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Foreword

Four years ago, the CSU Sacramento McNair Scholars Program was in its infancy. The Program goals and objectives had been outlined in a grant proposal, but newly recruited staff members were assigned the task of implementing those ideas. It was a humble beginning for the staff, the scholars, and the faculty mentors. Here, in the first decade of the new millennium, the university was awarded continued grant funding, and a more experienced group of individuals is ready to meet the challenges of implementing new ideas and shaping the future of the CSUS McNair Scholars.

Over the next decade, higher education will experience a 50 percent turnover of faculty. Meanwhile, polls show that 80 percent of the general population believes that a college education is no longer a luxury but a necessity. Through the McNair Program, universities across the nation have an opportunity to shape the face of the professorial ranks. Here at CSUS, we are proud of the group of scholars whose work is represented in this journal. They are a group of intelligent, dedicated, and courageous individuals. Through their efforts and with the support of their faculty mentors, these scholars have been able to take ideas and design original research plans to investigate their topics. It is a feat many of the scholars thought unattainable at the beginning of their McNair experience. However, at the conclusion of their summer research experiences, these scholars now know and understand the perils, excitement, and importance of research in their respective fields of study.

It has been a gratifying process that would not have been possible without the support of the faculty mentors, university administrators, and McNair staff members. The articles in this journal serve as the beginning of a bright future for each and every one of these scholars. We hope you enjoy reading their work.

Chevelle Newsome, Ph.D.
Director
McNair Scholars Program
Parental Investment as a Function of Body Condition in Female Convict Cichlids (Archocentrus nigrofasciatus)

Ameer Thompson

Abstract

Many fish exhibit parental investment behaviour. It has long been assumed that parental investment behaviour would be affected by the parent's body condition. Using the defensive attacking behaviour of female parental convict cichlids, Archocentrus nigrofasciatus, on a predator model, their willingness to invest in their brood given a decline in somatic condition was tested. By decreasing the female's diet, thus degrading her body condition, this researcher found that the number the number of times she bit the model decreased as her body condition decreased.

Introduction

There are over 2,300 species of cichlid fishes, all of which provide some form of parental care (Coleman & Fischer 1991; Fraser, S. A., Wisenden, B. D. & Keenleyside, M.H.A. 1993). The convict cichlid (Archocentrus nigrofasciatus) is a biparental substrate brooding freshwater cichlid from Costa Rica and Nicaragua (Fraser et al., 1993). Under normal circumstances, the female deposits her clutch of eggs on a hard substrate and the male fertilizes them. After roughly three days the eggs hatch into wrigglers, which remain in the nest and cannot swim. Approximately four days later, they become free-swimming fry (Galvani & Coleman 1998), which the parents guard for several weeks until the fry become independent.

All broods, however, do not reach independence; an entire may brood disappear overnight. In the wild, eggs are subject to predation by catfish (Barbieri et al., 1992), and even other cichlids (Okuda & Yasunobu, 1994). An opportunistic predator can consume an entire brood in a matter of minutes. However, this en masse brood loss has also been observed in aquaria where no predators were present, negating the necessity of an outside predator in every case of brood loss. Brood loss may occur at, or prior to, the wriggler stage. In some cases, the male does not properly fertilize the eggs, so development does not occur. (personal communication, Ronald Coleman). In other cases, the parents may cannibalise the offspring or the fry simply die. Although the exact survival rate of an average brood is unknown, most broods do not just disappear. This suggests a mechanism for their demise. The purpose of this paper is
to examine change in parental investment as a possible mechanism of brood loss, and to examine whether a decline in parental investment behaviour can account for some cases of brood loss.

*Parental investment* is "any investment by the parent in an individual offspring that increases the offspring's chance of surviving (and hence reproductive success) at the cost of the parent's ability to invest in other offspring" (Trivers p. 76 1972).

While tending the eggs or fry, fish parents eat less than normal and expend a great deal of energy. For instance, the male pumpkinseed sunfish loses roughly 9% of its body weight during the egg and fry stages of the brood cycle (Coleman and Fisher, 1991). Like the cichlid parents, the pumpkinseed male stations himself close to his nest. When a predator approaches the nest, the male attacks it, and in doing so expends energy. The male may also use energy during other parental investment activities, such as fanning the brood with his fins. Eggs and fry are fragile and vulnerable to predation, so the male rarely leaves the nest unattended. As such, he is unable to forage for food. This poses a problem because he acquires the bulk of his food through foraging. His overall food intake decreases because he only feeds on food that might happen past him. If the male's food intake does not increase to match this difference, his body condition will continue to decline. The affect of body condition on parental investment is uncertain (Budaev, Sergey, Zworykin, Dymitry, Mocheck, Andrei, 1999).

One way certain species of fish invest in their offspring is by defending them against predators (Wisenden & Keenleyside 1994). In cardinal fish (Apogon notatus), a female lays her eggs in a male's mouth. The male carries the eggs while the female is primarily responsible for defence of their territory. The female experiences a greater degree of body loss than the male does, suggesting the net influence of egg production and brood defence leads to a loss of body condition (Okuda 2000). Cichlids have similar parental investment patterns, and, thus, likely experience similar loss of body condition. It is predicted that the female parent's investment will decline due to her loss of body condition.

This experiment measures parental investment in terms of attack behaviour as the female's body condition declines. Parental investment behaviour theory dictates that the female will act to maximize her reproductive success. Given her body condition, the female will decide how to maximize her reproductive success through investment in her offspring. She will likely invest according to either previous investment in her current brood or expected future reproductive success.
Under normal circumstances, a parent will invest in its current brood. Because the brood has already hatched and survived, the female has obtained a certain degree of reproductive success. The amount of parental investment to that point has been enough to sustain the brood, thus continued investment in the current brood will likely see them grow to maturity, reproduce, and pass on the parent's genes.

However, under some conditions, the parent's level of investment declines. It can be said that she is investing according to her expected reproductive success. This will likely occur under less than ideal conditions, because it involves a degree of uncertainty. In order for her gamble to pay off she must find another mate, lay more eggs, and raise them to maturity, all of which requires energy and time. She must also live long enough to reproduce again. If the female is able to mate again, her reproductive output may not be what she expected. All of these factors make investing in future reproductive success a less certain option.

If the female continues to invest the same amount of energy as her body condition declines, then investing in her current brood increases the likelihood of her genetic success. The chances of raising the current brood to maturity are greater than the chances of producing another brood. In this sense, present investment is favoured over expected future reproductive output. It can be expected that she will continue to attack even at great personal (physical, energetic, somatic, etc.) detriment. In so doing, the likelihood that her genes will survive through the reproductive success of her current offspring increases.

If the female's overall investment behaviour declines, then she likely values her expected future reproductive success. Despite all of the aforementioned risks, she expects that her chances of producing a new brood are better than her chances of raising her current brood to maturity. By decreasing her attack behaviour she conserves energy, thus slowing the rate of somatic decline. That conserved energy can be used to produce another brood.

There is also the possibility that the female will cannibalise her entire brood (Manica 2002, Lavery & Keenleyside 1990). By eating her brood, she recuparates some of the energy lost in producing them (Yanagisawa & Ochi 1991). Because they have the same body composition, the female obtains all of the necessary nutrients from eating her fry. Since there are no longer fry to invest in (i.e., protect from predators), she need no longer expend energy defending them. As such, she is no longer bound to her nest, and she is free to again forage for food (Yuma, Narita, Hori, Kondo, 1998). This increases the chance of finding food, thereby improving her somatic
condition, and her likelihood of reproductive success (Chellapa and Huntingford 1989). In the wild, the female might abandon her brood (Jennison & Polakow, 2001), but she would resort to cannibalism if the odds of them surviving are zero.

Rationale

It is unknown whether a relationship exists between the female convict cichlid's willingness to invest in her brood relative to her general body condition, and whether this relationship will affect brood loss. Although there has been much speculation as to the mechanism of brood loss, few empirical studies have focused on the influence of body condition using parental investment theory framework. Furthermore, few studies have considered the relationship between brood loss, in terms of parental investment, as a function of the parent's body condition. The purpose of this study is to determine if such a relationship exists, and if so, how the parent's investment behaviour compares to that of a typical parent.

Problem Statement

The vertebrate life cycle consists of a basic, predictable pattern. It starts when an organism gives birth to offspring. The offspring grow and develop, eventually reaching a point of sexual maturity. They mate, and give birth to other offspring, then eventually die, leaving the offspring to carry on their genes. In order for this cycle to continue, offspring must thrive. It is in a parent's best interest to do what it can to ensure that its offspring survive long enough to pass on their genetic traits. The very purpose of reproduction is to create offspring who will carry on the genetic traits of their predecessor. Logic dictates that a parent will act to ensure the likelihood of its offspring's survival, thus increasing the probability of their future genetic success. The parent would have to have some grand compelling reason to not invest in her offspring. This experiment is important because it seeks to understand why an organism would intentionally disrupt this cycle, seemingly ignoring its biological imperative.

Research Design

The experiment uses ten replicate aquaria, numbered 1-10. Each tank has three plastic plants, which provide the female with a sense of security. The back and sides of the tank were covered with white cloth, while the front panel is left uncovered in order to allow the experimenter a view of the fish. Approximately two centimeters (cm) of gravel was placed in the bottom of the fish tank. A small, bottomless, terra cotta pot was placed, lying on its side, in the centre of the tank, providing a substrate on which the female could spawn. The colour contrast between the eggs and the pot
also made the eggs easy to see.

Ten similarly sized females were weighed on an electronic balance (grams) and measured (standard and total length in millimeters) with callipers. Because there is a direct correlation between clutch size and body size (Galvani, & Coleman, 1998), the experiment used females of similar size and weight. For record keeping purposes, the males were weighed and measured, though this data had little relevance, as the males were removed prior to testing. One pair of convicts was placed in each tank and observed daily until they spawned.

During the pre-spawning period, a standard food ration was fed daily to each tank. For consistency, the day the pair spawned was denoted as day one. On day two, the male was removed from the tank. Because parents share the responsibility of raising the fry, it is safe to assume that both parents exhibit investment behaviour. If the male were left in the tank he would defend against the model as well. The pair splits the energetic cost of defending the brood, reducing the energetic stress to either party. By isolating the female’s behaviour, it is possible clarify how much she is willing to invest when she is forced to shoulder the burden of single parental investment, given the added energetic cost.

Each of the ten tanks was randomly assigned to one of two groups. Group one was designated as the control treatment and group two as the experimental treatment. After day one and through the duration of the experiment, the control treatment continued to receive a standard amount of food while the experimental treatment received a reduced food ration. In the wild, cichlid parents are not able to forage while defending their brood. Reducing their food ration simulates the expected dietary reduction due to this inability to forage for food. It was not necessary to control for the disturbance experienced during feeding. Both tanks experienced similar disturbance (person standing in front of the tank, dropping flakes into the water), so this did not skew the results.

Of the ten tanks, seven of the pairs spawned in time to be included in this study. Three of the tanks were in the control treatment, while the other four were in the experimental treatment. Each of the seven broods was reduced to a standard size of 100 eggs. Manipulation of a brood can introduce other variables into the experiment, such as the female’s willingness to invest when her brood size is lower than expected relative to her body size (Galvani & Coleman, 1997). If the brood size is reduced too much, the female will abandon it (Lavery & Keenleyside 1990). If the brood reduction number is too high (i.e., 200 eggs), a smaller female may not lay enough eggs to reach the preset limit, and she could not be included
in the experiment. This was not an issue because all of the females will be similar in size and thus should have similar expected brood sizes.

Testing of the female's willingness to defend will begin on day seven. A picture of a nonconspecific brood predator (Lamprologus moori) attached to a plexiglass handle served as the model (Coleman, et al., 1985). The model was placed in the tank and moved in a figure eight pattern for thirty seconds, and the number of bites to the model were counted and recorded. After testing, the model was removed for thirty seconds, and then placed back into the tank. The experiment did not use a model of a conspecific cichlid because the female may mistake the model for a mate. The female's attack behaviour can be assessed and quantified based on the number of hits to the model. The greater the number of hits on the model, the more the female attacks, and thus the greater her willingness to invest in her brood (Thompson et al., in prep).

Testing continued for five days. At the end of each testing day, the females were fed, and their tanks were inspected for the presence of fry. To prove that there was definite loss of body condition, the females in both treatments were weighed at the end of the experiment.

Variable Specifications

The independent variable for this experiment was the amount of food given to each treatment. The only manipulated difference in this experiment was the food ration. The control treatment received a standard food ration, which remained constant throughout testing. The experimental treatment received a normal food ration until the time they spawned. Afterwards, they received a reduced food ration.

The dependent variable for this experiment was the average defence score for each fish. The defence score is defined as the number of times the fish bites the model. Weight loss was also a variable, though it was noted only to show a difference between the two treatments.

Sampling Methods

One way a fish parent invests in its offspring is by defending them against predators. This defence can also be interpreted as attacking, because the parent must willfully attack the predator. It has been shown that convict cichlids will attack a synthetic mock-up of a predator the same way as they would attack a real predator (Coleman, et al., 1985). Because of the cost associated with defending a brood against a predator (i.e., energy used to strike predator, danger involved in combat, etc.), attack behaviour is a direct function of the female's willingness to invest in her brood. This experiment used attack behaviour to quantitatively gauge a female's willingness to invest
in her brood by counting the number of times the female strikes a model in a given time interval. For each female, the number of bites on the model over five days were totalled and averaged. This was her defence score. The five defence scores from each treatment were also be totalled and averaged. This gave the average willingness to invest of both a female with a normal diet and a female with a reduced diet. A non-paired t-test was used to show whether there was a significant difference in the attack behaviour of the two treatments.

Procedure
1. Place the model in the tank.
2. Move the model about in a small figure-eight pattern.
3. Continue for 30 seconds.
4. Count the number of times the female attacks (bites) the model.
5. Remove the model for 30 seconds.
6. Repeat steps 1-4 once.
7. After testing to check for presence of fry, observe tanks for five days.

Data Analysis

**H1:** The female's investment behaviour will decline as her body condition declines. She values the possibility of future reproductive success over the amount she has invested in the current brood. The data will show that the average defence score of the reduced food treatment will be lower than the defence score of the control treatment.

**H2:** The female's investment behaviour will remain the same as her body condition declines. She values her previous investment in her current brood over the possibility of future reproductive success. Despite her physical decline, she will continue to invest in her offspring in hopes that they will live and pass on her genes. The data will show that there is no significant difference in the average defence scores between the experimental treatment and the control treatment.

**H3:** The female's investment behaviour will not only decline as her body condition declines, but she will also consume her entire brood. She values the possibility of future reproductive success over the amount she has invested in the current brood. In order to minimize her current energetic losses and maximize her future reproductive success, she will replenish her body condition via brood consumption. In the wild she would abandon the brood. However, in aquaria, abandonment is not an option. The data will show a dramatic decrease in the average defence score of the experimental treatment due to the lack of offspring.
Results

Of the ten original tank pairs, only seven spawned in time to be included in this study. Three of the tanks were in the control treatment and the other four were in the experimental treatment. To test the female's willingness to invest in her offspring, the average defence scores of both the control and experimental treatments were compared. If the females with decreased body condition invested less in their offspring, one would expect a lower average defence score compared to the defence scores of the control group.

Each female was tested for a total of five days. At the end of the five-day testing phase, the total per day number of bites to the model were totalled for each female. To derive the defence score, that number was divided by five (i.e., the number of days in the testing phase). The average defence score for the control treatment (N control = 3) was 84.7, while the average defence score of the experimental treatment (N experimental = 4) was 48.2. A two-tailed, non-paired t-test, assuming unequal variances, found that difference between the two results was significant (P=0.046).

While the defence scores of each female in the control treatment varied little, the defence score mean of each female in the experimental treatment varied greatly. However, in every case, the defence score of the control treatment was higher than the defence score of the experimental treatment. It is clear that the females with decreased body condition invested less in their offspring than did the females with more provisions, and thus better body condition.

Discussion

This experiment shows that under certain circumstances the female will invest less in her offspring than one might normally expect. The females who experienced a greater degree of body condition loss due to provision deprivation were less apt to invest in their offspring. Conversely, the females who experienced a lesser degree of body condition loss were more apt to invest in their offspring.

It is important to realize that parental investment is not an all or nothing proposition. There exists a series of trade-offs. The parent must decide how best to invest her energy in order to increase the likelihood of the passage of her genetic traits through the survival of her brood. The female will not simply choose to invest or not to invest. She will pick and choose between the two. Under these experimental conditions, she decided how best to invest given her loss of body condition. The female must choose how much or how little to defend her offspring. If she defends too much, she runs the risk of expending too much energy, thus leaving herself
and her offspring vulnerable to predatory attack. If she defends too little, then she increases the likelihood that a predator will eat her brood. In either case, if the correct trade-offs are not made, the female decreases the chance that her brood will survive.

Limitations

This experiment is limited primarily by time and nature. Ideally, a larger number of samples would be used in both the experimental and control treatments. One of the problems with using live specimens is that one is invariably at their mercy. Though the experimenter can exercise a certain degree of control over the situation, at some point one can only sit back, cross one's fingers, and wait for nature to do what nature does best. In that sense, there are infinite permutations that can limit the effectiveness and scope of a study. In this experiment, the fish did not spawn in a timely manner.

Another problem faced in this experiment was controlling the aggressiveness of the subjects. The very characteristic that makes convict cichlids valuable to science is the same characteristic that makes them difficult and unpredictable. This experiment exploits the aggressive attack behaviour of parental convict cichlids. When a parental convict cichlid is confronted by a predator, they attack—vigorously and repeatedly. Unfortunately, this aggression is not limited simply to parents. Convict cichlids are also remarkably territorial. When another fish enters their space, they will attack it. Though this attack is less consistent, it can have deadly consequences. Of the first five tanks in the experiment, three of the males killed their potential mate. Future experiments should consider the size ratio of the male and female, as males are less likely to attack a moderately-sized female versus a small female.

Another point to consider is the survival rate of the offspring. This experiment tests the female's willingness to invest in her offspring. It does not, however, shed light on whether or not that investment directly correlates to the survival rate of a brood. Future experiments should count the number of fry that hatch at the beginning of the experiment, to the number of fry that survive the experimental phase. This would show what bearing the female's willingness to invest has on the survival rate of her brood. If the female invests less, one would assume that the fry are less likely to survive. However, in aquaria, these results may vary (Lavery & Kieffer 1994), as there are fewer threats to the fry's survival, namely the absence of a predator.
Conclusion

The defence score is an indicator of how much the female is investing in her offspring. If she does not invest the right amount of energy, she decreases the likelihood that her offspring will survive. Attack is one way to quantify her investment, though it should be noted that attacking is only one way that a fish parent invests in its offspring. Other investment activities include such behaviours as fanning.

Further examinations of the brood loss phenomenon should take into account the health of the fry. An experiment such as that might control for the food available to the fry instead of the food available to the parent. However, this presents a logistical hurdle in that it is hard to control what fry eat, or even what food is available to them. In this experiment, the parent's diet was easily controlled. The food flakes fed to her were too large for the fry to eat, yet small enough that she could consume it all in one fell swoop, thus decreasing the presence of free-floating food particle. The parent was allowed complete access to food without competition.

The difficulty in such an undertaking is the ability to control the fry's diet. To control the diet of the fry while keeping the parent's diet constant would be hard. Fry can survive on small food particles that collect on gravel, the sides of the tank, as well as the filter. Fry can also survive on algae, which grows rapidly in aquaria.
References


In Search of a Rulebook: A Content Analysis of Academic Debate Judging Philosophies

Jessica Gordley

Abstract

Academic debate has no codified set of rules, but academic judging philosophies may provide insight into the subjective rules and norms that are communicated to debaters. Through a content analysis of the 2003 Cross Examination Debate Association (CEDA) National Judging Philosophy Booklet, this study examined judges’ argument preferences pertaining to two relatively new types of argumentation: critiques and performance. Findings revealed that more judges indicate a preference towards both critiques and performance than do not, so long as their reservations are met. Findings show that the relationship between critique preference and geographic region a judge is from is statistically significant. However, findings indicate that years of judging experience and sex of the judge do not have a statistically significant relationship to argument preference for critiques or performance. This research contributes to a better understanding of judges’ argument preferences and the way demographics relate to those preferences.

Introduction

What do Lyndon Johnson, John Kennedy and Richard Nixon all have in common? Most people quickly recognize them as former U.S. presidents. However, they also share another common tie. They were all former debaters. Although research has not substantiated a correlation between participating in academic debate and becoming a U.S. president, academic debate has been praised for its many benefits.

There are many areas of research within debate that can contribute to a better understanding of the community that surrounds this activity. Recent research has highlighted and critiqued the exclusive nature of intercollegiate debate, noting that instead of offering the benefits of participation to all college students, those benefits are often realized by only a select few. Researchers have increasingly begun to gain a better understanding of ways that the community can operate to foster inclusiveness. One area that has yet to be thoroughly explored is how the subjective rules of the debate community contribute to an exclusionary environment. This study will be the first step in filling this gap.
There is no rulebook in debate; no single statement of community norms exists. Wood (1992) notes the various failed attempts to "codify a set of rules to govern the activity" (p. 70). Today, the artifact that comes closest to laying out community guidelines for argumentation can be found in one of two annual judging philosophy books. These philosophy books are distributed to debaters who participate in one of the two national tournaments, and are geared towards helping debaters and coaches better understand which arguments judges prefer. Individual judging philosophies that appear in these books communicate individual preferences about debate. Combined, these philosophies can be used to describe what is valued as argument by the community at large. This knowledge can be a useful tool in the broader discussion of what debate offers, and to whom it is offered.

This study will examine judging philosophies of the intercollegiate policy debate community, and describe argument preferences as represented by those philosophies. This study will first describe preferences concerning areas of argument such as critical theory and performance, which have yet to be thoroughly explored. A second goal of the study is to discover whether the discussion is altered when other variables are considered in this context. This will be achieved by examining demographic variables of geographic region, years of experience, and sex of a judge.

**NDT and CEDA**

Over the past 55 years, there have been many changes in the world of academic debate. In 1996, the NDT, the oldest intercollegiate debate organization, and CEDA, the largest intercollegiate debate organization at that time, moved to an era of a *shared topic*. Each year debaters are given one topic that requires them to conduct research in that area, identify a problem of some significance, advocate a policy solution for that problem when affirmative, or argue against the affirmative policy solution when negative. For example, in 1996/1997, the topic called upon affirmative teams to advocate for substantial increases in environmental regulations on industries. For 2002/2003, debaters were called to advocate the accession or ratification of an international treaty. The two organizations that were at one point quite different are today very similar. The majorities of schools are now members of NDT and CEDA, and attend tournaments sanctioned by both. CEDA offers an opportunity for greater numbers of inclusion because any school that is a member can have two-person teams represented at the national tournament, while the NDT offers a source of prestige for the 78 teams that qualify to compete at its national tournament. In order to qualify, a two-person team must be invited by the organization,
win a slot at a regional qualifying tournament, or petition to be invited based on a high win-loss ratio at tournaments over the year.

Although there is no longer an ideological split in what constitutes intercollegiate debate along organizational lines, there still remain great inconsistencies amongst members of the debate community. Wood (1992) described the lack of formal rules in academic debate, and argued that what existed instead was a confusion of norms. Judges often define these norms. Debate is a competitive activity where judges determine who wins debate rounds (and therefore tournaments) and speaker awards. At the end of each debate round the judge determines one winner, and the judge's decision is final. Those debaters with the best records go on to compete in a series of elimination rounds. The process is organized similarly to basketball playoffs, where teams with the best records compete against each other until the final round where a champion is declared. In addition to rewarding the top team, debate tournaments also reward the top speakers. Judges give debaters points and the debaters with the most points are recognized. Wood argues that meeting the expectation of judges can be crucial to winning debate rounds and points, and that judges therefore have "enormous power… to shape the activity" (p. 72).

The primary way judges' expectations are communicated is in a judging philosophy. While judges remain willing to orally tell competitors their philosophies, there is increasing reliance on written statements, which detail judges' preferences on issues relating to evaluation of various argument choices. The best collection of judging philosophies can be obtained by attending either the CEDA or NDT national tournament. As stated previously, most programs have judges represented at both tournaments, although with the lower numbers of participation at the NDT, there will be judges representing schools at the CEDA national tournament that will not qualify for the NDT.

Literature Review

Literature that describes both the benefits of intercollegiate debate and the limitations of the current environment is increasingly prevalent. However, there is a relatively limited body of research concerning debate judging philosophies. To provide a foundation for this research, prior studies will be examined and discussed in terms of judging philosophies, forms of alternative argumentation, and demographic variables.

