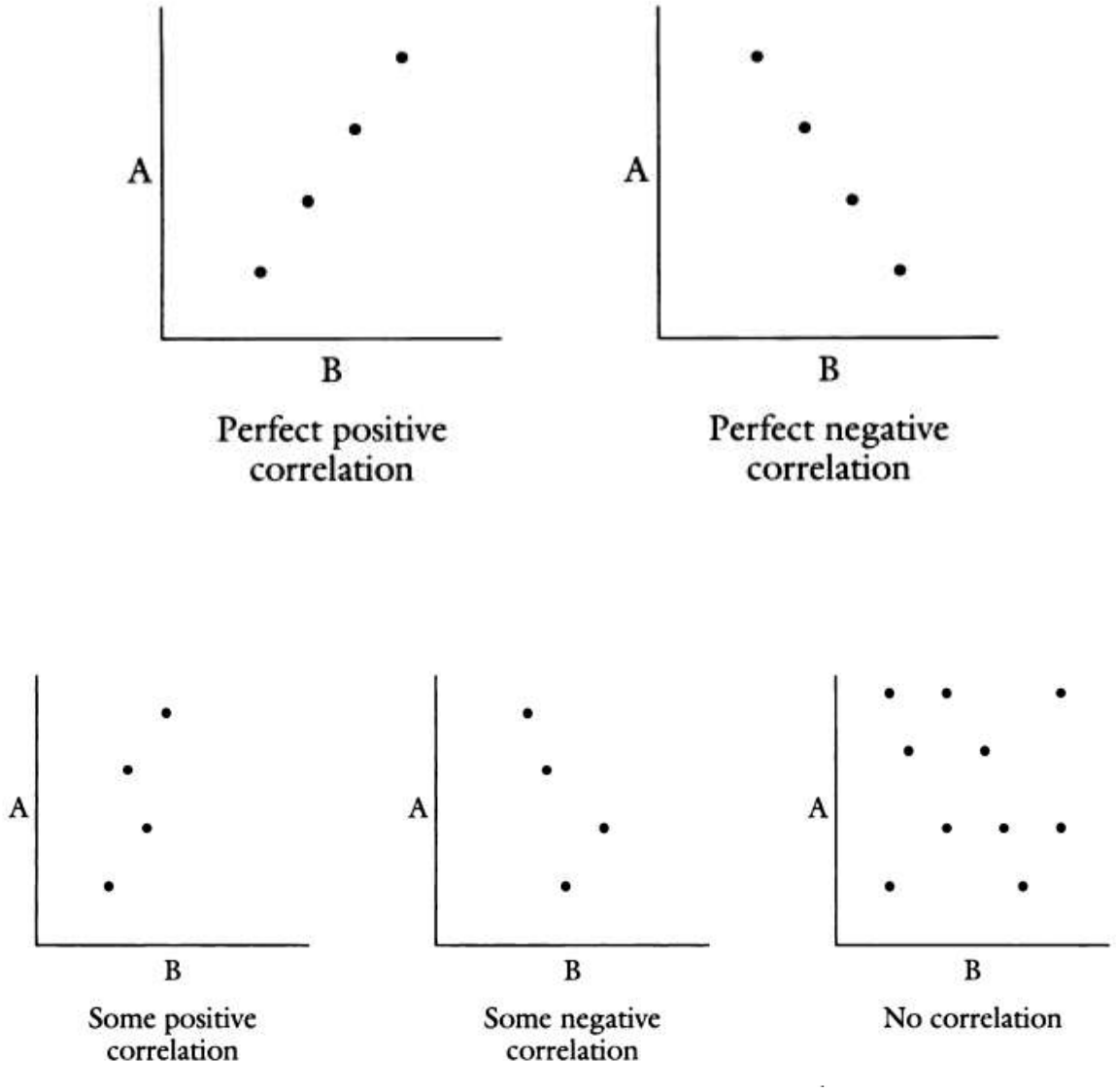
Pressure and volume of a contained gas are negatively correlated. When you increase the pressure, you usually notice a decrease in volume, and vice versa.

Definition: If A tends to increase when B decreases and vice versa, then there is *negative correlation* between A and B.

Definition: If A changes haphazardly as B changes, then there is *no correlation* between A and B.

Being correlated is a matter of degree. Also being correlated negatively or positively implies that the two variables are not independent of each other. If we were to delete the phrase *tends to* from the first two definitions, we would have *perfect correlations*. When A *always* increases with increases in B, and *always* decreases with decreases in B, then A and B are perfectly positively correlated. When scientists say two variables are *directly proportional*, they mean that a perfect positive straight-line correlation exists between them. A perfect negative correlation between two variables, such as the pressure and volume of an ideal gas, is often expressed by saying

they are *inversely proportional*. The accompanying graphs show some of these possible relationships between two variables A and B.



In the two top, straight-line graphs, we have evidence that A is directly proportional to B. In the second, we have evidence that A is inversely proportional to B. When A is correlated with B, it follows with certainty that B will be correlated with A, and vice versa. In other words, correlation is a symmetrical relationship.[352]

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[352] We've been using discrete, not continuous variables; that is, the points on the graphs are disconnected. Many variables are continuous rather than discrete—for example, time, altitude,

We've introduced correlations by talking about variables, but correlations can also occur among characteristics. For example, there's a correlation between the characteristic of being a Canadian and the characteristic of owning a warm, hooded coat. The characteristic "being a Canadian" can be thought of as a variable with two values "characteristic is present" and "characteristic is absent." In other words, the characteristic C can be thought of as a variable with the possible values of "present" and "absent" or the values C and Not-C. With this sort of variable, it doesn't make sense to talk about their values "changing in synchrony." Here are some new definitions of *correlation* that apply to these kinds of characteristics:

> Definition: A is **positively correlated** with B in a given population whenever the percentage of A's among B's is greater than the percentage of A's among the Non B's.
>
> Definition: A is **negatively correlated** with B in a given population whenever the percentage of A's among the B's is less than the percentage of A's among the Non B's.
>
> Definition: A and B are **uncorrelated** if the percentages of A's among the B's is the same as among the Non-B's.

For example, being tall is positively correlated with being a professional basketball player because you'll find a higher percentage of tall people among the players than among the non-players. In applying the above definition of positive correlation, we would let

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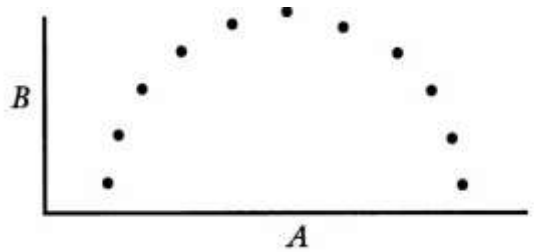
and degree of satisfaction with a politician. Continuous variables can always be turned into discrete variables by dividing the continuum into separate categories; for example, the continuous variable *time* could be replaced with the discrete variable *time-to-the-nearest-minute*. Correlation between two variables can actually be quantified. That is, a number can be assigned to the correlation. The number, called the **correlation coefficient**, can range from minus one for a negative correlation to plus one for a positive correlation. In this chapter, we will not investigate how to calculate these coefficients. The correlation coefficient is a measure of how well a straight line graph will represent the data. Consider a graph that looks like this:



This graph has a small correlation coefficient, so a straight line does not do a good job of representing this graph. Nevertheless, there is clearly some sort of correlation between A and B. It is a **nonlinear correlation**.

A = tall people

B = professional basketball players

Non-B = people who aren't professional basketball players

Is there any correlation between being Canadian and having a banana tree in one's backyard? Yes, definitely. Randomly examine groups of people. The higher the percentage of Canadians, the fewer people in the group who will have a banana tree in their backyard. There is a negative correlation.

———CONCEPT CHECK———

Given our common knowledge about horse racing and the jockeys who ride the horses, is there any correlation between a person's body weight and their being a professional jockey?

a. Yes, they are positively correlated.
b. Yes, they are negatively correlated.
c. No, they are uncorrelated.

———[353]

Correlation is a matter of degree. Some correlations are strong; some are weak. If the percentage of people with lung cancer were only slightly higher among smokers than nonsmokers, the correlation between lung cancer and smoking would be weak. In reality, however, the percentage of people with lung cancer is twenty times higher among smokers than nonsmokers, so the correlation is very strong.

Definition The **strength of the correlation** between characteristics A and B is proportional to the difference between the percentage of B's that are A and the percentage of Not-B's that are A.[354]

———CONCEPT CHECK———

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[353] Answer (b). In a group of jockeys, you'd expect the average weight to be less than the average weight of most people in society.

[354] Statisticians prefer to use a somewhat more complicated measure of strength for correlations, but this definition can be quite helpful as a rule of thumb.

Are U.S. income taxes correlated with citizens' gross incomes? Positively or negatively? Strongly or weakly? Perfectly?

[355]

Some persons find correlations where others do not. Here is a dispute that occurred many years ago. The lobbyist for the Associated Anglers of the Colorado River claimed there is a correlation between the number of striped bass in the Colorado River and the amount of water taken out of the river by the State of Nevada. A housing developer in Las Vegas said he sees no correlation. Who is correct? Well, let's look at the data. The lobbyist and the housing developed do not disagree on the raw data. Here are some charts of this data from the previous century:

Water exports from the Colorado River to Nevada

Date	Water (mill. acre-feet)	Date	Water (mill. acre-feet)
1950	0.5	1975	4.5
1955	1.0	1980	5.0
1960	1.0	1985	4.5
1965	2.0	1990	5.9
1970	2.8		

Estimated Adult Striped Bass in the Colorado River

[355] U.S. income taxes are positively correlated with citizens' gross incomes. The correlation is not perfect, but it is fairly strong. The correlation is weak in the highest income brackets, where those persons tend to pay proportionately a fairly small percentage of their income in taxes thanks to tax shelters.

Date	Fish (millions)
1969	1.6
1970	1.7
1971	1.6
1972	1.8
1973	1.6
1974	1.4
1975	1.8
1976	1.5
1977	0.9
1978	1.1
1979	1.1
1980	1.0
1981	0.9
1982	0.8
1983	1.0
1984	1.0
1985	1.0
1986	1.0
1987	1.0
1988	1.0
1989	0.7
1990	0.5
1991	0.5

How can you look at these two sets of data and tell whether a correlation exists? If you look for trends in the data, you will notice that through time the exports of water have increased, while the number of fish have more or less decreased. As one goes up, the other comes down, which is a sign of a negative correlation. Only a statistician can tell how strong the correlation is, but you can tell from the trends that a correlation is present and that it is unlikely to be due to accidental fluctuations in the levels of water and fish.

Significant Correlations

Given an observed correlation, how can you tell whether it is significant rather than accidental? Well, the problem of telling when an association is significant is akin to the problem of telling when any statistic is significant. The point is that the correlation is significant if you can trust it in making your future predictions. Conversely, an observed correlation is not significant if there is a good chance that it is appearing by accident and thus wouldn't be a reliable sign of future events. However, you usually aren't in a position to perform this kind of calculation of the significance of the correlation. If you are faced with a set of data that show a correlation, you might never be able to figure out whether the correlation is significant unless you collect more data. If the correlation is just an accident, it will disappear in the bigger pool of data when more data are collected.

> Significant correlations are those that continue into the future. They are the correlations that occur because some real causal activity is at work.

If you cannot collect more data, and cannot ask a statistician to calculate the correlation coefficient for you, then the only other way to tell whether the correlation is significant is to see whether accepted scientific theories about how the world works enable you to predict that the correlation will hold. For example, suppose you have all the data available about Napoleon Bonaparte's childhood and you discover a positive correlation between his height as a child and his age as a child. Is the correlation significant? You cannot collect any more data about Napoleon's childhood; you have all there is to have. You cannot start his life over again and collect data about his childhood during his second lifetime. Nevertheless, you know that the correlation between his height and age is no accident, because you hold a well-justified theory about human biology implying that height in childhood increases with age. If this connection holds for everybody, then it holds for French emperors, too. So the correlation in the Napoleon data is significant. In summary, to decide whether a correlation is accidental, you might try to collect more data, or you might look to our theoretical knowledge for an indication of whether there ought to be a correlation.

———CONCEPT CHECK———

What is the story behind the correlation in the passage below?

Amid Wall Street's impenetrable jargon and stone-faced forecasts for the stock market in 1984 comes this nugget of foolishness: If the Washington Redskins win the Super Bowl this Sunday, the market is going up. Or, conversely, if you think the market is going up this year, you ought to put your money on the Redskins.

If this method of market forecasting sounds like nonsense, you're in good company. But consider this: The results of the Super Bowl have become a . . . signal of future market activity.

In the 17 Super Bowl games that have been played since 1967, every year [in which] the National Football Conference team won, the New York Stock Exchange composite index ended the year with a gain. And in every year in which the American Football Conference team won, the market sank.[356]

a. This correlation is caused by heavy betting on the Super Bowl results.

b. There is a correlation because game results caused stock market investments by football players.

c. The correlation is a coincidence (that is, not a significant association).

d. The correlation can be used as a reliable indicator that if the NFC won the Super Bowl last time, then the AFC will win next time.

———[357]

The stronger a correlation, the more likely that some causal connection or some causal story exists behind it. Investigators are usually interested in learning the details of this causal story; that is the central topic of the next section, but here's a word of caution: The rooster crows, then the sun comes up. He didn't cause it, did he?

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356 R. Foster Winans, "Wall Street Ponders If Bull Market in '84 Hinges on Redskins," *The Wall Street Journal*, January 18, 1984, p. 49.

357 Answer (c). The pattern will not continue in the future. It is an accident. Answer (a) is unlikely to be correct because bets are unlikely to affect the Stock Exchange so radically.

Causal Claims

Magic doesn't cause food to appear on your table at dinnertime. Someone has to put some effort into getting it to the table. Effort **causes** the effect, we say. Similarly, houses don't just "poof" into existence along the edge of the street of a new subdivision, except perhaps in Harry Potter books. It takes a great deal of physical labor to create these effects. Although effort causes some events, other events are caused with no effort at all. For example, the moon's gravity is the cause of tides on Earth, yet the moon is not making an effort. It just happens naturally.

Cause-effect claims don't always contain the word *cause*. You are stating a cause-effect relationship if you say that heating ice cubes *produces* liquid water, that eating chocolate *cures* skin rashes, that the sun's gravity *makes* the Earth travel in an ellipse, or that the pollen in the air *triggered* that allergic reaction. The terms *produces*, *cures*, *makes*, and *triggered* are **causal indicators**; they indicate that the connection is more than a mere accidental correlation. Not all causal claims are true, of course. Which one of the previous ones isn't?

———CONCEPT CHECK———

Here is a 1950s newspaper advertisement for cigarettes. The cause-effect claim is hidden between the lines. Identify it by rewriting it so it uses the word *causes* explicitly.

More Doctors Smoke Our Cigarette

Check for yourself—smoke our cigarette and see if you don't get less throat irritation.

———[358]

The causal claim about chocolate was false. If you want to cure a skin rash, try something other than chocolate.

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[358] Smoking our cigarette causes less throat irritation than smoking other brands of cigarettes.

We need to be careful and not to take causal claims too literally. Here is a causal claim:

7 I succumbed to nostalgia.

Literally, this is suggesting that there is something called "nostalgia" that caused me to succumb. But we know not to interpret it that way. Instead of making the abstract thing called "nostalgia" have these causal powers, it would be better to interpret the sentence this way:

> My mental state caused me to choose actions that would best be described as reflecting an unusual desire to return to some past period of my life.

———CONCEPT CHECK———

What is the best way to interpret this causal claim?

> Extreme blondness brings bad luck; it cries out to be pillaged.

[359]

Some scientific reports make causal claims, and some make only associational (correlational) claims. It's important to be able to distinguish the two in order not to misinterpret what is being reported. Unfortunately many claims are ambiguous and aren't clearly one or the other. The next concept check will help you learn to distinguish these kinds of claims.

———CONCEPT CHECK———

In one of the following three passages, the speaker is claiming not only that A and B are associated but also that they are causally related. In another, the scientist is more cautiously claiming only that there is an association between A and B. In the third, the scientist is being ambiguous, and you cannot tell which kind of claim is intended. Which passage is which?

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359 Before concluding that blondness causes bad luck, namely being pillaged, it would be better to interpret the sentence [from the film *White Material*] along these lines:

> In our community, people who are very blond often have unpleasant events happen to them that I would describe by saying, "That was unlucky." Those unlucky events are caused by a belief, held by many people, that encourages them to pillage the homes, farms and businesses of very blond people.

i. Statistics reported by the Ugandan ministry of police establish a relationship between a person's age and whether he or she was a victim of violent crime in Uganda last year.

   a. causal b. only association c. ambiguous

ii. Our study has now uncovered a link between inflation and people's faith in the stability of their economy.

   a. causal b. only association c. ambiguous

iii. Eating too much licorice candy produces diarrhea.

   a. causal b. only association c. ambiguous

[360]

If you insert a cup of sugar into the gas tank of your gasoline-driven car this afternoon, its engine will become gummed up. This is a **specific causal claim**. More generally, if you put sugar into any engine's gas tank, the engine will get gummed up. This last causal claim is more general; it doesn't apply only to this sugar in your car, nor to this date. Because it mentions kinds of objects rather than specific ones, it is a general causal claim—a **causal generalization**. So causal claims come in two flavors, general and specific. Scientists seeking knowledge of the world prefer general claims to specific ones. You can imagine why.

An event can have more than one cause. If John intentionally shoots Eduardo, then one cause of Eduardo's bleeding is a bullet penetrating his body. Another cause is John's intention to kill him. Still another is John's action of pulling the trigger. All three are causes. We say they are **contributing causes** or **contributing factors** or **partial causes**.

Some contributing causes are more important to us than others, and very often we call the most important one *the* cause. What counts as the cause is affected by what we are interested in. If we want to cure Eduardo, we might say the bullet's penetrating the skin is *the* cause. If we are interested in justice, we might say that John's actions are *the* cause, and we would leave all the biology in the background.

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[360] (i) b (ii) c (iii) a. The notorious word *link* is sometimes used to assert a causal connection and sometimes to assert only a correlation, so it is not a reliable causal indicator term. The claim about chocolate is false. The claim about pollen might or might not be true, depending on the circumstances. Because you don't know the circumstances, you are not in a position to call it false.

Causal claims come in two other flavors in addition to specific and general: those that say causes *always* produce a certain effect, and those that say causes only *tend* to produce the effect. Heating ice cubes in a pan on your stove will always cause them to melt, but smoking cigarettes only tends to cause lung cancer. Scientists express this point by saying heating is a *determinate cause* of ice melting, but smoking is not a determinate cause of lung cancer. Rather, smoking is a *probable cause* of cancer. The heating is a determinate cause because under known proper conditions its effect will happen every time; it doesn't just make the event happen occasionally or make its occurrence more likely, as is the case with smoking causing lung cancer. If our knowledge is merely of causes that tend to make the effect happen, we usually don't know the deep story of what causes the effect. We understand the causal story more completely when we have found the determinate cause.[361]

The verb *causes* can be ambiguous. Speakers often say "smoking causes cancer," when they don't mean determinate cause but only probable cause. We listeners must be alert so that we correctly interpret what is said.

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[361] In some systems, there are no determinate causes to be found. So-called "stochastic systems" behave this way. Quantum mechanics is a theory of nature that treats natural systems as being stochastic in the sense that the state of the system at one time merely makes other states probable; it does not determine which state will occur. Systems described by quantum mechanics are stochastic systems. So are the systems of inheritance of genes, which the Austrian monk Gregor Mendel first described back in the nineteenth century.