Chemerinsky (2001) highlights some of the benefits associated with academic debate including travel, friendships, and development of speaking skills, research skills, and audience adaptation. Ziegelmueller (1996) describes academic debate as an educational activity that has been praised
for cultivating analytical and argumentation skills among participants. The skills debaters acquire prove beneficial not only in debate competition, but also in academic and future career success.

Recent research has focused on who is able to access the benefits associated with academic debate. Ziegelmueller (1996) notes that, in recent years, debate has been condemned for its "elitism and promotion of rapid, aggressive patterns of communication" (p. 143). Panetta (1990) argued that the specialized nature of policy debate was partially at fault for declining rates of participation of those without prior high school debate experience. Wade (1996) highlighted the need for a shift to occur in debate, arguing that current research concerning participation in debate, and specifically in awards, "reflect an institutional system which is overwhelmingly populated with one type of student, the affluent, white male, in an educational system which urgently needs role models from different groups to meet the demographic and pedagogical requirements of the future" (p. 41).

These authors argue that there are benefits of debate as an activity, but that as it stands, it has failed to achieve a level of inclusiveness needed to extend those benefits to the diversity of students that exists today. Research that contributes to understanding academic debate in general, and participation patterns in particular, is important given the potential benefits of academic debate (Wade 1996).

Judging Philosophies

In the absence of a single rulebook for debate, debaters have often drawn on existing rhetorical strategies to formulate arguments, with judges engaging the same for evaluating arguments. Whedbee (1992) argues that Richard Whately's concept of presumption "has played a pivotal role in academic debate" (p. 25). Presumption, he argues, "gives debaters a clear sense of what types of arguments they must make, and it also provides judges with a standard for evaluating the arguments and rendering a decision" (p. 25). Although presumption was long used in debate as a sort of tie-breaker, where the negative team defending the status quo was presumed to be the best (and therefore winning) option unless the affirmative successfully proved otherwise, this is not necessarily so today.

Burnett (1992) noted the shift that was occurring regarding the application in academic debate, and suggested "students and teachers can be active participants in the creation and application of debate theory and the subsequent alterations of debate practice" (p. 37). In today's academic debates, presumption is rarely debated, and rarely utilized as a standard of evaluation. More often, rules are subjectively offered via judging philosophies, and with various levels of success, are interpreted by coaches.
In 1974, prompted by the first booklet compiling judging philosophies, Cox engaged in the first academic study of judging philosophies. This original article examined judges’ attitudes on a set of questions they had responded to in their judging philosophies. These questions included areas of paradigm, topicality, inherency, conditional counterplans, and rate of delivery. Paradigm deals with how judges perceive their role in the debate, such as a policy maker or educator. Topicality asks whether an affirmative team is addressing the agreed upon topic. Inherency asks what status quo barrier exists. Conditional counterplans are a negative strategy of offering, but not advocating, another way to solve the problem. Rate of delivery concerns itself with judges' varying preferences for how fast a debater speaks. As there was no prior data for comparison, the Cox study primarily served to describe the existing set of assumptions amongst the selection of judges.

In the fifteen years following the Cox article, literature is scarce. In 1986, CEDA held its first national tournament, and beginning in 1987, philosophy books were distributed. In 1989, Brey reviewed philosophy statements for the first two years. At the time, CEDA debate and NDT were ideologically different. CEDA topics were generally value oriented, as compared to the NDT topics, which were generally policy oriented. Also, the amount of preparation necessary to compete successfully in the NDT usually forced a choice by institutions and programs to participate in only one of the organizations. As the organizations were so different, no comparison was made in the two studies. Instead, Brey used the Cox study as a model to describe the CEDA philosophies.

Pettus (1991) argued that given the significant lapse in time since the Cox study, it was necessary to evaluate more recent judging philosophies. Pettus noted that there was a shift in the format of written judging philosophies that now focused more broadly on issues instead of answering specific questions. Pettus offered not only a description of judging philosophies at the NDT in 1988, but also compared the assumptions they contained with those that Cox had reviewed.

Alternative Argumentation

Hynes (1996) described a shift in intercollegiate debate that emerged with the introduction of critical theory into debate rounds. Debaters began using authors, such as Kant, Foucault, and Derrida, to make arguments about the very assumptions that affirmative policies were based upon. This new form of argument sought to question these assumptions prior to engaging in questions of policy actions. For example, on the environment and debaters.
topic debaters would argue that environmental policies are anthropocentric in nature. Furthermore, the very nature of these anthropocentric policies was at the root of not only the specific environmental harms the affirmative sought to solve for, but all environmental harms. The negative would insist that until those assumptions were addressed, no policy should be implemented. They would also argue that debate is not about making policies, but rather about advocacy, and the judge should in turn reject advocacy of flawed assumptions. This form of argument was very different from more "traditional" arguments because the reason not to vote affirmative was no longer because the other debaters advocated a policy that caused harms, but rather because the assumptions behind the policy were ideologically flawed. Hynes suggested that the process of introducing new types of argument within academic debate would "continue to unsettle the norms and rules of debating" (p. 160).

The most recent shift in debate has included the development of yet another type of argumentation. In both discussions and judging philosophies, this new type of argumentation is referred to as "performance" or "performance debate." Within the community these terms are emotionally charged. There are those who label this type of argument as "performance" in attempt to distinguish it as something different from debate. Some members of the community argue that not only is this type of argument without value, but that those who wish to pursue it do not belong in the activity. Others reject the term, or attempt to utilize it as a way of defining a type of argument that is as valid as topicality or counterplans.

There is no all-encompassing definition of what constitutes a performance debate. This is perhaps due, in part, to the rapid expansion of this style of argument. To date, debate teams that have engaged in performance debate have used film, music, poetry, pantomime, dance, and skits to advance arguments. For example, on the treaty topic, one team engaged in an internal dialogue representing two competing voices within a person's mind. These voices debated about whether the United States should join the International Criminal Court (ICC). The team would answer arguments against the ICC through their dialogue. Another team played music and rapped a story from a death row inmate as part of their argument for why the United States should join a treaty to abolish the death penalty. Arguments that utilize performance are at times explicit, but more often are implicit, relying on metaphors and the judge's own subjective interpretation. Some teams advance all of their arguments through performance, while others interweave traditional claim and evidence based
argumentation.

At the 2002 CEDA tournament, judges were asked to include preferences concerning this form of argument (which some contend is not argument) in their judging philosophies. As this area of argument is still developing, to date, the 2002 and 2003 philosophy books contain the bulk of available information on this topic.

**Demographic Variables**

The existing literature on judging philosophies addresses demographic variables such as geographic region and years of coaching experience (Pettus, 1991), and noted variations along these lines. For example, in the middle experience category (6-10 years), judges were less likely to specify a judging paradigm, and when specifying were less likely to be policy makers. Judges from the Midwest were far more likely to warn debaters about evidence falsification. These variables were noted, but little discussion occurred as to possible causes or consequences of these variations.

Other research concerning argumentation in general and academic debate in particular, has begun to focus on issues related to race, sex, and gender. Stepp (1997) notes, "demographic academic debate research conducted during the past twenty years indicates that our community has not kept up with the changing college population, nor does it reflect our future workforce. Women and minorities have missed opportunities to prepare for participation in the public sphere through intercollegiate debate" (p.176). Stepp further argues that academic debate culture privileges white males. Palczewski (1996) examines how sex and gender affect the argument process stating, "feminist critiques of rhetoric and argument present the possibility of recognizing that at least two forms of argumentation exist" (p. 165). To date, research that links demographic variables of race, sex, and gender with argument preferences has not been published, nor has the role of gender in relation to performance as argument been explored.

**Rationale**

Pettus (1991) argued that the time lapse was sufficient to warrant revisiting judging philosophies to trace trends in debate theory. Given the similar time lapse since study in this area, the lack of literature on alternative forms of argumentation, and the possibility that argument preferences have shifted, it is necessary to once again examine judging philosophies in academic debate.
Research Questions

The content analysis for this study asks whether, based on the text of each philosophy, a judge indicates a preference for the following types of argumentation: critiques and performance. These two variables will further be divided into four categories. Once each of the two types of argumentation is coded as "yes", "yes with reservation", "no", or "no mention", the results will be used to explore whether a relationship exists between argument preference and the following variables: geographic region of the judge, years of experience coaching/judging, and sex of the judge.

Critical theory/critiques and performance represent recent shifts in the types of argumentation available to college debaters. Literature indicates that this shift has unsettled the existing norms of the debate community. However, research has yet to establish judges' current attitudes toward this type of argumentation. Therefore, the following questions are asked:

RQ1: Do judges indicate differing preferences on critiques?
RQ2: Do judges indicate differing preferences on performance?

In addition to differing preferences on critiques or performance, this study recognizes that differing reservations may also exist. This study hopes to better understand what preferences judges have, including a more in depth view of their reservations concerning critiques and performance. Therefore, the following questions are asked:

RQ3: What reservations do judges identify where critiques are concerned?
RQ4: What reservations do judges identify where performance is concerned?

In prior research, the geographic region of a judge has been found to be related to the judge's argument preferences. Pettus (1991), for example, noted that judges from the Midwest were more likely to warn debaters about evidence falsification. Research has yet to establish whether the geographic region of a judge is related to a judge's preference, where critiques and performance are concerned. Therefore, the following questions are asked:

RQ5: Is a judge's preference on critiques related to the geographic region of the judge?
RQ6: Is a judge's preference on performance related to the geographic region of the judge?

In prior research, years of experience of a judge have been found to be related to the judge's argument preferences. For example, Pettus (1991) noted that judges in the middle experience category (6-10 years) were less
likely to specify a judging paradigm. Research has yet to establish whether these demographic variables are related to a judge's preference where critiques and performance are concerned. Therefore, the following questions are asked:

**RQ7:** Is a judge's preference on critiques related to the judge's years of experience?

**RQ8:** Is a judge's preference on performance related to the judge's years of experience?

Literature has begun to explore the relationship of sex and gender to various aspects of debate. Palczewski (1996) suggests that feminine ways of knowing (often exhibited in Western culture by females) may increase how many forms of argument are perceived. The relationship between sex and argument preference expressed in a judging philosophy has yet to be explored. Therefore, the following questions are asked:

**RQ9:** Is a judge's preference on critiques related to the judge's sex?

**RQ10:** Is a judge's preference on performance related to the judge's sex?

**Methodology**

This study employs a content analysis to interpret the 2003 CEDA national tournament judging philosophies. A coding sheet is used to analyze judging philosophies. The 2003 CEDA judging philosophy booklet contains philosophies from 165 judges. Each judge is required to write a philosophy detailing information relevant to how they judge debates. Any judge who does not complete a judging philosophy prior to the tournament is not eligible to judge. The philosophies are generally one–half of a page to one page in length. Judges typically include information about their argument preferences, including which types of argument they find the most persuasive, and those that they find the least persuasive.

**Variables**

Critical theory arguments include arguments referenced as "critiques", "kritiks", "the k", or by critical authors (such as Zizek, 2002 or Hooks, 2000). Preference for critiques was coded, with one of four options selected, as outlined above. Where a judge was coded as "yes, with reservations", the researcher(s) also coded the type of reservation(s) that applied to that judge. Twelve reservations were coded, and a judge was coded for all that applied. For example, a judge who said that a criticism must also have an alternative that solves for the criticism was coded as "yes, with reservation", and reservation three was marked.

Performance arguments include those arguments that integrate film,
music, poetry, pantomime, dance, skits, or other "non-traditional" forms of evidence/ justification. Where a judge referenced the type of argumentation as "performance" or by one of the indicators listed above, the researcher coded the preference, with one of four options selected, as outlined above. Where a judge was coded as "yes, with reservations", the researcher(s) selected the reservation(s) that applied. Eleven reservations were coded, and judges were coded for all that applied.

Demographic variables were coded for each philosophy using the self-reported information on each of the philosophies for years of experience. Years of experience were evenly divided into three categories: new (0-2 years), middle (3-6 years), and old (7 or more years). Sex of the judge was obtained by the researchers identifying the sex of the judge based on personal knowledge of the judges. Finally, using the school affiliation listed on the philosophy, each philosophy was subdivided into five geographic regions: East, Midwest/Central, Northwest, South, and West. These geographic regions were determined by combining CEDA competition regions.

**Coding Sheet**

Each of the two types of argumentation were coded as "yes", "yes, with reservation(s)", "no", or "not mentioned". In this study a preference does not necessarily indicate that a judge prefers one type of argumentation to others, but rather that he or she is receptive to the type of argumentation and would vote for it. A preference with reservation indicates that a judge is receptive to the type of argumentation, and would vote for it providing certain reservations are met. A preference coded as no indicates that the judge either would not listen to the type of argumentation or that they would not vote for a team advancing arguments of that type. The final coding indicates that the judge did not mention anything about the particular type of argumentation, not that no preference exists. The data collected was used to explore whether a relationship exists between argument viability and the following variables: geographic region, years of experience coaching/judging and sex of the judge.

**Reliability**

This study utilized a method of analysis similar to that used by Cox, Pettus, and Brey. Two researchers evaluated 40 of the judging philosophies in terms of the research questions and variables described in the prior section. Once 40 of the judging philosophies had been coded as outlined above, intercoder reliability was established by a percentage of agreement. The ratio of agreement between coders was greater than .70 for all items.
Findings/Results

RQ1 asked if judges indicated differing preferences on critiques. For these data a chi-square test indicated that the preferences differed significantly $(3, N = 165) = 117.21, p < .001$ (see Table 1). These data show that 82% of judges in some way indicate a preference for critiques, 59% of whom also indicate at least one reservation.

RQ2 asked if judges indicated differing preferences on performance. For these data a chi-square test indicated that the preferences differed significantly $(3, N = 165) = 157.79, p < .001$ (see Table 2). These data show that 65% of the judges did not mention a preference where performance was concerned, and that only 2% indicated that they would not listen to or would not vote for performance.

RQ3 asked what reservations judges identified where critiques were concerned. For these data, all of the reservations were significant such that a greater number of the judges did not identify a reservation (see Table 3). The top reservation, identified by 17% of the judges that had been coded as "yes, with reservation", was that critiques have clear explanations $(N = 97)$. The second most common reservation, identified by 28% of the judges, was that the debaters identify a unique, specific, or clear link $(N = 97)$. The third most common reservation, identified by 12% of the judges, was that teams advancing a criticism also advocate for an alternative to their criticism.

RQ4 asked what reservations judges identified for performance. For these data, all of the reservations were significant such that a greater number of judges did not identify a reservation (see Table 4). The top two reservations, identified by 20% of the judges that had been coded as "yes, with reservation", were first, that teams engaging in performance defend the resolution (topic) or have a plan as part of their advocacy, and second, that their performance include a clear explanation $(N = 41)$. The third most common reservation, identified by 12% of the judges, was that teams identify the role of the judge or ballot.

RQ5 asked if a judge's preference on critiques was related to the geographic region of the judge. For these data a $2 \times 4$ chi-square test indicated a significant two way interaction such that $(12, N = 158) = 21.6, p = .042, V = .21$ (see Table 5). The significant two-way interaction was due to a greater frequency of region east judges who indicated a preference for critiques than those in the west.

RQ6 asked if a judge's preference on performance was related to the geographic region of the judge. For these data, a $2 \times 4$ chi-square test indicated that there was not a significant two way interaction, $(12, N = 158) = 11.13, p = .52$. 
RQ7 asked if a judge's preference on critiques was related to the judge's years of experience. For these data a 2 x 4 chi-square test indicated that there was not a significant two way interaction, (4, N = 117) = 1.54, p = .82.

RQ8 asked if a judge's preference on performance was related to the judge's years of experience. For these data, a 2 x 4 chi-square test indicated that there was not a significant two way interaction, (6, N = 117) = 5.23, p = .51.

RQ9 asked if a judge's preference on critiques was related to the judge's sex. For these data a chi-square test indicated that the preferences did not differ significantly, (3, N = 164) = .73, p < .87.

RQ10 asked if a judge's preference on performance was related to the judge's sex. For these data, a chi-square test indicated that the preferences did not differ significantly, (3, N = 164) = .73, p < .26.

Discussion
Consistent with the goals of this study, this section will first describe what the data revealed about argument preferences for the both critiques and performance and how demographic variables relate to these preferences. This will be followed by a brief discussion of limitations of the study. Finally, suggestions will be made for future research.

Where argument preference is concerned, the data of this study indicates that judges' preferences are varied. Judging philosophy books do not appear to offer a clear codification of rules or norms, leaving the confusion that Wood (1992) described. This does not mean that the information contained within is without value. This study revealed that where critiques and performance are concerned, the majority of judges are willing to listen and vote for both types of arguments, although most of them identify reservations that must be met. The greatest reservation, where both types of argumentation were concerned, was that debaters offer a clear explanation. This may indicate that, for debaters then who wish to construct their arguments in "non-traditional" ways, they can find an audience willing to hear their arguments, as long as the audience is able to understand them.

These data indicate that, for the demographic variables this study was concerned with, there is no significant relationship with argument preferences. The exception was the relationship between preference on critiques and the geographic region of a judge. The relationship between these variables is such that judges in the West were less likely to indicate a preference for critiques (with or without reservation). For all other regions, judges' preferences were similar. This would initially indicate that a debater
wishing to utilize critiques would find a more receptive audience from a judge who was not from the west. However, it should also be noted that the number of judges who did not mention their preference was more than double in the west, leaving an incomplete picture.

The number of "no mention" responses for critiques, and especially for performance, may in fact be more revealing than the responses indicating a preference for or against a type of argumentation. The incomplete picture that exists in the data where the West is concerned, exists within the debate community. For debaters seeking a judge who is willing to evaluate their arguments, judging philosophies seem to lack sufficient information to articulate what a judge's argument preferences are or what reservations they may have. The researchers in this study found that information available through interactions with the same judges whose philosophies were contained in the sample revealed a more complete, and sometimes different, picture of that judge's preferences. It is possible then that not only do philosophies not codify or even clarify norms, but that they reinforce a system that rewards those who are able to decode the "rules of the game" in other ways.

Limitations

The limitations of this study are many. First, the sample population writings were from a National Tournament philosophy book, with very open guidelines concerning content. Many of the judges did not mention anything about critiques and/or performance. For example, fifty-nine percent of female judges did not mention anything about performance, which limits the data on argument preference, but also on the interaction between argument preference and sex. Also, the subjective nature of judging philosophies is such that they are very difficult to code. To create a measure that was reliable, the researchers had to rely on explicit statements by judges. However, part of decoding a philosophy involves reading for implicit statements as well. Finally, decoding philosophies is also aided by prior experience with a judge.

Second, the only philosophies that were included in this study came from judges affiliated with schools that were present at the 2003 CEDA National Tournament. This necessarily means that judges whose schools had fulfilled their judging commitment were not in attendance. Also, many schools do not attend the CEDA National Tournament because of budget considerations. Smaller schools and junior colleges rarely attend, and philosophies from these schools are therefore absent.
Conclusion

There are many possibilities for future research. First, a comparison could be made between how philosophies are coded for the variables in this study, and how judges describe themselves on a self-reported questionnaire. A study that compared the way a researcher who has prior experience with a judge who codes his or her preferences with one who does not could establish whether a significant relationship does exist between experience with a judge and interpretation of a philosophy. These results could also be compared with a self-report measure to discover which is most likely to reflect the judge’s view of their preferences. Finally, a time study comparing judging philosophies in 2003 with those five years from now could be useful in discovering short-term change in preferences, and also whether more judges begin to discuss performance in their philosophies.
References


Table 1. Judges' Preferences on Criticism

<table>
<thead>
<tr>
<th>Judge Response</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>No mention</td>
<td>28</td>
</tr>
<tr>
<td>Yes</td>
<td>38</td>
</tr>
<tr>
<td>Yes, with reservation</td>
<td>97</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
</tr>
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</table>

Table 2. Judges' Preferences on Performance

<table>
<thead>
<tr>
<th>Judge Response</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>No mention</td>
<td>107</td>
</tr>
<tr>
<td>Yes</td>
<td>13</td>
</tr>
<tr>
<td>Yes, with reservation</td>
<td>41</td>
</tr>
<tr>
<td>No</td>
<td>4</td>
</tr>
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</table>

Table 3. Judges' Reservations on Criticism

<table>
<thead>
<tr>
<th>Reservation</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Must/Should solve affirmative harms</td>
<td>0</td>
</tr>
<tr>
<td>Must/Should solve critique harms</td>
<td>1</td>
</tr>
<tr>
<td>Must/Should advocate an alternative</td>
<td>12</td>
</tr>
<tr>
<td>Must/Should not violate the critique</td>
<td>0</td>
</tr>
<tr>
<td>Must/Should have a unique/specific/clear link</td>
<td>27</td>
</tr>
<tr>
<td>Role of judge/ballot</td>
<td>10</td>
</tr>
<tr>
<td>Clearly/Well developed framework</td>
<td>5</td>
</tr>
<tr>
<td>Real world implications/weigh against policy option</td>
<td>10</td>
</tr>
<tr>
<td>Must/Should turn affirmative solvency or impact solvency</td>
<td>11</td>
</tr>
<tr>
<td>Clear voting criteria/decision calculus</td>
<td>5</td>
</tr>
<tr>
<td>Well developed argument/warrants</td>
<td>1</td>
</tr>
<tr>
<td>Clear explanation</td>
<td>32</td>
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</table>
### Table 4. Judges' Reservations on Performance

<table>
<thead>
<tr>
<th>Reservation</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Must/Should explicitly state argument</td>
<td>0</td>
</tr>
<tr>
<td>Must/Should impact argument</td>
<td>1</td>
</tr>
<tr>
<td>Must/should read evidence</td>
<td>1</td>
</tr>
<tr>
<td>Must/Should defend resolution/have plan</td>
<td>8</td>
</tr>
<tr>
<td>Provide reasonable/fair division of ground</td>
<td>3</td>
</tr>
<tr>
<td>Role of judge/ballot</td>
<td>5</td>
</tr>
<tr>
<td>Clearly/well developed framework</td>
<td>3</td>
</tr>
<tr>
<td>Real world implications/weigh against policy option</td>
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<tr>
<td>Well developed argument</td>
<td>2</td>
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<tr>
<td>Clear voting criteria/decision calculus</td>
<td>3</td>
</tr>
<tr>
<td>Clear explanation</td>
<td>8</td>
</tr>
</tbody>
</table>

### Table 5. Relationship of Geographic Region of Judge and Judge's Preference on Criticism

<table>
<thead>
<tr>
<th>Frequency by Region</th>
<th>No Mention</th>
<th>Yes</th>
<th>Yes, w/ reservation</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>East</td>
<td>3</td>
<td>14</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td>Midwest/Central</td>
<td>6</td>
<td>9</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>Northwest</td>
<td>1</td>
<td>4</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>South</td>
<td>6</td>
<td>5</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td>West</td>
<td>12</td>
<td>3</td>
<td>15</td>
<td>0</td>
</tr>
</tbody>
</table>
Appendix A is not included in the journal.

**Appendix. Coding Sheet**

**Demographic Variables**

<table>
<thead>
<tr>
<th>Sex of Judge (circle one)</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
</table>

Region of Judge (circle one):

Years judging/coaching (write in): __________

**Argument Preferences**

<table>
<thead>
<tr>
<th>Critical Theory (circle one)</th>
<th>Yes</th>
<th>Yes, With Reservations</th>
<th>No</th>
</tr>
</thead>
</table>

If Yes, With Reservations Mark the Reservation Below

Must Solve Affirmative Harms __________

Must Solve Critique Harms __________

Must Advocate an Alternative __________

Must Not Violate the Critique __________

Must Have a Unique/Specific/Clear Link __________

Other (write in):

Performance (circle one): Yes | Yes, With Reservations | No |

Must Explicitly State Argument __________

Must Impact Argument __________

Must Read Evidence __________

Other (write in):
A Near-Infrared H2 Emission-Line Survey for Herbig-Haro Outflows in the Rosette Molecular Cloud

Jason E. Ybarra

Abstract
In order to learn about how stars form in any region of space, an understanding of not only the infall onto, and outflow from a star must be available. Information on the outflow activity from young stars in the Rosette Molecular Cloud, an important star–forming region, is currently lacking. Specifically, there is no information available on the level of near-infrared emission, which is often found in regions containing optically visible outflow features called "Herbig-Haro objects". An imaging study has been undertaken to detect near-infrared emission line outflow features within the Rosette Molecular Cloud. Data from the all-sky 2MASS near infrared survey is used to identify possible protostellar objects within these regions. Spatial relationships between young stellar objects, optically visible Herbig-Haro objects, and newly detected near-infrared emission features are discussed.

Introduction
By understanding star formation we can understand how our own sun formed billions of years ago. Our sun, like other stars, was formed within a dense region of molecular gas and dust called a molecular cloud (Wuchterl and Klessen, 2001). By studying these clouds we can learn about the environments and mechanisms in which stars form. One mechanism of importance is the jet-like bipolar outflow of material (Reipurth and Bally, 2001) that may be responsible for slowing the rotation of the star, and the disruption of the molecular cloud out of which the star itself is forming. This research has undertaken a survey to detect outflows from newly forming stars through observations in the near-infrared portion of the electromagnetic spectrum.

The purpose of the survey is to search, for the first time, for outflows within the Rosette Molecular Cloud (RMC). The RMC is a well-known star–forming region, with properties that have been established using radio and mid-infrared techniques (e.g., Perez, Thé, and Westerlund, 1987; Williams, Blitz, and Stark, 1995). Additionally, a near-infrared JHK band (filters centered at 1.2, 1.6 and 2.2 μm) study has revealed the presence of newly forming clusters of stars in the RMC (Phelps & Lada 1997). Together, the previous studies indicate that the RMC is an interesting region
for further study. For example, the level of outflow activity from newly forming stars within the cloud is unknown. Establishing the connection between newly forming stars and outflow activity is essential for building a complete picture of star formation in the RMC, and hence a survey for outflow activity in the RMC is needed.

When outflowing material from young stars interacts with the surrounding medium, atoms in the gas are excited. The region where gas is cooling then emits light, and this region is called a Herbig-Haro (HH) objects. By imaging the region in the infrared H2 emission line, Herbig-Haro outflow features can be identified in the dusty regions where stars form. These data can be used in future studies to verify current theories of star formation (for example, how molecular clouds are disrupted), and to learn more about the star formation process. First, however, the features must be discovered. The locations and properties of the features discovered from this survey will be shared with the astronomy community through journal publication and/or presentation at professional meetings, so that the might be studied in greater detail, in the tradition of scientific research.

The Theory of Star Formation

Stars are born in giant molecular clouds of gas and dust. The dust particles act as a catalyst in forming molecules within the cloud. The dust also plays a role in removing ions in the gas, thereby reducing the magnetic pressure of the cloud, and allowing gravity to take over (Williams, 2000). As the density of the gas and dust increases, due to gravity, the early stage of a star (called a protostar) emerges. This protostar has a disk of material surrounding it referred to as the protostellar disk. Gas and dust continue to accrete onto the protostar, through the protostellar disk, as the protostellar core contracts. The molecular cloud carries some initial angular momentum, and as the protostar contracts it spins faster and faster due to the law of conservation of angular momentum. The protostar needs to lose this angular momentum or it will break apart, and angular momentum must also be lost on a continuing basis in order to allow the continuous accretion of gas and dust (Hartigan, Bally, Reipurth, and Morse, 2000).

Outflows from the protostar seem to be the mechanism to rid the protostar of its excess angular momentum (Hartigan et al., 2000). As the protostar is forming, outflows of particles and gas develop along its axis of rotation (Shu et al., 1994). The rates at which the outflows (or "jets") expel gas into the surrounding medium have been correlated to the accretion rates of the disks. Because outflows may be critical in determining if a star can form, and may be responsible for disrupting the molecular cloud and hence preventing further star formation, they play an important part in star
Herbig-Haro Outflows

When the outflowing material from a newly forming star collides with the surrounding gas, a shock front is created with a region behind the front called the cooling zone. This cooling zone gives rise to emission lines, such as [S II], [OIII], and Ha, that can be seen in visible light. [S II] and [OIII] refer to forbidden-line emission from singly ionized sulfur and doubly ionized oxygen, respectively. In low-density regions of space, energy levels in atoms that in denser environments are normally depopulated very quickly due to collisions, can now participate in electron transitions. The resulting emission of light is referred to as forbidden-line emission because its origin was not known for some time.

It is the gas in the cooling zone that is emitting light that defines a Herbig-Haro object. By studying HH objects, the dynamics of the protostellar outflow can be further understood. The regions in which stars form are very dusty, and the dust often obscures visible light. Fortunately, the primary cooling mechanism in Herbig-Haro shocks is through the near-infrared H2 (molecular Hydrogen) emission of radiation (Reipurth and Bally, 2001). Infrared light has the ability to penetrate dusty environments better than visible light and, hence, allows for a more complete picture of the outflow morphology to be obtained when compared to visible light observations (Hartigan et al., 2000). In addition, H2 emission will trace different parts of the outflow than do optical HH objects, thus complementing visible light observations (Reipurth and Bally, 2001).

Near-Infrared Imaging of Herbig-Haro Objects

Near-infrared H2 emission line imaging can be used to observe low-velocity shocks in regions where visible light suffers high levels of extinction. Infrared light is less obstructed than is visible light, and therefore near-infrared observations can be used to probe these dusty regions, and possibly result in the identification of protostellar outflow sources. The H2 line is the brightest observable near-infrared line (with peak emission at 2.122 μm), and is thus a standard line used for observing HH objects in obscured regions.

Shocked gas at temperatures around 2000-3000 K is responsible for collisionally exciting molecular Hydrogen after the Herbig-Haro jets flow through the ambient material. The H2 emission line is the primary cooling mechanism for the molecular Hydrogen gas, since energy is radiated away through light emitted at the H2 emission line wavelength (Reipurth & Bally, 2001).
A Recent Optical $[\text{S II}]$ Survey of HH Outflows in the RMC

Recently, a visible light survey has been undertaken of the Rosette Molecular Cloud that resulted in the identification of several visible Herbig-Haro objects (Ybarra & Phelps, 2003). This study used $[\text{S II}]$ emission line and continuum images obtained from the 60-inch telescope at Palomar Observatory. The $[\text{S II}]$ images were obtained using a filter whose central wavelength is 6730 Å. The $[\text{S II}]$ (6731) emission line is produced when sulfur ions are excited by collisions with the fast moving hydrogen atoms and electrons produced by the outflows. Herbig-Haro objects emit light at this wavelength and thus they appear in the $[\text{S II}]$ images. These Herbig-Haro objects will be practically missing from the off-line continuum images. By visually comparing the $[\text{S II}]$ and continuum images of the same region, Herbig-Haro objects were detected. Nine candidate Herbig-Haro objects were discovered in the study (Ybarra & Phelps, 2003). Four of these objects were found in locations coincident with embedded clusters found by Phelps & Lada (1997). Six of the nine objects were found along the ionization front from the star cluster named NGC 2244, suggesting triggered star formation (Elmegreen & Lada, 1976).

Although recent work has established the presence of Herbig-Haro objects in the Rosette Molecular Cloud for the first time, the extent of those features remains unknown because dust in the cloud obscures visible light: called extinction. In order to see outflow features in regions where visible light suffers from extinction, an imaging survey using the infrared $\text{H}_2$ (2.12 $\mu$m) emission line is needed.

Rationale

Because the level of outflow activity in the RMC is only now beginning to be established, an understanding of the star formation process within the cloud remains limited. The recent $[\text{S II}]$ study detected several optical Herbig-Haro objects but there are currently no near-infrared outflow data available. Given that the RMC is a dusty star--forming region, near-infrared observations should reveal $\text{H}_2$ flows near the optical HH objects, and possibly allow for the identification of the newly forming stars that are driving the outflows.

Literature Review

The RMC sits southeast of the Rosette nebula on the edge of an ionization front created by the stars within the cluster NGC 2244. It is located at a distance of 1600 parsecs from earth (Perez, Thé, and Westerlund, 1987). A parsec is equivalent to 3.26 light-years. The RMC is a region of space extensively studied and mapped at different wavelengths.
For example, radio observations of the region have identified molecular clumps (regions with a higher density) within the cloud (Williams, Blitz, and Stark, 1995; Schneider, Stutzki, Winnewisser, and Bloch, 1998). Seven optically hidden, embedded star clusters have also been identified in the cloud and are associated with the local clumps (Phelps & Lada, 1997). Six radio molecular lines have been observed near the clusters where faint possibly protostellar sources were detected, and emission peak offsets suggest a photo-induced or time-dependant chemistry (Román-Zúñiga, Williams, and Lada, 2003). Currently, a team from the University of Florida is undertaking a sensitive, high-resolution JHK near-infrared survey of the RMC.

Near-Infrared H2 Studies of Other Star-Forming Regions

To establish the importance of H2 studies of Herbig-Haro objects, it is useful to review how similar studies have been used in other star forming regions. Near-infrared studies have been successful in revealing deeply embedded Herbig-Haro objects and have helped to establish the location of the driving sources in other regions. For example, an H2 imaging survey of the Monoceros OBI molecular cloud revealed H2 emission knots in both the HH 572 and HH 575 regions (Wang, Yang, Wang, and Yan, 2003). In the OMC-2 and OMC-3 cloud cores near the Orion Nebula, a H2 survey revealed many newly forming stars, and several H2 outflows were found to be associated with bipolar CO outflows that were detected in the radio part of the electromagnetic spectrum (Yu, Bally, and Devine, 1997). A survey of the Vela Molecular cloud traced different parts of an outflow using infrared H2 and optical [FeII] observations (Lorenzetti et al., 2001). In the HH 110 region, additional jets, not visible in optical images, were found in H2 (Davis, Mundt, and Eislöffel, 1994). Hubble Space Telescope images of the Herbig-Haro object HH 168 reveal H2 surrounding the optical ([S II] and Ha) emission. The H2 emission is present within a heating zone that arises ahead of the shock, apparently through magnetic heating (Hartigan, Morse, & Bally, 2000). H2 can be heated through magnetic precursors as well as collisional excitation. By observing where H2 emission occurs in relation to optical emission, the physical conditions within the regions can be determined, and hence a better understanding of the physics at work can be obtained. For example, observations of the H2 knots can used to compare different shock models (magnetic precursor C-shock or J-shock) that are used in star formation studies (Davis, Eislöffel, and Ray, 1994).
Problem Statement

While the presence of optically revealed HH objects within the RMC has been established (Ybarra & Phelps 2003), the extent of those features remains unknown because dust obscures visible light. However, optical HH objects often possess infrared H2 counterparts, and while it is expected that H2 emission features exist, no survey around the optical HH objects has yet been undertaken. Therefore, in order to more completely understand star formation within the RMC, a survey to detect H2 emission is needed. This researcher has undertaken just such a survey, through which H2 emission features have been found. These findings will complement optical observations and aid in the identification of the driving sources of the outflows, and thus aid in determining what physical processes are at work within the cloud. Hence the findings will further advance the understanding of star formation within the RMC, and in general.

To accomplish this goal of detecting emission features, an infrared imaging survey using the H2 (2.12 μm) was undertaken. This project used images obtained during an observing run in February 2003 with the Shane 3-meter telescope at Lick Observatory on Mt. Hamilton. The data required standard processing to remove instrumental effects before analysis began. Calibration, which involves so-called dark and flat field corrections, was undertaken using data obtained for this purpose during the observing run. Standard data reduction software (the Image Reduction and Analysis Facility, or IRAF) was used to reduce and analyze the data. Identification of Herbig-Haro objects was made by comparing H2 and continuum (K') images, visual inspection and subtracting the scaled K' images from the H2 images. Spatial relationships between the emission features, visible HH objects and other indicators of star formation were then investigated.

Cataloging these outflows, establishing their connection to newly forming stars, and making the information available to the astronomy community will allow further research to bring about a better understanding of star formation in the Rosette Molecular Cloud. This type of study typically leads to future studies (e.g., spectroscopy), and hence provides a foundation to gain a better understanding of the star formation process in general, and bring new insight into the processes that created our own sun.

Research Design

For this research, the previously mentioned infrared imaging survey was conducted. The selected regions were imaged using two bands of near-infrared light. Both K' broadband and H2 narrow-band filters were utilized in obtaining the images. The K' band is used distinguish between continuum and emission line features, and is a standard method by which
infrared emission features are identified (Yu, Bally, and Devine, 1997, Davis, Eislöffel, and Ray, 1994). Data reduction software (IRAF) was used to reduce and analyze the data using standard procedures for sky subtraction and flat fielding (Davis, Eislöffel, and Ray, 1994, Lorenzetti et al., 2001). This survey data reduction used standard procedures for infrared imaging using available technologies.

Procedure
The data were collected using the Gemini Twin-Arrays Infrared Camera on the Shane 3 meter telescope at Lick Observatory. The images were taken on the night of February 9, 2003. Gemini has two separate infrared detectors that can be operated simultaneously. The camera is equipped with J, H, K, K' and L band filters and a variety of narrow band filters. For this study, the majority of images were taken in K' and the H2 (1-0) narrowband filter. The H2 filter is centered on 2.125 microns with a delta lambda over lambda passband width of 1.1%. The K' broadband filter is centered on 2.1235 microns with a passband width of 16% (Gates, 1998). The detector used for all observations was an InSb array of 256x256 pixels. The image scale is 0.7 arc seconds/pixel, resulting in a field of view of 3x3 arc minutes. Each K' image was obtained using five co-adds, while a single co-add was used for the H2 observations. Co-added images are used to avoid saturation of the array, which would occur for long individual exposures. Each observed field contained nine offset dither positions. Dark frames were obtained to allow for removal of internal instrumental signals that accumulate during exposures. Flat field frames, required to calibrate instrumental responses to external signals, were constructed by median filtering the offset dithered target frames. The large number of dithered images for each field also allowed for an effective subtraction of the background sky from the images. Target selection was based on known positions of embedded clusters (Phelps & Lada 1997), and visible HH objects (Ybarra & Phelps 2003).

Data Reduction and Analysis
The images were reduced using the IRAF on a Linux-based computer. The ccdproc routine within IRAF was used to process the images using the dark, flat field, sky and image frames. For each target frame, a dark frame, appropriate for the exposure time, was subtracted and the flat field frame was divided by a flat field frame to remove the instrumental effects from the image. Flat field frames for each filter were made by averaging over 27 dither positions. The nine dithered images that comprise the set of observations for each target field were scaled and median combined to
create a sky background image. The sky background image was
subsequently subtracted from each dither position. The nine dither
positions were then shifted and combined into one image using routines to
account for and subtract noise to achieve a very high quality image.

The H2 and K’ images were compared to identify H2 emission
features (Davis, Eislöffel, and Ray, 1994). The H2 image will sample the
emission line while the K’ image samples both the emission line and the
broader continuum portion of the electromagnetic spectrum. By scaling
the images to match the brightness of stars, which have no H2 emission,
and subtracting the K’ image from the H2 image, true emission features are
revealed. By comparing image coordinates of stars to published
coordinates (known as astrometry), the coordinates of the H2 features were
obtained. Images and coordinates for newly identified infrared HH objects
will be submitted for review and cataloging, and made available to the
astronomy community for further study.

Findings/Results

Three H2 emission features have been found in the region surveyed
(see Figure 1). Towards the northwest of the features is located a previously
known mid-infrared point source, IRAS 06291+0421. The two emission
features (labeled EF-1 & EF-2) towards the west are knot-like in
appearance; while emission feature 3 (EF-3) is diffuse and extends from an
object labeled S1. Coordinates of the emission features are presented in
Table 1. Object S1 appears to be a star with a reflection nebula extending
northwest and southwest. The nebula may be caused by light reflecting off
the surface of a cavity created by outflow material. S1 is designated
06315136+0419110 in the 2MASS Point Source Catalog (PSC); hence its
nature as a star is quite certain. The 2MASS catalog, however, has limited
information available for this object (it has no published J-band magnitude,
for example), and hence it is not possible to determine the evolutionary
status of this object.

Figure 2 shows an optical [S II] image of the region, revealing [S II]
emission features labeled RMC-A and RMC-B. Figure 3 shows the H2
image with [S II] contours superimposed. Feature EF-1 is spatially
coincident with RMC-A, while feature EF-3 is coincident with RMC-B.
The slight offset in the positions of the [SII] emission relative to that
revealed in H2 is as expected given the different physical conditions
required for the excitation of these different emission lines. The
association of the optical and infrared emission is a key goal of these types
of studies, and one that is rarely realized to this level of confidence.
Discussion

Although the [S II] images were taken five years earlier, with the Rosette Molecular Cloud at a distance of 1600 pc and the typical tangential velocity of a HH flow being 200 km s\(^{-1}\) (Reipurth & Bally, 2001), a shift of .13 arc seconds might be expected. This value is much smaller than the resolution of the images. Therefore, comparison of the [S II] data with the H\(_2\) data can give insights into the nature of the outflows and help in the identification of the driving source. The [S II] image of RMC-B and the H\(_2\) image of EF-3 show different morphologies as expected because [S II] traces higher velocity regions of the (Davis, Eisloffel, and Kay, 1994). EF-1 and EF-2 are co-linear with the star (labeled S2) designated 06315195+0419125 in the 2MASS PSC. Star S2 has a J-H color of 2.15 ± 0.17 and an H-K color of 1.32 ± 0.08. When plotted on a color-color diagram, S2 is found to lie in a region populated by so-called Class I sources and other young stellar objects, or YSOs (Lada & Adams 1992). Hence S2 may be the driving source for EF-1 and/or EF-2. The morphology of RMC-A suggests a source either northwest or southeast of EF-1 and RMC-A. The IRAS source 06291+0421 is located northwest of the feature and is therefore another candidate driving source for EF-1. If future observations of S1 can establish its protostellar nature, it may also be a candidate for the driving source for features EF-2 and EF-3. Due to the limited resolution of the 2MASS survey, however, there is little or no photometric information available for many of the candidate driving stars within the region. Future observations will remedy this situation.

Limitations

As with most astronomy studies, a major limitation to further progress is a resolution. The Shane 3-meter telescope and Gemini detector provided a resolution of .7 arc seconds per pixel. Given that the Rosette Molecular Cloud is at a distance of 1600 pc, objects 28 times the size of our solar system show up as one pixel in an image. With higher resolution, morphologies of the features would become more apparent and defined. Also, due to limited availability of large telescope observing time, and the lead time and competitive nature of acquiring it, this study relied on the 2MASS database for photometric information on stars in the field. Many stars had no photometric data in the 2MASS database due to its limited resolution and sensitivity limits, resulting in limited information with which to identify possible outflow sources.
Conclusion

As hypothesized, near-infrared H2 emission features were found in the high density regions containing optical [S II] shock features with the Rosette Molecular Cloud. Two of the features show spatial correlation with the [S II] features. Possible sources for outflows are suggested but further studies are needed to determine the outflow sources. Higher resolution photometric studies can increase the number of potential sources and help determine the actual sources. Mid-infrared studies can provide information on the nature of the protostellar objects in the region. Once the outflows are correlated with their sources, kinematic studies of the outflows will bring information on star formation process. Studies at other wavelengths can complement the current data and allow for a comprehensive examination of outflow processes with the RMC.
References


Table 1

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<tr>
<td>EF-1</td>
<td>06 31 50.20</td>
<td>04 19 15</td>
</tr>
<tr>
<td>EF-2</td>
<td>06 31 50.95</td>
<td>04 19 13</td>
</tr>
<tr>
<td>EF-3</td>
<td>06 31 51.49</td>
<td>04 19 11</td>
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Figure 3

[S II] contour + H2
Development and Testing of DNA Microsatellite Primers for the Prairie Falcon (Falco Mexicanus)

Alejandra Cazares

Abstract

Microsatellite analysis was used to test if DNA microsatellite markers developed for the peregrine falcon (Falco peregrinus) also work on a closely related species of falcon, the prairie falcon (Falco mexicanus). Five DNA markers were analyzed across 13 individuals. Upon completion of successful amplification of the microsatellite alleles, genotypes were determined for all 13 individuals. Population genetic characteristics were obtained from the genotypes of prairie falcon from the Pinnacles National Monument. Additionally, prairie falcon genotypes were compared to peregrine falcon genotypes and the utility of this method for use of falcons systematic was considered.

Introduction

We live in a system in which survival is one of the driving aspects of our lives. In order to survive, we must build connections with other individuals and obtain familiarity with our environment. Both of these factors need to be kept in balance to ensure survival and increase the quality of life. Yet, humans often forget that we are only part of an even larger system with other organisms, such as plants and animals, with which we form an ecological system.

This ecological system needs to be kept in a regulated balance between human interactions, animals, and plants to keep a stable environmental system in which everyone has the opportunity to grow, survive and reproduce (Hickman, et al., 1998). Having knowledge about the animals and plants that surround us is needed in order to understand how our actions may affect other species and how those changes ultimately affect our ecological system and environment.

For example, the prairie falcon (Falco mexicanus), is listed in California as a species of special concern (CDFG, 2000). Yet according to Marzluff, et al. (1997), prairie falcons are "one of the most common raptors of montane desert and shrub habitats of western North America" (p. 567). Much research documented the population changes and ranging behavior of the prairie falcon in the Snake Rivers Birds of Prey National Conservation Area (NCA) (Marzluff et al., 1997). Past research has shown how different conditions, such as prey abundance, land use and habitat conditions, have affected populations of the prairie falcon at the NCA (Steenhof, Koehert, Carpenter & Lehman 1999). In their research,
Steenhof et al., (1999) found that, overall, prairie falcon reproductive rates were tied to the abundance of their main prey, the Townsend's ground squirrel (Spermophilus townsendii). In this study they (1999) also concentrated on addressing the possible effects that military training exercises in the area may have on the foraging opportunities for the falcons. It was speculated that military training could influence the falcon foraging efficiency by disturbing foraging falcons and preventing them from seeking adequate prey. Subsequently, this disturbance could result in nesting failures. Additionally, it is speculated that military training may cause habitat changes that could have a direct affect on the ground squirrel populations. It is for this reason that the managers of NCA are facing serious challenges in their attempts to regulate land use to protect and enhance raptor populations (Steenhof et al., 1999).

Concern for determining how to monitor land use, in order to maintain a high prairie falcon density, is also of great interest in the Pinnacles National Monument, located in San Benito County, California (Bell 2003 and personal communication). With 9-13 pairs, Pinnacles has one of the highest nesting densities of prairie falcon in the United States. However, according to Bell (2003), the "land use around the Pinnacles is rapidly changing. The continued rapid urbanization of the San Jose Metropolitan Area and associated conversion of traditional farm towns, such as Hollister, San Juan Bautista and Salinas," is resulting in an alarming decline in the amount of open space within the San Benito and Monterey counties. If this rate of development continues, it will lead to a serious impact on the prairie falcon population by eliminating or reducing the quantity and quality of hunting areas (Bell, 2003). As mentioned previously, habitat changes have direct influence on the primary prey of the prairie falcon. Subsequently, such activity disturbs their reproductive success and foraging ranges, which was the case with the prairie falcons at the NCA (Steenhof et al., 1999, Marzluff et al., 1997).

In order to prevent the same from happening at the Pinnacles, resource managers from the National Park Service are working with the San Benito County Board of Supervisors on a Habitat Conservation Plan (HCP), in order to identify those areas that the HCP should target for conservation (Bell, personal communication). This is of vital importance in order to maintain and enhance long-term falcon population viability at the Pinnacles. Therefore, any information that can be obtained about the prairie falcons at the Pinnacles could contribute to the management and preservation of the natural resources at the Pinnacles National Monument (Bell, personal communication). As a result, this study concentrates on using DNA microsatellite analysis to study the population genetics that
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characterizes the prairie falcons at the Pinnacles.

Literature Review

DNA Microsatellite analysis has been used to address numerous important issues in biology (Dawson et al., 1997). Microsatellites are very useful for identifying and understanding parentage, kinship, population differences, effective population sizes and inbreeding (Queller, et al., 1993). Queller et al. (1993) mention that microsatellites consist of "tandem repeats of very short nucleotide motifs (1-6 bases long). For example, a microsatellite locus might be a stretch of DNA with the base sequence CA repeated 17 times in succession [(CA)17]" (p. 285). Because microsatellites are quite numerous and abundant in the genome, they are becoming the marker of choice (Queller et al. 1993, Dawson et al., 1997, Ellegren, 1992), and they can be readily amplified with the Polymerase Chain Reaction (PCR). McDonald & Potts (1997) mentioned that PCR is suitable for almost all microsatellites loci, which allows for adequate amplification of microsatellites. Additionally, McDonald & Potts (1997), state: "the advantages afforded by PCR amplification are one reason we feel microsatellites will increasingly dominate the field of genetic markers for ecological and evolutionary studies" (p. 31).

However, before one can use microsatellites, one must first "construct a genomic library, screen the library for clones bearing one or more tandem repeats, sequence the clones, and develop PCR primers that amplify the tandem repeat" (McDonald & Potts, 1997, p.32). This approach was taken by Dawson et al. (1997) when they engaged in the isolation and genetic characterization of five microsatellite loci for the migratory songbird, the yellow warbler (Dendroica petechia). Thanks to this work, they were later able to use those markers to "assess parentage to a high degree of certainty in this species and also how they can be used to assess levels of differentiation among breeding population of yellow warbles" (Dawson et al., 1997, p. 507).