Eating peanuts tends to cause cancer, too. But for purposes of good decision making about whether to stop eating peanuts, we would like to know how strong the tendency is. How probable is it that eating peanuts will be a problem for us? If there is one chance in a million, then we are apt to say that the pleasure of peanut eating outweighs the danger; we will risk it. For practical decision making we would also like to overcome the imprecision in the original claim. How much cancer? How many peanuts? How does the risk go up with the amount? If we would have to eat a thousand peanuts every day for ten years in order to be in significant danger, then pass the peanuts, please.

Inferring from Correlation to Causation

Unfortunately, additional problems occur with the process of justifying causal claims. If we know that A causes B, we can confidently predict that A is correlated with B because causation logically implies correlation. But we cannot be so confident about the reverse—a correlation doesn't usually provide strong evidence for causation. Consider the correlation between having a runny nose and having watery eyes. We know neither causes the other. Instead, having a cold causes both. So in this case we say that the association between the runny nose and the watery eyes is **spurious**, because a third factor is at work causing the correlation.

In general, when events of kind A are associated (correlated) with events of kind B, three types of explanation might account for the association:

1. The association is accidental, a coincidence.
2. A is causing B, or B is causing A.
3. Something else C is lurking in the background and is causing A and B to be significantly associated. That is, the association is spurious because of lurking factor C.

———CONCEPT CHECK———

Why is the frequency of lightning flashes in Iowa in the summer positively correlated with popcorn production in Iowa in the summer? Hint: Your explanations should be able to show why the association is spurious.

———[362]

Given an observed correlation, how can you figure out how to explain it? How can you tell whether A is accidentally correlated with B, or A causes B, or B causes A, or some C is causing both? Here is where scientific sleuthing comes in. You have to think of all the reasonable explanations and then rule out everything until the truth remains. An explanation is ruled out when you collect data inconsistent with it. This entire process of searching out the right explanation is called the **scientific method** of justifying a causal claim. Let's see it in action.

There is a strong positive correlation between being overweight and having high blood pressure. The favored explanation of this association is that being overweight puts stress on the heart and makes it pump at a higher pressure. Such an explanation is of type 2 (from the above list). One alternative explanation of the association is that a person's inability to digest salt is to blame. This inability makes the person hungry, which in turn causes overeating. Meanwhile, the inability to digest salt also makes the heart pump faster and thereby helps distribute what little salt there is in the blood. This pumping requires a high blood pressure. This explanation, which is of type 3, is saying that the association is spurious and that a lurking factor, the inability to digest salt, is producing the association.

When someone suggests a possible explanation—that is, proposes a hypothesis—it should be tested. The test should look at some prediction that can be inferred from the explanation. If the actual findings don't agree with that prediction, then the explanation is refuted. On the other hand, if the prediction does come out as expected, we hold onto the hypothesis.

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362 The real causal story behind the correlation is that storms cause both the lightning and the rain that helps the corn grow.

However, it is not always an easy matter to come up with a prediction that can be used to test the hypothesis. Good tests can be hard to find. Suppose, for example, my hypothesis is that the communist government of the U.S.S.R. (Russia, Ukraine, and so on) disintegrated in the early 1990s because it was fated to lose power then. How would you test that? You can't.

The process of guessing a possible explanation and then trying to refute it by testing is the dynamic that makes science succeed. The path to scientific knowledge is the path of conjecturing followed by tough testing. There is no other path. (Philosophers of science say that the path to scientific knowledge is more complicated than this, and they are correct, but what we've said here is accurate enough for our purposes.)

Notice the two sources of creativity in this scientific process. First, it takes creativity to think of possible explanations that are worth testing. Second, it takes creativity to figure out a good way to test a suggested explanation.

———CONCEPT CHECK———

A third explanation of the association between high blood pressure and being overweight is that stress is to blame for the correlation. Stress leads to anxiety, which promotes overeating and consequent weight gain. This extra weight causes not only a higher body temperature but also extra blood flow. That flow in turn requires the heart to pump faster and thus to increase the blood pressure. This explanation is of which of the following three types?

a. coincidence b. cause leads to effect c. spurious correlation

———[363]

Criteria for a Causal Relationship

I would commit the post hoc fallacy if I said that the sun regularly comes up after the rooster crows, so he's the cause of the sun coming up. The fallacy lies in supposing that A caused B when the only evidence is that A has been followed by B. For another example, suppose you get a lot of headaches and you are trying to figure out why. You note that you are unusual because you are the sort of person who often leaves the TV set on all day and night. You also note that whenever you sleep near a TV set that is on, you usually develop a headache. You suspect that

[363] Answer (b). The correlation is not spurious. The explanation is of type 2.

being close to the TV is the cause of your headaches. If you were to immediately conclude that the closeness to the TV does cause the headaches, you'd be committing the *post hoc fallacy*. If you are going to avoid the post hoc fallacy, then how should you proceed?

First you should ask someone with scientific expertise whether there's any scientific evidence that sleeping close to a TV set that is on should cause headaches. If it should, then concluding that being close to the TV is the cause of your headaches does not commit the post hoc fallacy. Let's assume that there is no convincing evidence one way or the other, although a few statistical studies have looked for a correlation between the two. If the data in those studies show no association between sleeping near the TV and getting headaches, you can conclude that your suspicions were wrong. But let's suppose such an association has been found. If so, you are not yet justified in claiming a causal connection between the TV and the headaches. You—or the scientific community—need to do more. Before making your main assault on the causal claim, you need to check the temporal relation, the regularity, the strength, and the coherence of the association. What does that mean?

1. *Temporal Relation*: To be justified in saying that A causes B, A should occur before, not after, B. The future never causes anything in the present. This temporal relation is important because effects never precede their causes. Fear of sleeping near a TV in the future might cause a headache, but the future sleeping itself cannot cause it now. That is one of the major metaphysical presuppositions of all the sciences. Our claim, or hypothesis, that sleeping close to a TV causes headaches does pass this first test.

2. *Regularity*: Suppose that three scientific studies have examined the relationship between sleeping near a TV and having headaches. In two of the studies an association has been found, but in one, none was found. Therefore, the association has not been so regular. Sometimes it appears; sometimes it doesn't. The greater the regularity, the more likely that the association is significant.

3. *Strength*: Even when an association is regular across several scientific studies, the strength of the association makes a difference. The weaker the association between sleeping near a TV and getting headaches, the less justified you can be in saying that sleeping near the TV causes headaches. If, after sleeping near the TV, you get a headache 98 percent of the time, that's a much stronger association than a 50 percent rate.

4. *Coherence*: The coherence of an association must also be taken into account when assessing whether a causal claim can be inferred from an association. Coherence is how well the causal claim fits with the standard scientific ideas of what is a possible cause of what. Suppose a researcher notices an association between color chosen by painters for the Chinese government's grain silos and the frequency of headaches among Canadian schoolchildren. On years when the percentage of blue silos in China goes up, so do the Canadian headaches. In green years the headaches go down. Suppose the researcher then speculates that the Chinese colors are causing the Canadian headaches and provides these data about the correlation to make the case. Other scientists would write

this off as a crackpot suggestion. They would use their background knowledge about what could possibly cause what in order to deny the causal claim about the colors and the headaches. This odd causal claim does not cohere with the rest of science. It is too bizarre. It is inconsistent with more strongly held beliefs. The notion of coherence is quite fascinating. We will examine it in more detail in the next chapter when we discuss the paradigm of a science.

———CONCEPT CHECK———

Have you ever noticed that night is associated with day? First there's the night, then there's the daytime. Again and again, the same pattern. Regular as clockwork. A consistent, strong association. This would seem to establish the causal claim that night causes day. Or would it?

———[364]

Criteria for Creating Good Explanations

We create explanations to show our listeners or readers how something works or how things got to be the way they are. If you're creating an explanation for why China has so many more people than Siberia, you may want to talk about history and the social, political, and geographical forces shaping those two areas of the world. In doing so, you take it for granted that your audience accepts the fact that China really does have more people than Siberia. If you have to get your audience to first accept this fact, you need to argue for it, not explain it.

To create a good explanation of something is not easy. In this section we will examine some of the faults in explanation construction and then introduce criteria for constructing good explanations. Explanations have many features in common with arguments, so many of these criteria apply to constructing good arguments as well.

The explanation should fit the facts to be explained and should not conflict with other facts. When you are explaining an event, you must show why the event should have occurred, and your

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[364] The correlation does support the claim somewhat, but the claim is ridiculous, as we now know from our knowledge of scientific theories. The correlation is spurious. Unlike the people of 3,000 years ago, we know what causes daylight, and it's not night. We can suggest a much better explanation of why there's an association between night and day. No doubt you are thinking about the rotation of the Earth under the sun's spotlight. If you had lived 3,000 years ago when everyone believed the world to be flat, you'd probably never have imagined the alternative suggestion that the correlation between daytime and nighttime is caused by rotation of the Earth.

explanation should not be inconsistent with any facts. For example, suppose you want to explain why your friend recovered from the flu after only four days of being ill. Here is an explanation of this event: Your friend drank five glasses of orange juice every day he was sick, and drinking orange juice in such heavy doses will knock out anybody's flu virus within four to six days. This explanation does imply that your friend's recovery is to be expected. That's a plus for the explanation. Unfortunately, a doctor can tell you that many, many flu victims who have been tested with orange juice this way have not recovered for several weeks. So your explanation is in conflict with the facts about these other people. Consequently, the explanation violates our rule and should be rejected.

An explanation should do more than merely describe the situation to be explained. For example, suppose we ask a psychic, "How do you successfully locate oil and gold with your mental powers?" and she answers, "Geologists conduct an initial survey of the area for me. Afterward I fly over it, extend my hand, and sense the location of the underground deposit. Or I run my finger over a map and point out where to drill." This answer describes the sequence of events leading up to the event to be explained, but it is intellectually unsatisfying, since we wanted to find out more details about the cause of the psychic's supposed success. We hoped for a causal explanation that would show what makes the psychic's actions work for her when they won't work for us.

Good explanations are not circular. A good explanation doesn't just rephrase what it is trying to explain. A biologist makes this mistake if she tries to explain why humans have two feet by saying it is because they are bipeds. It is true that humans are bipeds, but the definition of *biped* is "two-footed animal," so the biologist's “explanation” merely names the phenomenon; it does not explain it. It does not give us what we want—either the causal mechanism that makes humans have two legs instead of some other number, or some evolutionary story of the genesis of two legs in humans. What would a noncircular explanation look like? Well, the causal explanation might say that our genes control growth and force humans to have two legs as they develop. A second kind of explanation could point out how, through evolution, a gradual change occurred in hip structure as our ancestors adapted to situations that favored walking on two legs. Whether either of these two explanations is correct is another matter; however, neither of them is circular.

Supernatural explanations should be avoided unless it is clear that more ordinary, natural explanations won't work. For example, suppose Inge says, "I got skin cancer because my number came up; evidently it was my time. She is explaining her cancer as being the consequence of some supernatural force that intervenes into the natural causal order of things and makes events happen; this is the supernatural force we call "fate." It's not impossible that she is correct, but her explanation is very weak. Here is a better explanation: Inge works in a manufacturing plant where she comes in daily contact with benzene fumes, and benzene is a

well-known cause of skin cancer, so the benzene caused Inge's skin cancer. Until we rule out benzene, let's not pay much attention to fate.

Good explanations are relevant. A Toyota is a Japanese car. If I explain why Julie has never owned a Toyota by saying that she hates German cars, I can be accused of violating the need for relevancy. Her hating German cars might explain why she doesn't own a BMW, but it's not clearly relevant to why she doesn't own a Toyota. If there is some connection, it should have been stated as part of the explanation.

Explanations should be consistent with well-established results except in extraordinary cases. Suppose I explain why I have a headache almost every day at noontime by pointing out that at noon I'm the closest I am to the sun all day; because the sun's gravitational pull on me is strongest at noon, its pull must be the cause of my headaches. This would be an odd explanation. It is a well-established scientific fact that the sun does exert a gravitational pull on us and that this pull is strongest at noon. However, it is also well established that our bodies are insensitive to these small gravitational changes. So, I should look elsewhere for the cause. The inconsistency of my explanation with well justified scientific theory detracts from the quality of my explanation. My explanation might still be correct, but for it to be convincing to the experts a revolution would have to occur in the field of biology. Extraordinary explanations are those that require big changes in the beliefs of the experts, and extraordinary explanations require extraordinarily good evidence. An ordinary explanation of the headaches, such as their being caused by my eating a half-pound of beets only on the days I get the headaches, would be a more promising explanation if it's true that I do eat beets that often.

> Extraordinary explanations require extraordinarily good evidence.

We do not need a great deal of evidence to be convinced that

> the kitchen cup made a sound during the night because a rat pulled it over,

but we should demand an extraordinarily large amount of high-quality evidence to be convinced that

> the kitchen cup made a sound during the night because a ghost kicked it.

Explanations should be tailored to the audience whenever possible. Suppose we try to explain the red marks on Emilio's nose as being due to overexposure to sunlight. If our audience already knows that sunlight can cause skin cancer and that skin cancer can cause red marks, we may not need to add any more to the explanation beyond perhaps reminding the audience of these facts. However, if the audience doesn't know these facts, we are obliged to support the facts.

Also, our explanation should be pitched at the proper level of difficulty for our audience; we cannot use technical terminology on an audience that won't understand the technical terms. Explanations are easier to understand if they explain something unfamiliar in terms of something familiar, even if being easy to understand is not a sign of being correct. Most of us are unfamiliar with the principles of electricity, such as the relationship between current and voltage, but we are familiar with how water flows through a pipe. So, a good explanation of electricity for us might be based on an analogy between electrical current and water flow:

> The amount of water flowing through a pipe per second is analogous to the amount of electrical charge flowing through a wire per second, and this amount is called the electrical "current." If you want to increase water flow, you've got to increase the water pressure. Similarly, if you want to increase the electrical current in a wire, you have to turn up the voltage.

OK, that helps explain the behavior of electricity to an audience untutored in physics, but it's not a correct explanation that would convince the scientific community. Correct explanations might be very difficult to understand, as you'd find out if you tried to read the paper of 1864 written by James Clerk Maxwell that really did explain electricity to the scientists.

The more precise the explanation, the better. Excessive vagueness weakens an explanation. The more precise a claim, the easier it is to test and thus to refute. If someone claims that eating five medium-sized dill pickles will bring on a headache within twelve minutes, you can test it on someone, perhaps yourself. However, if the person is vaguer and instead claims only that eating pickles will produce headaches, you have a tougher time. What kind of pickles? What size? How many? Will eating them produce headaches in five minutes, five days, next year? The vague claim is too hard to test. The more precise claim is more easily refuted, if it is false, but it tells us so much more if it can't be refuted. This is why precise claims are said to be more "scientific" than vaguer ones.

Testable explanations are better than untestable ones. Saying "She wasted all her month's food money on lottery tickets because she was in the wrong place at the wrong time" would be an example of an untestable explanation. How do you test it?

———CONCEPT CHECK———

All the following statements are trying to explain why tigers eat meat but not plants. Which explanation is the best, and why?

a. Tigers are carnivores.

b. Professor DeMarco says so, and he is an expert on tigers.

c. Tigers are naturally meat eaters, because many years ago the most powerful witches on earth placed a spell on the tigers and forced them to be that way.

d. Tiger cells contain a gene that prevents their stomachs from digesting plant cells.

e. My science textbook says tigers eat meat but not plants.

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[365] Answer (d) is best. Although (d) is probably not a correct explanation of why tigers are carnivores, at least it is testable, consistent with well-justified biological theory, not circular, and doesn't appeal to the supernatural. Answer (a) is circular because carnivore just means "eater of flesh, not plants." Answer (b), like (e), is an argument, not an explanation; it provides a good argument for believing that tigers are meat eaters and not plant eaters, but it gives no explanation of why tigers are this way. Answer (c) is not acceptable because it violates the canon to be cautious about offering supernatural explanations until it is clear that more ordinary, natural explanations won't work.

Assessing Alternative Explanations

Suppose your TV-headache correlation has a proper temporal relation, regularity across several studies, strength, and coherence with your background knowledge. Despite this, a factor lurking in the background could be causing both the headaches and the TV to be on. For example, maybe family quarrels cause the headaches and also cause you to turn on the TV to escape the quarrels.

Unless you had thought of this possibility, or alternative hypothesis, and unless you had also thought of ways to test it and had then ruled it out successfully, your confidently asserting that sleeping next to the TV caused your headaches would be committing the post hoc fallacy.

Here is one test that would help confirm some of the hypotheses and rule out others. Suppose you were to hire several people to sleep in a laboratory near TV sets like yours. For half the subjects in this test, the TV would be on; for the other half, the set would be off. What would you predict about the results, given each of the alternative hypotheses? The prediction from your favored hypothesis is that there would be a lot more headaches among those people whose set is on and a lot fewer among those whose set is off. However, from the hypothesis that family quarrels are to blame, you would predict that the two groups of subjects would have the same frequency of headaches. Therefore, your test can produce results that will be consistent with one hypothesis while refuting the other. That ability to discriminate between two competing hypotheses is a sign of a good scientific test.

Another point illustrated here is that the best way to infer from a correlation between C and E to the claim that C causes E is to do a **controlled experiment**. In a controlled experiment, you divide your subjects into two groups that are essentially equivalent with one major exception: the suspected cause C is present in one group but not the other. The latter group is called the **control group**. The group with the suspected cause is called the **experimental group**, or, in the case of a drug experiment, the **treatment group**. Run the test and see whether the effect E occurs much more in the experimental group than in the control group. If you notice a big difference, then it's likely that C really does cause E.

Let's suppose that you decide it is too expensive to do this sort of testing—you don't have the lab or the TV sets or the time it would take to run the experiment. Instead you decide to put an advertisement in a magazine asking readers to write if they have

noticed headaches after sleeping near a TV set while it is on. You subsequently receive forty letters from people who have had experiences similar to yours. If you were to take these letters to be sufficient evidence that sleeping near the TV does cause headaches, you'd be jumping to conclusions. This second test isn't very good. All you've found are data consistent with your favorite hypothesis. You haven't actively tried to refute your hypothesis. So, you haven't really followed the scientific method. Your results don't qualify as a scientific proof.

This same point about experimental design can be made by considering whether it's true that every emerald is green. Let's say that, although you do suspect this hypothesis to be true, you want to test it to find out. Which would be the best test? (1) Try to find positive evidence by putting an ad in the paper asking people to let you know whether they own a green emerald. (2) Try to find negative evidence by putting an ad in the paper asking people to let you know whether they own an emerald that is not green. One response to the second ad would be much more informative than many responses to the first, wouldn't it? So strategy 2 is the best. This is the strategy of searching for inconsistent data rather than confirming data.

> Good scientists runs tests designed to disconfirm, not to confirm.

Probably the single greatest source of error in science is the natural human failing of trying to confirm one's own guess about the correct explanation of something while failing to pay enough attention to trying to disconfirm that explanation. That is, we all have a tendency to latch onto a hypothesis and try to find data consistent with it without also actively searching for data that would show us to be wrong. We have this tendency because we really don't want to be shown wrong, because we are lazy about using our imagination to produce alternative explanations, and because it takes a lot of physical effort and expense to create tests that would show our suspicions to be wrong. In short, we have a natural tendency to look for a shortcut to the truth. Unfortunately, there is no effective substitute for the long, difficult path of conjectures and refutations. This is the path of guessing the reasonable alternative suggestions and systematically trying to refute them. The scientific method is this method of conjectures and refutations.