Nesje, RØed, Lifjeld, Lindberg & Steen (2000) developed microsatellite markers for peregrine falcon (Falco peregrinus) in order to determine the parentage of the peregrine broods from the same nest. Typically, developing markers is quite laborious but once created their importance in determining genetic information is tremendous. This is especially true for endangered species, such as the peregrine falcon or species of special concern, such as the prairie falcon. The markers developed by Nesje et al. (2000) were very useful in detecting "genetic variability, structuring and population assignment of peregrine falcons within Scandinavia and Scotland" (p. 268). Once this was determined, they
compared the difference of genetic variability between the peregrines who suffered rapid decline in population to those where the decline was less severe (Nesje, ROed, Bell, Lindberg & Lifjeld, 2000).

In the cases of the peregrine falcon and the yellow warbler, specific markers were developed for each species. However, it is also believed that markers developed for one species can also be used within a closely related species (Queller et al. 1993, Jarne & Lagoda 1996). Such was the case with SchlÖtterer, et al. (1991), who used primers for the long-finned pilot whale Globicephala melas (Delphinidae), which provided useful information on the mating system as well as on the genetic structure of populations" (p. 63). Yet, they were curious to see if the same could be done for other whale species, such as toothed and baleen whales. So, they used the primers designed for Globicephala and discovered that "all loci tested could be amplified in all species [of whales]" (SchlÖtterer et al., 1991, p. 63). This study attempts to do the same procedure with the prairie falcon using primers that were developed for the peregrine falcon by Nesje, ROed & Lifjeld (2000).

As mentioned before, the prairie falcon is a species of special concern, and in California we are lucky to have a large population at the Pinnacles National Monument, in San Benito County. As a result, population genetics information obtained from the prairie falcons at the Pinnacles may help determine how isolated the Pinnacle's prairie falcons are from the other prairie falcon populations. However, before comparisons can be made, the effectiveness of the primers that were developed for the peregrine falcon need to be examined to see if they will work for the prairie falcon. Thus, the primary aim of this study is to test if the DNA primers that work on peregrine falcon DNA will also work on prairie falcon DNA. The degree to which the primers work on the prairie falcon will help assess the actual genetic-evolutionary relationships of peregrine falcon to prairie falcons. More importantly, if the primers work, microsatellites alleles will be amplified to study the population genetic characteristics of the prairie falcon at the Pinnacles National Monument.

Methodology

DNA microsatellites were used as a tool to investigate genetic variability of populations of prairie falcons. The aim of this research is to obtain population genetic information once prairie falcon DNA has been amplified.

The use of microsatellites is well suited for this study because of the power that microsatellites have as genetic markers. Microsatellites have
high variability, and are abundant in the genome. Additionally, the Polymerase Chain Reaction (PCR), which is used to amplify the DNA, is another attribute that makes microsatellites markers more efficient than other genetic markers. Queller et al. (1993) mentions that microsatellites come very close to meeting the characteristics of the ideal marker (p. 285). Subsequently, microsatellites are the marker of choice when dealing with genetic information.

In order to use microsatellites, one must have a source of DNA. In this study, blood samples were collected from 13 adult prairie falcons of a single breeding population at the Pinnacles National Monument. Blood samples of about 0.20 ml were collected during a previous study in which the prairie falcons home range was being studied.

This research involved a series of procedures that lead the researcher to find population genetics information. In general, the procedures were composed of four stages: DNA extraction, amplification of DNA, the use of ABI Gene Analyzer and computer data organization and data analysis. Each step is a procedure of its own, and all are of equal importance. However, the main goal before any genetic information is obtained is to extract DNA to work with and get it amplified. These two steps were essential to the success of this study.

**DNA Extraction**

DNA extraction was carried out using a Quiagen Dneasy Tissue Kit from which the protocol for isolation of genomic DNA from whole nucleated blood was followed. First, blood samples from the prairie falcons was lysed in a lyses buffer, and then proteins were broke down using the enzyme Proteinase K. Buffer conditions facilitated DNA binding to DNease minicolumn. Secondly, the solution was centrifuged to ensure DNA binding to the DNease membrane. Thirdly, the column was washed to eliminate wastes and/or contaminants. Finally, the DNA was eluted in buffer and released from the membrane again by centrifuge action. Extracted DNA was run out on agarose gels to ensure successful extraction. Successfully extracted DNA served as the template for microsatellite amplification on the PCR.

**Amplification of DNA**

In order to amplify DNA microsatellites, the prairie falcon DNA and microsatellite locus specific primers were used in the Polymerase Chain Reaction (PCR). The purpose of the primers is to flank the adjacent regions of the uninterrupted sequence of base pairs that make up the microsatellites. The five primers utilized in this study were developed by Nesje et al. (2000) for the peregrine falcon.
PCR Conditions

PCR amplification was carried out using a mix of 25μl. Each reaction included 11.0μl of sterile double distilled water, 12.0μl of Taq mix (Taq polymerase, buffer, and dNTP), 0.5μl of reverse and forward primers, and 1.0μl of genomic DNA template. Initial reactions underwent cycles: three minutes at 95oC, followed by 30 cycles of one minute at 95oC, one minute at 45oC (annealing temperature), and two minutes at 72oC. The 30 cycles were proceeded by eight minutes for 72oC and 20 hours for 4oC.

Optimization of Microsatellite Amplification

Optimization was accomplished by finding the ideal annealing temperatures of each primer. The proper annealing temperatures were determined by Maren Bell from UC Berkeley, who assisted by running all the primers with just one sample and determined that the most suitable annealing temperature was 55oC. This temperature was then applied to the following PCR reactions. Microsatellite amplification conditions had to be optimized to ensure that the primers were amplifying a clear, distinct band, and in the case of primer NVH fp 79-4 and NVH fp 89 optimization occurred to try and eliminate double bands that were very close together.

Upon completion of optimization, and to determine if amplification occurred, samples were run out using electrophoresis on a 2% agarose gel stained with ethidium bromide. Under UV light, successfully amplified DNA appeared as dark single bands in the size range of the microsatellite locus. Because the resolution of agarose gels is not high enough to distinguish between fragments that are only two base pairs in length, a genetic analyzer was used to determine the length of the fragments (alleles) at each microsatellite locus.
**Gene Analyzer**

The ABI Gene Analyzer visualizes the length of the amplified fragments from the PCR to determine the alleles and genotypes of individuals at each microsatellite locus. This is important because it permits the researcher to see small differences in base pair length that are not obvious from the gels. For example, it allows the researcher to determine microsatellites that are 10 base pairs long to one that is 12 base pairs long. The ABI Gene Analyzer reads fluorescent tap that are attached to the end of the label forward primers (before the PCR reaction). The labeled primers have a different color bands that, on the computer, appeared as yellow, green, or blue. Additionally, a sequence ladder was added to aid in determining microsatellites allele sizes, along with peregrine falcon amplified samples that served as positive controls and also aided in size determination. Each sample contained the ladder, amplified DNA with a fluorescent tap. Before placing the DNA into the ABI Gene Analyzer, the DNA had to be denatured into single strands by heating it to 95°C in a thermocycler for 3 minutes. Immediately after heating the DNA had to be cooled in ice for another 3 minutes. Once the cooling is been done, the amplified products are ready to be placed in the ABI Gene Analyzer. Upon completion of the Gene Analyzer, the length of the microsatellites for each sample had to be determined. When amplification occurred, pronounced peaks were observed in either the yellow, green or blue bands that represented the allele amplification by the primer pair in the PCR process.

The length variation of the alleles is the genotypes of each individual that may later be used to find relatedness, family groups and variability information of the prairie falcons that were sampled. Because each reaction is performed twice, two sets of information using the same primer under a different PCR number were recorded to ensure that the analysis of the same individual with two different amplifications yields the same genotype.

**Finding/Results**

Results of this study show successful amplification of prairie falcon DNA with four out of the five DNA microsatellite primers that were developed for the peregrine falcon. All of the prairie falcon microsatellite loci proved to be polymorphic, possessing from 2-6 alleles per locus (Table 2). The most variable locus was NVH fp 79-4 with six alleles (Table 2). Loci NVH fp 31 and 92-1 were the least variable, possessing only 2 alleles per locus among the 13 individuals sampled (Table 2). Although loci NVH fp 31 and 92-1 were the least variable, they yielded the most consistent
results in allele detection between independent amplification experiments. Allele scoring was most difficult for locus NVH fp 89 due to stutter bands. According to Ellegren (1992), stutter bands are due to "slippage events as the Taq polymerase synthesizes the complementary strand of the repeat region" (p. 888).

An alternative explanation is that the bands may be due to amplification of a second locus by the primers responsible for amplifying NVH fp 89. Consequently, this locus will need additional PCR optimization. Allele data for locus 13 could not be obtained because of poor PCR amplification results. Attempts at allele characterization of this locus on the ABI Gene Analyzer were subsequently unsuccessful.

In addition, peregrine falcon DNA that served as positive controls in the experiments yielded consistent results for the following loci: Locus 31 for peregrine sample ALB allele size 153 and 155 were observed in both runs whereas for peregrine SAS no size data was observed in one run. Locus 92 for ALB 116 allele size range was detected in both runs and for SAS 114 and 118 was observed in only one run. Locus 89 for ALB had 124 allele size in just one run and SAS was homozygous at 128 in one run and heterozygous at 128 and 130 in another run. Locus 79-4 for ALB 146 and 151 allele size was observed and for SAS 155, both of these were examine once only.

When using prairie falcon DNA, four of the five loci revealed proper allele size determination and most of the allele size were consistently detected twice—on two separate amplification run reactions. However, some samples yield positive results in only one run. These are listed as follows: Locus 31 in PRFA (prairie falcon) 12 and 13; locus 89 in PRFA13 and in locus 92-1 in PRFA 3, 5, & 6. Subsequently, these samples must be repeated in future experiments.
Results of DNA microsatellite allele size ranges in the prairie falcon are compared to peregrine falcon allele size ranges from Nesje et al. 2000(B) in Table 3. The size ranges uncovered in this study revealed that the microsatellite loci belonging to prairie falcon were in general shorter than those of peregrine falcon. For locus NVH fp 89, prairie falcon allele sizes fell entirely within the range of the peregrine falcon (Table 3). For loci NVH fp 31 and NVH fp 92-1, prairie falcon alleles were shorter than those of the peregrine (Table 3). For locus NVH fp 79-4, prairie falcon allele sizes ranged from below the lower sizes ranges of those recorded for the peregrine falcon (Table 3).

### Table 3. Summary of alleles per locus and allele length

<table>
<thead>
<tr>
<th>Locus</th>
<th>Alleles</th>
<th>Size</th>
<th>Alleles</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>NVH fp 13</td>
<td>HH</td>
<td>54-108</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NVH fp 31</td>
<td>2</td>
<td>140-142</td>
<td>7</td>
<td>154-158</td>
</tr>
<tr>
<td>NVH fp 79-4</td>
<td>0</td>
<td>143-166</td>
<td>16</td>
<td>169-171</td>
</tr>
<tr>
<td>NVH fp 89</td>
<td>3</td>
<td>125-150</td>
<td>10</td>
<td>151-147</td>
</tr>
<tr>
<td>NVH fp 92-1</td>
<td>2</td>
<td>104-108</td>
<td>7</td>
<td>15-130</td>
</tr>
</tbody>
</table>

### Allele Frequencies

When considering allele frequencies it was noted that biallelic locus NVH fp 31 had near-equal allele frequencies, the other biallelic locus, NVH fp 92-1, yielded widely different frequencies for the two alleles (Table 2). The triallelic locus NVH fp 89 possessed one rare allele (126 bp). The most polymorphic locus, NVH fp 79-4, yielded a range of allelic frequencies of 0.1 to 0.3 in the prairie falcon population at the Pinnacles.

### Discussion

The primary objective of this study was achieved. The study revealed successful amplification of prairie falcon DNA using microsatellite locus specific primers that were developed for the peregrine falcon. The microsatellite allele size ranges obtained for prairie falcon fall within other falcon size ranges as published in Nesje et al. 2000(A). For example, locus NVH fp 79-4 allele size range for the prairie falcon reflects that of the merlin (Falco columbarius) (142-166 bp) with almost complete overlap. Such was the case for locus NVH fp 31, which additionally overlaps that of the hobby (Falco subbuteo) (141-142 bp) Nesje et al. 2000(A). Locus NVH fp 89 is the only one that falls partially within the range of the peregrine falcon and locus NVH fp 92-1 completely falls out of the range of the
peregrine falcon and no close comparisons can be made with any of the other falcons from Nesje et al. 2000(A).

Limitations
The main limitation encountered in this study was time. Some of the DNA microsatellite locus-specific primers needed further optimization of experimental conditions to achieve cleaner visualization of alleles on the ABI Gene Analyzer. However, due to time constraints, it was not possible to repeat some of the PCR amplifications. Additionally, for future research, a larger sample size would be ideal for expanding the study to other falcon populations.

Conclusion
The study results support the literature done on similar studies, such as on the yellow warbler (Dendroica petechia) by Dawson et al. 1995, and on whales (SchlÖtterer et al., 1991). Although difficulties came about when determining allele size, especially for locus NVH fp 89, result were still comparable to either the peregrine falcons and other falcons from Nesje et al. 2000 A & B. When comparing the size ranges is noted that most of the prairie falcons microsatellite locus are shorter in length then those of the peregrine. According to McDonald and Potts (1997), generally this is observed "when the primers are applied to other taxa, the repeat length will tend to be shorter and the locus less polymorphic" (p. 42). This may explain why some of the allele size range of the prairie falcon fall outside the range of the peregrine but when compared to other falcons, such as the merlin and the hobby identical overlaps occurred. This observation is a perfect example of the power that microsatellites have as genetic markers, and the fact that differences are observed leaves room for philogenetic information for future studies. This study proved to be successful in obtaining preliminary work that will allow for the continuation of future research to obtain population genetics information on larger samples of prairie falcons from the Pinnacles National Monument.
References


Appendix A. Advertisement Characteristics

Circle one  EB or ES  Mo/Yr ___/___  Ad # ___  Product/Co.____________

A. Type of Advertisement*
   1  2  3  4  5  6  7

B. Prominence of Black Male in ad*
   1  2  3

C. Racial Makeup*
   1  2  3

D. Celebrity Status*
   1  2

E. Sports Status*
   1  2

F. Romance Status*
   1  2

* See Key

Appendix B. Key for Items in Advertisement Characteristics

I. Characteristics of the advertisement
   A. Type of ad
      1. Cigarettes
      2. Alcohol
      3. Entertainment (books, music, movies)
      4. Personal product (hair care, toothpaste, clothes)
      5. Automobile
      6. Service (insurance, airline, public service, etc.)
      7. Food
   B. Prominence of Black male in the ad
      1. Background figure
      2. Equally displayed as other character(s)
      3. Central or predominant figure
   C. Racial makeup
      1. All characters Black
      2. Separate pictures (panel ad, compact photos with White and Black individuals need to each other, Blacks and Whites not present in the same scene)
      3. Mixed (Blacks and non-Blacks in the same scene)
   D. Celebrity Status
      1. Black male is a celebrity/media personality
      2. Black male is not a celebrity/media personality
   E. Sports Status
      1. Black male is a sports figure (well known athlete, or someone portrayed playing or involved in sports)
      2. Black male is not a sports figure (not known for sports, not portrayed playing or involved in sporting activity)
   F. Romance Status
      1. Black male portrayed romantically (romantic setting, implied or implied)
      2. Black male is not portrayed romantically (non-romantic setting, no implied or stated romance or sex in advertisement)
## Appendix C. Model Characteristics

### A. Facial Type (physiognomy)

<table>
<thead>
<tr>
<th>Thin lips, Narrow nose</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Thick lips, Wide Nose</th>
</tr>
</thead>
</table>

### B. Hair Type

<table>
<thead>
<tr>
<th>Smooth, straight</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Tightly curled, coarse</th>
</tr>
</thead>
</table>

### C. Complexion

<table>
<thead>
<tr>
<th>Light-skinne d</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Dark-skinne d</th>
</tr>
</thead>
</table>


Racial Identity and Political Mobilization among African Brazilians

Sewit Hezchias

Abstract

Despite the fact that Afro-Brazilians—Pretos (blacks) and Pardos (browns) alike occupy a distinctly subordinate place in society, the state and political system of Brazil continue to perpetuate the myth of racial democracy, the idea that Brazil is a land of racial equality. Not only has this myth operated to deny racial difference's in Brazil, it has suppressed racial mobilization and significantly inhibited the formation of a shared ethnic identity.

Ethnic identity is vitally important in understanding political mobilization, because it can be the organizing principle of a group. This study examines the construction of ethnic identity among Afro-Brazilians, and corresponding levels of political mobilization. Using text and content analysis, this researcher examined the extent to which English language publications, within the last five years, link an increase in racial consciousness with a rise in political mobilization among Afro-Brazilians.

Introduction

According to Richard L. Jackson, in Brazil "black skin and African features continue to be handicaps, white racism and anti-black consciousness realities, and ethnic lynching a serious threat to the racial identity of black people" (Jackson, 1992, p. 229). Studies comparing blacks' access to education, health care, employment, housing, and other quality of life indexes with that of browns and whites reflect massive inequality. "The lowest social-economic class is unquestionably 'black'" (Brown 1992, p. 229). Nevertheless, the state and the political system of Brazil continues to perpetuate the myth of racial democracy—the idea that Brazil is a land of racial equality. Not only has this myth operated to deny racial difference in Brazil, according to the literature, it has suppressed racial mobilization and significantly inhibited the formation of a shared ethnic identity.

Ethnic identity is vitally important in understanding political mobilization because it can be the organizing principle of a group. According to Edward Telles, "the major prerequisite for organizing or mobilizing enough people to sustain prolonged resistance is a clear sense of shared ethnic identity" (Telles, 1999, p. 82). Markers of ethnic identity, such as language, religion, skin color, and nationality, are necessary, says Telles,
for a group to "define its boundaries and pursue its collective ends" (Telles, 1999, p. 83).

In this study, the construction of ethnic identity among Afro-Brazilians and corresponding levels of political mobilization will be examined. This researcher is particularly interested in identifying how political mobilization influenced changes in self-identification among Afro-Brazilians. On the basis of English language publications within the last five years (1998-2002), the researcher will examine the extent to which these publications link an increase in racial consciousness with a rise in political mobilization among Afro-Brazilians. This study will enable this researcher to determine whether English language publications indicate that a high level of political mobilization among Afro-Brazilians can be associated with high levels of racial identity. This study hypothesizes that the literature will indicate that Afro-Brazilians who are politically mobilized will have a higher level of racial identity than those who are not.

Literature Review

Racial democracy originated from the theory of miscegenation that was based on, "the notion that the greater the incidence of racial mixing, the closer to a pure-white society, hence an adequate resolution of the race question" (Brown, 1992, p. 228).

The discrepancy between the discourse surrounding the political arena and the reality of the social situation for Afro-Brazilians can be attributed to the deliberate effort of Brazilian elites aiming to cover up the reality of racial discrimination. In her essay, My Conscience, My Struggle, Thereza Santos shares a personal account that is reflective of this discrepancy. As a member of the Popular Center of Culture (CPC) of the National Union of Students, Thereza was constantly reminded that "Prejudice and discrimination did not exist" (Santos, 1999, p.190). ”Whenever I would ask questions about the racial issue, I would hear a lecture about my ideological deviations, as there was no racial question but only the question of social class" (Santos, 1999, p. 180). CPC gathered white "intelligentsia" of the Brazilian left to repudiate any reference to the existence of prejudice and discrimination in Brazil. Theresa began to convince herself that they were right. "Who was I to question people like Oduvaldo Viona Filho, Ferreira Gular, Jose Serra, Dias Gomes, Francisco de Assis, Carlos Estevan, Carlos Lira, and others" (Santos, 1999, p.190)? Theresa describes how she was not only repeatedly made to feel stupid when expressing an opinion, but was also constantly interrupted by someone who would then proceed to translate what she was thinking. Theresa Santo's experience is symbolic of the contradictions that
surround Afro-Brazilian politics. On one hand, a large majority of the population adheres to the belief in racial democracy, and on the other hand, massive prejudice and discrimination mask the lives of Afro-Brazilians.

In *Notes on Racial and Political Inequality in Brazil*, Carlos Hasenbalg and Nelson do Valle Silva provide results of research outlining inequalities in Brazil. Data gathered by the National Housing Survey (PNAD) of 1987, show extremely unequal geographic distribution of groups of color in the population. The south and southeast regions, considered to be the most developed parts of the country, contain three-quarters of the white population while almost three-fifths of the non-white population lives in the less developed northeast, north, and central-west regions. As a result of the non-whites' geographic disadvantage, they have had fewer educational and economic opportunities. According the PNAD (1987), the illiteracy rate among non-whites was 36.3 percent, two times greater then that of whites at 18 percent (Hasenbalg & Silva, 1999). Moreover, 29.5 percent of whites completed eight years of elementary schooling compared with 13.6 percent of non-whites (Hasenbalg & Silva, 1999). Finally, whites have about four and a half times greater probability than do non-whites of completing college (Hasenbalg & Silva, 1999).

In terms of economic opportunities, not only are non-whites overrepresented in manual labor jobs, they are "disproportionately represented in the worst jobs in the informal sector" (Hasenbalg & Silva, 1999, p. 156). According to the National Housing Survey: Color of the Population 1987, 26.9 percent of whites held non-manual occupations compared with 11.6 percent of nonwhites (Hasenbalg & Silva, 1999). In relation to the United States, whites are 5.3 percent times as likely as blacks to be in professional occupations in Brazil compared to only 2.2 times as likely in the U.S.

The fact that 6.7 percent of blacks held non-manual occupations compared with 12.6 percent of browns suggests how even the slightest difference in phenotype are important factors for gaining access to these positions. It is perhaps this understanding that has consistently led a great majority of Afro-Brazilians to identify as white. As Calomee states, Afro-Brazilians are faced with the reality that, "To be black is bad, to be mulatto is better, to be white is best of all" (Calomee, 1992, p. 251).

In her book, *Freedoms Given Freedoms Won*, Kim Butler shows how often times the Brazilian state will downplay prejudice and racism by comparing the situation of Brazilian blacks to blacks in other countries, particularly in the U.S. They say, for example, that unlike the U.S., blacks in Brazil have never been exposed to the horrors of lynching and Jim Crow
laws. However, Butler points out "such reasoning confuses racism with animosity, violence, and prejudice, none of which need to be present to have a racist ideology." Furthermore, such a comparison falls short particularly because, unlike the U.S., in Brazil over 60% of the population is black. Therefore, a racial caste system with a rigid color line like that of the U.S. would not have served in the best interest of the white power structure. Brazil had to be much more innovative in the strategy utilized to control blacks. Brazil adopted "a racial classification system in which racial categories (such as Pardo, brown, and mulatto) between white and black are used, and a whitening ideology which places a higher value on lighter skin color" (Telles, 1999, p. 84).

Gloria Calomee describes how this system "has worked to the detriment of Afro-Brazilians insofar as their economic, social, and political status within the society" (Calomee, 1992, p. 249). Thomas Skidmore shows how this racial classification system is operating to prevent any sense of shared ethnic identity among Afro-Brazilians. Edward Telles states, "blacks and browns are aware that being of African origin as opposed to being white is the fundamental cleavage determining life chances along Brazil's racial continuum" (Telles, 1999, p. 85).

In Making Race and Nation, a comparison of the United States, South Africa, and Brazil, Anthony Marx blames the absence of overt domination in Brazil for inhibiting black solidarity and protest comparable to the civil rights movement in the United States. According to Marx, in the U.S., racial domination reinforced racial identity and provoked protest among blacks; while in Brazil the absence of overt domination is working to restrict a shared sense of racial identification and mobilization. As Anani Dzidzienyo explains, racial democracy, "by not reflecting reality and indeed by camouflaging it, achieves without tension the same results as do overtly racist societies" (Marx, 1998, p. 251).

The reluctance among Afro-Brazilians to identify themselves as black is evidenced by the Brazilian census. Between 1955 and 1980, there was a dramatic increase in the number of people in the brown and white categories and a decrease in the black category. While theorists of miscegenation would have us believe that Brazil was getting close to a "pure white society", this census was actually a reflection of the increased inclination amongst Afro-Brazilians to identify as white. According to Michael Hanchard, in Racial Politics in Contemporary Brazil, there was "a steady and increasing turn toward white phenotypic ascription". This may possibly be a result of the emphasis that, up to this point, was put on national identity versus racial identity. Butler explains how, during the
1930s and 1950s, it was neither color nor ethnicity that was responsible for the creation of social identity; rather it was nationality that took precedence.

Darien Davis explains that, while resistance was apparent, as ever, it had conformed to the new era of nationalism. The Frente Negra Brasileira (Brazilian Black Front), the first visible organization to challenge the state's denial of racism, emerged during this time. The focus of the Frente was assimilation; it was a step towards the consciousness movement bringing together blacks and mulattos with affiliations from all over the country. At one point, it claimed as many as 200,000 members. Influenced by the national fervor of the time, the Frente called for a national sense of identity as a means to combat racial conflict. Arlindo Viega dos Santos, the Frente's first president, sought unity among Blacks, "to help Brazilian powers be Brazilian." Santos called for a "definite, total integration of the Negro in all of Brazilian life" (Davis, 1999, p. 183).

According to Davis, the Frente's strategy was a "euphemistic way of combating Brazilian nationalistic racist practices which ignored the African element, while at the same time promoting order and sense of community among blacks." Irrespective of the Frente's commitment to securing a shared sense of national identity, a race-based organization during this time was perceived as a threat to a nationalist agenda. The emphasis on national identity made it incredibly difficult for blacks to identify themselves through racial consciousness. Those who attempted to do so were often dismissed as racist or unpatriotic.

Despite the fact that blacks occupied the lowest socio-economic class, the national rhetoric deliberately downplayed prejudice and racism. It was not until the 1970s that discourse on race and the legacy of slavery were finally dealt with in public forums. By comparing the situation of Brazilian blacks to blacks in other countries, particularly in the U.S., the Brazilian elite mitigated racial conflict. They contended that blacks in Brazil received better treatment than blacks in any other country. The elite, to boast of their supposed cultural and social superiority, particularly used this point of comparison. Oftentimes, the Brazilian state would embellish the myth of racial democracy by making reference to sports, particularly soccer. The fact that there were black athletes on the team was used as evidence that racism did not exist, and that Brazil was indeed a racial democracy. Writers of this generation were particularly responsible for the dissemination of this myth. For example, well-known Bahian author, Jorge Amado wrote, "our outlook on life is fundamentally anti-racist, based on intermingling" (Davis, 1999, p. 224). A Tarde, a major newspaper of this time, reported, "We do not have
a racial problem. This is a great happiness of the Brazilian people" (Davis, 1999, p. 224).

The Frente, nevertheless, maintained its allegiance to the nation and would continue to struggle for civil rights within the construct of national unity. It was perhaps the Frente’s very reliance on establishing a strong sense of national identity as a means of attacking racial conflict that prevented any possibility of dismantling the myth of racial democracy. After all, the very system that the Frente was showing its allegiance to was the system responsible for the historical displacement of blacks.

During the mid-1970s, however, political mobilization took on a new light. Brazil was experiencing, as Howard Winant describes, an "upsurge of democratic aspirations" (1999, p. 103). With that came the successful proliferation of several race-based organizations. What was significantly different during this time period was that unlike the 1930s and 1940s, political mobilization was not held within "a discourse of patriotism." According to Winant, black groups during this time had "a specific political orientation to community organization and racial consciousness raising" (1999, p. 103). Several race-based organizations, study groups, and cultural groups, such as afóxes and blocos Afros, emerged during this time (Winant 1999, pg. 103). Ile Aiye, the first bloco afro (Afro-centric Carnival society) was powerful in spreading and encouraging black pride. At first, the press condemned Ile Aiye as a racist organization, but it would eventually grow to influence the establishment of other groups, such as Olodum (Henry Kraay, 1998, p. 22).

The most visible organization to emerge during this time was the Movimento Negro Unificado (MNU) in 1978. According to Michael Hanchard, "the appearance of the MNU signaled the greatest upswing in black political activity since the 1930s" (Hanchard, 1994, p. 221-40). Black Brazilians would begin to actively participate in the elections. For example, several black candidates participated in the 1982 elections, despite poor outcomes. In 1992, an Afro-Brazilian elected official, Benedita da Silva, running on the ticket of the Partidodos Trabalhadores, nearly won the mayorship of Rio de Janeiro. Also, for the first time in history, race was being addressed in mainstream media and political institutions.

The MNU seized the political shift to democracy during the 1980s as an opportunity to overcome racism by demonstrating direct opposition to the policies of the military dictatorship. Some of the issues that the MNU focused on were "discrimination, prejudice, and lack of jobs". During this period, issues such as, "police brutality, health care, battered women, the rights of children, and the rights of religious expression" were addressed
On March 21, 1983, the MNU would lead "The International Day for the Elimination of Racial Discrimination". In 1986, the Brazilian Constitution began to be revised to meet the needs of blacks. According to Davis, this period marked the emergence of a "national forum for civil rights' advocates to influence national law and attitudes concomitantly" (Davis, 1999, p. 227).

The MNU embraced ideas of the Frente, but its strategy for overcoming inequality was radically different. Unlike the Frente, the MNU did not attempt to create a shared sense of national unity; it focused rather on the construction of a shared sense of racial identity. According to Henry Kraay, the MNU was responsible for the creation of a "new Afro-Brazilian identity". Afro-Brazilians were increasingly identifying themselves as "negro" as opposed to "preto" which is another term for black, but as Kraay describes, preto is a polite term that ignores African ancestry.

"Cultivating an Afro-centric identity and speaking out against racial discrimination, the black movement has created a broad cultural space often linked to older expressions of black culture such as Candomble…one that challenges Afro-Brazilians' subordinate integration into Brazil's 'racial democracy'" (Kraay, 1998, p. 23). Black Brazilians no longer occupy a marginal role in national culture, and the modern black movement can be described as a force to be reckoned with. Unlike before, Brazilians are forced to deal with issues of race (Kraay, 1998, p. 23).

**Methodology**

Content analysis is defined as "a method of inquiry into the symbolic meaning of messages" (Holsti, 1969, Krippendorf, 1980). Using content analysis this researcher will be conducting an in depth analyses of English publications within the last five years (1998-2002) relating to the subject of racial identity and political mobilization in Brazil. Content analysis will enable this researcher to make a specific characterization of English language publications on this question over the past five years. Limiting this study to the specific time period of 1998-2002, will enable this researcher to describe the contemporary understanding of race and politics available to English language readers. Such an assessment is not currently present in the literature. It is significant because it will reveal the extent to which English language publications offer a sophisticated appreciation of the complex circumstances now encompassing questions of race in Brazilian social and political life.

The presence, meaning, and relationship of racial identity and political mobilization in Brazil, based on discussions in English language publications, will be analyzed. This study consists of the entire universe of
literature for the time period being considered. Because it is not a sample, it will not be subject to the limitations of probability theory. The population was arrived at by searching various library databases for all 1998-2002 English language publications containing the following key search terms, within two words of each other. The terms and their definitions are:

- racial—"a family, tribe, people or nation of the same stock"
- identity—"sameness of essential character"
- political—"of or relating to government or politics (2) "involving or charger or concerned with acts against a government or a political system"
- mobilization—"to assemble and make ready for action"
(1994 Merriam Webster Dictionary)

Reducing the text to categories consisting of a word, set of words or phrases enabled this researcher to focus on, and code for, specific words or patterns that are indicative of the original hypothesis. The selected texts were reduced to the following specific categories: words or phrases that indicate racial identity and words or phrases that indicate levels of political mobilization. For instance, the following is a sentence from the literature review: "The appearance of the MNU signaled the greatest upswing in black political activity since the 1930s" (Hanchard, 1999, p. 221-40). In this sentence, there is a word that indicates racial identity (black) and a word that indicates political mobility (political activity).

Research Question

The presence of racial identity, with respect to political mobilization, will be examined by asking the following research questions:

- RQ1–Is racial identity present in the literature?
- RQ2–Is political mobilization present in the literature?
- RQ3–How often is racial identity present in the literature?
- RQ4–How often is political mobilization present in the literature?
- RQ5–Is there an association between political mobilization and racial identity?

Counting the number of times the identified words or phrases are found with respect to each of the two phrases—in each work, in the total number of works, in each year, and for each author, altogether, will constitute a description of the presence of the characteristics. Finally, an assessment of the findings will be arrived at by asking whether these terms are found frequently in the literature, and if they are, whether they are found in such a manner that they support the hypothesis.
To ensure that this coding scheme is not limited to use by only one individual, inter-coder reliability which is defined as "the amount of agreement or correspondence among two or more coders" (Holsti, 1969, Krippendorf, 1980) must be established. Without reliability a measure cannot be considered valid. For this purpose, a second individual will be assigned to code for the selected words and phrases.

Results/Findings

Although black political organizations in Brazil, such as the Frente Negra and the MNU, appeared to have played a critical role in raising consciousness among Afro-Brazilians, such success was mitigated by a pervasive sense of nationalism. The emphasis on national identity made it incredibly difficult for blacks to identify through a racial consciousness. Those who attempted to do so were often dismissed as racist or unpatriotic.

This research also found racial identity present in the literature. All of the ten texts examined were found to contain references to racial identity. According to the literature, Brazil's racial classification system, which places a high value on lighter skin color, is operating to prevent any sense of shared ethnic identity among Afro-Brazilians. Brown people are choosing to not identity as black because they recognize that their opportunities would be lesser as such (Telles, 1999; Hanchard 1999; Butler 1998; Hamilton 2001).

With respect to the frequency of the presence of racial identity and political mobilization, there were 2,521 references to racial identity and 1,148 references to political mobilization in the ten texts examined. It is apparent that racial identity and political mobilization are embedded in the literature. Although these numbers go far in revealing the significance of racial identity and political mobilization in Brazil, they fall short of showing whether high levels of political mobilization can be associated with high levels of racial identity.

Limitations

Although this researcher utilized all search engines available in the CSU, Sacramento library to identify all English language publications from 1998-2002, whether the selected sources provided a universal representation may be questionable and present a possible limitation to this study.

A second limitation of this study was that the coding system that was used did not allow for an accurate characterization of the association between political mobilization and racial identity primarily because
references to low levels of racial identity and low levels of political mobilization were not properly accounted for. For example, the following is an example of a sentence that was identified as containing the presence of political mobilization: "...political mobilization that might be expected from a high level of inequality may actually be constrained by such structural inequalities" (Telles, 1999). In order for an accurate characterization to be made of the association between political mobilization and racial identity, the coding scheme used in this study needed to identify presence with respect to the manner in which references were made. Future researchers should consider this information when developing coding schemes for additional research in this area.

Conclusion

It can be concluded from this research that political mobilization is indeed present in the literature. Of the ten texts examined in this study, all were found to have contained references to political mobilization. From the literature, one is clearly able to gauge the prevalence of black protest and restriction thereof. As Marx (1998) stated, "Black protest long remained a 'revolution within an order' relatively respectful of the well entrenched social hierarchy in which blacks hoped to advance" (p. 255). Recognizing that it is better to be white then black, blacks identified more often then not as white and advancement was sought on an individual basis versus collectively. It is apparent also from the literature that the centralization of nationalism had a tremendous impact on the establishment of a strong movement based on a shared sense of racial identity. Furthermore, Brazil's persistent denial of racism and insistence of a racial democracy has worked to serve as a major impediment to identity formation and mobilization, which illustrates that political mobilization was indeed evident in the literature.
References


A Perspective on God's Relation to a Dynamic Conception of Time

Martin A. Chamorro

Abstract
This study analyzes the competing theories of God's relation with time, according to a dynamic view of time, in order to offer a logical description of such a relationship. The dynamic view of the world maintains that only the present is real and exists, whereas the future and the past do not exist. God can be timeless, existing wholly outside of time, or He can be temporal experiencing past, present, and future. The aim of the study is to show that God is temporal in relation to a dynamic view of the world. This researcher utilizes a test for hypothesis to determine whether the theory that God is temporal in a dynamic world outweighs all rival theories. When this hypothesis is compared to the hypothesis that God is timeless, the former proves more plausible.

Introduction
Allow this researcher to state from the very beginning that God need not exist for this study to be conducted. Further, no particular form of God is needed either. That said, this study is exploring the nature of God in relation to time, regardless of any other attribute such a God may have. Ultimately, the study is limited only by logic (if that is a limit at all). This study assumes that any God that may exist conforms to logic and if that is the case, then, according to logic, this study describes God's only possible logical relationship to time. In regard to time, there are only two possible modes of existence: timeless or temporal. Timelessness refers to the state of being independent of time. Temporality refers to being of, related to, or limited by time. If God is timeless, then He exists outside of time. On the other hand, if God is temporal, then God exists within time and experiences tenses of time, such as past, present, and future. God is timeless if and only if God is not temporal, and vice versa. Lay people often assert that God is both timeless and temporal without realizing that there is a flat contradiction in such a statement.

The main question for this study is whether God is temporal or timeless. Science and philosophy seem to indicate that God can be timeless without a universe, but must be temporal if there is a universe. This researcher's argument is that if there is a universe, and if God relates to that universe, either by creating it or by interacting with it, then God must be temporal.
This study will also briefly discuss the dynamic conception of time and why this researcher believes it to be the correct description of time. In 1908, John Ellis McTaggart published a paper in the journal *Mind*, entitled *The Unreality of Time*, in which he argued that time does not exist (McTaggart, 1908). He formulated a paradox, which states that time is tensed but that tensed time is self-contradictory. It therefore follows that time is unreal. The paradox, along with Einstein's Special Theory of Relativity, has led many scientists and philosophers to embrace what is known as the *B-theory* or *static theory of time*. This conception holds that time is tenseless. Tenseless time in our universe is a conception that time is essentially like a block, where events are ordered earlier and later by their proximity to each other (see Figure 1). Events in the B-theory of time are always real (or exist) even if they are past or future events. According to this theory, Napoleon continues to be real in the universe though he exists in the past in relation to our present, and in the future in relation to people existing at the time of the reformation. The alternate theory of time is known as the *A-theory of time* or the *Dynamic theory*. This concept states that only the present is real (see Figure 2). Past events no longer exist and future events have not yet come into existence. In defense of the dynamic concept of time, many philosophers believe McTaggart's paradox "does not provide good grounds for rejecting a dynamic theory of time" (Craig, 2001). One of the objectives of this study is to accurately describe the dynamic view of time, and to provide good reasons for accepting it over static time. Admittedly, the study is narrow in that it focuses only on God's relation to time in a dynamic world rather than a static world; however, knowing that a dynamic view of the world is correct can only strengthen the study.

**Rationale**

There are several reasons why this is an important and necessary work of research. The first reason is that noteworthy philosophers have argued that the difficulties that the study of time presents to conceptions of God indicate that God may not exist in the first place. Time essentially becomes a proof against the existence of God. Paul Davies (1992), for example, believes that there is a real dilemma in this problem that may lead one to believe that God does not exist. He claims that if God is timeless, then God is unable to feel, converse, think, or do any other temporal activities because it would involve Him interacting with temporality. Therefore, if God is timeless He is not all powerful. On the other hand, if God is temporal then He is limited by the restrictions of time, such as relativity; but this renders God a slave to time. Therefore, if God is temporal He is not all powerful. According to Davies, this leads to the conclusion that God
is neither timeless nor temporal, so He must not exist; or if He does exist as either timeless or temporal, then He is not omnipotent. These conclusions, however, are unacceptable to theists; hence they must develop arguments against Davies challenge. Theists must show that a temporal God is not only possible but likely.

A second reason for the importance of conducting this research is to rid the confusion that lay people have of God's relationship to time. As was noted previously, it is apparent that when lay people claim God is both temporal and timeless, they have no idea they are claiming a contradiction. This study will help lay people understand why such a statement is a contradiction.

Finally, it is also incumbent upon philosophers to study the relationship of God and time because it is a sophisticated metaphysical problem that demands their attention as does Relativity Theory, God's existence, and other such challenging philosophical questions. The philosophy of God and time should receive more attention than it does.

Literature Review

This literature review is not exhaustive, but it is representative of what contemporary philosophers deem to be the best arguments for each side of the investigation explored in this paper.

Examining God's Nature in Time

Eternalists, or Defenders of Divine Timelessness, the view that God is timeless, have argued that Relativity Theory makes it implausible that God is temporal. The argument can be stated as follows (Craig, 2001):

1. The Special Theory of Relativity (STR) is the correct description of time.
2. If STR is the correct description of time, then if God is temporal, He exists in either the time associated with a single inertial frame or the times associated with a plurality of inertial frames.
3. Therefore, if God is temporal, He exists in either the time associated with a single inertial frame or the times associated with a plurality of inertial frames.
4. God does not exist in either the time associated with a single inertial frame or the times associated with a plurality of inertial frames.
5. Therefore, God is not temporal.

According to Paul Fitzgerald (1972), if God exists in a plurality of inertial frames, then He has an "infinitely split personality, each sub-personality evolving in monad-like isolation from the others." This paints a
picture of a God who is schizophrenic, to put it lightly. Craig (2001) points out that Einstein's "whole theory rests on [his] redefinition of simultaneity." This issue would take an entire paper to describe thoroughly, but in brief what this means is that Einstein redefined the way we are able to find out what is occurring in a reference frame in the universe that is not our own. Because we are not in that outside frame, we cannot know what is occurring simultaneously there with what is occurring in our reference frame. Einstein left science and became a philosopher when he claimed that, because we are unable to empirically verify what is occurring outside of our reference frame, nothing is occurring. In other words, things are occurring in other reference frames in their own time, not ours. There is no universal time for the universe, only individual times that correspond to each individual frame in the universe.

If God is temporal in this universe, then He suffers from being in all these different times, none of which occur simultaneously. God essentially exists in different times, different "nows", if you will, all over the universe, never knowing which is the real "now." Einstein's philosophy is known as Verificationist Philosophy, and as Lawrence Sklar (1981) points out "I don't know…how to formulate a coherent underpinning for relativity which isn't verificationist." Sklar, however, shows that verificationism is defunct because the foundations of the philosophy (also known as Logical Positivism) are self-contradictory.

Recent philosophers and scientists have even noticed that "the idea of restoring absolute simultaneity no longer has a pseudo-scientific flavor" (Balashov, 2000). Philosophers and scientists admit that Einstein's math was completely correct, where he erred was in his interpretation of his theory. The discoverer of Bell's Theorem, John Bell, admits that not all inertial frames are equal, as Einstein held, instead there may be a privileged frame such that an observer from this reference frame is able to observe all events in the universe occurring simultaneously (Bell, 1986). Philosopher of Science, Karl Popper (1982) even proposes a replacement for Einstein's interpretation: "we have to give up Einstein's interpretation of relativity and return to Lorentz's interpretation and with it to Newton's absolute space and time."

Another more promising argument for Eternalists is the argument authored by Brian Leftow (1991) of Fordham University, dealing with the incompleteness of a temporal life. It can be formulated as follows:

1. God is the most perfect being.
2. The most perfect being has the most perfect mode of existence.
3. Temporal existence is a less perfect mode of existence than timeless existence.
4. Therefore, God has the most perfect mode of existence.
5. Therefore, God has a timeless mode of existence.

This argument is based on the sense that the passage of time makes it impossible for any temporal being to possess all of its life at once: the past is gone forever and the future is yet to come. Leftow considers this a handicap that a perfect being would not have. He gives the example of a widow who mourns the passing of her spouse. Only a temporal being/God would be subject to such grief, a timeless and perfect God would not.

According to Temporalists or Defenders of Divine Temporality, God must be temporal if He is to interact with His creation, which is temporal. This camp of philosophers acknowledges that humans and everything within the universe is temporal. The question they ask is: Can the gap between a timeless God and temporal beings ever be bridged? Their argument against such a bridge is as follows:

1. God is creatively active in the temporal world.
2. If God is creatively active in the temporal world, God is really related to the temporal world.
3. If God is really related to the temporal world, God is temporal.
4. Therefore, God is temporal.

This argument fails to prove that God is temporal unless God is the creator of a temporal world. If God never created a temporal world, then He could remain timeless without any objection from Temporalists. However, it is apparent to humans that a temporal world exists. Therefore, the argument is applicable to our world.

Contemporary philosophers who attack this argument focus on the third premise. They claim that God can be related to the temporal world without being temporal. As Eleonore Stump and Norman Kretzmann (1981) stated:

What really interests us among the species of simultaneity...[is] a simultaneity relationship between two relata of which one is eternal and the other temporal. We have to be able to characterize such a relationship coherently if we are able to claim that there is any connection between an eternal and a temporal entity or event. An eternal entity or event cannot be earlier or later than, or past or future with respect to, any temporal entity or event. If there is to be any relationship between what is eternal and what is temporal, then, it must be some species of simultaneity.

Stump and Kretzmann developed the idea of Eternal-Temporal Simultaneity based on Einstein's version of simultaneity. Einstein's version of simultaneity dealt with the relativity of different points of view of the universe, depending on where one was located within the universe.
However, rather than points of view in the universe based on physical space, Stump and Kretzmann came up with the idea of points of view based on temporal relations. God’s point of view of the universe is from an eternal reference frame, whereas ours is from a temporal reference frame. The idea was never very popular amongst philosophers, prompting Stump and Kretzmann to revise the idea in 1992. Even other Defenders of Divine Timelessness disagreed with their solution: "ET-simultaneity has no independent merit or use; nothing is illuminated or explained by it" (Helm, 1988). What Stump and Kretzmann were forgetting to explore was the causal relation between the eternal and the temporal. Their solution simply stated that such frames existed, one is eternal and the other temporal, but gave no explanation as to how the two could relate causally.

Examining the Study of Time

Previously in the literature review, this researcher presented information about temporality and timelessness. What follows is an examination of the study of time in the universe. At the moment that Einstein first formulated his Special Theory of Relativity (STR) he believed time was dynamic. So, it is immensely ironic that the greatest reason people began to adhere to a static conception of time is precisely because of his STR. In 1908, German mathematician Hermann Minkowski came up with the idea that Einstein's STR should be interpreted in light of a four-dimensional picture of the universe known as space-time (Minkowski, 1952). Three dimensions belong to space, the fourth belongs to time. The genius behind this view is that, though space and time measurements when taken separately are relative, space-time measurements are absolute. This means that space-time, if it is absolute, never changes, remaining static. On this view, one can build a time machine and travel to different times because all times exist statically, whether past or future, and as long as one has a machine that can traverse the four dimensions, one can essentially travel through time.

Furthermore, according to this view, every temporal and spatial characteristic of an event is fixed at some point in the space-time continuum. Think of a two-dimensional graph in which a point is permanently affixed to the graph via its two coordinates. The point can be easily located by looking for the location of the coordinates. If space-time is real, then special and temporal locations can be permanently affixed via four coordinates. This means that any events, past, present or future is real and can be located at anytime via its coordinates in the space-time graph of the universe. Upon learning about this view, Einstein claimed that Relativity Theory was "distinctly in favor of the static picture" (Einstein and Infeld,
The argument for static time based on Relativity Theory is formulated as (Craig, 2001):

1. Either Einstein's original dynamic interpretation of relativity is correct or Minkowski's space-time static interpretation of relativity is correct.
2. If Minkowski's interpretation is correct, then the static theory of time is correct.
3. Einstein's original dynamic interpretation of relativity is not correct.
4. Therefore, a static theory of time is correct.

The problem with this argument lies in its first premise: it is a false dilemma. Maybe both Einstein and Minkowski had incorrect interpretations of relativity.

The question then becomes: Does Dynamic Time offer a better picture of the world as we know it? D. H. Mellor (1981) admits that the Dynamic Theory of Time "is so striking an aspect of reality that only the most compelling argument justifies denying it." Talbot philosopher William Craig (2001) claims that "if a dynamic theory of time is correct, our experiences and beliefs are entirely rational and appropriate...insofar as we think such experiences are justified, we should embrace a dynamic theory of time." His argument is formulated as:

1. Belief in the objective reality of the distinction between past, present, and future is properly basic. 
2. If our belief in the objective reality of the distinction between past, present, and future is properly basic, then we are prima facie justified in holding this belief.
3. Therefore, we are prima facie justified in holding our belief in the objective reality of the distinction between past, present, and future.

Craig is arguing against critics who claim that our experience of tense is illusory, especially our experience of the present. He is simply stating that belief in a tensed universe is not irrational, and that if one subscribes to such a view, then he/she are within reason to do so. Mellor (1981), though he states that belief in a tensed universe is alluring, ultimately claims that it is irrational to believe in tense and proposes McTaggart's paradox as evidence: "the tensed view of time is self-contradictory and so cannot be true." McTaggart's paradox is formulated as follows:

1. If a tensed view of time is correct, events are past, present, and future.
2. Events cannot be past, present, and future unless either:
   a. events are past, present, and future in relation only to other
events; or
b. events are past, present, and future in hyper-time.
3. If a tensed view of time is correct, then events cannot be past, present, and future in relation only to other events.
4. If a tensed view of time is correct, then events cannot be past, present, and future in hyper-time.
5. Therefore, if a tensed view of time is correct, events cannot be past, present, and future.
6. Therefore, if a tensed view of time is correct, events are past, present, and future, and events cannot be past, present, and future.
7. Therefore, a tensed view of time is not correct.
Craig claims that McTaggart was incorrect about the second premise and committed a false dilemma: "McTaggart's whole argument is based on a misguided attempt to marry a dynamic theory of temporal becoming to a static series of events." Others, such as C.D. Broad (1976), have shown that belief in a dynamic theory of time implies a commitment to Presentism. The importance of this opinion is that McTaggart's paradox only applies to a theory of time in which events flow into different tenses of existence (i.e. the present flows into the past). A presentist, however, denies such a flow. They claim that once the event that is currently present ceases to be present, it simply stops existing, it does not flow into the past and change tenses.