The Scientific Method

Let's now summarize the major points about the scientific process of finding our way to the truth. Scientific sleuths conjecture possible explanations—the so-called scientific hypotheses—then try to test them in order to rule them out. Testing is not normally a passive process of observation. Instead, it is an active attempt to create the data needed to rule out a hypothesis. When a hypothesis can stand up to many and varied attempts to rule it out, we have confirmed the hypothesis. Optimists say we have produced a scientific proof of the hypothesis. But the proof is always tentative because scientists also realize that any hypothesis or theory that is proved today is likely to be shown in the future to be an approximation of an even better hypothesis or theory.

The key idea of the scientific method is that the true hypothesis cannot be ruled out; the truth will survive the ruling-out process. So if we were correct in suggesting that A really does cause B, then observing and testing will eventually produce data inconsistent with the alternative suggestions that B causes A instead, and we can rule out the possibility that some C causes both A and B to be correlated.

This whole procedure of doing science might seem easy at first, but actually scientific proofs are not easy to come by. A major problem is lack of imagination. If you cannot imagine the possible lurking C's, how can you be expected to rule them out? To illustrate, consider why having lung cancer is associated with buying a copy of *The New York Times* newspaper on Tuesdays. The claim implies that the percentage of lung cancer cases is higher among those people who buy this newspaper on Tuesdays than among those people who don't buy it. Why? Although some associations are accidental, just statistical flukes, this one is not. So which causes which? Is buying the paper on Tuesday causing people to get lung cancer, or is having lung cancer causing the paper-buying behavior? Finding the answer scientifically is much like solving a mystery. Can you solve it?

Here are some suggestions to pursue. What is special about the ink on Tuesday's newspaper? Could there be a cancer-causing agent in the ink? Or should we give up on showing that the buying causes the cancer and try to go the other direction? Maybe cancer victims have a good reason to buy the paper. Maybe Tuesday is the day the paper contains the most articles about cancer, so lung cancer patients are especially likely to buy the paper on that day.

Unfortunately for these suggestions, a little testing will refute them. Perhaps you spotted the error in the reasoning. You were being misled away from the real causal

story behind the association between lung cancer and Tuesday *Times* buying. First, there's a significant association between lung cancer and *Times* buying on Friday, too. And Wednesday. The real story is that living in a city tends to cause both the lung cancer and the *Times* buying on Tuesday; it causes their association. Living in a city, any city, makes it more likely that a person will take in cancer-causing agents such as air pollution. Also, living in a city makes it more likely that a person will buy *The New York Times* on Tuesday, and Wednesday, and other days. Country folks are less likely to read big-city newspapers—on Tuesday or any other day. So, city living is the cause. By asking whether lung cancer causes the paper buying or vice versa, I was purposely committing the false dilemma fallacy. Pointing out that something else could be the cause of both is a way of going between the horns of this dilemma.

What this story demonstrates is that proving something scientifically can be quite difficult because of lack of imagination. Scientific proofs can't just be "ground out" by some mechanical process. Your leap from association to cause is successful to the degree that all the other explanations of the association can be shown to be less probable, and this can require a considerable amount of scientific imagination. This same point can be re-expressed by saying that if somebody can imagine an equally plausible explanation for the association, or a more probable one, then your original inductive leap from association to cause is weak.

Some Case Studies

The following letter to the editor is fun to read, and analyzing it will demonstrate all the points we've made about using your creative abilities in justifying causal claims. For background, the Planned Parenthood organization, which is attacked in the letter, is the largest dispenser of birth control information in the United States.

> **Dear Editor:**
>
> **The author of your letter to the editor last week claims we need Planned Parenthood. We need something—but it's not Planned Parenthood. Not if a tree is to be judged by its fruit.**
>
> **Hasn't it struck anyone a little bit strange that ever since Planned Parenthood has been "educating" teenagers, teenage pregnancy and venereal disease rates have shot through the roof? Doesn't it seem a little awkward that legal abortions, which are**

supposed to eliminate all but "wanted" children, have coincided directly with a rise in child abuse as well as symptoms of high stress and emotional disorders in women?

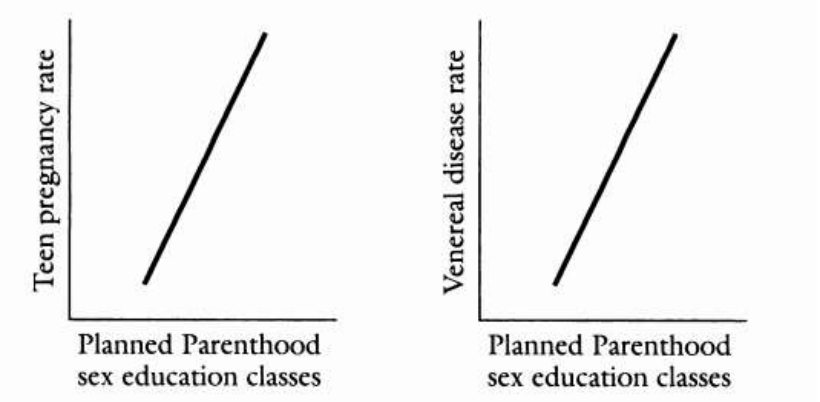
Are we so far down the road to self-indulgence that we don't recognize simple cause and effect?

I personally know three teenage girls who had their first sex because of the way sex education was presented in their high schools. They were led to think that sex was normal for teenagers and that if they maintained their virginity something was a little strange about them. Each episode followed a Planned Parenthood presentation!

Planned Parenthood makes a lot of money from what it does. Chastity would put it out of business. Are our children only animals that we cannot expect the vast majority to control themselves?

Ashley Pence

The point of Pence's letter is primarily to state her beliefs and to give a few suggestive reasons; she is not trying to provide scientific proofs for her beliefs. Nevertheless, if she expects readers to change their own beliefs and adopt hers, as she appears to want, then she has the burden of proof and should offer some good reasons. What reasons does Pence offer? In her early sentence that begins "Hasn't it struck anyone a little bit strange . . .," she suggests there are positive associations of the following sort:



Pence implies a causal connection in these associations when she says, "Are we so far down the road to self-indulgence that we don't recognize simple cause and effect?" Assuming that the positive associations can be shown to exist (and a logical reasoner would like to be satisfied of this), the next step for the logical reasoner is to ask whether there are plausible alternative explanations for these associations. Maybe the associations are accidental. Or maybe the causal connection goes the other direction; for example, the rise in teenage pregnancy might be causing Planned Parenthood to be invited to offer more sex education classes in order to reduce the pregnancy rate. Thus,

there are serious alternative explanations that the author apparently has not ruled out. That makes her causal claim weakly justified. However, caution is called for because:

> an unjustified claim isn't necessarily a false one.

In the next sentence of her letter, Pence implies, between the lines, that legal abortions are causing three problems: child abuse, symptoms of high stress in women, and symptoms of emotional disorders in women. Can you imagine other possible causes for these effects that she hasn't ruled out? For example, what else can cause high stress?

In short, there are serious problems with the causal reasoning in this letter. As a result of our analysis, it is clear that the letter is basically stating opinion, not fact.

———CONCEPT CHECK———

Pence has several suggestions for what should be done about all the problems mentioned in her letter to the editor. Which one of the following is definitely not one of her direct or indirect suggestions?

a. Children should stop acting like animals.

b. Stop sex education classes.

c. Stop funding Planned Parenthood.

d. Planned Parenthood should be stopped from performing its illegal abortions.

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Here is a speech that might have been given to the County Sheriffs Association of the United States. It contains a report of a scientific study of crime. Be on the lookout for mistakes made by John Doe who misunderstands the report; he understands some things and misunderstands others.

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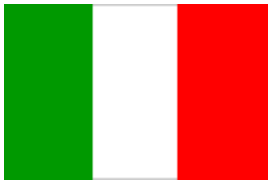
366 Answer (d). The letter did not suggest that Planned Parenthood should be stopped from performing illegal abortions; the focus was on legal ones.

> Slowly, science is figuring out crime. A reputable, independent, Italian social research organization found that 66 percent of criminals in U.S. jails did not have a high school degree. To me, this shows that lack of education is partly to blame for crime in our nation. Isn't it time to act on the causes, not just the symptoms of crime?



Suppose John Doe is asked to comment on the quality of the speaker's preceding argument, and he gives the following response.

> (1) The first problem with the study is that it was conducted on convicted criminals, which is not a representative sample of the U.S. (2) The study did not state the age of these criminals; maybe they were all seventeen and were not old enough to complete high school but were in the 11th grade. (3) They should also do a study on the people who had not finished high school but who were not convicted criminals. (4) They cannot say that lack of education is the cause of crime in other countries because some countries do not have the funds or desire to educate their population. (5) How do we know where this firm got its information? (6) Maybe they just got it from one prison. (7) And why should it be an Italian firm? Italians don't live in the U.S. and do not understand us Americans. (8) Lack of money causes crime, not just lack of education.

John has missed some of the key things that should have been said about the report. There are other errors. What? Can you suggest any improvements in his answer? For our final activity in this chapter, let's dig deeply into this situation. The principal difficulty with John Doe's response to the report is its failure to mention the two main errors contained in the report. First, the 66 percent statistic by itself does not establish a correlation between lack of high school education and being convicted of crime in the U.S. Second, even if it did, there is no basis for jumping to the conclusion that lack of education is partly causing U.S. crime.

Why doesn't the 66 percent statistic make the case for the correlation? For it to do so, you'd need to know that 66 percent is unusual. Maybe 66 percent of all Americans don't have high school degrees. If so, there is no correlation. Assuming for a moment that there is a significant correlation, it still isn't a basis for saying that lack of education

partly causes crime, because there are other reasonable explanations that haven't been ruled out. Perhaps poverty, greed, and bad genes cause both the crime and the lack of education. Or maybe becoming a criminal causes lack of education, not the other way around.

Let's now analyze John Doe's response sentence by sentence. Sentence (1) is mistaken in saying that the sample is not representative of the U.S. The real goal is to be representative not of the U.S. but of U.S. criminals. The target population of the statistical reasoning is convicted criminals in the U.S., not everybody in the U.S.

There is also a problem with sentence (2). Doe is complaining that he doesn't know the ages of the criminals whose education was examined. But he mistakenly implies that his lack of information is a sign of some error in the study. He may be thinking of the correct, but minor, point that the reader is not given enough information to tell whether the sample is representative of U.S. criminals. If the sample were only of seventeen-year-olds, undoubtedly it would be non-random and apt to be unrepresentative of U.S. convicted criminals. However, Doe shouldn't make too much of this. His answer would be better if it showed some awareness of the fact that there is no reason to believe the sample was of seventeen-year-olds because the study was done by a "reputable . . . research organization," which presumably means a competent one. Also, Doe gives no indication that this is in fact a minor point.

The point in sentence (3) is not made clearly. Yes, the study also should have included people who had not finished high school but who were not convicted criminals, but why should it have done so? The point would be to make sure that the figure of "66 percent" is unusual. A finding that significantly fewer than 66 percent of the unconvicted people had not finished high school would demonstrate the correlation that the speaker implies does exist—namely, that there's a negative correlation between crime and education. Doe should say all this explicitly, but he doesn't. In addition, if that is Doe's point in sentence (3), it is a major point and should have been emphasized, say by placing it first, not third.

Sentence (4) complains that some countries are too poor or are not as motivated as the U.S. to educate their citizens. That comment may be true, but it is irrelevant to whether the lack of education causes crime; it speaks only to why there is lack of education, which isn't the issue.

In sentence (5), Doe says we aren't told the source of the study's information. This would be a minor but correct statement by itself, but when (5) is accompanied by

sentence (6), which says the study might have been done in only one prison, it makes the mistake of implying that the sample was too small. Doe's comments fail to recognize that the sample is probably large enough, simply because it is common knowledge to social researchers that the U.S. has many prisons, and a reputable research organization would not have obtained its data from just one prison. The reason that sentence (5) would be a minor point by itself is that there isn't much need for the reader to know where the organization got its information; what is more important is whether the organization is good at its research and whether it can be counted on to have made a good effort to get a representative sample of U.S. criminals.

Sentence (7) is mistaken because there is no good reason why Italians cannot do high-quality social research on Americans.

Sentence (8) states, "Lack of money causes crime, not just lack of education." This is probably true, but if off the mark. The speaker said only that lack of education is *partly* a cause of crime; the speaker didn't rule out poverty as another cause. Doe's answer mistakenly implies that the argument did rule out poverty.

In summary, Doe missed or didn't adequately express the main points, and most of his other points were mistaken, too. Note how this evaluation of Doe's evaluation addresses many topics of logical reasoning: sticking to the issue, arguments from authority, vagueness, implication, identifying arguments, and distinguishing cause from correlation.

Review of Major Points

This chapter explored the difference between a causal claim and one that is merely correlational. Causality and correlation are intimately connected in three ways. First, if A does cause B, there will always be a correlation between A and B, but the reverse isn't true. Second, if you suspect that A causes B, then finding the predicted correlation between A and B will help justify the causal claim, whereas not finding the correlation will refute it. Third, a correlation between A and B is a reason to suspect that A does cause B. Of these three connections between causality and correlation, the first is about prediction, the second is about justification, and the third is about discovery. Prediction, justification, and discovery are three major elements of the scientific process.

The "scientific method" is the method of discovering possible causes, then testing them. The key idea in justifying a claim about what causes what is to actively test alternative causal stories (hypotheses) in an attempt to rule them out. Testing is active, whereas observation alone is more passive. That is one reason that the method of inductive generalization is not as powerful a tool as the scientific method.

Criteria for creating good explanations include the following: (1) The explanation should fit the facts to be explained and should not conflict with other facts. (2) An explanation should do more than merely describe the situation to be explained. (3) Good explanations are not circular. (4) Supernatural explanations should be avoided unless it is clear that more ordinary, natural explanations won't work. (5) Good explanations are relevant. (7) Explanations should be consistent with well-established results except in extraordinary cases. (8) Extraordinary explanations require extraordinarily good evidence. (9) Explanations should be tailored to the audience whenever possible. (10) The more precise the explanation, the better. (11) Explanations should be testable.

Glossary

causal claim A claim that asserts or denies the existence of a causal connection between two things, such as events, people, states, or between two types of things. A causal claim indicates that the connection is more than a mere accidental one. The standard form of a causal claim is: C causes E, where C is the cause and E is the effect. A causal claim is also called a *cause-effect claim* or a *causal statement*.

causal generalization A generalization that makes a causal claim. Causal generalizations assert causal connections between kinds of things rather than between specific things. The standard form is: (All, most, many) events of kind C cause events of kind E.

causal indicator A term that signals the presence of a causal claim. Examples: produces, cures, makes, triggers.

cause-effect claim A causal claim.

contributing cause One among many causes. The contributing cause that is most important for our present purposes we call *the* cause. A contributing cause is also called a *contributing factor* or *partial cause*.

control group In a controlled experiment, the group that does not receive the cause that is suspected of leading to the effect of interest.

correlation An association. Finding a correlation between two variables A and B is a clue that there may be some causal story to uncover, such as that A is causing B. Characteristics A and B are correlated if the percentages of A's among the B's is not the same as the percentages of A's among the not-B's.

determinate cause A cause that will make its effect happen every time under known proper conditions.

directly proportional A perfect positive straight-line correlation between two variables.

experimental group In a controlled experiment, the group that receives the suspected cause of the effect being studied. Sometimes called the "treatment group."

inversely proportional Characteristic of a perfect negative straight-line correlation between two variables.

negative correlation A relationship that exists when variable A tends to increase when B decreases, and vice versa. Characteristic A is negatively correlated with characteristic B in a given population whenever the percentage As among the Bs is less than the percentage of As among the not-Bs.

no correlation A lack of relation between two variables. Characteristics A and B are uncorrelated if the percentages of A's among the B's is the same as among the not-B's.

perfect correlation A relationship that exists when two variables always change together. That is, both may increase together or both may decrease together.

positive correlation A relationship between A and B that exists when variable A tends to increase when B increases and vice versa. Characteristic A is positively correlated with characteristic B in a given population whenever the percentage of A's among the B's is greater than the percentage A's among the not-B's.

post hoc fallacy The mistake of supposing that A caused B when the only evidence is that A is followed by B a few times.

probable cause A cause that will make the effect happen occasionally. When a probable cause occurs, the effect is probable but not certain.

specific causal claim A causal claim that asserts a specific claim rather than a general claim.

spurious association An association between A and B that results not because A is causing B or B is causing A but instead because some lurking factor C is causing A and B to be associated.

strength of the correlation A measure of how well two things are correlated. As a rule of thumb, the strength of the correlation between characteristics A and B is proportional to the difference between the percentage of B's that are A and the percentage of B's that are not-A.

treatment group The experimental group in an experiment involving treatment with a drug.

uncorrelated A lack of correlation between two variables.

Exercises

Correlations

■ 1. Refer to the exercise in an earlier chapter about Lady Theresa.

> Analyzing the data from the laboratory, you discover a statistically significant correlation between when Lady Theresa gets the right answer on the card tests and when she twitches her right hand. What do you recommend doing to determine, whether a statistically significant correlation holds the other way around—that is, between her right hand twitching and her getting the right answer on those card tests?[367]

[367] You need to do nothing. If A is correlated with B, then B must be correlated with A.

■ 2. If increases in the percentage of citizens in jail is caused by decreases in income among the citizenry, among other things, what can you say about the correlation between the citizens' income and the citizens' criminal convictions?

a. It is positive. b. It is negative.[368]

3. Create an original, nontrivial multiple-choice question, with answer, that requires an understanding of the notion of correlation of two discrete variables.

■ 4. How strong is the correlation mentioned in this passage? Comment also on any causal inferences.

> The Surgeon General has determined that breathing is dangerous to our health. This conclusion was drawn from a survey of 100 prisoners in a New York prison who have died within the past five years. All were habitual breathers. A strong correlation; take heed and watch your breathing.[369]

5. Barometers measure air pressure. When the air pressure is low, air from farther away rushes in to restore the imbalance. This new air is likely to bring with it new weather, especially rain. So, the height of mercury in an outside barometer is

a. positively correlated

b. negatively correlated

c. not correlated

with the probability of rain (in the vicinity of the barometer).

6. State something that, in the summer in mountainous states, is positively correlated with the amount of the previous winter's snowfall.

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368 Answer (b).

369 Would you find less death if you looked at nonbreathers? There is no significant correlation. This passage is a variation on a joke by Howard Kahane, *Logic and Contemporary Rhetoric: The Use of Reason in Everyday Life*, 4th ed. (Wadsworth, 1984), p. 111.

Identifying Causal Claims

1. Which phrase below is least likely to be used to say that A causes B?

a. A leads to B.

b. B is caused by A.

c. A makes B happen.

d. A occurs with B.

e. A produces B.

f. B is affected by A

■ 2. Rewrite the following causal claim using the word *cause* or *causes* explicitly.

Whenever the sun sets, it gets dark.[370]

3. In an exercise in an earlier chapter, you are asked to analyze the conversation between Lesley and Rico about a measles vaccine. Identify the causal claim that they inferred from the finding that 1 out of 622 children receiving the vaccine had gotten measles within the next seven months.

■ 4. Which of the following sentences contain causal claims, and which contain merely correlational claims?

a. Money makes you happy.

b. Sniffing ragweed pollen triggers the creation of histamine in the blood of allergy sufferers.

c. It therefore is the case that lack of education is partly to blame for crime, at least in the United States if not necessarily elsewhere.

d. Putting an infant on a feeding schedule would probably make it cry until its feeding time.

e. The data on the height of corn are associated with the amount of water the corn gets during its growing season.