McTaggart's paradox only affects those who hold that a temporal event is real and has the property of "presentness" when it is present, but if the same event then goes into the past, it would now contain the property of "being in the past" which is contradictory to "being in the present". An event that does not change properties but simply ceases to exist does not suffer from this problem. Craig seems to have defended the argument for the dynamic conception of time against McTaggart's paradox.

One can observe from the previous discussion about the concept of time that the arguments against dynamic time do not seem strong enough to deny its plausibility. On the other hand, the case for dynamic time seems quite strong. As Craig (2001) shows, our experience of tense in times is properly basic. Moreover, when we use language, we are unable to substitute tenseless language for tensed facts. If a static view of time were correct, then tensed facts could be dictated by tenseless language. Because one cannot do this, it seems the static view of time can be questioned. Further, if the static view of time was correct, then time would be isotropic, such as temperature is. Temperature is bi-directional so it can go back and forth in its measurements without fail. Time does not work that way; instead, time is anisotropic meaning it flows in only one direction just
as the dynamic view of time dictates. For the reasons previously stated, this researcher believes that a dynamic view of the world is more plausible than a static view.

For further study, a formal test must be applied to the hypothesis that God is temporal rather than timeless. To date, no formal test has been applied. However, when a test for hypothesis is applied to the idea that God is temporal in a dynamic world, all rival hypotheses must be run through the test as well. The rival hypothesis in this study is the concept that God is timeless in a dynamic world. By providing a representative review of the best arguments for the two hypotheses the test will allow this researcher to show that one hypothesis is indeed more plausible than the other. Ultimately, if one concept is more plausible than the other, that particular concept will describe reality.

Problem Statement

This researcher's aim is to review the ideas of the brightest scholars in the philosophies of time and of religion, as well as the brightest scientists dealing with relativity and cosmological time to come up with a cohesive and worthy theory of God and time. This researcher will then put the theory to the test by subjecting it to C. Behan McCullagh's test for a historical hypothesis. Though McCullagh's test is designed to be used to determine the plausibility of historical hypotheses, it can easily be adapted to test metaphysical hypotheses. After all, the goals of both types of hypotheses, historical and metaphysical, are the same: to obtain probability not mathematical certainty. The test is as follows:

1. The hypothesis must have greater explanatory scope (imply a greater variety of observable data) than rival hypotheses.
2. The hypothesis must have greater explanatory power (make the observable data more probable) than rival hypotheses.
3. The hypothesis must be more plausible (implied by a greater variety of accepted truths, and its negation implied by fewer accepted truths) than rival hypotheses.
4. The hypothesis must be disconfirmed by fewer accepted beliefs (when conjoined with accepted truths, imply fewer false statements) than rival hypotheses.
5. The hypothesis must so exceed its rivals in fulfilling conditions 1-4 that there is little chance of a rival hypothesis, after further investigation, exceeding it in meeting these conditions.

Plausibility, as described previously in condition four of the test, in regard to time and God, depends upon what best fits reality. It may be that no answer will be wholly inarguable. Rather, what this study is attempting
to do is to determine which view of God and time is most coherent with respect to reality (i.e. our experience of the universe). In order to do this, this researcher must:

- research all the theories of time in philosophy, astronomy, and physics;
- review what other scholars have said about the topic; and
- combine the information and use it to develop the thesis that God is temporal in a dynamic world.

The argument that this researcher must defend can be formulated as follows:

1. Time is dynamic (tensed).
2. God exists in either a timeless mode of existence or a temporal mode of existence in a dynamic world.
3. If God is timeless, then either:
   a. the universe does not exist,
   b. God does not relate to the universe, or
   c. time is static (tenseless).
4. The universe does exist.
5. God does relate to the universe.
6. Time is not static.
7. Therefore, God is temporal.

Methodology

The aim of this study is to propose a theory as a solution for a metaphysical problem, which consists of determining a correct description of God's relationship to time. Any theory that proposes a solution to this problem must meet the criteria of outdoing rival theories in terms of explanatory scope, explanatory power, plausibility, and confirmation by current knowledge. In order to arrive at such a theory, one must gather data about time and about God's relationship to time. This may be accomplished by acquiring secondary source information on the subjects, and by acquiring primary source information by conducting interviews with scholars who are experts on the topics. Once this researcher has the necessary information, and has developed a theory, this researcher must then collect literature and other information about rival theories in the same manner. The analytical method for this study, because of its nature of comparing rival theories, is argumentative.

Research Design

The study will be conducted by using research analysis and a test for hypothesis. Because the subject of the study is theoretical and
philosophical, the normal forms of research analysis (content, conversational, conceptual, etc.) do not apply, as they would in sociological and scientific studies in a laboratory. This research will be conducted using other methods, such as:

- utilizing a test for the premises of the theories;
- analyzing content about the two theories of God's relation to time; and
- using the data to show that competing theories fail where the theory this researcher subscribes to succeeds.

This research design will work best because the goal of the study is to show that the theory that God is temporal in a dynamic world outweighs the competing theories about God being timeless in such a world. The only way to prove this hypothesis is to show that competing theories either fail McCullagh's test for hypotheses or are weaker in fulfilling the criteria for the test than the theory proposed here.

Procedure

This research will be conducted in the following manner:

1. Divide the collected information by topic: A-theory, B-theory, Timelessness, or Temporality.
2. Analyze the content in each topic.
3. Evaluate the arguments for and against each position on each topic.
4. Combine the strongest arguments into a theory.
5. Subject the theory to McCullagh's test for hypotheses.

The first step involves researching journals, articles, and books pertaining to each of the topics listed. The second step involves analyzing the content of the literature and the interviews by traditional philosophical methods. This includes, but is not limited to, looking for logic holes (i.e. fallacies), plausibility, and explanatory power. The third step is an extension of the second step. The difference is that the third step deals only with the best arguments for and against each position on each topic. This researcher will arrive at which are the best arguments in step three by applying the methods in step two to the data collected in step one. Step four holds the theory this researcher proposes. The entire process described here is used simply to corroborate the theory, and to show that rival theories fail in comparison in explanation and plausibility. Step five is the culmination of the entire study. This step is designed to show that this researcher's theory is the best hypothesis. Conditions 1-4 of McCullagh's test involve checking the researcher's theory against rival theories and showing that it succeeds where they fail. Furthermore, McCullagh's test is sufficient to establish that
the current researcher's theory, though not mathematically certain, is the best solution to the metaphysical problem of time and God, even if there were no rival theories.

Data Analysis

Data analysis in this study is dependent on checking one theory against others. This is an adequate method to test the research hypothesis because it provides a representative account of the current knowledge on the subject, and allows the researcher to establish that the theory being promoted is indeed the best one. It is worthy to note that McCullagh's test condition five states:

The hypothesis must so exceed its rivals in fulfilling conditions (1–4) that there is little chance of a rival hypothesis, after further investigation, exceeding it in meeting these conditions.

By applying this test to the theory that God must be temporal in a dynamic world, it will be sufficient to establish that the theory will endure. All research questions will be answered by the entire procedure previously described and not simply through data analysis. However, the data analysis and McCullagh's test will allow the researcher to confirm that the theory that God is temporal and therefore interacts with dynamic time answers his research questions better than rival theories, and is therefore the best theory about God and His relationship to time in a dynamic world.

In McCullagh's test, the strength and scope of a theory is dependent on whether it explains a larger number and greater variety of facts than its rival theories (McCullagh, 1984). If one explanation does this better than any competing explanation, then, advises McCullagh, it is likely to be true. McCullagh's test is much like a court trial where a jury must decide that one explanation fits the facts and evidence better than any other explanation. Thus when dealing with a historical or metaphysical test for hypothesis, one must attempt to reach a decision that is beyond a reasonable doubt and not necessarily one that is beyond all doubt. The goal of the test is to arrive at the conclusion that is the most plausible and provides the most probable explanation of the evidence.

The data this researcher utilized is a composite of the best contemporary arguments in the debate about the relationship between time and God. The arguments are provided by Brian Leftow (1991), William L. Craig (2001), Paul Helm (1988), Lawrence Sklar (1981), Eleonore Stump and Norman Kretzmann (1981), and others (Ganssle, 2001).

When conducting research in the area of God's relationship to time, one finds that eternalists and temporalists are well represented by theologians and philosophers. Eternalists believe that timelessness is
coherent and there is no problem with claiming that a timeless God can simultaneously exist alongside a temporal world (Ganssle, 2001, pp. 35-38). Along these same lines, this camp believes that though it may be difficult to explain how a timeless God can interact with a temporal world, He can in fact do so. Some philosophers have provided a mechanism by which they believe this is possible (Stump and Kretzmann, 1981). Another common belief amongst those who adhere to the theory that God is timeless is the belief that God is omniscient because of, rather than despite, the fact that He is timeless (Ganssle, 2001, pp. 40-42). These theologians and philosophers deny that a timeless God cannot apprehend tensed facts and claim instead that temporalists must deal with the fact that a temporal God cannot apprehend tenseless facts. There are also some popular yet uncommon beliefs in the eternalist camp. Some eternalists claim that God need not be temporal if the world never had a beginning, and He never needed to enter into a relation with the world as "Creator" of it (Helm, 1981). Temporalists claim that God entered into a temporal relation with the world when He created it, but some eternalists claim that God never created it and rather simply existed alongside it (Ganssle, 2001, pp. 47-55). One eternalist in particular, Paul Helm, argues as well that the world is static, and, therefore, God is not restricted by any of the problems a timeless being would encounter in a dynamic world (Helm, 1981).

The research shows that temporalists also have many common beliefs. Many temporalists believe that it is incoherent to claim that a timeless God can exist simultaneously with any two temporal events. For example, God's timeless life with the release of the movie "Star Wars" in 1977 is simultaneous with God's timeless life during the release of "The Phantom Menace" in 1999, which makes both events simultaneous, but that is incoherent (Swinburne, 1977, pp. 220-21). Furthermore, temporalists assert that if God were to interact with the world in any way, he would have to be temporal because the world itself is temporal (Craig, 2001). Temporalists argue that God, as creator of the world, requires him to enter a temporal relationship with it. Temporalists are firm also in their belief that the universe had a beginning from which God entered this temporal relationship with it as its creator (Craig, 2001). Temporalists also claim that God is unable to be omniscient if he is timeless, because a timeless mind cannot entertain tensed facts (Ganssle, 2001, pp. 64-65). This is the opposite from what eternalists claim when they say that a temporal God cannot entertain tenseless facts in his mind.

In summary, the research shows that the eternalist and temporalist camps are divided by two major contentions and a few minor ones. The first major contention is that of relations with a temporal world:
temporalists say that God must be temporal to interact with a temporal world, eternalists disagree. The second major contention is that of knowledge of tensed/tenseless facts: eternalists claim a timeless God can comprehend tensed facts, temporalists say that is impossible. The minor contentions between the two camps revolve around whether the universe began or not, and whether the universe is static or not.

McCullagh's Test Results

Based on the data analysis, any theory about time and God must account for the two facts that the two camps hold in major contention, which are:

1. there are tensed facts in the world, and
2. relation with a temporal world.

According to McCullagh's test, the first criterion for establishing the best theory is explanatory scope. In other words, which of the two theories about God's relation to time explain more of the facts listed? If God is temporal in a dynamic world, there is no problem in Him holding tensed facts about the world in His mind. Many religious believers further believe that God is omniscient. The theory that God is temporal explains very well how it would be possible for God to be omniscient. Tenseless facts can be comprehended by anyone, whether they are temporal or not. Such facts as "it rains" or "red is a color" are easy to maintain in one's temporal mind. On the other hand, tensed facts cannot be comprehended by a timeless mind for the simple fact that a timeless mind does not think within time. Tensed facts are facts such as "it is now raining" but if one has a timeless mind, how can one know when "now" is? Based on McCullagh's first criterion, the theory that God is temporal accounts for fact one easily whereas the theory that God is timeless has a much more difficult time doing so.

Fact two is also easily explained by the theory that God is temporal because a temporal being can interact with a temporal world without any special mechanism. A timeless being, however, cannot interact so easily with a temporal world because, as of yet, there is no explanation as to how this would be possible. Current explanations like the one Stump and Kretzmann attempted to provide, are inadequate and fail to explain this theory. A temporal God can interact with a temporal world through a temporal relation. There is no easy explanation for that fact if God is timeless.

Thus, the theory that God is temporal explains both facts, whereas the theory that God is timeless does not. The second criterion for McCullagh's test is the explanatory power of the theories. However, if the
theory that God is timeless cannot account for the two facts listed in
criterion one, it certainly has no strength in explaining those facts. The
theory that God is temporal does not simply explain those facts, but
explains them fully. The explanatory power of the theory that God is
temporal is thus greater than the explanatory power of the theory that God
is timeless.

The third criterion for McCullagh's test is that the best hypothesis is
more plausible than rival hypotheses. This researcher cannot think of any
accepted truths that would negate the theory that God is temporal in a
dynamic world. On the other hand, this researcher also finds it difficult to
find accepted truths that would negate the theory that God is timeless in a
dynamic world as well. However, some variations of the theory that God is
timeless may actually be less plausible than the theory that God is temporal.
Paul Helm (Ganssle, 2001, pp. 47-55) proposes a version of the theory that
God is timeless in which he believes God has existed eternally with the
universe. This version of the timeless God theory may be negated by the
accepted scientific truth of the origin of the universe. If the universe began
to exist at some time in the finite past, as the Big Bang Theory proposes,
then the universe cannot have existed eternally in the past alongside God.
One must note, though, that this variation of the timeless God theory is
not popular and so does not affect the most popular arguments for a
timeless God. Therefore, either of the two theories seems, to this
researcher, to be equally plausible.

The fourth criterion for McCullagh's test states that the best
hypothesis must be disconfirmed by fewer accepted beliefs (in addition to
being disconfirmed by fewer accepted truths as noted in the previous
criterion). For the theory that God is temporal, this researcher can think of
only two accepted beliefs that might call the theory into question. However,
these "accepted" beliefs are not accepted by everyone, maybe not even the
majority. There is the belief that Einstein's interpretation was correct about
the Special Theory of Relativity. If this belief is correct, then a temporal
God would have a split mind because of having to exist in so many
different inertial frames at once. However, as was noted in the literature
review, there is a great deal of evidence that Einstein was wrong about his
interpretation, so this belief is not very damaging to the temporal God
time theory. The only other belief that may disconfirm the theory that God is
temporal is the belief in the static conception of time. Regarding this, there
are two notes this researcher would like to make. The first is that the study
is focused on God's relation to time in a dynamic world, so even if time is
static, it does nothing to hinder the study. The study is more of a thought
experiment to determine that if God exists, and if God is logical, and if time is dynamic then the following is how God must relate to time. This researcher has narrowed the domain of the study to include those three assumptions. Because the study is a thought experiment based on three assumptions, the assumptions themselves do not require proof. Secondly, belief that time is static is itself a doubtful belief. The literature review provides reasons to accept a dynamic conception of time over a static conception of time. Apart from these two beliefs, there seem to be none that disconfirm the theory that God is temporal in a dynamic world.

The theory that God is timeless in a dynamic world also seems to fair well against accepted beliefs. This researcher has not been able to find accepted beliefs that disconfirm the theory that God is timeless.

The final criterion is a summation of the previous four. Because both theories seemed plausible and were not disconfirmed by accepted beliefs, one must look at the first two criterion of McCullagh's test to determine which theory is the best one. Clearly, from the analysis, the theory that God is temporal in a dynamic world has more explanatory scope and power than does the theory that God is timeless in a dynamic world, therefore it is to be preferred.

Discussion

When this researcher began the study, he did not have an opinion about or argument for either side. This researcher was not an eternalist or a temporalist; he simply had no knowledge of the subject. After conducting the research the researcher began to understand the debate about God and time. The researcher was familiar with McCullagh's test long before the study began to be conducted, so applying the test to the debate seemed like an appropriately scholarly method to approach an answer regarding which theory was best.

What this study demonstrated was that when a formal test of hypothesis is applied to the competing theories about God and time, at least within the conception that time is dynamic, the theory that God is temporal proves more plausible than the rival theory that God is timeless.

All the "ifs" and assumptions seem to make the study weaker than it actually is. They are set up to form a domain for the study, yet this researcher does indeed believe each of the "ifs" and assumptions are facts about the world. This researcher does believe God exists, that God is logical, and that time is dynamic. However, to provide proof for all of those beliefs would require a lengthier treatment that a journal article provides, thus, the need to narrow the study to the hypothesis presented here. Because the reality seems, to this researcher, to be that God does exist
and that He is logical and that time is dynamic, the researcher wanted to see
how a logical God must relate to time in a dynamic environment.

The importance of the study is that the view that God is temporal is
not popular, yet seems to be the most plausible. This researcher has
observed that most religious believers think of God as being timeless or
both temporal and timeless, very few confess that God is simply temporal.
The incredible finding is that, according to McCullagh's test, the conception
that God is temporal seems to be the correct view. This is an astonishing
claim to say the least! The view that God is temporal may not be most
popular belief in the minds of the majority of the world, but this study has
shown that, if the world is dynamic, it seems to be the correct one.

Limitations

From the outset, there were three assumptions this researcher
affirmed in the study, which created the domain of the study. Although
many consider them facts, this researcher conducted the study as if they
were assumptions. These assumptions limited the study because the
researcher would need a lengthier treatment to prove each of the
assumptions.

One other limitation of the study is the fact that it is a metaphysical
study, and, as such, cannot be tested in a lab. Thus, the study becomes a
thought experiment, which does not make it any less powerful and accurate
than a lab study. Even scientific studies may be conducted as thought
experiments rather than laboratory experiments, the Einstein-Podolsky-
Rosen Paradox is an example (Craig, 2001).

Conclusion

Eventually, theologians and philosophers of religion, as well as
philosophers of science, will begin to shift towards the view that God is
temporal. Not because of this study, but rather because of the theory's own
merits. Future philosophical study conducted in this area will move in the
direction of solidifying the theory that God is temporal. On the same note,
eternalists are not ones to give up easily, and they should not. They need to
continue to provide arguments to try to show that their position is stronger
than it is now, and they must continue to attempt to debunk the view that
God is temporal. The ongoing debate can only spark more interest in the
topic, though ultimately in the end; it is the opinion of this researcher that
no matter how hard eternalists try, the temporalist view will continue to be
the most plausible.
References


Footnotes
1 A properly basic belief is one that is warranted and rational but not held on the evidential basis of other beliefs.
2 A reference frame in STR refers to the point of view from which an object is in the universe. Since there are a great many (maybe infinite) points of view from which to observe the universe, there are a great many reference frames. No inertial frame is preferred over any other. In other words, no frame is more correct in its description of the universe as the next frame.
Figure 1. A depiction of the B-theory or Static theory of time

Figure 2. A depiction of the A-theory or Dynamic theory of time
Economic Sanctions: The Conditions for Success and the Case of Zimbabwe

Alanna Perez

Abstract
This study identifies the conditions that allowed for the successful use of economic sanctions against South Africa, which effectively led to the downfall of the repressive apartheid regime, and applies them to the current case of Zimbabwe. As identified by Schwartzman, the ideal social and economic conditions that allowed sanctions to be effective in the downfall of apartheid were international consensus, global economic integration and an economy sensitive to embargoes, mass opposition, and organized elite opposition. Are these social and economic conditions present in Zimbabwe and if so, how? This study determines that the current economic sanctions against Zimbabwe stand a promising chance because of the presence of at least three out of the four conditions identified by Schwartzman.

Introduction
Between 1993 and 1996, the United States implemented economic sanctions against at least 35 countries (Kaempfer & Lowenberg, 1999). The number is shocking, yet it is also evidence of the significant proliferation of the use of economic sanctions throughout the globe. Economic sanctions are a common tool of foreign policy used to place pressure on foreign governments by denying political leaders and their citizenry economic opportunities and commodities. The intended outcome is that the "target" regime will find this weakening of its economy so intolerable that it will change whatever policy has been found objectionable to the "sanctioner" or "sanctioners" (Askari, Forrer, Teegen, & Yang, 2001). Types of sanctions range from trade embargoes to the freezing of a country's financial assets. Reasons for the imposition of sanctions have varied from human rights violations, the proliferation of nuclear, biological, or chemical weaponry, the support of terrorism, and unlawful military engagement (Askari, et al., 2001). Whatever the reason, the target country is expected to alter its current policy to one found more preferable to the "sanctioner."

Because the use of economic sanctions is so rampant, much controversy exists over the issue. The most common debate is whether these sanctions are actually effective. Most arguments suggest they are not. For example, Iraq, Iran, and Cuba have been punished with sanctions for a
number of years. Iraq was imposed with sanctions after the Gulf War in order to impede development of weapons of mass destruction (Mueller & Mueller, 1999). Iran has been punished for support of international terrorism, "...hostility toward the U.S. ...[and]...acquisition of nuclear and ballistic weapons..." in addition to other reasons (Askari et al., 2001, p. 9). Lastly, Cuba has been victim to U.S. sanctions for decades in an effort to collapse the, "totalitarian state controlled by Fidel Castro" (Schwartzman, 2001, 3). However, to date there has been no real documentation that the sanctions on these countries have achieved the intended political aims.

Although the majority of cases suggest that sanctions are ineffective, one case in particular suggests otherwise. The total renouncement of the apartheid regime that in 1994 granted full citizenship to black South Africans is widely credited as a positive result of extensive economic sanctions combined with other social and economic conditions (Schwartzman & Taylor, 1999). For decades, the white South African government enforced an extremely repressive system of racial segregation onto the black majority by denying them citizenship rights and jobs, among other things. In opposition to the apartheid regime, the international community imposed various sanctions on South Africa over a span of several decades. Many scholars hold these sanctions accountable for the slow crumble of the racist system.

Recently, Zimbabwe, a neighboring country of South Africa, has become the subject of such scrutiny. Following similar moves by the European Union (EU), the U.S. has declared economic sanctions against the president of Zimbabwe, Robert Mugabe, and 76 of his government officials. "[The] executive order bars Americans from having any business dealings with the Zimbabwean leaders and freezes whatever assets they may have in the United States" (Stout, 2003, p. A3). Because of the accusation of a rigged election, the U.S. has not recognized the re-election of Mugabe since the last elections held in March 2002. Mugabe is accused of "undermining democracy and using violence to stifle political opposition" (BBC News, 2003 2).

Although the declaration of sanctions on Mugabe and his officials is relatively new, the implications that led up to the sanctions are not. Like South Africa, Zimbabwe has been inflicted with oppression instigated by the government. This investigation compares the previous case of South Africa with current example of Zimbabwe. Do economic sanctions have a chance of success in Zimbabwe as they did in South Africa? Are these economic sanctions against Zimbabwe combined with the same social and economic conditions as were the sanctions against South Africa? This study seeks to answer these questions.
Rationale
Because the use of economic sanctions is so rampant, this study is important in exploring criteria for future economic sanctions. The effectiveness of sanctions, their financial implications, as well as their indirect impact, have already been debated. This study, however, identifies specific social and economic conditions that buttressed the use of sanctions against South Africa and then determines whether these conditions are present in another sanctioned country in order to make some general explanations regarding the likelihood of success. Prior to imposing economic sanctions on another country, governments should first consider these consequential conditions rather than making costly decisions that may never be effective.

Literature Review
Given the extensive use of economic sanctions and the controversy behind them, scores of written work concerning sanctions are available. The debate of whether sanctions are effective, what types of sanctions are considered more effective than others, and what indirect effects they have on other countries, as well as upon civilians, have all been examined from various perspectives. Each of these issues will be addressed in turn.

The debate over the effectiveness of economic sanctions has been a widely examined issue and most research suggests that they do not work. Some scholars have sought to evaluate their "...use as a diplomatic weapon" as did Hendrickson (1994, p. 18). Hendrickson argues, like many others, that sanctions are generally not as effective as intended, and that U.S. foreign policy needs to be reconstructed so that sanctions are not always the automatic answer to a dislike of foreign policies elsewhere.

The cases of Cuba, Iran, and Iraq have been the most popularly used examples as evidence of the ineffectiveness of economic sanctions. These countries have been sanctioned for decades and have not produced the desired outcomes. Schwartzman (2001) concluded, "the embargo against Cuba cannot have its intended results" because the necessary conditions for success are not present (p. 115). Askari, Forrer, Teegan, and Yang (2001) made the same argument concerning the case of Iran. These authors claim that all that was achieved by sanctions against Iran was missed foreign direct investment, which will have a long-term effect on both countries. Similarly, Canes (2000) identifies the ineffectiveness of sanctions on Iraq. Rather than achieving the U.S.’s political intentions, Canes addresses the spillover effects of the sanctions on Iraq. Using the example of the oil embargo, he identifies the negative and sometimes positive impacts of the sanctions on third parties.
Other researchers view economic sanctions on a more positive note. Elliot (1998) claims that sanctions do have a relative effectiveness. The argument is that sanctions have the ability to provide more leverage and aid in military efforts. She also notes that the rate of success largely depends on the types of results sought.

Probably the most widely used example of the effectiveness of economic sanctions concerns the fall of the apartheid regime in South Africa. Coovadia (1999), Schwartzman (2001), Klotz (1995), and Schwartzman and Taylor (1999) all note that during the Mass Democratic Movement (MDM) in South Africa, sanctions played a key role. Coovadia stresses the importance of the sports and academic boycott at the time.

Klotz, Schwartzman, and Taylor agree, but also stress the significance of mass opposition, elite opposition, and the financial boycotts, that allowed the sanctions to work.

The most important existing research relevant to this study was conducted by Schwartzman (2001). She argues, "to the extent that sanctions appeared to be effective, it was only because they combined with a number of other social and economic factors" (Schwartzman, 2001, 5). Schwartzman identified specific social and economic conditions that, combined with economic sanctions, eventually collapsed the apartheid regime. She then applied these conditions to the current sanctions on Cuba, and concludes that these sanctions will not have the intended results because of the absence of some of these conditions. The conditions she identified as significant are international consensus on sanctions, global economic integration, an economy sensitive to embargoes, mass opposition, and organized elite opposition.

In addition to the debate over the relative effectiveness of economic sanctions, there exists the debate of which types of sanctions are most effective. The popular belief is that multilateral sanctions are more advantageous because these sanctions are a group effort made by numerous countries, which is believed to cause more harm to the "target" country. However, there does exist the argument that unilateral sanctions are actually more effective, as argued by Kaempfer and Lowenberg (1999). Their argument is that, viewed from a public choice perspective, foreign policy outcomes can be determined by domestic pressures (Kaempfer & Lowenberg, 1999).

Strydom (2001) discusses the newer interest of making sanctions "...smarter by targeting leaders and elite groups rather than vulnerable groups" (p. 58). She identifies the assumption of sanctioners that financial sanctions aimed at political leaders are less likely to hurt the citizenry.
However, Strydom stresses that it must be assumed that "...the target regime will attempt to shift the burden of suffering onto opposition constituencies and vulnerable populations" (2001, Some preliminary issues section, 5).

Possibly the most examined aspects of economic sanctions are the indirect effects suffered by the citizenry of the target country, as well as other nations not imposed with sanctions. Mueller and Mueller (1999) labeled economics sanctions as another form of weapons of mass destruction because of the harmful effects sanctions have had on the lives of civilians. They argue "that economic sanctions may have contributed to more deaths during the post-Cold War era than all weapons of mass destruction throughout history" (P. 43).

Economic sanctions have come under investigation in terms of the health of the target nation's citizenry. In some cases, the citizenry has been seriously harmed. Morin and Miles (2000) reported the lack of medical supplies and basic health-related products are the main reason behind the increase in malnutrition, disease, and infant mortality among these countries. After the 1991 Gulf War, the United Nations (UN) imposed sanctions "...made it virtually impossible for the country to recover from the devastating effects of the war and to rebuild its infrastructure" (Frankish, 2003, 6). Because of these sanctions there has been large numbers of unnecessary deaths - especially Iraqi children who have died from curable sicknesses, such as diarrhea (Frankish, 2003).

More unique analyses of sanctions have also been conducted. Erickson's (1999), Low-Level Trade Sanctions addresses the proliferation of the use of sanctions in the U.S. at the local and state level "without any connection to overall national policies or goals" (p. 375). He sifts through the usefulness of such sanctions and concludes that they gain little unless the nation as a whole takes on the task.

**Problem Statement**

The specific purpose of this study is to identify whether the social and economic factors that aided in the success of economic sanctions against South Africa (as described by Schwartzman) are present in Zimbabwe. What this study does not do is attempt to give a definite prediction of whether or not sanctions against Zimbabwe will actually be effective. Because the social and economic factors described by Schwartzman have not yet been applied to a significant number of cases involving sanctioned countries, there would be a lack of credibility in such a prediction. In addition, this study also does not attempt to measure the extent to which these social and economic conditions are present, but
rather identifies whether there is indeed a presence of these conditions. In summary, the research question at hand is: Are the social and economic conditions that Schwartzman identified as important in the successful use of sanctions against South Africa present in the current case of Zimbabwe? And if so, how?

Research Design

For the purposes of this study, a comparative case study design. The case study design is necessary for several reasons. First, this study is non-experimental due to the lack of control over the events under investigation. "For example, the researcher is not able to assign subjects or cases to experimental control groups, manipulate the independent variable, or control contextual and extraneous factors" (Johnson & Joslyn, 1986, p. 112). Secondly, comparative case studies have been considered to have more explanatory power than single case studies because they allow for replication (Johnson & Joslyn, 1986). Thirdly, it has also been noted that "...tests performed with case studies are often strong, because the predictions tested are quite unique" (Van Evera, 1997, p. 54). The comparative case study design will help answer the research questions posed because of the careful observation involved, which may provide some general explanations.

Variable Specifications

The variables sought in this study are the social and economic conditions that were addressed by Schwartzman in her study that aided in the successful use of sanctions against South Africa. However, the one noticeable limitation in Schwartzman's analysis was that she did not clearly define these conditions so that they can be more readily identified. This study attempts to more clearly define the following conditions with the help of outside sources and the author's own criteria:

- **International consensus:** For the purpose of this study, the author defines international consensus as a collective agreement in opinion to take action against another country or its leaders in the form of economic sanctions. The collective agreement must be among a significant number of countries, international organizations, and any other form of institution that has the power to take action against a country or its leaders.

- **Global economic integration and an economy sensitive to embargoes:** Global economic integration is present when the target country demonstrates a significant dependency on the international political economy. Schwartzman stresses that, "...the
target economy must be sufficiently integrated into the global economy such that trade or capital boycotts will have substantial ramifications" (Schwartzman, 2001, Global economic integration section, 1). Prakash (2000) defines this as, "the processes leading to integration of final products, intermediate goods, and factor markets across countries coupled with the increased salience of cross-border value chains in international economic flows" (95). In summary, the target country must demonstrate a recognizable economic dependency on the rest of the globe.

• **Mass opposition:** International sanctions, argues Schwartzman, "work best when they are combined with extensive internal opposition" (2001, Mass opposition section, 7). This can be demonstrated by the domestic "unceasing mobilization and strenuous organization of people" including political opposition parties, coalitions of worker, civic, and student groups, and the involvement of ordinary men and women (Coovadia, 1999, 4). Their actions may include organized and unorganized public protest as well as strikes.

• **Organized elite opposition:** This is demonstrated by the significant organization within the country of the wealthy and elite class that has the power to place pressure on the ruling party or leader.

**Methodology**

In order to obtain information on the situation in Zimbabwe, several sources will be researched, including the websites of the U.S. State Department and the International Monetary Fund (IMF). Articles from the regional news source allAfrica.com will also be analyzed for more detailed domestic information concerning Zimbabwe. These sources are appropriate because they provide detailed information and are updated regularly. These sources will be researched between the time frame of March 2002 and June 2003.

**Procedure**

Having already identified the social and economic conditions that allowed for the success of economic sanctions in South Africa, the purpose of this study is to determine if these conditions (international consensus, global economic integration and an economy sensitive to embargoes, mass opposition, and organized elite opposition) are present in the case of Zimbabwe. To determine if these conditions are present, the sources identified in the sampling methods section of this study will be researched.
between March 2002 and June 2003. The information obtained from these sources will be analyzed in order to determine if the conditions are indeed present and if so, how? If the identified conditions are present in the case of Zimbabwe, they will be discussed in comparison with the conditions that were present in South Africa.

Data Analysis

In order to assess whether any of Schwartzman's four social and economic conditions are present in Zimbabwe, the sources identified in the sampling methods section of this study will be researched in order to determine whether there is a presence of an international consensus on sanctions, a presence of global economic integration and an economy sensitive to embargoes, mass opposition, and organized elite opposition. In order to analyze the data obtained from the chosen sources, several questions will be posed:

- Does the data show a presence of any of Schwartzman's social and economic conditions as defined in the variable specification section of this analysis?
- If so, how many conditions are present?

Finding/Results

The results of this study found that, in the current case of economic sanctions against Zimbabwe, at least three of the four social and economic conditions that helped gain success in the use of economic sanctions against South Africa are present. The following three conditions were deemed present in combination with the sanctions against Zimbabwe:

- international consensus on sanctions
- global economic integration and an economy sensitive to embargoes
- mass opposition

The one condition not yet found present in Zimbabwe was organized elite opposition.

Discussion

The common argument behind economic sanctions is that they must be multilateral in order to have any type of real force. In the case of South Africa, there was certainly an international consensus primarily composed of the European Community (EC), the United States, and the British Commonwealth. The consensus was considerably strong concerning financial investment. Although the sanctions against South Africa had been in force for decades, by the 1980s, "the actions of international anti-apartheid groups expanded...and by 1986 over twenty state governments
and some institutional investors had been persuaded to divest their pension funds of stocks from companies operating in South Africa" (Schwartzman & Taylor, 1999, Economic contributions…section, 13). Because MNCs were also transferring funds out of the country, by 1987 about 40% of foreign subsidiaries had disinvested from South Africa (Schwartzman & Taylor, 1999).

Although the targeted economic sanctions against Zimbabwe's leaders are still quite new, there already exists an international consensus. After the 2002 elections were determined as flawed, the Commonwealth suspended Zimbabwe's membership (Africa Review World of Information, 2002). On March 7, 2003 the U.S. jumped on board following similar steps taken by the EU to sanction Mugabe and his officials (U.S. Department of State, Office of the Spokesman). Australia and New Zealand have also imposed similar financial sanctions in opposition to Mugabe's government (Massamvu, 2003). The consensus is promising considering the situation in Zimbabwe gained international attention only a few years ago. However, the country continues to conduct business and receive aid from countries such as Libya, Malaysia, and South Africa (Chanakira, 2002).

Global Economic Integration & An Economy Sensitive to Embargoes

In her analysis, Schwartzman also stressed that for embargoes to have an impact, "…the target economy must be sufficiently integrated into the global economy such that trade or capital boycotts will have substantial ramifications" (Schwartzman, 2001, Global economic integration section, 1). South Africa was quite integrated and dependent on the rest of the globe—especially the Western industrialized countries. South Africa did not have an adequate level of domestic savings to cushion itself from the sanctions and was rather dependent on foreign capital. The South African economy was tremendously damaged by disinvestment, the denial of loans, and capital flight (Schwartzman, 2001). The country was also quite vulnerable to trade sanctions. At the time of the sanctions, South Africa's economy was mainly geared towards foreign trade and technology. The Western sanctions of military, nuclear, and computer technology transfers to South Africa were extensive and significantly weakened the military (Moorsom).

In terms of commodities, a notable listing of South Africa's exports was perfectly vulnerable. Because of the world surplus of "…coal, most metals, steel, and fruit; alternative suppliers [were] ready and waiting" (South Africa: The Sanctions Report, 1989, 95). This made it difficult for the country to find buyers of the country's exports.

What makes the situation in Zimbabwe unique is that prior to the
imposition of sanctions, the country's economy was already facing collapse. With approximately half of Zimbabweans reliant on foreign aid for food and an inflation rate of 200%, Zimbabwe is highly dependent on the rest of the globe (U.S. Department of State, Office of the Spokesman). Zimbabwe is also a member of such organizations as the World Bank and the International Monetary Fund (IMF). However, the Executive Board of the IMF "has suspended Zimbabwe's voting and related rights, after having determined that Zimbabwe had not sufficiently strengthened its cooperation with the IMF in areas of policy implementation and payments" (International Monetary Fund, 2003, 1). And since 1999 there has been a fuel crisis throughout the country because of a lack of foreign currency to buy the commodity (Integrated Regional Information Network). Because of poor management of the economy and political instability, Zimbabwe has had a steep drop in investor confidence and "since 1999, the national economy has contracted by as much as 15%..." (U.S. Department of State, Bureau of African Affairs, 2002, Economy section, 4). In addition, Zimbabwe continues to depend on Libya and South Africa (the country's largest supplier) to secure alternative markets for its beef in replacement of its former EU market.

**Mass Opposition**

International sanctions, argues Schwartzman, work best when they are combined with extensive internal opposition. In South Africa, amongst excessive police force and repression, people continued to protest. The internal opposition was not only grand in scale, but it also was quite organized. At the forefront of the struggle was the Mass Democratic Movement (MDM), which was a "...coalition of worker, civic, and student organizations" (Coovadia, 1999, 6). The United Democratic Front (UDF) was also a coalition fighting for democracy, but consisted of hundreds of community-based organizations. Other groups such as the Congress of South African Trade Unions (COSATU) and even the National Medical and Dental Association (NAMDA) all played pivotal roles that increased the pressure to denounce apartheid (Coovadia, 1999).

Likely the most relevant group in the fight against apartheid was the African National Congress (ANC). Although the ANC was a banned organization from 1960 to 1990, the organization continued to have influence among the anti-apartheid community. There were four central pillars the ANC expressed in its attempt to unravel apartheid. The combination of an armed struggle, mass mobilization, underground resistance, and international pressure were what the ANC hoped would assist in the unraveling (Coovadia, 1999).
Zimbabwe, too, has its own share of internal opposition; however not yet on as grand a scale as South Africa. Established in 1999, the opposition of Mugabe's government is led by the Movement for Democratic Change (MDC). Amidst government-backed violence voters were still able to give the MDC almost 50% of the seats in the parliamentary elections. With the addition of various labor unions, student groups, and an unemployment rate of 70%, Mugabe opposition continues to grow (U.S. Department of State, Office of the Spokesman, 2003).

**Organized Elite Opposition**

Not only did the black population protest the apartheid regime, but there also began to be an increase in the amount of white opposition. Part of the country's elite capitalist class supported the end of the apartheid regime in response to the discomfort caused by the economic sanctions. In March of 1992, the white South African population voted in national referendum to put an end to the apartheid system. With about 69% of the vote Prime Minister de Klerk was forced to open up talks of a new constitution that extended rights to black South Africans (Klotz, 1995).

What caused this willingness of the white population to vote for a reform in the government? White South Africans were feeling the grunt of the economic sanctions and began to doubt the apartheid system that was already flawed in its effectiveness of economic development. The apartheid system invoked a color bar system that prevented blacks from obtaining jobs that were to be reserved for whites. The result was a lack of skilled labor and a more expensive labor force. In addition, the purchasing power of the masses was diminishing. Leaders of the business community such as Henri de Villers, chairman of the Standard Bank, and Gavin W. Rely, director of the Anglo-American Corporation of South Africa, began to speak out and stressed that South Africa needed the rest of the world. The white elites had concluded that reforms were necessary if they wanted to live comfortably (Schwartzman & Taylor, 1999).

The apartheid system was broken down partly with the help of the white elite class, yet in Zimbabwe this is one factor that remains absent (or at least has not been documented). Zimbabwe does have a small percentage of whites that up until recently had control of most agricultural production. However, Mugabe's controversial land reform program has resulted in the violent seizure of land from the white farmers and their workers without compensation. "The government maintains that as the first white settlers obtained their farmland mostly by expelling the indigenous black population, it has no obligation to pay the commercial value of seized farms. [This] has led to a crisis within the agricultural
sector and widespread food shortages” (Africa Review World of Information, 2002, Farming section, 2).

Limitations
The main limitation in this study was time. Given more time to complete the study, a more extensive comparative case study may have been conducted by identifying Schwartzman's social and economic factors against multiple sanctioned countries. By doing so, a more credible general explanation or even theory may have been reached.

Future research may be able to draw some explanatory theory by attempting to identify whether or not these social and economic conditions exist in various other sanctioned countries. By doing so, predictability may be possible in the use of sanctions in the future.

Conclusion
Although the targeted economic sanctions against Zimbabwe are only in their infancy, at least three of the four social and economic conditions that supported sanctions against South Africa are indeed present. An international consensus on sanctions, global economic integration and an economy sensitive to embargoes, and mass opposition all can be said to have a significant presence in regards to the current sanctions against Zimbabwe. However, there is not yet a presence of organized elite opposition. Although this study does not attempt to measure the extent to which these conditions are present, it is safe to say that these three present conditions have not yet reached as grand a scale as they were in South Africa.

The possibility for success of sanctions against Zimbabwe may also be considered somewhat promising—even with the lack of an elite opposition. With the growing international consensus of the sanctions backed by the EU, United States, and the Commonwealth, other non-Western states may find the temptation to jump on board in an effort to end corruption and government-backed violence against Zimbabweans.

Zimbabwe's extreme dependence on foreign aid is another key factor that places pressure on the Mugabe government as well as the growing amount of mass opposition led by the MDC. Although there is not yet an organized elite opposition in the country, the situation may change in the future and the ruling elite may see it in its best interest to turn on Mugabe's government if the sanctions are harmful enough. It must be remembered that the sanctions against South Africa lasted for about 30 years. If the same results are sought, it may take just as long in the case of Zimbabwe.
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The Availability of Yellow Grease at Fast Food Chains and Restaurants in Sacramento for Biodiesel Usage

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Abstract

The availability of fry oil in Sacramento is researched to find if there is a good source of tallow or bio-waste from restaurants and fast food chains. The tallow and bio-waste is necessary for the production of low-cost biodiesel for decreasing greenhouse gas emissions. Biodiesel is a clean alternative fuel made from vegetable oil or animal fats that can be used as a substitute in diesel engines. Greenhouse gas emissions, such as carbon oxides, sulfur oxides, and particulate matter, can all be diminished if diesel engines use biodiesel as an alternative fuel. The availability of yellow grease for biodiesel has the possibility of decreasing the cost of biodiesel, so that it can be used in the Sacramento Valley to decrease the amount of air pollution that comes from local sources as well as windblown pollutants from the Bay Area. This study will pinpoint which types of restaurants are the best sources for yellow grease rendering in Sacramento. No difference was found between non-fast food chains and fast food chains yellow grease availability. However, with a larger sample size it is possible to find a difference in both the amount of yellow grease at restaurants and especially the price of yellow grease per restaurant.

Introduction

There are numerous reasons why biodiesel should be used as a transition fuel from petroleum-based gasoline. These reasons include a decrease in the dependency on imported petroleum products, a decrease in carbon monoxide (CO), carbon dioxide (CO2), sulfur oxides (SOX), and particulate matter coming from vehicle exhaust, increased local employment and income, and increased production of motor fuels on a renewable basis. Large trucks that run on diesel fuel can easily be run on biodiesel without any modifications, and in doing so primary greenhouse gas emissions will decrease. However, there is a need for more resources or production of vegetable oil to supply the economy with biodiesel fuel, in order for it to be economically supplied to the public.

Biodiesel is an alcohol ester made from vegetable oil or animal fats, which is a clean alternative fuel for diesel engines, having the same energy content as a diesel fuel. Biodiesel has comparable performance ratios with petroleum-based diesel, considering the mileage and engine longevity. It is created through a process called transesterification (Bender, 1999).
Transesterification is a way to break down the triglycerides within the oil content by combining the oil with alcohol and increasing the heat to create the alcohol ester that is biodiesel. Unfortunately, if the free fatty acid (FFA) content is too high, the cost of transesterification increases (C.T. Donovan, 1998). Knowing this, it is essential to find local sources for yellow grease with a small percentage of free fatty acids (less than 5%). It is then safe to say that the estimated $0.60 cents per gallon for transesterification costs can be met (Texas Food and Fiber Commission, 2002). If biodiesel can compete economically with regular diesel fuel, then this cleaner alternative will be viable commercial use.

One of the main obstacles holding back biodiesel production is the availability of land resources to grow crops for vegetable oil. However, another resource for oil is animal fats and bio-wastes, which might make up a substantial difference in the availability. Tallow and fry oil from restaurants can increase production of biodiesel for a larger market, therefore decreasing the high cost of farming of vegetable oil (C.T. Donovan, 1998).

More evidence supporting alternative fuels is that, by the year 2050, the total world oil reserve will be depleted to be insufficient for a primary energy source. It is estimated by the U.S. Department of Energy that a transition to more clean burning fuels, such as biodiesel and hydrogen, could take anywhere from one to five decades, if not longer (U.S. Department of Energy, 2003). This means that alternative fuels for transportation must be addressed now so that actions will occur to stimulate economic growth for alternative fuels.

This study seeks to examine the availability of yellow grease, which is used to make biodiesel, and will argue that there is a significant difference in the amount of yellow grease available either at fast food chains or other restaurants. The difference between the availability of yellow grease from fast food chains and non-fast food chains will be analyzed to see which one would have the most availability. The overall goal is to provide support to decrease the production costs of biodiesel sufficiently enough to affordably start a local yellow grease rendering industry, which could be a model for other cities to develop and use alternative fuels.

Rationale

If a cost effective method for recycling fry oil is developed, then the market for biodiesel as an alternative fuel can be opened up to decrease the United State’s reliance on foreign petroleum products. That said, Sacramento and the surrounding area has a wide variety of over 3,000 fast food chains and local restaurants with fryers that produce bio-waste and
The availability of yellow grease at these restaurants may be established by this initial study to spur further studies on the feasibility of yellow grease rendering companies in Sacramento that supply additional sources for biodiesel fuel. This research seeks to answer the following three questions:

- What is the availability of yellow grease in Sacramento?
- Where is the best source to find yellow grease (fast food or non-fast food restaurant)?
- What is the cost of the yellow grease? (Depending on the renderer and the size of the business, costs fluctuate)

Literature Review

Biodiesel is made from agricultural sources, such as soybeans, rapeseed, mustard seed, cotton and other plants, which have high oil yields (U.S. Department of Energy, 2003; Texas Food and Fiber Commission, 2002). It can also be processed from tallow, fry oil, and bio-wastes (2003). Biodiesel is a good transition fuel for the U.S. economy because it decreases pollution in comparison to petroleum diesel (Duffield, 1998), requires zero engine modifications, and has lower carbon dioxide, carbon monoxide, sulfur dioxide, and particulate matter emissions (1998). Other benefits of biodiesel, in contrast to regular diesel, are that there is improved biodegradability, reduced odor, less soot, and safer handling due to a higher flash point (Peterson et al., 1996; Graboski and McCormick). A higher flash point means that it is less flammable and less explosive.

Bio-fuels have been around for the past 100 years, just as long as the diesel engine. In the early 1900s, peanut oil was used in some of the first diesel engines (Duffield, 1998). However, because of economic feasibility, regular petroleum-based diesel fuels have been used as the primary source of fuel (Bender, 1999). As stated in the rationale, if a cost effective method for recycling fry oil is developed, then the market for biodiesel as an alternative fuel can be opened up to decrease the U.S. reliance on foreign petroleum products.

Because fuel prices have drastically increased in the past two years, not only can alternative fuels environmentally benefit society, but they also have the possibility of decreasing the overall cost of transportation (C.T. Donovan, 1998). Two studies about decreasing the price of biodiesel were done in 1998 and 1999. In 1998, C.T. Donovan and Associates, Inc. reviewed "The availability of no- to low-cost feedstock for biodiesel and ethanol in Philadelphia." They found that yellow grease is the most economical way to decrease costs of biodiesel to make it affordable and competitive with regular fuel (1998). In 1999, Martin Bender from the Land...
Institute analyzed the economic feasibility for community-scale cooperatives for biodiesel. Bender found that it was not economical to make cooperatives due to fuel prices, lack of land resources, and the high cost of farming (1999). However, both studies argue that the feasibility of biodiesel improves with the help of yellow grease produced from restaurants.

Research has also been conducted at the University of Idaho on contrasting biodiesel and regular diesel fuel with different blends to see which one works best with the diesel engine. If a sufficient amount of yellow grease waste is produced locally, it will increase the chance of biodiesel being the transition fuel for more environmentally-efficient transportation, such as hydrogen energy from fuel cells (Fuel Cell Partnership, 2003). Although manufacturers have only approved a blend of 5% biodiesel mixed with regular diesel #2, biofuels are working towards 100% reliability at higher grades (U.S. Department of Energy, 2003).