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370 The setting of the sun causes darkness.

f. Adding water to corn plants usually leads to taller growth.

g. There are more smokers among Japanese-born Canadians than among other Canadians.[371]

■ 5. David claims that there is a link between smoking and sugar consumption. He says he has noticed that people who avoid the sugar jar when offered a cup of coffee also are more apt to be a smoker than someone who does dip into the jar. If so, Davis is likely to have uncovered

a. a positive correlation

b. a negative correlation

c. a non-standard transverse Kurzweil correlation[372]

■ 6. Following are three causal claims. Which claim is a specific, rather than general causal claim?

a. John Jameson stabbed her with his own kitchen knife.

b. PEOPLE kill people; bullets don't.

c. Anyone who drinks a cup of gasoline will get very sick.[373]

7. Label the following passages:

i. Statistics reported by the Ugandan ministry of police establish that a person's age makes the person more susceptible to being mugged.

a. only an association b. causal c. ambiguous

ii. Our study has now uncovered a link between people's religion and their faith in the stability of their economy.

a. only an association b. causal c. ambiguous

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371 a. causal b. causal c. causal d. causal e. correlational f. causal g. correlational

372 The more apt a person is to consume sugar the LESS apt the person is to be a coffee drinker. A group with many coffee drinkers would be a group with relatively fewer sugar consumers. So, this is a negative correlation.

373 Answer (a). It makes a specific causal claim rather than a general one.

iii. Medical doctors believe that high sugar consumption is associated with weight gain in rats and mice.

a. only an association b. causal c. ambiguous

iv. Medical doctors believe that having diarrhea is associated with eating too much licorice.

a. only an association b. causal c. ambiguous

v. Medical doctors now believe that eating too much licorice is associated with diarrhea.

a. only an association b. causal c. ambiguous

9. What causal claim is the speaker, Huckleberry Finn, making in the following quotation?

> I've always reckoned that looking at the new moon over your left shoulder is one of the carelessest and foolishest things a body can do. Old Hank Bunker done it once, and bragged about it; and in less than two years he got drunk and fell off of the shot tower, and spread himself out so that he was just a kind of a layer, as you may say; and they slid him edgeways between two barn doors for a coffin, and buried him so, so they say, but I didn't see it. Pap told me. But anyway it all come of looking at the moon that way, like a fool."

a. Looking at the new moon over your left shoulder causes most cases of drunkenness.

b. Drunkenness causes looking at the new moon.

c. Carelessness or drunkenness on the shot tower was stupid.

d. Looking at the new moon over his left shoulder caused Bunker to die.

Inferring from Correlation to Cause

■ 1. If scientific studies were to show that 80 percent of juvenile delinquents are from homes under the poverty line, could being from a home under the poverty line be a determinate cause of juvenile delinquency? Why?[374]

■ 2. If there is a causal connection between two variables, then there must be a positive correlation between them.

a. true

b. false[375]

3. Given that you have observed a correlation between A and B and have noticed that A doesn't occur after B, you then need to consider whether A causes B. Which one of the following would be the worst methodology to adopt to find out?

a. Look to see whether the causal connection between A and B can be deduced from other acceptable theories.

b. Try to eliminate alternative hypotheses about the connection between A and B by running tests on those hypotheses.

c. Consider whether some third factor C is causing A and also causing B.

d. Check to see whether the probability of A equals the probability of B.

■ 4. The following comment was made as a joke, but if it were made seriously, what would be wrong with it?

All muskrats walk single file; at least the only one I ever saw did.[376]

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374 To be a determinate cause, the statistic would have to be 100%, not 80%.

375 Answer (b). Why couldn't it be negative?

376 First, by making a universal generalization from just one example, the speaker is committing the fallacy of hasty generalization. In addition, there is no file at all if there is just one member of the file. If you noticed that one muskrat cannot walk single file, then you realized that the generalization is an inconsistent remark. By the principle of charity, you might consider assuming that the one muskrat was walking single file with other non-muskrats; however, this assumption probably violates the principle of fidelity because it lessens the impact of the original joke and because there is no other indication that any other animals were observed. The joke was told to the author by Robert Garmston.

5. Explain why the correlation between monthly ice cream revenues in New York City and monthly revenues in Utah from snow ski rentals is spurious. Be specific; don't merely restate the definition of *spurious*.

■ 6. The stronger a correlation between two variables

a. the more likely there is

b. the less likely there is

c. still does not affect the probability of[377]

a causal connection between them

■ 7. The "scientific method" is the method of guessing possible explanations of interesting phenomena of nature and attempting to refute them by running experiments or making observations.

a. more or less true b. clearly false[378]

■ 8. Dr. Thomas Pyne has noticed a correlation between the color of the chairs in his college classrooms and the handedness of the chairs. The chairs for left-handers are always black, never the bright colors of the other chairs. What is most likely to be correct about the situation?

α. The color of the chair is causing its handedness.

β. The handedness of the chair causes it to receive the paint color it does.

χ. Decisions by chair manufacturers affect paint manufacturing, often causing paint supplies to run out of all colors except black.

δ. The correlation does not cohere with our background knowledge.[379]

---

[377] Answer (a).

[378] Answer (a). This description of the scientific method as being the method of conjectures and refutations was first clearly stated by Karl Popper.

[379] Answer (b). Some manufacturer has probably decided to paint all the left-handed chairs black. The chair's being black is caused in part by its being left-handed and caused in part by the painter in the plant following the manufacturer's decision.

9. Write an essay about a significant piece of scientific research that uncovers a correlation and then tries to establish a causal connection. Begin by describing the research and its results in your own words. Use a footnote to indicate the source of your information. Then show how various points made in this chapter apply to the research. The essay should contain at least four of the terms from the glossary at the end of this chapter.

10. Write an essay that describes an experiment you yourself designed and ran in order to test the significance of a suspected correlation. The correlation need not have great social or scientific importance. Within your essay, argue for why your test does establish that the correlation is or is not significant.

11. What is the name of the fallacy that is committed in this reasoning?

> I have noticed a pattern about all the basketball games I've been to this year. Every time I buy a good seat, our team wins. Every time I buy a cheap, bad seat, we lose. My buying a good seat must somehow be causing those wins.

Explanations

1. Write an essay explaining one of the following:

> How to torpedo a non-money bill in the state legislature before it reaches the floor for a vote. Audience: fellow lobbyists.
>
> How the game of basketball has changed since its creation. Audience: college physical education majors.
>
> How to build a fireplace in a new house. Audience: homeowners.
>
> Why World War I was not won by the Germans. Audience: high school seniors in a history class.
>
> How a refrigerator refrigerates. Audience: high school science class at the sophomore level.
>
> How to get shelf space in U.S. supermarkets for the new cereal your company is planning to manufacture. Audience: your manager.

■ 2. Which comment below most accurately characterizes the following letter to the editor:

> Dear Editor:

> You smeared the public relations trade in your editorial when you said, "If Ollie North is lying to the U.S. Senate, he's lying very well, which would make him a highly excellent PR guy." This is a terrible indictment!
>
> In my eighteen years as a public relations consultant, working on some very controversial issues, I have never found it necessary to lie on behalf of a client, nor have I ever been asked to. Lying is not an important criterion for becoming an "excellent PR guy."

a. The writer believes most public relations people do lie to help their clients.

b. The writer is appealing to anecdotal evidence.

c. The writer believes that lying for one's client usually causes bad public relations for that client.

d. The writer is committing the black-white fallacy.

e. The writer is committing the straw man fallacy.[380]

3. What is the main principle of good explanation construction that is violated in this explanation?

> Reporter: Why do you suppose that National Football Conference teams always win the Super Bowl, and the American Football Conference teams always lose?
>
> Coach: I think it has something to do with the caliber of the teams in each conference. The AFC teams such as the Buffalo Bills just aren't as good as the Redskins and Giants of the NFC.

a. The explanation is supposed to fit the facts to be explained and not conflict with other facts.

b. A good explanation doesn't just rephrase what it is trying to explain.

c. Good explanations will explain something in terms of something else that we can understand to be relevant.

d. Good explanations will explain something unfamiliar in terms of something familiar.

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[380] Answer (b). The anecdotal evidence is his own experience. It is true that most PR people are not primarily liars, although they are experts at shaping a sentence so that it emphasizes the good aspects of the client's product and the bad aspects of the opponent's.

e. Explanations should be consistent with well-established results except in extraordinary cases.

4. Discuss the pros and cons of the explanation in this letter to the editor. Begin by clearly identifying the explanation—that is, by saying what is being used to explain what.

> There is an evil current running throughout history. People haven't been nice to each other. Take a look most recently at Nazism in Germany and Stalinism in the Soviet Union. Look at all the cases of demon possession in the files of the Catholic Church. It's time for your readers to wake up to the fact that the Devil is at work.

CHAPTER 15 Scientific Reasoning

Because the contributions of modern science are our culture's best examples of advances in knowledge, it is important for everyone to have some appreciation of how scientists reason. Previous chapters in this book discussed three main aspects of scientific reasoning: justifying a scientific claim, explaining phenomena, and making new discoveries. This chapter more deeply examines the nature of scientific reasoning, showing how to assess the scientific claims we encounter in our daily lives, how to do good scientific reasoning, and how to distinguish science from mere pseudoscience. We begin with a description of science and a review of some of the methods of doing science that were introduced in previous chapters.

What is Science?

Science creates machinery of destruction. It spawns mutants. It spews radiation. It murders in order to dissect. Its apparently objective pose is a cover for callous indifference. Its consequence will be the annihilation of us all. Edward Rothstein said this….

Oops. Wait a minute, a message just arrived, and I need to make an announcement: "Dr. Frankenstein, please call your office."

OK, where was I? Oh, yes, well, enough of this glowing praise of science. "Science" is the Latin term for knowledge. By "science" we will mean pure empirical science, the kind of science that makes observations and runs experiments trying to make predictions, create explanations and produce theoretical understanding of the physical world. This rules out mathematics and formal logic, and it rules in physics, chemistry,

and biology. At any particular time in history, science has what it claims is a body of knowledge, but actually science is more a way of getting knowledge than it is a body of knowledge.

Creating science is not what doctors, engineers and inventors do. These people apply science, but usually they do not *do* science in the sense of create science.

Consider engineering. Unlike scientists, the engineers primarily want to improve existing things that have been made by humans, such as tractors and X-ray machines, or they want to improve human beings' abilities to move faster and to communicate more easily with people who are far away.

Scientists often make use of advances in engineering, but they have different primary concerns. Pure science is concerned primarily with understanding, explaining, and predicting. Engineering isn't. Engineering is focused on creating technology and controlling it, on getting machines to function as we want them to in a particular situation. That is how scientists are different from engineers. Inventors and doctors are more like the engineers than like the scientists.

Let's precisely define three important empirical sciences: If it wiggles, then it's biology; if it stinks, then it's chemistry; and if it doesn't work, then it's physics.

OK, enough with the stereotypes. What about precision? Is precision important in science? Yes, proposing precise questions and seeking precise answers is one of the keys to successful science. With precision comes sophistication.

Although the scientist's vocabulary is often so technical that the rest of us cannot read a scientific research paper, science is not as distant from common sense as many people imagine. Science isn't the only way to know the world around us. They don't have a "lock" on knowledge. But scientists, like the rest of us, do look around at the world, try to explain what they observe, and are careful to back up what they say. Science is a slowed-down and more open and accountable image of what we normally do in coming to know about the world around us. Nevertheless, science isn't just common sense. Science is more cautious about what it claims to know, and it often overthrows traditional common sense in favor of new beliefs that can better stand up to testing.

Everybody agrees that science is important, even Edward Rothstein whose sarcastic remarks inspired the paragraph above about science spawning mutants and spewing radiation. But some people think science is much more important and valuable than others do. According to the distinguished historian of science Herbert Butterfield, the rise of European science in the 17th and 18th centuries

> ...outshines everything since the rise of Christianity and reduces the Renaissance and Reformation to the rank of mere episodes.... It changed the character of men's habitual mental operations even in the conduct of the nonmaterial sciences, while transforming the whole diagram of the physical universe and the very texture of human life itself.

The scientific revolution Butterfield is talking about was noteworthy for promoting the notion that scientific knowledge should be produced by the process that we now call *the scientific method*. This new method was very different from the medieval method of attempting to acquire knowledge from careful reading of ancient texts. At its heart, the scientific method is the method of testing hypotheses. The idea is that the true hypotheses will stand up to repeated testing while the false hypotheses eventually will get refuted. Science and the scientific method are the main thing that Western culture (which is approximately the culture of Western Europe and North America) has contributed to the culture of the rest of the world.

In addition to biology, chemistry, and physics, which are the more commonly known sciences, another lesser known science is stamp collecting. Here is why. Stamp collectors are careful; they use tools; they explain; they predict; and they make generalizations. These are marks of good science.

Stamp collectors are careful, like scientists. They measure and use tools such as rulers. They can explain why stamps have perforations and why they aren't cubical. They can predict that most collections will have more three-cent stamps from 1944 than seventy-

four cent stamps from 1944. They make generalizations, such as “There are more European stamps than Egyptian stamps.” So that's why stamp collecting is a science.

No, think again. Don’t believe everything you read. Stamp collecting is definitely not a science. It’s a hobby. All that reasoning I just performed was making the same kind of error as if I’d argued like this:

> A woman has two legs, one nose, and breathes air.
> Mr. Dowden has two legs, one nose, and breathes air.
> ---
> Mr. Dowden is a woman.

More is involved in being a woman, right? Similarly, more is involved in being a science. The difficulty is in being more specific about just what else is involved. Here is an attempt to specify what else.

Many philosophers of science would say that in addition to being precise, careful, using tools, explaining phenomena, predicting observations, and making generalizations, science also (1) requires using the scientific method to justify its claims. More on this later. (2) Science assumes a background of no miracles and no supernatural causes. It is unscientific to say there was a hurricane in the Philippine Islands because God was angry with the people there. (3) Science continually makes inferences for new predictions in order to test general theories about how the world works. It is not stagnant like astrology and alchemy and stamp collecting. (4) Science has theories that are held tentatively and are falsifiable. That means science is opposed to dogma, and it requires science’s claims to be true or false depending on what the evidence is. If you have a theory that couldn’t be shown to be incorrect no matter what happens, then you aren’t doing science. Freud's theory of psychoanalysis has that defect.

———CONCEPT CHECK———

Given the discussion above, the profession of a biologist is most like that of a

a. butterfly collector
b. nuclear engineer
c. astronomer
d. heart surgeon
e. inventor of new lighting systems

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Reviewing the Principles of Scientific Reasoning

One fairly significant aspect of scientific reasoning distinguishes it from other reasoning: The justification process can be more intricate. For example, you and I might look back over our experience of gorillas, seeing them in zoos and seeing pictures of them in books, and draw the conclusion that all gorillas are black. A biological scientist interested in making a statement about gorilla color would not be so quick to draw this conclusion; he or she would contact gorilla experts and would systematically search through information from all the scientific reports about gorillas to check whether the general claim about gorilla color has even one counterexample. Only if none were found would the scientist then say, "Given all the evidence so far, all gorillas are black." The scientific community as a whole is even more cautious. It would wait to see whether any other biologists disputed the first biologist's claim. If not, only then would the community agree that all gorillas are black. This difference between scientific reasoning and ordinary reasoning can be summed up by saying that scientific reasoning has higher standards of proof.

Scientists don't rummage around the world for facts just so they can accumulate more facts. They gather specific facts to reach general conclusions, the "laws of science." Why? Because a general conclusion encompasses a great variety of specific facts, and because a general claim is more useful for prediction, understanding and explanation, which are the three primary goals of science. Scientists aren't uninterested in specifics, but they usually view specific data as a stepping stone to a broader or more general overview of how the world works. This point can be expressed by saying that scientists prefer laws to facts. Although there is no sharp line between laws and facts, facts tend to be more specific; laws, more general.

The power that generality provides is often underestimated. At the zoo, suppose you spot a cage marked "Margay" although the margay is out of sight at the moment. You have never heard of a margay, yet you can effortlessly acquire a considerable amount of knowledge about the margay, just by noticing that the cage is part of your zoo's new rare-feline center. It's cat-like. If so, then you know it cannot survive in an atmosphere of pure nitrogen, that it doesn't have gills, and that it was not hatched from an egg. You know this about the unseen margay because you know on scientific authority that no cat-like beings can survive in nitrogen, that no cats have gills, and that no cats are

381 Answer (c).

hatched from eggs. You don't know all this first-hand, but you've heard it indirectly from scientists, and you've never heard of any serious disagreement. Of course, scientific generalizations can be wrong. And maybe no experiment has ever been performed to test whether margays can live on pure nitrogen. But you are confident that if there were serious suspicions, the scientists would act quickly to run the tests. Knowing this about how scientists act, you rest comfortably with the generalizations and with your newly acquired knowledge about margays.

A **test** is an observation or an experiment intended to provide evidence about a claim.

A **law** of science is a sufficiently well-tested general claim.

A **theory** is a proposed explanation or a comprehensive, integrated system of laws that can be used in explaining a wide variety of phenomena.

Testability, Accuracy, and Precision

If a proposed hypothesis (a claim) cannot be tested even indirectly, it is not scientific. This point is expressed by saying that scientists highly value **testability**. For example, suppose someone suggests, "The current laws of chemistry will hold true only as long as the Devil continues to support them. After all, the Devil made the laws, and he can change them on a whim. Luckily he doesn't change his mind too often." Now, what is a chemist to make of this extraordinary suggestion? Even if a chemist were interested in pursuing the suggestion further, there would be nothing to do. There is no way to test whether the Devil is or isn't the author of the laws of chemistry. Does the Devil show up on any scientific instrument, even indirectly? Therefore, the Devil theory is unscientific.

Testability is a key ingredient of any truly scientific claim.

Scientists value accuracy and precision. An accurate measurement is one that agrees with the true state of things. A precise measurement is one of a group of measurements that agree with each other and cluster tightly together near their average. However, precision is valuable to science more than in the area of measurement. Precise terminology has helped propel science forward. Words can give a helpful push. How? There are two main ways. A bird may go by one name in the Southeastern United States but by a different name in Central America and by still a different name in Africa. Yet scientists the world over have a common Latin name for it. Thus, the use of precise terminology reduces miscommunication among scientists. Second, a precise claim is easier to test than an imprecise one. How do you test the imprecise claim that "Vitamin C is good for you"? It would be easier to run an experiment to check the more precise claim "Taking 400 milligrams of vitamin C per day will reduce the probability of getting a respiratory infection by fifty percent." If you can test a claim, you can do more with it scientifically. Testability is a scientific virtue, and precision is one path to testability.

Testability is a key ingredient of any truly scientific claim.

Because the claims of social science are generally vaguer than the claims of physical science, social scientists have a tougher time establishing results. When a newspaper reports on biology by saying, "Vitamin C was shown not to *help prevent* respiratory infections," and when the paper reports on social science by saying, "Central America is more *politically unstable* than South America," we readers don't worry as much about "help prevent" as we do about "politically unstable." Behind this worry is our understanding that "help prevent" can readily be given an unproblematic **operational definition**, whereas "politically unstable" is more difficult to define operationally. That is, the operation the biologist performs to decide whether something helps prevent respiratory infections can be defined more precisely, and easily, and accurately than the operation to be performed to decide whether one country is more politically stable than another.

Although vagueness is usually bad and precision good in science, pseudoprecision is also to be avoided. Measuring a person's height to five decimal places would be ridiculous. The distance between two parallel mirrors can have that precision, but human height cannot, even though they are both lengths. Unfortunately, when newspaper and TV stories report some scientific result to us, they rarely tell us how the

scientists defined their controversial terms. Information gets to the public by being created in science labs, then the information is published in scientific journals and other professional publications. Sometimes reporters of newspapers and magazines pick up the information here, then try to say it more simply for the nonscientists. Or perhaps the reporters notice it in the journal, then telephone the scientist to ask for it to be explained to them more simply. Then they publish on their webpage or on the air or in their newspaper, and in this way the average citizens learns about it. Hardly any ordinary citizen checks things out for themselves.

Reliability of Scientific Reporting

Almost every piece of scientific knowledge we have, we justify on the authority of what some scientist has said or is reported to have said. Because scientists are authorities on science, we usually take their word for things scientific. But chemists are not authorities on geology, and chemists who are experts in inorganic chemistry usually are not authorities on organic chemistry. Thus, when we are told that something is so because scientists believe it to be so, we should try to determine whether the proper authorities are being appealed to. Also, we know that scientists disagree on some issues but not on others, and we know that sometimes only the experts know which issues the experts disagree about. Is the reporter reporting the view of just one scientist, unaware that other scientists disagree? Scientists have the same moral failings as the rest of us, so we should also worry about whether a scientist might be biased on some issue or other. If a newspaper reporter tells us that the scientist's research on cloth diapers versus disposable diapers was not financed by the manufacturer of either diaper, we can place more confidence in the report.

Scientific journals are under greater pressure than daily newspapers to report the truth. A scientific journal will lose its reputation and its readers faster when there is a slipup than will the daily newspaper. So the stakes in reporting the truth are higher for journals. That is one reason the editors of scientific journals demand that authors provide such good evidence in their articles. If we read a report of a scientific result in a mainstream scientific journal, we can assume that the journal editor and the reviewers demanded good evidence. But if we read the report in a less reputable source, we have to worry that sloppy operational definitions, careless data collection, inaccurate instruments, or misunderstandings by the reporter may have colored the result.

When the stakes are high and we are asked to take an authority's word for something, we want independent verification. That means doing something more than merely buying a second copy of the newspaper to check whether what our first copy says is true. In medicine, it means asking for a second opinion from a different doctor. When

the doctor says he wants to cut off your leg, you want some other doctor who is independent of the first doctor to verify that your leg really needs to be amputated. The term *independent* rules out your going to a partner in the first doctor's practice.

Ordinarily, though, we can't be bothered to take such pains to find good evidence. When we nonscientists read in the newspaper that some scientist has discovered something or other, we don't have enough time to check out the details for ourselves; we barely have enough time to read the reporter's account, let alone read his or her sources. So, we have to absorb what we can. In doing so, though, we who are critical thinkers are not blank slates willing to accept anything told to us. We are sensitive enough to ask ourselves: Does the report sound silly? Are any scientists protesting the result? What is the source of the report? We know that a reputable scientific journal article about some topic is more reliable than a reporter's firsthand interview with the author; we trust the science reporters for the national news magazines over those for a small, daily newspaper; and we know that daily newspapers are more reliable than independent bloggers and grocery store tabloids. But except for this, we nonscientists have severe difficulties in discriminating among the sources of information.

Suppose you were to read the following passage in a magazine: "To ensure the safety of raw fish, it should be frozen for at least five days at minus 4 degrees Fahrenheit (-20°C). That temperature kills all relevant parasitic worms so far tested." Should you believe what you read? It depends. First, ask yourself, "Where was it published and who said it?" In fact, the passage appeared in *Science News*, a well-respected, popular scientific publication. The magazine in turn was reporting on an article in an authoritative scientific publication, the *New England Journal of Medicine*. The journal in turn attributed the comment to Peter M. Schantz of the Centers for Disease Control in Atlanta, Georgia, a well-respected U.S. federal research laboratory. The magazine merely reported that Schantz said this. If you learned all this about the source of the passage in *Science News*, then you should probably accept what is said and add it to your knowledge.

You should accept it, but to what degree? You should still have some doubts based on the following concerns. The magazine did not say whether any other scientists disagreed with what Schantz said or even whether Schantz made this comment speculatively rather than as the result of a systematic study of the question. The occurrence of the word *tested* in the quote would suggest the latter, but you can't be sure. Nevertheless, you can reasonably suppose that the comment by Schantz was backed up by good science or the magazine wouldn't have published it the way it did—that is, with no warning that the claims by Schantz were not well supported. So, you can give Schantz's claims a high degree of belief, but you could be surer of what Schantz said if you had gotten direct answers to your concerns. Hearing from another scientific expert that Schantz's claims about fish are correct should considerably increase your degree of belief in his claims.

Causal Explanations vs. Causal Arguments

Scientists and reporters of science present us with descriptions, explanations, and arguments. Scientists describe, for example, how ballistic missiles fall through the sky. In addition to description, scientists might also explain the phenomenon, saying why it occurs the way it does. The explanation will give the causes, and in doing so it will satisfy the following principle: Explanations should be consistent with well-established results (except in extraordinary cases when the well-established results are being overthrown with extraordinarily good evidence).

> Explanations should be consistent with well-established results.

Scientists who publicly claim to have the correct explanation for some phenomenon have accepted a certain burden of proof. It is their obligation to back up their explanation with an argument that shows why their explanation is correct. We readers of scientific news usually are more interested in the description and the explanation than in the argument behind it, and we often assume that other scientists have adequately investigated the first scientist's claim. This is usually a good assumption. Thus, reporters rarely include the scientific proof in their report, instead sticking to describing the phenomenon, explaining it, and saying that a certain scientist has proved that the phenomenon should be explained that way.

Scientific proofs normally do not establish their conclusions as firmly as mathematical proofs do. Scientific proofs usually are inductive; mathematical proofs are deductive. So, one scientific proof can be stronger than another scientific proof even though both are proofs. In any inductive scientific proof, there is never a point at which the conclusion has been proved beyond a shadow of all possible doubt. Nevertheless, things do get settled in science. Scientists proved that the Earth is round, not flat; and even though this result is not established beyond all possible doubt, it is established well enough that the scientific community can move on to examine other issues confident that new data will not require any future revision. In fact, you haven't a prayer of getting a research grant to double-check whether the Earth is flat.

> One scientific proof can be stronger than another scientific proof even though both are proofs.

Good Evidence

Many persons view science as some vast storehouse of knowledge. That is an accurate view, but we also should view science as a way of getting to that knowledge. This latter way of looking at science is our primary concern in this chapter. In acquiring knowledge, a good scientist adopts a skeptical attitude that says, "I won't believe you unless you show me some good evidence." Why do scientists have this attitude? Because it is so successful. Scientists who are so trusting that they adopt beliefs without demanding good evidence quickly get led astray; they soon find themselves believing what is false, which is exactly what science is trying to avoid.

What constitutes good evidence? How do you distinguish good from bad evidence? It's not like the evidence appears with little attached labels of "good" and "bad." Well, if a scientist reports that tigers won't eat vegetables, the report is about a phenomenon that is repeatable—namely, tiger meals. If the evidence is any good, and the phenomenon is repeatable, the evidence should be, too. That is, if other scientists rerun the first scientist's tests, they should obtain the same results. If not, the evidence was not any good. The moral here is that reproducible evidence is better than evidence that can't be reproduced. The truth is able to stand up to repeated tests, but falsehood can eventually be exposed. That is one of the major metaphysical assumptions of contemporary science.

A scientist who appreciates good evidence knows that having anecdotal evidence isn't as good as having a wide variety of evidence. For example, suppose a scientist reads an article in an engineering journal saying that tests of 300 randomly selected plastic ball bearings showed the bearings to be capable of doing the job of steel ball bearings in the electric windows of Honda cars.

Photo by Solaris 2006

The journal article reports on a wide variety of evidence, 300 different ball bearings. If a scientist were to hear from one auto mechanic that plastic bearings didn't hold up on the car he repaired last week, the scientist won't be a good logical reasoner if he (or she) immediately discounted the wide variety of evidence and adopted the belief of the one auto mechanic. We logical reasoners should trust the journal article over the single anecdote from the mechanic, although the mechanic's report might alert us to be on the lookout for more evidence that would undermine the findings of the journal article. One lemon does not mean that Honda's electric windows need redesigning. If you discount evidence arrived at by systematic search, or by testing, in favor of a few firsthand stories, you've committed the **fallacy of overemphasizing anecdotal evidence**.

A Cautious Approach with an Open Mind

The scientific attitude is also a cautious one. If you are a good scientist, you will worry initially that perhaps your surprising new evidence shows only that something is wrong somewhere. You won't claim to have revolutionized science until you've made sure that the error isn't in the faulty operation of your own measuring apparatus. If a change of beliefs is needed, you will try to find a change with minimal repercussions; you won't recommend throwing out a cherished fundamental law when you can just as easily revise it by changing that constant from 23 to 24 so that it is consistent with all data, given the margin of error in the experiments that produced the data. The cautious scientific attitude recognizes these principles: Don't make a broader claim than the evidence warrants, and don't reject strongly held beliefs unless the evidence is very strong. In short, don't be wildly speculative.

> Don't make a broader claim than the evidence warrants.

Scientists are supposed to think up reasonable explanations, but what counts as a reasonable explanation? An explanation that conflicts with other fundamental beliefs that science has established is initially presumed to be unreasonable, and any scientist who proposes such an explanation accepts a heavier than usual burden of proof. A related principle of good explanation is to not offer supernatural explanations until it is clear that more ordinary, natural explanations won't work.

———CONCEPT CHECK———

What is the main mistake in the following reasoning?

> Yes, I've read the health warnings on those cigarette packs, but my uncle smokes, and he says he's never been sick a day in his life, so I'm going to continue smoking regularly.

a. overemphasizing anecdotal evidence

b. not having a cautious attitude about scientific revolutions

c. not appreciating the need for independent verification

d. overemphasizing unrepeatable phenomena

b. pseudoprecision

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In assessing potential new beliefs—candidates for new knowledge— scientists actively use what they already believe. They don't come into a new situation with a mental blank. When scientists hear a report of a ghost sighting in Amityville, they will say that the report is unlikely to be true. The basis for this probability assessment is that everything else in the scientists' experience points to there being no ghosts anywhere, and so not in Amityville, either. Because of this background of prior beliefs, a scientist

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382 Answer (a). The anecdote from the uncle should be given less weight than the warning on the pack. The warning came from statistical tests covering a wide variety of smokers.

will say it is more probable that the reporter of the Amityville ghost story is confused or lying than that the report is correct. Better evidence, such as multiple reports or a photograph, may prompt a scientist to actually check out the report, if Amityville isn't too far away or if someone provides travel expenses.

Good scientists don't approach new data with the self-assurance that nothing will upset their current beliefs. Scientists are cautious, but they are also open to new information, and they don't suppress counterevidence, relevant evidence that weighs against their accepted beliefs. They do search for what is new; finding it is how they get to be famous. So the scientific attitude requires a delicate balance.

> Keep an open mind, but don't be so open that you spend most of your valuable time on wild goose chases.

Discovering Causes, Creating Explanations, and Solving Problems

Contrary to what Francis Bacon recommended in 1600, clearing your head of the B.S. and viewing nature with an open mind is not a reliable way to discover the causes behind what you see. Unfortunately, there is no error-free way. Nevertheless, the discovery process is not completely chaotic. There are rules of thumb. For example, to discover a solution to a problem, scientists can often use a simple principle: Divide the problem into manageable components. This principle was used by the space program in solving the problem of how to travel to the moon. The manager of the moon program parceled out the work. Some scientists and engineers concentrated on creating a more powerful rocket engine; others worked on how to jettison the heavy, empty lower stages of the rocket; others designed the communication link between the Earth and the spaceship's computer; and still others created the robot mechanisms that could carry out the computer's commands during flight and after landing on the moon. In short: Divide and conquer.

Another principle of scientific discovery says to assume that similar effects are likely to have similar causes. The history of medicine contains many examples of using this principle effectively. Several times before 1847, Doctor Ignaz Semmelweis of the General Hospital in Vienna, Austria had tried but failed to explain the alarming death rate of so many women who gave birth in his maternity ward. They were dying of puerperal fever, a disease with gruesome symptoms: pus discharges, inflammation throughout the body, chills, fever, delirious ravings. One day, a Dr. Kolletschka, who

worked with Semmelweis, was performing an autopsy on a puerperal fever victim when a clumsy medical student nicked Kolletschka's arm with a scalpel. A few days later Kolletschka died with the same symptoms as the women who died of puerperal fever. Semmelweis suspected a connection. Perhaps these were similar effects due to a similar cause. And perhaps whatever entered Kolletschka via the student's scalpel was also being accidentally introduced into the women during delivery. Then Semmelweis suddenly remembered that the doctors who delivered the babies often came straight from autopsies of women who had died of puerperal fever. Maybe they were bringing infectious material with them and it somehow entered the bodies of women during delivery of their babies. Semmelweis's suggestion of blaming the doctors was politically radical for his day, but he was in fact correct that this disease, which we now call blood poisoning, was caused by doctors transferring infectious matter from the dead mothers on the dissecting tables to the living mothers in the delivery rooms. Semmelweis's solution was straightforward. Doctors must be required to wash their hands in disinfectant before delivering babies. That is one reason that today doctors wash their hands between visits to patients.

A good method to use when trying to find an explanation of some phenomenon is to look for the key, relevant difference between situations in which the phenomenon occurs and situations in which it doesn't. Semmelweis used this method of discovery. You can use the same method to make discoveries about yourself. Suppose you were nauseous, then you vomited. You want to know why. The first thing to do is to check whether prior to your symptoms you ate something you'd never eaten before. If you discover there was something, it is likely to be the cause. Did you get those symptoms after eating raw tuna, but not after eating other foods? If so, you have a potentially correct cause of your problem. This sort of detective work is encoded in the box below.

> To find a cause, look for a relevant difference between situations where the effect occurs and situations where it does not.

The rules of thumb we have just discussed can help guide scientific guessing about what causes what. There are a few other rules, some of which are specific to the kind of problem being worked on. Guessing is only the first stage of the discovery process. Before the guess can properly be called a discovery, it needs to be confirmed. This is the second stage, and one that is more systematic than the first, as we shall see.

Confirming by Testing

To prove your hypothesis about tuna scientifically, you would need to run some tests. One test would be to eat the tuna again and see whether it causes the symptoms again. That sort of test might be dangerous to your health. Here is a better test: acquire a sample of the tuna and examine it under a microscope for bacteria known to cause the symptoms you had.

Suppose you do not have access to the tuna. What can you do? You might ask other people who ate the tuna: "Did you get sick, too?" Yes answers would make the correlation more significant. Suppose, however, you do not know anybody to ask. Then what? The difficulty now is that even if you did eat tuna before you got your symptoms, was that the only relevant difference? You probably also ate something else, such as french fries with catsup. Could this have been the problem instead? You would be jumping to conclusions to blame the tuna merely on the basis of the tuna eating being followed by the symptoms; that sort of jump commits the post hoc fallacy. At this point you simply do not have enough evidence to determine the cause of your illness.

Let's reexamine this search for the cause, but at a more general level, one that will provide an overview of how science works in general. When scientists think about the world in order to understand some phenomenon, they try to discover some pattern or some causal mechanism that might be behind it. They try out ideas the way the rest of us try on clothes in a department store. They don't adopt the first idea they have, but instead are willing to try a variety of ideas and to compare them.

Suppose you, a scientist, have uncovered what appears to be a suspicious, unexplained correlation between two familiar phenomena, such as vomiting and tuna eating. Given this observed correlation, how do you go about explaining it? You have to think of all the reasonable explanations consistent with the evidence and then rule out as many as you can until the truth remains. One way an explanation is ruled out when you collect reliable data inconsistent with it. Another way is if you notice that the explanation is inconsistent with accepted scientific laws. If you are unable to refute the serious alternative explanations, you will be unable to find the truth; knowledge of the true cause will elude you. This entire cumbersome process of searching out explanations and trying to refute them is called the scientific method of justifying a claim. There is no easier way to get to the truth. People have tried to take shortcuts by gazing into crystal balls, taking drugs, or contemplating how the world ought to be, but those methods have turned out to be unreliable.

Observation is passive; experimentation is active. Experimentation is a poke at nature. It is an active attempt to create the data needed to rule out a hypothesis. Unfortunately, scientists often cannot test the objects they are most interested in. For example, experimenters interested in whether some potential drug might be harmful to humans would like to test humans but must settle for animals. Scientists get into serious disputes with each other about whether the results of testing on rats, rabbits, and dogs carry over to humans. This dispute is really a dispute about analogy; is the animal's reaction analogous to the human's reaction?

Scientists often collect data from a population in order to produce a general claim about that population. The goal is to get a representative sample, and this goal is more likely to be achieved if the sample size is large, random, diverse, and stratified. Nevertheless, nothing you do with your sampling procedure will guarantee that your sample will be representative. If you are interested in making some claim about the nature of polar bears, even capturing every living polar bear and sampling it will not guarantee that you know the characteristics of polar bears that roamed the Earth 2,000 years ago. Relying on background knowledge about the population's lack of diversity can reduce the sample size needed for the generalization, and it can reduce the need for a random sampling procedure. If you have well-established background knowledge that electrons are all alike, you can run your experiment with any old electron; don't bother getting Egyptian electrons as well as Japanese electrons.

Aiming to Disconfirm

In the initial stages of a scientific investigation, when a scientist has an idea or two to try out, it is more important to find evidence in favor of the idea than to spend time looking for disconfirming evidence. However, in the later stages, when a scientist is ready to seriously test the idea, the focus will turn to ways to shoot it down. Confirming evidence—that is, positive evidence or supporting evidence—is simply too easy to find. That is why the scientist designs an experiment to find evidence that would refute the idea if it were false. Scientists want to find the truth, but the good scientist knows that the proper way to determine the truth of some idea is to try to find negative, not positive, evidence. A scientific generalization, at least a universal one of the form "All X are Y," will have all sorts of confirming instances (things that are both X and Y), but it takes just one X that is not Y to refute the whole generalization. So disconfirming evidence is more valuable than confirming evidence at this later stage of scientific investigation. Failure to find the disconfirming evidence is ultimately the confirming evidence.

> When a hypothesis can stand up to many and varied attempts to rule it out, the hypothesis is tentatively accepted as true or proved.

Although scientific reasoning is not so different from other kinds of logical reasoning, it is special in that its claims tend to be more precise, and the evidence backing up the claims is gathered more systematically. This completes our review of what earlier chapters have said about scientific reasoning. Let's now probe deeper into the mysteries of science.

Superstition

The people of China think Americans are silly and superstitious to believe that the number thirteen causes bad luck. This is because they know that the real unlucky number is four.

Suppose that anthropologists have discovered a very remote village in the Amazon River Basin where virgins are sacrificed during every solar eclipse. The tribe blames eclipses on an angry sun god. Immediately after every eclipse, the leader of the tribe throws a teenage girl to the alligators with the intention of appeasing the sun god and making certain the god returns to shine on the tribal lands.

"Superstitious, ineffective, and immoral," you might say. However, the tribal leader might respond with, "We have always sacrificed virgins, and it has worked every time before, hasn't it?" If you were to accuse the tribal leader of jumping to conclusions, and if you were to tell him that if he did nothing the sun would still return, he could reasonably respond by saying, "Your suggestion of doing

nothing is too dangerous to try; the village cannot risk the possibility that the sun god will never return."

Because the tribal leader has his own explanation for why the sun disappears and reappears, shouldn't we say his explanation is true for him, while ours is true for us? No. The leader might genuinely believe what he believes, but what he believes is not true. Period. Don't say, "It's true for him." This phrase is a misuse of words. Instead, say, "It's his belief." Truth in these matters is not subjective; it is not relative to whichever human subject is doing the talking. That is, truth is not a matter of human choice; it is a matter of the way things are, objectively out there in the world. Our culture knows why the solar eclipse occurs; it has to do with the moon casting a shadow on the Earth, not with any sun god. We have the correct explanation because we can predict when and for how long solar eclipses will occur. These predictions are made using scientific knowledge that has been successfully tested in many other ways. That knowledge can be used to predict the tides, predict the angle of the sun at noon at any place in the world, and so forth. The tribal leader cannot do any of these things. That is why we most probably are onto the truth in these matters, while the tribal leader probably is not. Saying this is not a sign of our cultural insensitivity but only of our being straightforward and not misleading.

What gets *called* "the truth" can be relative to one's culture, but the truth itself cannot be. Given what we know, the tribal leader is wrong and has jumped to conclusions. However, he is not being silly or irrational, because he cannot be expected to know what we know. If he had been raised in our modern civilization and yet persisted in his belief, he would be superstitious and acting irrationally. His beliefs about the sun god are "rational relative to his culture." Nevertheless, those beliefs are not "true in his culture." The beliefs may be justifiably believed, but they are not true in his or in anyone's culture.

There are other reasons why the phrase *true for* is so dangerous. With that concept, someone can create all kinds of nonsense. If the sentence "Leonardo da Vinci was a great Italian Renaissance inventor, but he was a terrible painter" is true for you and not true for me, then it is both true and not true for us. Ridiculous. That is a contradiction and a telltale sign that the concept of "true for" is incoherent.

The phrase *true for* is meaningful in English when used in certain ways, but only as long as it is not taken too literally. When someone says, "Everybody should get eight hours sleep a night," it would be appropriate to respond with "Well, that may be true for you, but it's not true for me." However, more straightforwardly, what the responder means is something like "Well, you may need eight hours of sleep a night, but I don't." The straightforward response doesn't use the unfortunate phrase *true for*, and it does not imply that truth is relative.

People who are **superstitious** about some topic are people who hold a belief about what causes what in regard to that topic despite having good evidence that should convince them their belief is false. In our society, the so-called modern world, that good evidence is usually what we know about the results of science and the proper and improper methods of gaining knowledge. Science tells us what can cause what.

A man (or woman) is rational provided he arrives at, accepts, and revises his beliefs according to the accepted methods of his society. Otherwise, he is **irrational**. Although the tribal leader may be rational in his sacrifice of the virgin to the sun god, he is still superstitious about that because he holds beliefs for reasons that are well known *to us* to be unacceptable—usually those unacceptable reasons are based on fear of the unknown or trust in magic. When you say someone has a particular superstition you always imply that you don't.

> It is possible for a person to be rational in adopting a superstition if the person isn't in a position to know better.

In our own culture, superstitious people believe that Friday the 13th is an unlucky day, that they should prevent a black cat from walking across their path, and that they will be safer if they occasionally throw salt over their shoulder. They hold these beliefs in spite of ample evidence to the contrary from the experts. These people are *both* irrational and superstitious on this topic, but just because a person is superstitious on one topic doesn't imply they are superstitious on others.

The proof that convinces the experts that some belief or action is a superstition is actually a rather complicated philosophical argument that makes use of a principle called **Occam's Razor**. According to Occam's Razor, if you can have an adequate explanation without assuming some particular exotic entity (such as the hand of fate or devil cats), then don't assume that the exotic entity exists. Closely related to the notion of fate are other notions that are at the root of much superstition: destiny, fortune, chance, providence, predestination, and luck. If you believe that on some days Lady Luck will be with you and that you then have a better than one in fifty-two chance of picking your favorite card from an ordinary, shuffled deck of fifty-two cards, then you are being, well, you know.

Not every superstitious belief is false. What is important to its being superstitious is only *why* it is believed. If you believe it is unwise to walk on a hilltop during a rainstorm or to seek shelter there under a tree because the Devil or some other supernatural force might use the lightning to try to destroy you, then you are being superstitious and irrational even though you are correct about what to do during a storm.

———CONCEPT CHECK———

Some of these statements about superstition and irrationality are false. Which ones?

a. Australian aborigines of the twelfth century who believed that the world was flat must have been irrational for believing this.

b. If Albert Einstein had believed more accidents happen on Friday the 13th than any other day because all the statistical data available to him showed these ideas to be so, he would have been rational.

c. A person can be both superstitious and irrational.

d. A person can be superstitious while being a nice person.

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Because explanations need to be tailored to the audience, those that will be accepted by superstitious people might not be acceptable to the rest of us.

How should we react when faced with stories of the miraculous visions of clams flying over Los Angeles? We should apply the principle of logical reasoning that we need extremely good evidence before rejecting widely held beliefs. These miracles are too improbable to be believed solely on the basis of anecdotal reports, even though the reports are widespread and even though the people doing the reporting are speaking honestly. For a more detailed discussion of miracles, see the article "Miracles."

All of us at one time or another imagine we see things that we later learn aren't really there. We have good imaginations; sometimes too good. Drugs can promote hallucinations. A mass hallucination, one in which everybody imagines the same thing, is rare, drugs or no drugs. Because mass hallucination is so rare, if everybody were to say they see clams flying over Los Angeles but you see no clams, you would have to worry seriously that the problem is with you, not them.

At this point in our critical thinking course it is time for you to stop and make a telephone call to 888-278-7384 and speak with one of our operators who are standing by for your call. You'll be charged $4.95 for your first call of three minutes, and you can speak with a *genuine* psychic, not one of those fake psychics that charge $2.95 per call. Call now. As an added bonus, you will receive two lucky numbers for the lottery.

Looking for Alternative Explanations

Mass hallucination is in some ways like mass hypnotism. The hypnotist can place spectacular ideas into your mind, because hypnotism is a matter of suggestion. Mass hypnotism is the key to the famous Indian rope trick, say several magicians. The trick is performed by an Indian magician, called a "fakir." After showing a rope to his audience, he throws it into the air, where it stays vertically suspended. A boy, the fakir's assistant, climbs the rope and then disappears at the top. Several magicians who have analyzed

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[383] Answer (a). Presumably, many aborigines believed the world is flat on the basis of the methods acceptable within their own culture. So they were rational, though superstitious. If you today believed the world is flat for those same reasons, you would be both irrational and superstitious.

the trick claim that the Indian fakir hypnotizes all the members of the audience into believing they have seen the trick, even though they haven't.

This is a fascinating but implausible explanation. Mass hypnotism is too difficult to pull off. It may not be as difficult to create as a mass hallucination, but it is right up there in implausibility.

There is, instead, a better **alternative explanation**. If a thin, strong wire were strung between two trees above the fakir, he could disguise a hook in the rope and toss the rope so that it hooks the wire and hangs suspended. The fakir's assistant could then climb the rope even though the rope looks to everyone in the audience as if it is unsuspended. Behind a puff of smoke, the boy could scramble along the wire and hide in the tree.

———CONCEPT CHECK———

The wire and hook explanation is better than the mass hallucination alternative because

a. if it were correct, the trick would be less expensive.

b. mass hallucination is logically impossible.

c. it is too difficult to create a mass hallucination.

d. mass hypnotism requires accepting Eastern mysticism.

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To further explore the intricacies of finding the best explanation for a phenomenon when alternative explanations need to be considered, suppose you receive a letter asking you to invest your money with Grover Hallford and Associates (GHA), a new stock brokerage firm. You do have a little extra cash[385], so you don't immediately shut the idea out of your mind. The new stock brokers charge the same rates as other major brokers who offer investment advice. GHA is unusual, though, in that it promises to dramatically increase your investment because, according to the letter, it has discovered a special analytic technique for predicting the behavior of the stock market. Normally you would have to pay for any stock advice from a broker, but to show good faith, the

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[384] Answer (c).

[385] Some textbook authors make some fantastic assumptions, don't they?

GHA letter offers a free prediction for you. It predicts that the price of IBM stock will close lower next Tuesday from where it closed at the end of trading on the previous day, Monday. You place the letter in file 13, the circular file. However, the following week you happen to notice that IBM stock did perform as predicted. Hmmm. What is going on?

A few days later you receive a second letter from GHA. It says that GHA is sorry you have not yet become a client, but, to once again show its good faith, the company asks you to consider its prediction that Standard Oil of New Jersey stock will close up next Tuesday from where it was at the end of Monday. Again you decline to let GHA invest your savings, but you do keep an eye on the stock price of Standard Oil of New Jersey during the next week. Surprisingly, the prediction turns out to be correct. A few days later you receive a third letter suggesting that you invest with GHA, containing yet another free stock tip, but warning that there is a limit to how much free advice you will receive. Are you now ready to invest with GHA? If not, how many more letters would you have to receive before you became convinced that the brokers truly do understand the logic of the stock market? If you demand thirty letters, aren't you being foolish and passing up the chance of a lifetime? Surely GHA is on to something, isn't it? Other brokers cannot perform this well for you. How often do you get a chance to make money so easily? Isn't GHA's unknown technique causing them to be able to make correct predictions? And even if GHA is cheating and somehow manipulating the market, you can still take advantage of this and make money, too. Think about what you would do if you were faced with this decision about investing.

You may not have been able to find a reasonable alternative explanation to GHA's claim that it understands the causal forces shaping the stock market. Many people cannot. That's why the swindle works so well. However, it is a swindle, and it is illegal. What GHA did is to get a long mailing list and divide it in half. For their first letter, half of the people get a letter with the prediction that IBM stock will close higher next Tuesday; the other half get a letter making the opposite prediction—that IBM will not close higher. Having no ability to predict the stock market, GHA merely waits until next Tuesday to find out who received a letter with the correct prediction. Only that half then gets a second letter. Half of the second letters say Standard Oil of New Jersey stock will go up; the other half say it won't. After two mailings, GHA will have been right two times in a row with one-fourth of the people it started with. The list of names in the lucky fourth is divided in half and GHA generates a new letter. Each new mailing cuts down by 50 percent the number of people GHA has given good advice to, but if the company starts with a long enough list, a few people will get many letters with correct predictions. You

are among those few. This explains why you have received the letters. Along the way, many people will have sent their hard-earned money to GHA, money that will never be returned. This swindle is quite effective. Watch out for it. And don't use it yourself on anybody else.

Once again we draw a familiar moral. The degree of belief you should give to a claim that A causes B (that GHA's insight into the stock market causes its correct predictions) is improved or lessened depending on whether you can be more or less sure that reasonable alternative explanations can be ruled out. Thinking up these alternatives is crucial to logical reasoning. Without this creativity you can be more easily led away from the truth, that is, conned.

———CONCEPT CHECK———

Back in the nineteenth century, a manuscript was discovered in a large, sealed bottle underground in London. The tightly rolled manuscript was signed "Brother Bartholomew," who was known to have been a famous prophet of the fifteenth and sixteenth centuries. The manuscript contained several remarkable statements. Unlike the vague predictions in the sixteenth-century writings of Nostradamus, this manuscript made precise predictions. It described in some detail how to build a steam engine, a repeating rifle, and a telegraph. The manuscript didn't contain the English names for these inventions, just the plans. It also said that a new country would someday be formed far to the west of London and that its first leader would be named "Woshen-tun." The manuscript contained the date "1523" on its cover page. A reliable chemical analysis of the ink on the cover page established it as a kind of ink commonly used during the sixteenth century.

Assuming that this fictitious story is true, what is the best comment to make about whether the evidence shows Brother Bartholomew to have been a successful prophet?

a. I wouldn't put a whole lot of faith in this claim. Making a decision about Brother Bartholomew from just one source of evidence is tough; if two manuscripts were found, it would be twice as good evidence though. So, it is about 25 percent likely he was a prophet.

b. Everything Brother Bartholomew says came true, so he was foretelling the future. Also, the chemical tests that were done on the manuscript show with high probability that it was written back in 1523.

c. I can't believe this shows he is a prophet, since the manuscript doesn't predict anything that wasn't already known at the time of its discovery.

d. I can't believe in the authenticity of the document because London did not exist in 1523.

e. There is no proof that the document was *not* foretelling the future.

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Creating Scientific Explanations

The power to explain is a mark of your having discovered the truth. Those who can explain more know more. Hundreds of years before astronauts photographed the Earth, our civilization proved that the Earth is round, not flat. How did it do this? Not by gathering many positive reports from people declaring that the Earth is round while failing to receive any negative reports declaring it to be flat. The evidence was more indirect: the hypothesis that the Earth is round enabled so many things to be explained that otherwise were unexplainable.

386 (e) is true, but the answer is (c). Predicting a repeating rifle in the nineteenth century is not predicting something unexpected, because the rifle was already invented by then. Yet a good test requires predicting an unexpected event. So (c) is the right answer. Notice that there were no predictions of x-rays, lasers, genetic engineering, computer games, or the AIDS epidemic. If the document had predicted something new for a time after it was discovered, then it would be a stronger piece of evidence in favor of Bartholomew's prophetic powers. Because it did not, there is a mundane and more plausible alternative explanation that hasn't been ruled out—namely, that the document is a forgery created in the nineteenth century using a sixteenth-century cover page.

By assuming that the Earth is round we can explain why Magellan's ship could keep sailing west from Spain yet return to Spain. By assuming that the Earth is round we can make sense of the shape of eclipses of the moon (they are round shadows of our round Earth). By assuming that the Earth is round we can explain why, when we look away from port with our telescope at a ship sailing toward the horizon, the top of the ship disappears after the bottom, not before. By assuming that the Earth is round we can explain why the sun can shine at midnight in the arctic. All these facts would be deep mysteries without the round-Earth hypothesis, and it would be nearly a miraculous coincidence if all these facts fit so well with an assumption that was false; therefore, the assumption is a fact. The moral is that science is propelled forward by its power to explain.

> Science is propelled forward by its power to explain.

Probabilistic and Deterministic Explanations

The best explanations of an event usually give us a good reason to have expected the event. Suppose you want to explain why apples fall of the apple tree and hit the ground. One untestable explanation would be that it was the apple's "time" to leave the tree. That explanation appeals to a supernatural notion of fate or destiny. A scientific explanation is that the apple fell because it absorbed enough water through its stem that its weight increased above the maximum downward force that the brittle stem could resist.

Because explaining people's behavior is harder than explaining the behavior of apples, the current principles of psychology are less precise than the principles of physics. Psychologists depend on rules of thumb; physical scientists have deterministic laws that indicate what will happen rather than what might happen. For example, why did Sarah decide not to go out with Wayne when he mentioned he had an extra ticket to the concert? After talking with her, a psychologist might explain her action this way:

1. Wayne suggested that Sarah spend her time doing something she believed wouldn't be interesting to her.

2. People will not usually do what they have little interest in doing, nor what they perceive to be against their self-interest.

Sentence 1 states the relevant initial facts of the situation, and sentence 2 expresses the relevant law of psychology. This law is less precise than the law of gravity. It is only probabilistic, not deterministic, because it doesn't say what will happen but only what probably will happen. Using 1 and 2 in advance, we could predict only what Sarah *probably* would do, not what she *will* do. Psychology can't give a deterministic explanation. Such is the current state of that science.

Suppose you asked why you can see through glass but not through concrete, and you were told: "Because glass is transparent." That answer is appropriate for an elementary school student, but not for a more sophisticated audience. After all, *transparent* merely means being able to be seen through. The explanation is trivial. Up until 1926, however, no one had a better explanation. Glass's being transparent was just one of the brute facts of nature. It was accepted, but no deeper explanation could show why. Then, in 1926, the theory of quantum mechanics was discovered. From the principles of quantum mechanics, it was possible to deduce that anything made of glass should permit light to pass through. Similarly, quantum mechanics allowed us to find out why water is wet. These examples illustrate two main points: (1) General theories are more valuable than mere collections of specific facts, because with a general theory you can explain a large variety of individual facts. (2) If you can deduce a phenomenon from some well-accepted principles, you have a much deeper explanation of the phenomenon than if you can't carry out this deduction.

Fruitful and Unfruitful Explanations

Untestable explanations are avoided by good scientists, but fruitful explanations are highly valued. To appreciate this virtue of fruitfulness, consider the scientists' favorite explanation of what caused the demise of the dinosaurs 65 million years ago. Four explanations or specific theories have been proposed in the scientific literature: the sex theory, the drugs theory, the violence theory, and the crime theory.

- According to the sex theory, 65 million years ago the world's temperature increased a few degrees. This increase warmed the male dinosaurs' testes to the point that they became infertile.

- According to the drug theory, 65 million years ago the world's first psychoactive (mind-altering) plants evolved. Dinosaurs ate these plants, overdosed, and died.

- According to the violence theory, 65 million years ago some violent global event—perhaps caused by an asteroid or volcano—led to the dinosaur extinctions.

- According to the crime theory, 65 million years ago the first small mammals got braver and more clever. Some mammals learned to steal dinosaur eggs, which caused the dinosaur extinctions.

Of all four theories, current science favors the violence theory. Why? There are two reasons: it has been successfully tested, and it has been fruitful. The other three theories are testable in principle, but they are too hard to test in practice. The soft parts of male dinosaurs don't leave fossils, so the sex theory cannot be tested by looking for fossil remains. The drug theory is too hard to test because nothing much is known about which drugs were in which plants so long ago. The crime theory is too hard to test because there is no practical way to check whether little mammals did or didn't steal the dinosaur eggs. On the other hand, the violence theory can be. Suppose a violent global event threw dust into the air, darkening the Earth, leading to cold weather and the end of most plant photosynthesis. Digging down to the 65-million-year layer should reveal a thin layer of dust, no matter where in the world the scientists dig down. And indeed, scientists have discovered a layer of dust there containing a high concentration of a very rare element, iridium. Although naturally scarce on the Earth's surface, the element is relatively abundant both in asteroids and deep inside volcanoes.

In addition to its having stood up to this observational test, the violence theory is favored because it is so fruitful. That is, scientists can imagine many interesting and practical ways in which the theory can be tested. They can search satellite photos looking for 65-million-year-old asteroid craters. At suspected crater sites, they can analyze rocks for signs of impact—tiny fractures in shocked quartz. Digging might reveal pieces of an asteroid. A large speeding asteroid would ionize the surrounding air, making it as acidic as the acid in a car battery, so effects of this acidity might be discovered. Imagine what that rain would do to your car's paint. Scientists can also examine known asteroids and volcanoes for unusual concentrations of other chemical elements in addition to iridium. Ancient beaches can be unearthed to look for evidence of a huge tidal wave having hit them 65 million years ago. All these searches and examinations are under way today, and there has been much success in finding data consistent with the violence theory and little uncontested counterevidence.

Thus, the violence theory is the leading contender for explaining the dinosaur extinctions not because the alternative explanations have been refuted but because of its being successfully tested (so far) and its being so fruitful.

This brings us to the edge of a controversy about scientific methodology. The other alternative theories of dinosaur extinctions have not been refuted; they have not even been tested. But if they have not been refuted, and if proving the violence theory requires refuting all the alternative theories, doesn't it follow that the violence theory will never be proved, no matter how much new positive evidence is dug up by all those searches and examinations mentioned above? This question cannot be answered easily. We will end our discussion of this problem about scientific reasoning with the comment that not only is there much more to be learned about nature, but there are also unsolved problems about the nature of the science itself.

———CONCEPT CHECK———

The explanation of the dinosaur extinctions most favored by today's scientific community is the one appealing to a violent impact or explosion. One of the reasons that this explanation is favored over reasonable alternative explanations is not that the others have been tested and shown to be inconsistent with the data but that the violence theory

a. has not been falsified, unlike the alternative theories.

b. has suggested a variety of new tests.

c. is known not to be pseudoprecise.

d. has been confirmed by deducing it from previously known facts and theories.

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Testing Scientific Explanations

If you don't test the claim, you don't know it's true.

Designing a Scientific Test

It is easy to agree that scientific generalizations should be tested before they are proclaimed as true, and it is easy to agree that the explanations based on those generalizations also should be tested. However, how do you actually go about testing them? The answer is not as straightforward as one might imagine. The way to properly test a generalization differs dramatically depending on whether the generalization is universal (all A are B) or non-universal (some but not all A are B). When attempting to confirm a universal generalization, it is always better to focus on refuting the claim than on finding more examples consistent with it. That is, look for negative evidence, not positive evidence. For example, if you are interested in whether all cases of malaria can be cured by drinking quinine, it would be a waste of research money to seek confirming examples. Even 20,000 such examples would be immediately shot down by finding just one person who drank quinine but was not cured. On the other hand, suppose the generalization were non-universal instead of universal, that is, that most cases of malaria can be cured by drinking quinine. Then the one case in which someone drinks quinine and is not cured would not destroy the generalization. With a non-universal

387 Answer (b). The violence theory not only is testable but can also be practically tested in many ways. The alternatives cannot be. Choice (a) makes the good point that the violence theory has not been falsified, but it makes the incorrect point that all the alternative theories have been.

generalization the name of the game would be the ratio of cures to failures. In this case, 20,000 examples would go a long way toward improving the ratio.

There are other difficulties with testing. For example, today's astronomers say that all other galaxies on average are speeding away from our Milky Way galaxy because of the Big Bang explosion. This explosion occurred at the beginning of time, when the universe was supposedly smaller than the size of a pea. Can this explanation be tested to see whether it is correct? You cannot test it by rerunning the birth of the universe. But you can test its predictions. One prediction that follows from the Big Bang hypothesis is that microwave radiation of a certain frequency will be bombarding Earth from all directions. This test has been run successfully, which is one important reason why today's astronomers generally accept the Big Bang as the explanation for their observations that all the galaxies on average are speeding away from us. There are several other reasons for the Big Bang theory having to do with other predictions it makes of phenomena that do not have good explanations by competing theories.

We say a hypothesis is confirmed or proved if several diverse predictions are tested and all are found to agree with the data while none disagree. Similarly, a hypothesis gets refuted if any of the actual test results do not agree with the prediction. However, this summary is superficial—let's see why.

Retaining Hypotheses Despite Negative Test Results

If a scientist puts a hypothesis to the test, and if the test produces results inconsistent with the hypothesis, there is always some way or other for the researcher to hold onto the hypothesis and change something else. For example, if the meter shows "7" when your hypothesis would have predicted "5," you might rescue your hypothesis by saying that your meter wasn't working properly. However, unless you have some good evidence of meter trouble, this move to rescue your hypothesis in the face of disconfirming evidence commits the fallacy of ad hoc rescue. If you are going to hold onto your hypothesis no matter what, you are in the business of propaganda and dogma, not science. Psychologically, it is understandable that you would try to rescue your cherished belief from trouble. When you are faced with conflicting data, you are likely to mention how the conflict will disappear if some new assumption is taken into account. However, if you have no good reason to accept this saving assumption other than that it works to save your cherished belief, your rescue is an **ad hoc rescue**.

———CONCEPT CHECK———

Say why this is not a successful argument:

> People such as Galileo will tell you that the Earth turns, but it really doesn't. If the Earth did turn, then when you drop a ball off the top of a tall building, the Earth would turn away from the ball, and the ball would land some distance away from the building. Instead, when you try this, the ball lands right at the base of the building. Therefore, the Earth doesn't really turn after all.

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———CONCEPT CHECK———

Back in the times of ancient Greece and Rome, augurs would advise the rulers about the future. These respected priest-prophets carried a staff or wand and specialized in foretelling events by using omens, or unusual events. Because the universe is made for people, anything unusual must be a sign, a special message that people are supposed to interpret, or so the augurs believed. They would try to predict the future for their rulers by interpreting the unusual flight of a bird, the shape and markings of the guts of sacrificed animals, and the appearance of comets and eclipses. Often, when their divining with ravens, livers, and comets was obviously not working and the ruler was complaining, the augurs would blame their failure on the negative influence from nearby Christians. Their solution was to ask the ruler to order the deaths of all the Christians. Examining this story from the perspective of scientific reasoning, we see that the principal mistake of the augurs was

a. that they should have relied more on scientific astrology.

b. their insensitivity to pseudoprecision.

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388 In any good scientific test, the predicted outcome of the test will follow from the hypothesis being tested. It doesn't here. A faulty prediction was made from the hypothesis that the Earth turns. The Earth does turn; however, the ball and the building it is dropped from are both with the same angular velocity, so the dropped ball should merely go straight down, as in fact it does.

c. to use the method of ad hoc rescue.

d. to overemphasize repeatable phenomena.

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In 1790 the French scientist Lavoisier devised a careful experiment in which he weighed mercury before and after it was heated in the presence of air. The remaining mercury, plus the red residue that was formed, weighed more than the original. Lavoisier had shown that heating a chemical in air can result in an increase in weight of the chemical. Today, this process is called oxidation. But back in Lavoisier's day, the accepted theory on these matters was that a posited substance, "phlogiston," was driven off during any heating of a chemical. If something is driven off, then you would expect the resulting substance to weigh less. Yet Lavoisier's experiments clearly showed a case in which the resulting substance weighed more. To get around this inconsistency, the chemists who supported the established phlogiston theory suggested their theory be revised by assigning phlogiston negative weight. The negative-weight hypothesis was a creative suggestion that might have rescued the phlogiston theory. It wasn't as strange then as it may seem today because the notion of mass was not well understood. Although Isaac Newton had believed that all mass is positive, the negative-weight suggestion faced a more important obstacle. There was no way to verify it independently of the phlogiston theory. So, the suggestion appeared to commit the fallacy of ad hoc rescue.

An ad hoc hypothesis can be rescued from the charge of committing the fallacy of ad hoc rescue if it can meet two conditions: (1) The hypothesis must be shown to be fruitful in successfully explaining phenomena that previously did not have an adequate explanation. (2) The hypothesis's inconsistency with previously accepted beliefs must be resolved without reducing the explanatory power of science. Because the advocates of the negative-weight hypothesis were unable to do either, it is appropriate to charge them with committing the fallacy. As a result of Lavoisier's success, and the failure of

389 Answer (c). Their hypothesis was that examining omens would enable them to foretell the future. Their predictions based on this hypothesis were inconsistent with the facts. To rescue their hypothesis, they revised it to say that omens could be used to predict the future provided Christians didn't interfere. However, there is no basis for believing that this revision is proper; its only basis is that if it were true, then the augurs could stay in business. So their reasoning commits the fallacy of ad hoc rescue.

the negative-weight hypothesis, today's chemists do not believe that phlogiston exists. And Lavoisier's picture gets a prominent place in history:

Three Conditions for a Well-Designed Test

As a good rule of thumb, three definite conditions should hold in any well-designed test. First, if you use an experiment or observation to test some claim, you should be able to deduce the predicted test result from the combination of the claim plus a description of the relevant aspects of the test's initial conditions. That is, if the claim is really true, the predicted test result should follow. Second, the predicted test result should not be expected no matter what; instead, the predicted result should be unlikely if the claim is false. For example, a test that predicts water will flow downhill is a useless test because water is expected to do so no matter what. Third, it should be practical to check on whether the test did or did not come out as predicted, and this checking should not need to presume the truth of the claim being tested. It does no good to predict something that nobody can check.[390]

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390 These criteria for a good test are well described by Ronald Giere in *Understanding Scientific Reasoning* (New York: Holt, Rinehart and Winston, 1979), pp. 101-105.

To summarize, ideally a good test requires a prediction that meets these three conditions; it is

(1) deducible or at least probable, given that the claim is true,

(2) improbable, given that the claim is false, and

(3) verifiable.

> A good test of a claim will be able to produce independently verifiable data that should occur if the claim is true but shouldn't occur if the claim is false.

———CONCEPT CHECK———

Which of the three conditions above for a good scientific test are satisfied or violated, as far as you can tell, in the test mentioned in the following report?

> A researcher claims that an invisible evil hand, a dark force, is at work disrupting transportation in the Bermuda Triangle. This triangle is the area of the Atlantic Ocean defined by Bermuda, Florida, and Cuba. The researcher predicted that if the hypothesis about an invisible hand were true, then there should be mysterious disappearances of planes and ships into thin air and definitely an unusual number of transportation accidents in this area. The researcher gathered data about many such cases, and then published his results claiming his testing confirmed the existence of the evil hand.

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391 The major fault is with condition 2 (improbability). Condition 1 (deducibility) is satisfied; the researcher correctly deduced that if there were an evil hand, it would perform evil deeds. Condition 3 (verifiability) is satisfied because it is not too hard to check on whether planes and boats actually have had accidents or disappeared, and this checking doesn't depend on any assumption about whether there is or isn't an evil hand at work. Condition 2, on the

Deducing Predictions for Testing

Condition 1, the deducibility condition, is somewhat more complicated than a first glance might indicate. Suppose you suspect that one of your co-workers named Philbrick has infiltrated your organization to spy on your company's chief scientist, Oppenheimer. To test this claim, you set a trap. Philbrick is in your private office late one afternoon when you walk out declaring that you are going home. You leave a file folder labeled "Confidential: Oppenheimer's Latest Research Proposal" on your desk. You predict that Philbrick will sneak a look at the file. Unknown to him, your office is continually monitored on closed-circuit TV, so you will be able to catch him in the act.

Let's review this reasoning. Is condition 1 satisfied for your test? It is, if the following reasoning is deductively valid:

- Philbrick has the opportunity to be alone in your office with the Oppenheimer file folder, (the test's initial conditions).
- Philbrick is a spy. (the claim to be tested)
- So, Philbrick will read the Oppenheimer file while in your office, (the prediction)

This reasoning might or might not be valid depending on a missing premise. It would be valid if a missing premise were the following:

> If Philbrick is a spy, then he will read the Oppenheimer file while in your office if he has the opportunity and believes he won't be detected doing it. (background assumption)

Is that premise acceptable? No. You cannot be that sure of how spies will act. The missing premise is more likely to be the following hedge:

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other hand, hasn't been established, as far as we can tell from the information given. Condition 2 (improbability) requires that these disappearances be shown to be improbable, yet for all we know, given the traffic flow, there is no higher percentage of disappearances in the Bermuda Triangle than in any other part of the world. (In fact, there have not been an unusual number of disappearances, given that this area is one of the busiest of any ocean.)

> If Philbrick is a spy, then he will *probably* read the Oppenheimer file while in your office if he has the opportunity and believes he won't be detected doing it. (new background assumption)

Although it is more plausible that this new background assumption is the missing premise used in the argument for the original prediction, now the argument isn't deductively valid. That is, the prediction doesn't follow with certainty, and condition 1 fails. Because the prediction follows inductively, it would be fair to say that condition 1 is "almost" satisfied. Nevertheless, it is not satisfied. Practically, though, you cannot expect any better test than this; there is nothing that a spy must do that would decisively reveal the spying. Practically, you can have less than ideal tests about spies or else no tests at all.

In response to this difficulty with condition 1, should we alter the definition of the condition to say that the prediction should follow either with certainty or probability? No. The reason why we cannot relax condition 1 can be appreciated by supposing that the closed-circuit TV does reveal Philbrick opening the file folder and reading its contents. Caught in the act, right? Your conclusion: Philbrick is a spy. This would be a conclusion many of us would be likely to draw, but it is not one that the test justifies completely. Concluding with total confidence that he is a spy would be drawing a hasty conclusion because there are alternative explanations of the same data. For example, if Philbrick were especially curious, he might read the file contents yet not be a spy. In other words, no matter whether the prediction comes out to be true or false, you cannot be sure the claim is true or false. So, the test is not decisive because its result doesn't settle which of the two alternatives is correct.

Yet being decisive is the mark of an ideally good test. We would not want to alter condition 1 so that this indecisive test can be called decisive. Doing so would encourage hasty conclusions. So the definition of condition 1 must stay as it is. However, we can say that if condition 1 is almost satisfied, then when the other two conditions for an ideal test are also satisfied, the test results will tend to show whether the claim is correct. In short, if Philbrick snoops, this tends to show he is a spy. More testing is needed if you want to be surer.

This problem about how to satisfy condition 1 in the spy situation is analogous to the problem of finding a good test for a non-universal generalization. If you suspect that most cases of malaria can be cured with quinine, then no single malaria case will ensure that you are right or that you are wrong. Finding one case of a person whose malaria

wasn't cured by taking quinine doesn't prove your suspicion wrong. You need many cases to adequately test your suspicion.

The bigger issue here in the philosophy of science is the problem of designing a test for a theory that is probabilistic rather than deterministic. To appreciate this, let's try another scenario. Suppose your theory of inheritance says that, given the genes of a certain type of blue-eyed father and a certain type of brown-eyed mother, their children will have a 25 percent chance of being blue-eyed. Let's try to create a good test of this probabilistic theory by using it to make a specific prediction about one couple's next child. Predicting that the child will be 25 percent blue-eyed is ridiculous. On the other hand, predicting that the child has a 25 percent chance of being blue-eyed is no specific prediction at all about the next child. Specific predictions about a single event can't contain probabilities. What eye color do you predict the child will have? You should predict it will not be blue-eyed. Suppose you make this prediction, and you are mistaken. Has your theory of inheritance been refuted? No. Why not? Because the test was not decisive. The child's being born blue-eyed is consistent with your theory's being true and also with its being false. The problem is that with a probabilistic theory you cannot make specific predictions about just one child. You can predict only that if there are many children then 25 percent of them will have blue eyes and 75 percent won't. A probabilistic theory can be used to make predictions only about groups, not about individuals.

The analogous problem for the spy in your office is that when you tested your claim that Philbrick is a spy you were actually testing a probabilistic theory because you were testing the combination of that specific claim about Philbrick with the general probabilistic claim that spies *probably* snoop. They don't always snoop. Your test with the video camera had the same problem with condition 1 as your test with the eye color. Condition 1 was almost satisfied in both tests, but strictly speaking it wasn't satisfied in either.

Our previous discussion should now have clarified why condition 1 is somewhat more complicated than a first glance might indicate. Ideally, we would like decisive tests or, as they are also called, crucial tests. Practically, we usually have to settle for tests that only tend to show whether one claim or another is true. The stronger the tendency, the better the test. If we arrive at a belief on the basis of these less than ideal tests, we are always in the mental state of not being absolutely sure. We are in the state of desiring data from more tests of the claim so that we can be surer of our belief, and we always

have to worry that some day new data might appear that will require us to change our minds. Such is the human condition. Science cannot do better than this.

Detecting Pseudoscience

The word *science* has positive connotations, the word *pseudoscience* has negative connotations. Science gets the grant money; pseudoscience doesn't. Calling some statement, theory, or research program "pseudoscientific" suggests that it is silly or a waste of time. It is pseudoscientific to claim that the position of the planets at the time a person is born determines the person's personality and major life experiences. It is also pseudoscientific to claim that spirits of the dead can be contacted by mediums at seances. Astrology and spiritualism may be useful social lubricants, but they aren't scientific.

Despite a few easily agreed-upon examples such as these two, defining *pseudoscience* is difficult. One could try to define *science* and then use that to say pseudoscience is not science, or one could try to define *pseudoscience* directly. A better approach is to try to find many of the key features of pseudosciences. A great many of the scientific experts will agree that pseudoscience can be detected by getting a “no” answer to the first two questions or a “yes” answer to any of the remaining three:

1. Do the "scientists" have a *theory to test*?
2. Do the "scientists" have *reproducible data* that their theory explains better than the alternatives?
3. Do the "scientists" seem content to search around for phenomena that are hard to explain by means of current science; that is, do the scientists engage in *mystery mongering*?
4. Are the "scientists" quick to recommend *supernatural explanations* rather than natural explanations?
5. Do the "scientists" use the method of *ad hoc rescue* while treating their own views as unfalsifiable?

The research program that investigates paranormal phenomena is called **parapsychology**. What are the paranormal phenomena we are talking about here? They include astral travel, auras, psychokinesis (moving something without touching it

physically), plant consciousness, psychic healing, speaking with the spirits, witchcraft, and ESP—that is telepathy (mind reading), clairvoyance (viewing things at a distance), and precognition (knowing the future).

None of the parapsychologists' claims to have found cases of cancer cures, mind reading, or foretelling the future by psychic powers have ever stood up to a good test. Parapsychologists cannot convincingly reproduce any of these phenomena on demand; they can only produce isolated instances in which something surprising happened. Parapsychologists definitely haven't produced repeatable phenomena that they can show need to be explained in some revolutionary way.

Rarely do parapsychologists engage in building up their own theories of parapsychology and testing them. Instead, nearly all are engaged in attempts to tear down current science by searching for mysterious phenomena that appear to defy explanation by current science. Perhaps this data gathering is the proper practice for the prescientific stage of some enterprise that hopes to revolutionize science, but the practice does show that the enterprise of parapsychology is not yet a science.

Regarding point 1, scientists attack parapsychologists for not having a theory-guided research program. Even if there were repeatable paranormal phenomena, and even if parapsychologists were to quit engaging in mystery mongering, they have no even moderately detailed theory of how the paranormal phenomena occur. They have only simplistic theories such as that a mysterious mind power caused the phenomenon or that the subject tapped a reserve of demonic forces or that the mind is like a radio that can send and receive signals over an undiscovered channel. Parapsychologists have no more-detailed theory that permits testable predictions. Yet, if there is no theory specific enough to make a testable prediction, there is no science.

Paradigms and Possible Causes

Your car's engine is gummed up today. This has never happened before. Could it be because at breakfast this morning you drank grapefruit juice rather than your usual orange juice? No, it couldn't be. Current science says this sort of explanation is silly. OK, forget the grapefruit juice. Maybe the engine is gummed up because today is Friday the 13th. No, that is silly, too. A scientist wouldn't even bother to check these explanations. Let's explore this intriguing notion of what science considers "silly" versus what it takes seriously. What causes the pain relief after swallowing a pain pill? Could it be the

favorite music of the inventor? No, that explanation violates medical science's basic beliefs about what can count as a legitimate cause of what. Nor could the pain relief be caused by the point in time when the pill is swallowed. Time alone causes nothing, says modern science. The pain relief could be caused by the chemical composition of the pill, however, or perhaps by a combination of that with the mental state of the person who swallowed the pill. The general restrictions that a science places on what can be a cause and what can't are part of what is called the **paradigm** of the science. Every science has its paradigm.

That is, at any particular time, each science has its own particular problems that it claims to have solved; and, more important, it has its own accepted ways of solving problems that then serve as a model for future scientists who will try to solve new problems. These ways of solving problems, including the methods, standards, and generalizations generally held in common by the community of those practicing the science, is, by definition, the paradigm of that science.

The paradigm in medical science is to investigate what is wrong with sick people, not what is right with well people. For a second example, biological science is not sure what causes tigers to like meat rather than potatoes, but biologists are fairly sure the cause involves the chemical makeup of the meat, not the history of zipper manufacturing or the price of rice in China. The paradigm for biological science limits what counts as a legitimate biological explanation. When we take a science course or read a science book, we are slowly being taught the paradigm of that science and, with it, the ability to distinguish silly explanations from plausible ones. Silly explanations do not meet the basic requirement for being a likely explanation, namely **coherence with the paradigm**. Sensitivity to this consistency requirement was the key to understanding the earlier story about Brother Bartholomew. Scientists today say that phenomena should not be explained by supposing that Bartholomew or anybody else could see into the future; this kind of "seeing" is inconsistent with the current paradigm. It is easy to test whether people can foresee the future if you can get them to make specific predictions rather than vague ones. Successfully testing a claim that someone can foresee the future would be a truly revolutionary result, upsetting the whole scientific world-view, which explains why many people are so intrigued by tabloid reports of people successfully foretelling the future.

———CONCEPT CHECK———

Even if you've never had a college biology course, you ought to be able to identify which explanation below, about why spiders don't get stuck in their own webs, deviates the most from the paradigm.

a. The color of the web causes the spider to wrinkle its feet, which in turn causes new, wet, webbing to flow out of the spider, yet only dry webbing can stick to a spider.

b. Spiders are possessed by demons that use demonic power to keep themselves unstuck.

c. A chemical oozing out of the spider's feet won't mix with the web, much the way oil won't mix with water.

d. The hot breath of the spider sends shock waves through the web, temporarily altering its chemical structure and thereby giving the spider the power to walk freely on the web.

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Suppose a scientist wants to determine whether adding solid carbon dioxide to ice water will cool the water below 32 degrees Fahrenheit (0 degrees Celsius). The scientist begins with two glasses containing equal amounts of water at the same temperature. The glasses touch each other. Solid carbon dioxide is added to the first glass, but not the second. The scientist expects the first glass to get colder but the second glass not to. This second glass of water is the control because it is just like the other glass except that the causal factor being tested—the solid carbon dioxide—is not present in it. After twenty minutes, the scientist takes the temperature of the water in both glasses. Both are found to have cooled, and both are at the same temperature. A careless scientist might draw the conclusion that the cooling is not caused by adding the carbon dioxide, because the water in the control glass also got cooler. A more observant scientist might draw another conclusion, that the experiment wasn't any good because the touching is **contaminating the control**. The two glasses should be kept apart during the experiment

[392] Choice (a) is very strange, but the answer is (b). Demons are not supposed to be used in explanations that fit within the current paradigm of biological science. All the other possible answers are probably incorrect explanations, but at least they don't radically depart from the current paradigm.

to eliminate contamination. The paradigm of the science dictates that the glasses not touch because it implies that glasses in contact will reach a common temperature in much faster than glasses not in contact.

For a second example of the contamination of experimental controls, suppose a biologist injects some rats with a particular virus and injects control rats with a placebo—some obviously ineffective substance such as a small amount of salt water. The biologist observes the two groups of rats to determine whether the death rate of those receiving the virus is significantly higher than the death rate of those receiving the placebo. If the test is well run and the data show such a difference, there is a correlation between the virus injection and dying. Oh, by the way, the injected rats are kept in the same cages with the control rats. Oops. This contamination will invalidate the entire experiment, won't it?

Reputable scientists know how to eliminate contamination, and they actively try to do so. They know that temperature differences and disease transmission can be radically affected by physical closeness. This background knowledge that guides experimentation constitutes another part of the paradigm of the sciences of physics and biology. Without a paradigm helping to guide the experimenter, there would be no way of knowing whether the control group was contaminated. There would be no way to eliminate experimenter effects, that is, the unintentional influence of the experimenter on the outcome of the experiment. There would be no way of running a good test. That fact is one more reason that so much of a scientist's college education is spent learning the science's paradigm.

Review of Major Points

When scientists are trying to gain a deep understanding of how the world works, they seek general patterns rather than specific facts. The way scientists acquire these general principles about nature is usually neither by deducing them from observations nor by inductive generalization. Instead, they think about the observations, then guess at a general principle that might account for them, then check this guess by testing. When a guess or claim is being tested, it is called a hypothesis. Testing can refute a hypothesis. If a hypothesis does not get refuted by testing, scientists retain it as a prime candidate for being a general truth of nature, a law. Hypotheses that survive systematic testing are considered to be proved, although even the proved statements of science are susceptible to future revision, unlike the proved statements of mathematics.

Scientific reasoning is not discontinuous from everyday reasoning, but it does have higher standards of proof. This chapter reviewed several aspects of scientific reasoning from earlier chapters, including general versus specific claims, testing by observation, testing by experiment, accuracy, precision, operational definition, pseudoprecision, the role of scientific journals, independent verification, consistency with well-established results, reproducible evidence, anecdotal evidence, a scientist's cautious attitude and open mind, attention to relevant evidence, the scientific method of justifying claims, disconfirming evidence, and the methods of gaining a representative sample.

Deterministic explanations are preferred to probabilistic ones, and ideal explanations enable prediction of the phenomenon being explained. Explanations are preferred if they are testable and fruitful. A good test requires a prediction that is (1) deducible, (2) improbable, and (3) verifiable.

Science provides the antidote to superstition. There are criteria that can be used to detect pseudoscience.

A reasonable scientific explanation is coherent with the paradigm for that science. Only by knowing the science's paradigm can a scientist design a controlled experiment that does not contaminate the controls and that eliminates effects unintentionally caused by the experimenter.

Glossary

ad hoc rescue A fallacy committed by those faced with data that appear to conflict with a claim, when they try to rescue the claim by pointing out how the conflict will disappear if some new assumption is taken into account and there is no good reason to accept this assumption other than that it successfully rescues the claim.

clairvoyance Remote viewing of the world; seeing without being there.

coherence with the paradigm Logical consistency with all the features of a science's paradigm.

contaminating the control A situation that occurs when a supposedly controlled experiment permits the control group to be affected by the suspected causal factor applied to the experimental group.

control In an experiment that applies the suspected causal factor to one group but not the other, the group that doesn't get it is called the control group. The group that does get it is called the experimental group or treatment group. Well-designed experiments create the control group and the experimental group by random assignment.

decisive test A test between two hypotheses that will result in one of the hypotheses being refuted and the other confirmed. Ideally, we would like decisive tests, that is, crucial tests. Practically, we usually have to settle for tests that only tend to show whether one claim or another is false.

ESP Extrasensory perception. A person with ESP can perceive by means other than the usual sense organs. Three main kinds of ESP are telepathy, clairvoyance, and precognition.

experimenter effects Effects on the outcome of an experiment that are caused by the unintentional influence of the experimenter. Contamination of the control would be such an effect.

fruitfulness The ability of a theory to inspire scientists to imagine many interesting ways in which the theory can practically be tested. A fruitful theory generates a great deal of scientific research.

hypothesis A proposed explanation or claim or theory.

paradigm The ways of solving problems in a particular science, including the methods, standards, and generalizations generally held in common by the community of those practicing the science. The paradigm guides the scientific investigator by setting limits on what can be a possible cause of what.

parapsychology The field or research program that tries to scientifically study unusual (paranormal) phenomena such as ESP and psychokinesis.

placebo A substance known not to be effective for causing a phenomenon of interest. In a controlled experiment designed to test whether a drug is causally effective, the experimental group might be given a green liquid containing the drug while the control group is given a placebo, a green liquid that appears to be identical but contains only water.

precognition Sensing the future. Fortune telling is an example.

psychokinesis Giving kinetic energy to a physical object by using "mind power."

rational Pertaining to those who arrive at, accept, and revise their beliefs according to the accepted methods of their culture.

superstition Beliefs based on reasons that are well known *to us* or to our culture to be unacceptable because those reasons are based on fear of the unknown, trust in magic, or an obviously false idea of what can cause what.

telepathy Mind reading; direct mind-to-mind communication without using the normal, indirect channels such as hearing, seeing, feeling, smelling and tasting.

test An observation or an experiment intended to provide evidence about a hypothesis.

theory Either a proposed explanation or else a comprehensive integrated system of laws that can be used in explaining a wide variety of phenomena.

Exercises

1. Suppose that for the last month and a half you've been slightly nauseous. You've had a mild headache almost every day. This illness is something new in your life. Aspirin helps with the headache but not with your stomach. Switching to other pain killers doesn't seem to make a difference. The world and your friends have lately been especially boring, and you don't want to do much of anything except watch TV. Usually you like to munch while watching the tube, but for the last few weeks you've lost your appetite. Your grades are suffering. Create several possible explanations for your illness. How would you go about testing your explanations to see whether any one is correct? [In this scenario, don't merely be passive and call the doctor; you are your own doctor.]

2. Professor William Whewell thought that the aim of science is to discover the works of God. Dr. G. Bell believed that the aim is to acquire specific facts. These days, a more generally acceptable answer than either of these two is that the aim of science is to

a. build technologically useful products.

b. improve our power to predict and explain phenomena.

c. delineate all the known facts of the world.

d. establish the scientific method.

■ 3. Which groups below should you examine before which others if you are trying to confirm or refute the claim that all emeralds are green? Rank them, beginning with the most important. Do not suppose that emeralds are defined to be green.

a. emeralds

b. green things

c. non-green things

d. non-emeralds[393]

4. If there has been a 10 percent drop in the lung cancer rate for black females who smoke cigarettes over the last two years, but not for white females who smoke cigarettes, why should you not yet conclude that cigarettes are now safer for you to smoke if you are a black female? Be specific; don't merely say there could be reasons.

5. Referring back to the Concept Check about Brother Bartholomew's being a successful prophet, say which answers are better than which others and why.

6. Evaluate the quality of the following reasoning and defend your evaluation. Can you suggest any improvements? (100 words)

> Inge has been a regular sun worshipper ever since she was a little girl in Denmark—summer in the pool or on a towel under the sun, spring and fall on the patio with solar reflectors focused on her exposed skin. She was a bronzed beauty, but now, after twenty-five years, two malignant skin cancers have started growing. She says it's the luck of the draw, but I say it's another case of the harmful effects of sunlight. The sun is just like an infrared lamp; if you put something under it long enough, it will fry. She has her explanation and I have mine, so mine is at least 50% correct.

■ 7. Discuss (under 50 words) the following scientific test in regard to the three conditions for a good scientific test, the deduction condition, the improbability

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393 Ranking of groups: (1) emeralds, (2) non-green things, (3) green things and non-emeralds. The most useful group to examine would be the emeralds. Check to see that they are all green. If you can't do that, then check the non-green things making sure you don't discover an emerald in there.

condition, and the verifiability condition. You need not define or explain the three conditions.

> Our hypothesis is that all people have telepathic abilities that occasionally show up during their lives, even though most people don't realize it. If the hypothesis is correct, then occasionally people will be stunned by instances in which they and other persons have the same thought at the same time even though they aren't having a conversation and aren't in any other ordinary contact with each other. Our testing has documented many such instances. Some of them are truly remarkable. We have testimony from a wide variety of citizens who have no reason to lie and who in fact have passed lie detector tests. Therefore, our hypothesis is correct.[394]

■ 8. Which of the following is not a useful principle for making scientific progress?

α. Similar effects are likely to have similar causes.

β. Look for confirming instances of the hypothesis, never disconfirming instances.

χ. To find the cause, look for the key, relevant difference between situations where the effect occurs and situations where it does not.

δ. Divide the problem into manageable components.[395]

■ 9. Suppose your copy of yesterday's newspaper says, "The Detroit Pistons will win their basketball game tomorrow night," and you know that this prediction came true this evening. Prophecy by the sports writer? No, your hypothesis is that the writer is not psychic, and you do not feel obliged to design some experiment to test this. If so, why does good scientific methodology require you to treat the Brother Bartholomew situation mentioned in an earlier section of this chapter any differently?[396]

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394 Doesn't satisfy the improbability condition for a good test. The test result would be likely to occur either way.

395 Answer (b).

396 The sports writer wasn't claiming prophetic powers, but only using the evidence at hand to guess what the future might bring. What the sports writer did is ordinary; the Bartholomew prediction is extraordinary, and extraordinary claims require extraordinarily good evidence. If the story about the Detroit Pistons is true, nothing much turns on that fact, compared with the story about Brother Bartholomew—at least nothing much as far as our

10. Write an essay in which you critically analyze the following claims.

> I am reincarnated. I once was a male slave who worked as a personal assistant to King Tut of ancient Egypt. I can prove it. I happen to know something that only a reincarnated person could know. I know that one of the members of Tut's harem was a dancer who wore special pearl bracelets on each wrist. I documented this fact six months ago by publishing drawings of the bracelets, yet it was only last week that archaeologists dug up the woman's tomb and found the pair of bracelets. Nowhere in Egyptian literature are the bracelets ever mentioned.

In answering, assume that the last two statements have been verified as correct.

11. What is the best example below of the fallacy of ad hoc rescue?

a. Newton deduced Galileo's law of falling terrestrial bodies from his own laws of motion, thereby rescuing Galileo's law from refutation.

b. Newton adopted the particle theory of light even though Huygens's optical experiments showed definitively that light is a wave and not a group of particles.

c. Scientists struggling to explain the odd shape of Uranus's orbit using Newton's law of gravitation suggested that God wanted the orbit to be perturbed in just the ways astronomers observed it to be.

d. The dinosaur extinction hypothesis can be rescued by finding data that would be implied by the hypothesis.

12. Uranium becomes lead in 4.5 billion years, say the scientists. OK, but how do the scientists know this if they have never sat and watched a piece of uranium for that long?

13. What is wrong with the following reasoning?

> According to the dictionary definition of *science*, a science is a body of knowledge amassed in a systematic way. Therefore, because a telephone book and a repair manual both are systematized bodies of knowledge, it follows that they, too, are sciences. Thus, the following is a correct listing of some of the sciences: physics,

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worldview is concerned. If the prophecy part of the Bartholomew story is correct, then science's fundamental beliefs about precognition (seeing into the future) will need to be revolutionized.

botany, repair manual, chemistry, geology, telephone book, astronomy, and anthropology.

14. What is wrong with this as a scientific explanation?

> Rafael dropped the ball because of his carelessness.

15. The passage below was accepted by the Catholic Church as a refutation of the astrological hypothesis that the stars determine every person's destiny. It is from the *Confessions* of St. Augustine, a Catholic saint who wrote in about 400 C.E. (a) Briefly explain why the refutation is a successful refutation, and then (b) alter the astrological hypothesis so that St. Augustine's remarks no longer refute the essential claims of astrology.

> Firminus had heard from his father that, when his mother had been pregnant with him, a slave belonging to a friend of his father's was also about to bear. ... It happened that since the two women had their babies at the same instant, the men were forced to cast exactly the same horoscope for each newborn child down to the last detail, one for his [father's] son, the other for the little slave. . . . Yet Firminus, born to wealth in his parents' house, had one of the more illustrious careers in life . . . whereas the slave had no alleviation of his life's burden.

■ 16. Consider the following test:

I predicted that if mice have been stealing the strawberries during the night from my terraced garden, then they ought to show up on the infrared videotape that I had left running all night. I didn't really expect to get such a good video, but look at this clip. There they are! Look at that one snatching my berries. Will you loan me your hungry cat?

What is the conclusion of the argument that shows the test satisfies the deducibility condition?

a. If mice have been stealing strawberries during the night from my terraced garden, then strawberries should be missing the next day.

b. The videotape will contain parts showing mice taking strawberries from my terraced garden.

c. Mice stole strawberries during the night from my terraced garden.

d. If mice stole strawberries during the night from my terraced garden, then clearly they are the culprits.[397]

17. A science's paradigm is

a. that part of the science's methodology that has not changed throughout the history of science.

b. the normal way to solve problems in the science.

c. a nonstandard way of constructing explanations within the science.

d. the accepted way of revolutionizing the science.

■ 18. Occasionally in disputes about creationism and evolution, someone will say that the theory of evolution is both a theory and a fact, and the opponent will say that evolution is a theory and so should not also be called a fact. Explain this disagreement.[398]

■ 19. The International Testing Service, which tests third- and sixth-grade students throughout the world, recently reported that students at the Shalom Day School, a private school, have been doing significantly better each year for the last five years. Knowing that the tests do give an accurate report of the students' basic skills in reading, writing, and arithmetic, Dr. Julius Moravcsik of the Nashville School System commented that the report evidently shows that teachers at Shalom Day School are doing a better job each year. Justify why this comment could be an example of

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397 Answer (b).

398 The two are using the words theory and fact differently. The first person means by theory a general system of laws, and means by fact that these laws are true. The opponent could be doing one of two things: (i) he or she could mean by theory something that is general and mean by fact something that is not general; and in these senses a theory cannot be a fact, (ii) The opponent could mean by theory something that so far is poorly supported by the evidence and mean by fact something that is known to be well supported by the evidence; and in these senses a theory cannot be a fact. If the opponent is using the terms in sense (i), then the two people are merely having a semantic disagreement; each could easily agree with the other once they straightened out how they are using their terms. But if the opponent is using the terms in sense (ii), then not only are the two persons disagreeing about the meaning of the terms, they are also disagreeing about whether the theory of evolution is well supported by the evidence.

committing the post hoc fallacy. Do so by giving a specific alternative explanation of the improved scores, not by merely stating the definition of the fallacy.[399]

20. Sarah Manring says that her psychic friend has extraordinary mental power. When asked why she believes this about him, Sarah said, "Because once he offered to tell me what I was thinking. He said I had been thinking about having sex with my boyfriend but had decided not to, and he was right." Explain why Sarah is jumping to conclusions about her psychic friend. More specifically, what condition for a good test most obviously fails to hold and thus makes Sarah's test not a good test of the psychic's power?

a. Deducibility, b. Improbability, c. Verifiability.

21. I'm going to test my precognitive powers. I predict that my mother will be calling me the next time my phone rings. Oh, there goes the phone now. "Hello? Mom! Hey, I knew you were going to call!"

Discuss whether all three conditions for a good scientific test apply to this test. That is, is the predicted outcome of the test (a) deducible, (b) improbable, and (c) verifiable?

■ 22. Suppose competent archaeologists have extensively looked for, but not discovered, a trace of an ancient city on a particular island. Suppose Mr. Jones points out this failure to find the ancient city, then mentions the fact that other archaeologists don't dispute the results, and from this concludes that there was no ancient city there. Is Mr. Jones' conclusion probably correct? Why?[400]

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[399] Maybe the teachers aren't doing better but instead the admission standards at the school changed and now only more accomplished students are admitted. Moravcsik should rule out this alternative hypothesis before promoting his hypothesis about the teachers.

[400] Yes, this is fine reasoning. The conditions of a good test were met. The scientists' hypothesis is that there is no ancient city on this island. The deduction condition is satisfied because one can deduce from the hypothesis that, if there were no ancient city, then extensive looking for it should fail to find it. The probability condition is satisfied because it is improbable that they'd find no city if in fact the hypothesis were incorrect and there really was an ancient city there. The verifiability condition is satisfied because it is a straightforward matter to verify that the test came out as predicted, namely with finding no evidence of the ancient city.

23. Write an essay about astrology. Describe astrology and explain how its practitioners believe it works and what evidence they might offer in defense of its success. Use footnotes to indicate the source of your information. By applying some of the five criteria or detecting pseudoscience mentioned in this chapter, create an argument for why astrology is a pseudoscience.

24. Write an essay that responds to the following remark. "Evolutionary theory is both a science and a religion and cannot be conclusively proved. Creation science is no different."

25. Why can't scientists give poorly supported hypotheses the benefit of the doubt, and just accept them? Why the obsessional preoccupation with matters of validation?

26. Francis Bacon said that the way to do science is to clear your mind of all the garbage you've previously been taught, then collect data with an open mind, and after the data is collected the correct interpretation of the data will come to you. Today's philosophers of science say science doesn't work that way. What do you suppose they say instead?

27. Create a four-page essay in which you explain to a high school audience how science works. Use your own knowledge plus this textbook as your primary source of information about how science works, but express everything in your own words; do not quote from the textbook.

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