The United States Environmental Protection Agency (EPA) has published analytical statistics that show the 'idling' problem with large diesel trucks. Looking at California's estimated future gasoline consumption, by 2030, 10 billion more gallons of gasoline and diesel are needed to meet the projected demand (California Energy Commission, 2003). Biodiesel can be a part of the solution to keep up with demand, while being a clean option to solve part of the idling problem. The following is a closer look at the diesel truck idling problem:

Truck drivers idle their engines during their rest periods to provide heat or air conditioning for the sleeper compartment, keep the engine warm during cold weather, and provide electrical power for their appliances. Approximately one-half million trucks travel more than 500 or more miles as their primary range of operation. Based on this travel distance, truck drivers will likely require an extended rest period and may idle their engines during this time. Some studies indicate that the typical long duration rest period lasts from 6-8 hours per day, over 300 days per year. Truck idling affects our environment and our energy supply in several ways. Trucks consume up to one gallon of diesel fuel for each hour at idle, using as much as 2,400 gallons of fuel every year per truck. This totals 1.2 billion gallons of diesel fuel consumed every year from idling, costing $1.8 billion (at $1.50 gallon/diesel). On average, each idling truck produces about 21 tons of carbon dioxide (CO2) and 0.3 tons of nitrogen oxides (NOx) annually totaling over 11 million tons and 150,000 tons, respectively. Diesel exhaust also contains particulates, sulfur dioxide, carbon monoxide, hydrocarbons, and various air toxics. Idling emissions can contribute to
premature mortality, bronchitis (chronic and acute), hospital admissions, respirator symptoms (upper and lower), asthma attacks, work loss days, and minor restricted activity days. In addition to fuel costs and emissions, engine idling results in increased maintenance costs associated with substantial wear to the engine. Studies indicate that idling can cost over $300 annually in maintenance costs alone. (EPA, 2003). These statistics show the concern for wasted diesel gas and unwanted pollution. Biodiesel has a neutral carbon dioxide balance because it is taken directly from the environment, decreasing CO2 emissions from idling (Commission of European Communities, 2001). An added benefit is that illnesses from diesel exhaust may be reduced by using biodiesel as an alternative fuel.

Along with environmental efficiency possibilities, biodiesel also can help with foreign affairs by showing other countries ways to be more self-sufficient and spend less in energy used per mile traveled. One way to decrease the dependency on foreign petroleum imports is to increase the efficiency and reliability of alternative transportations. Alternative transportation options include formulated gasoline or diesel, methanol, ethanol, hydrogen (fuel cell) and electric (Ogden, 2002). The hydrogen fuel cells seem to be the fuel for the future, but do we keep using petroleum based fuels that are causing smog and pollution until the fuel cell is ready? Biodiesel is an efficient transition fuel that has the potential to stay on the market even when the fuel cell is fully developed.

Fossil fuels are used for 96% of the total transportation in the U.S. (Birky, 2001), even though it is a depletable resource, and is shown to have high pollution risks. Biodiesel, in contrast, is considered a renewable fuel because its agricultural production and processing have a positive energy balance of roughly 2.5:1 (Ahmed, I., Decker, J. & Morris, D. 1994). Although biodiesel can reduce particulate matter, it has also been shown to increase oxides of nitrogen (NOX) in some engines (Clark, 1999). However, the percentage of reduction of carbon monoxide and sulfur dioxide is greater than the percentage increase in nitrogen oxides (EPA, 2002).

With all the attributes biodiesel has to offer, there are only five biodiesel companies in the United States that produce an estimated 60 million gallons/year (C.T. Donovan, 1998), which is only a small percentage of the total used as the primary fuel. In order for biodiesel to have an effect on large scale pollution percentages, more resources are needed to increase production and decrease prices to feasible levels. The U.S. Department of Energy stated, "... despite the fact that we are not yet able to identify the
"best" transition path... it takes several decades for the effects of the new technologies and fuels to be fully effective." In other words, actions and measures for change must start now.

Due to the increase in biodiesel awareness, The Texas Food and Fiber Commission’s 2002 annual report on cotton seed oil for biodiesel use estimated national costs of transesterification of the cotton seed oil to be approximately $.60 cents per gallon (Texas Food and Fiber Commission, 2002). The cost was found to be too high to compete with regular diesel fuel prices. However, the Commission did note that agricultural costs for biodiesel production could decrease from the following factors:

• proximity of producers to consumers lowering feedstock and transportation costs
• deletion of middlemen lowering costs
• heightened environmental sensitivity assigning a premium to biodegradable fuels

Although the Commission’s report looked at only the economic viability of cotton seed oil, the report correlates to this study because the first and second factors may be affected by having a biodiesel plant near the source of the vegetable oil or yellow grease.

Heightened environmental sensitivity can only come with time as more pollution affects more humans and the ecosystem, so naturally heightened sensitivity should occur over time in benefit of cleaner alternative fuels. For this study, the price to produce biodiesel should decrease if a viable source of yellow grease is found in Sacramento, and if a biodiesel plant is set up locally in order to reduce transportation costs.

As biodiesel awareness is increasing, so are the steps to finding the most economically efficient way to mass produce it for the public. The purpose of this research is to determine the yellow grease available in Sacramento, and to see how economical it is to have local recycling facilities produce bio-fuels for local transportation. If data is found that fast food chains and/or local restaurants have a sufficient amount of yellow grease, then a recycling plan should be presented so that yellow grease can be used for alternative fuel transportation.

If a sufficient amount of yellow grease can be found in Sacramento-area restaurants, then a recycling pick-up plan should be implemented specifically created to help with the production of biodiesel, and require less dependence on the depleting resource of petroleum-based products. Given the above literature review, the hypothesis of the study is:

**Hypothesis Alternative:** There is a significant difference between the amount of yellow grease found at fast food chains and the amount of
yellow grease found at non-fast food chains.

**Hypothesis Null:** There is no significant difference between the amount of yellow grease found at fast food chains and the amount of yellow grease found at non-fast food chains in the Sacramento area.

With this information, a conclusion can be made whether the availability of yellow grease in Sacramento is worth studying for the production of biodiesel, or whether there is an insufficient amount, at too-high-a-cost, for biodiesel to possibly help decrease greenhouse gas emissions locally.

**Research Design**
The research plan is to conduct a survey of local restaurants that produce the by-product of yellow grease. This design is appropriate for this study because the survey asks the questions directly to the restaurants that are producing the by-product of yellow grease. A survey of statistics is precise in analysis due to the fact that there is less interpretation and more factual numbers, and 'yes' or 'no' questions. The analysis will include a descriptive ANOVA test, two-tailed t-test, along with a basic statistical analysis. If any pertinent information evolves through conversing with renderers or management at restaurants, it will be cited and documented in the results. An experimental design is unnecessary because the study is designed to test real numbers in the Sacramento area.

**Variable Specification**

**Hypotheses:**
1. The independent variables are the fast food chains and non-fast food chains.
2. The dependent variable is the amount of yellow grease found at both restaurant sites.

A potential confounding variable is the difference between the amount of yellow grease tested and the actual number of yellow grease sources in Sacramento. This confounding variable may drastically change the total estimation of yellow grease in Sacramento. To control for this variable, the average amount of yellow grease found for both fast food chains and non-fast food chains will be multiplied by the total amount of yellow grease renderers found in Sacramento.

**Elements/Sampling Methods**
The survey will be distributed by driving to local restaurants that produce yellow grease. If a restaurant cannot be surveyed on the spot, its address and telephone number will be documented so that surveys can be conducted over the phone. Every restaurant will be checked in person for
rendering contacts, and the size of yellow grease containers stored near the dumpsters. Out of the rendering companies surveyed, all three are expected to be contacted in person or by telephone. Because the data collected is split fifty-fifty for fast food restaurants and non-fast food restaurants, a weighted average will be conducted by looking in the 'Restaurants' section of the phone book, and finding the number of fast food chains listed versus non-fast food restaurants listed.

Procedure

Sacramento will be divided into five sections; North, South, East, West, and Central. From every section, ten restaurants will be surveyed concerning their availability of yellow grease. Only restaurants that have deep fryers will be surveyed. A comparison between privately owned restaurants and food chains will be analyzed. There will be a total of fifty surveys from the Sacramento area that will produce a summary of the estimated amount of yellow grease in the area. The average amount of yellow grease available from every section will be determined, and that figure will be multiplied by the additional "deep fryers" of every section.

When surveys are conducted on-the-spot, the researcher will state the following:

**Introduction One:**

Hello, my name is Justin Ancheta from CSUS Sacramento, and I am conducting a research project to find the availability of fry oil in Sacramento. Is there anyone here that I can talk to for about ten minutes on the subject matter?

**Introduction Two:**

Hello, my name is Justin and I am doing a study of urban waste grease in Sacramento. Do you have a few minutes to answer some quick questions?

As well as restaurants, renderers of yellow grease for Sacramento will be surveyed to find out how much yellow grease is put in landfills, and how much is being recycled, for additional research purposes. (See Appendices A and B for surveys.)

Final results will be calculated, estimating the availability of yellow grease for biodiesel production in Sacramento, and giving recommendations on which restaurants to work with, and the estimated feasibility options for yellow grease available for biodiesel use in Sacramento. The total amount of yellow grease in the Sacramento area will be found by looking at three random restaurant pages in the Yellow Pages of the Sacramento area phone book, and find the number of how many
fast food restaurants in comparison to non-fast food restaurants.

Data Analysis
The analysis will include a descriptive ANOVA test, two-tailed t-test, along with a basic statistical analysis. Further cross reference tests will be conducted such as a nonparametric chi-square test to check all final results. After the average of all sampled restaurants is found, the weighted average of fast food restaurants versus non-fast food restaurants will be applied to the data, and the total yellow grease availability in Sacramento will be calculated.

Results
The researcher drove around Sacramento for the three weeks for about three hours a day searching for fast food restaurants and non-fast food restaurants. The researcher made sure that he spread the data collection all the way across Sacramento by picking only ten restaurants in different areas of the city such as North, South, East, West, and Central Sacramento. Most managers at the fast food restaurants had no idea what this researcher was talking about, even after an explanation of what "fry oil" is. This required the researcher to alternately find out how much oil is put in a container daily or every other day, and then calculate the monthly mean total of yellow grease. Non-fast food restaurants, on the other hand, were more able to report how much yellow grease is used monthly. If the names of the contracted renderer were unknown to the restaurant's management, the researcher always double checked by going to the dumpster of each restaurant and checking which renderer had supplied their container.

After the quantity of yellow grease that was generated by the restaurants was included in the data, the contracted renderers were then called and asked questions about the cost of their containers (which depended upon size and frequency of pick-up). The researcher did have to pose as a customer, because the renderers did not trust that their companies' names would be kept confidential.

Because it was harder than first thought to collect the correct information from each restaurant, the sampling size was reduced to 20 restaurants instead of the proposed 50. Out of the 20 surveyed, 10 were fast food chains and 10 were non-fast food chains. As stated in the Methods section, a weighted average of fast food verses non-fast food restaurants was found to be 30 fast food restaurants compared to 94 non-fast food restaurants, a 1 to 3 ratio. The total population of fast food chains is only one–quarter of the total restaurants in the area. With this figure, the
total amount of yellow grease rendered in the Sacramento area was found to be 5,770,800 gallons/year. This does not include grease traps, which usually trap all un-renderable grease.

The data was collected and entered into a statistical software program to generate different statistical tests to find if there is a significant difference between the availability of yellow grease at fast food chains and the availability of yellow grease at non-fast food chains. The data showed that there is no significant difference between both restaurant groupings, showing the P-value to be .291 (P>.05). This concludes that the null hypothesis should be accepted, which states that there is no significant difference between the availability of yellow grease at fast food chains and non-fast food chains in the Sacramento area. Although the mean difference was substantial, the overall standard error and overlap of high and low variables made it statistically impossible to tell a difference between the means.

Discussion

Although the research question found no statistical values to back the hypothesis, it was found that there is a significant difference between the price per gallon of yellow grease at fast food chains and the price per gallon at non-fast food chains. The mean price per gallon of non-fast food chains almost doubled the per gallon price of fast food chains (fast food = $.15/gallon; non-fast food = $.29/gallon). As well, the mean amount of yellow grease at fast food verses non-fast food restaurants shows a difference of over 73 gallons/month. With this considerable difference, it is possible that, if the sample size increased, a significant difference can be proven between the availability at fast food restaurants verses non-fast food restaurants.

The data collected has also been compared with the National Renewable Energy Laboratory's research from 1997 (Wiltsee, 1998), and found that their estimation is extremely low in comparison to the current total estimation. In pounds, Wiltsee estimated that 4,500,000 pounds/year are collected in Sacramento for rendering. There are 7.3 pounds/gallon, so it equates about 616,500 gallons/year (excluding grease traps). With Wiltsee's low 1997 estimation on yellow grease in Sacramento, it can be concluded that restaurant quantities in Sacramento have increased as well as the area surrounding metropolitan Sacramento that drastically change the quantity of yellow grease available. In the 1997 study 2,200 restaurants were estimated whereas the current study estimates over 3,000 restaurants based on information provided by local renderers. This estimate does not include restaurants that do not work with a renderer currently (such as all local
Taco Bells equaling 15,600 gallons/year).

This research estimation of available yellow grease comes from the average of all 20 restaurants that were studied, and ended up being millions of gallons over Wiltsee's estimation. From this, it is possible to conclude that Wiltsee drastically underestimated the amount of yellow grease in the Sacramento area. Although this research could have also overestimated, it is much more current a figure than the previous research. It also supports the statement made by Wiltsee that he possibly underestimated the total availability of yellow grease in the Sacramento area (Wiltsee, 1998).

Limitations
This research was limited by the knowledge of the managers and restaurant owners surveyed, as well as their hesitation or inability to divulge information about renderers. All data collected has been found to be substantially significant by identifying the amount of yellow grease available in Sacramento for biodiesel usage. However, this research would be more substantial if there was access to rendering records for the past year in the Sacramento area. Yet, these records are restricted, which is a hinderance to the preciseness of this research. As well, the estimation of how many fast food restaurants versus non-fast food restaurants was estimated by looking in the phone book; the weighted average represents the entire population as best it can. Therefore, not all restaurants were counted one by one and the 3,000+ restaurant estimation also should account for error within the data.

Conclusion
Political actions to give extra incentive for renderers to start producing biodiesel are essential for the health of the city. Sacramento lies right along Interstate 80, which stretches all the way across the United States. The trucking industry currently relies entirely on petroleum diesel fuels and expels many toxins into the air. If biodiesel can be established at diesel truck stops locally, it will create a market for renderers to keep producing and expanding biodiesel until it can sustain the local diesel fuel industry. However, without tax incentives and subsidies, renderers seem to think that it would be "un-economical to produce biodiesel on a large scale in Sacramento" (Local Renderer). This researcher, however, sees it as being a challenge that has not yet been taken on.

Concerning rendering tactics, if biodiesel is established locally at rendering plants, pick-up containers must be modified to make sure that the yellow grease is cleaner than current standards require, and does not contain water and dirt. An option would be to find better yellow grease containers to place behind restaurants to make sure that they put in only
yellow grease without any other by-products, which contaminate the fry oil.

To conclude, the research has found that there is a substantial amount of yellow grease in the Sacramento area, and supports the belief that with the right business tactics and government support, a market can be established for biodiesel at a local level in the Sacramento area.
References


McNair Scholars Journal


Appendix A: The Survey of Restaurants

Instructions: Please circle the correct answer. When a line is given please enter the correct explanation.

1) How much yellow grease byproduct is there in a month period in gallons? 
   ___________________________ (If you know the free fatty acid content in percentage please specify).

2) Do you have a renderer that works with you to pick up the yellow grease? 
   Y / N 
   Name of company if applicable: ___________________________

3) What are you charged for yellow grease to be picked up from your restaurant? 
   $__________

4) Any other information that might help? ___________________________

Office Use Only
Name of Restaurant: ___________________________
Section: ___________________________
Address: ___________________________

Appendix B: The Survey of Renderers

Instructions: Please circle the correct answer. When a line is given please enter the correct explanation.

1) How much do you charge and what are the size containers given? 
   ___________________________

2) What is your price difference with size of containers and amount of pickups? 
   ___________________________

3) How many restaurants or businesses does this facility work with in the Sacramento Area? 
   (10-50)  (50-100)  (100-300)  (300+__________) 

4) What types and amounts of animal and vegetable oils and greases does your company collect (or have delivered) for processing or rendering from the greater Sacramento area? (Rough, order-of-magnitude estimates are sufficient.)

5) What is the average (or typical) moisture content, free fatty acid content, and solid content of the oils and greases collected? 
   Grease Traps: ___________________________ 
   Container picked up: ___________________________

6) Any other information that might help? ___________________________

Office Use Only
Name of Renderer: ___________________________
Section: ___________________________
Address: ___________________________
Reducing School Violence in a Northern California School District: Impact of the School Resource Officer Program

Edith Garcia

Abstract

America's schools are having difficulty completing their mission of education. Violence has plagued the school environment making it difficult to maintain safe learning institutions. The occurrence of school violence has resulted in the development of the School Resource Officer program (SRO). The SRO program places uniformed police officers on school grounds to help school administrators with school violence, and as a deterrent for inappropriate behavior. This study was designed to determine if SROs in a northern California school district are effectively reducing school violence and disciplinary problems at the high school level. A total of 6 SROs were surveyed from the school district. Each SRO represents a single high school, as there is only one SRO assigned for each high school. Using a questionnaire to measure the SROs' perceptions of the program, and high school data on crime, this study seeks to determine if certain goals and objectives are being met through comparative analysis.

Introduction

Throughout the United States, school violence has increased, resulting in radical innovations aimed at improving school safety and enhancing educational goals (Kipper & Bostain, 2001). These educational goals include improving attendance rates, scores on achievement tests, along with student, staff, and parent satisfaction with the handling of crime and disorder on school grounds (Atkinson, 2001). School violence has become a serious epidemic, a problem to the social learning environment of children (West & Fries, 1995; Elliot, Hamburg, & Williams, 1998). School administrators and teachers today are being prevented from completing their mission of education due to the presence of school violence. Bullying, harassment, gang activities, and drugs are some of the common social ills that America's school children are experiencing (Johnson, 1999). In response to the increase in school violence, many public schools have formed partnerships with their local law enforcement agencies to help reduce school violence.

Philosophical principles of the "community-oriented policing" model have been enacted within school communities (Kipper & Atkinson, 2001). Thurman, Zhao, and Giacomazzi (2001) define community policing as "the
guiding philosophy for the delivery of police services that relies upon positive interactions among police, other public servants, and community representatives to serve local needs regarding crime control, crime prevention, and crime related quality-of-life-issues" (p. 10). These authors state that police are more efficient when working with community members in a partnership effort. Community policing in schools allows for a coalition to be formed amongst school administrators, teachers, police, and citizens that works collectively to monitor student progress.

Uniformed police officials, known as School Resource Officers (SROs), have been placed in most city high schools. Research on SROs has revealed that the placement of uniformed police officer reduces the occurrence of school violence (Johnson, 1999). According to Atkinson (2001) "SROs reinforce high expectations for success by communication, through word and action, [and] clear expectations for appropriate behavior" (p. 55). This finding makes it important for schools to integrate the community-policing model in order to maintain a secure and law-abiding environment amongst the students.

Rationale

The purpose of this research is to assess the perception of the School Resource Officer on the perceived effectiveness of the School Resource Officer program, and to complete a comparative analysis on high school crime data in correlation with the placement of the SRO. This study advances current research as there has been only one study done regarding the effectiveness of SROs, and the study was done in a southern state. This study includes new school crime data for the 21 century in relation to the SRO in a northern California school district, and correlates each individual SRO with the school site in which he or she is placed.

According to the 2002 statistics by the National Center for Disease Control and Prevention, 17% of high school students reported that they carry a weapon, 33% percent have engaged in a physical fight, 19% have thought about suicide, 7,357 children, ages 5 to 19, were murdered, and 4,966 committed suicide. With the nation's youth experiencing violence in schools, it is important for SROs to be included in measuring the overall effectiveness of the School Resource Officer program. Measuring the SROs perceptions and correlating them into school crime data will allow researchers, policy makers, and school administrators to distinguish if certain variables of SROs are more efficient in meeting goals and objectives. The proposed research will examine the reported frequency of school violence, suspensions, and expulsions in schools with SRO programs, and determine whether certain goals and objectives are being accomplished.
Literature Review

In order to understand the relationship between school violence, community policing, and the SROs, the scope of this research will review literature from all three components. Each component provides an understanding of school violence within the community-oriented policing model. The main themes discussed include: definition of school violence, characteristics of communities, and expansion of the role of police.

Defining School Violence

The root of school violence has not been thoroughly identified, as there is such a broad range of categories of violent acts. Acts may range from vandalism to bullying to physical fights that may or may not result in injury or death. The Center for the Prevention of School Violence (2002) defines school violence as "any behavior that violates a school's educational missions or climate of respect or jeopardizes the intent of the school to be free of aggression against persons or property, drugs, weapons, disruptions, and disorder" (p. 1).

Lawrence's (1998) research indicates that the types of crimes most often committed in schools involve drugs and alcohol, theft and vandalism, and weapons and violence. In the health education field, studies have shown that gender, race, and grade level in schools are significant predictors of school-related violence. Hill and Drolet (1999), in their study of this issue, revealed that Asian, Black, and Hispanic students were significantly more likely to carry a weapon on school property. Their study suggests that the roots of violence are predominately intraracial; students of the same ethnic background are victimizing one another. Minority students were found more often to be victims of school violence, and had a higher percentage than Whites of engaging in physical fights.

Characterizing Communities

Given that school violence is highly associated within school grounds, sociologists have conducted studies of the characteristics of the communities in which the school resides. Literature reveals that the types of crimes committed in schools are a reflection of the community in which the school resides (Lawrence, 1998; Elliot, Hamburg, & Williams, 1998). For instance, a neighborhood that has a high crime and drug rate is more likely to experience those same negative problems in the school environment. Wilson & Kelling's (1982) well-known article, "Broken Windows," suggested that neighborhoods that show signs of disorder are ripe for deviant behavior and, indicate lack of social control. Having no social control is evidence in a neighborhood with broken windows, vandalism, drunkenness, drug sales, and gang presence (Wilson & Kelling,
Clark and Lab (2000) echoed the same argument in their study, hypothesizing that the conditions of surrounding neighborhoods significantly influence the level of crime in junior and senior high schools. Their research revealed little significance of neighborhoods being an influence on in-school crime. The results were surprisingly inconsistent with previous studies that examine community influence on in-school problems (Clark & Lab, 2000, p. 39). The authors contend that inconsistent results suggest that the internal characteristics of individual schools need to be considered. This finding suggests that school violence is not necessarily a mere reflection of the community as previous studies have suggested.

Given that the problem of school violence is no longer restricted to impoverished urban communities, recent school incidents have demonstrated that the problem has disseminated into middle-class suburban communities. An indisputable example is Columbine High School in Littleton, Colorado. That school community experienced an outbreak of school violence when two White, upper-middle class students went on a shooting spree. Such an incident reveals that school violence is not necessarily entrenched in the community in which the school resides. Community is no longer a significant influential factor of school-related problems.

Sociologists today have become too entrenched in school violence within the school institution (Hill & Drolet, 1999). This means that internal factors in schools rather than external factors might have more of an influence on school violence (Clark & Lab, 2000). Internal factors that may attribute to in-school violence are disciplinary practices, peer pressure, stress, and victimization. Research on violence often fails to acknowledge its heterogeneity and the likelihood that different forms of violence have different motivations and are a response to different conditions and circumstances (Fagan and Wilkinson, 1998). For instance, a student who is constantly being harassed at school may soon become prone to act upon his or her problem. This entails that students abide by a different value system because of internal factors that are present; such factors may lead students to respond with violent acts.

Expanding Role of Police in Schools

In response to the pervasiveness of school violence, police have been recruited to integrate their services into the school environment. Schools are now perceived as a separate community in which effective law enforcement response is needed to address in-school problems. By the mid-1980s, several police departments, led by reform-minded chiefs,
implemented a number of community policing programs, marking the beginning of the community era (Thurman, Zhao & Giacomazzi, 2001).

Community policing has expanded the role of the police in providing services to schools, drug treatment programs, parks and recreation specialists, and has improved police-youth relations. Bazemore, & Scott's (1997) study of police encounters with juveniles revealed that police have enacted a less aggressive style of enforcement. With the principles of community policing applied, youths come to view the police officer as role model and caregiver rather than as an oppressor fully equipped to act on a problem with force (Thurman, Zhao and Giacomazzi, 2001). Community policing expands the role of the police, and has allowed for the formation of support programs for children. Programs in school, such as Drug Abuse Resistance Education (DARE), Gang Resistance Education and Training Officers (GREAT), have placed police officers in schools since the early 1990s to prevent children from engaging in criminal misconduct. However, programs like DARE are strongly emphasized only in elementary schools. When children advance to secondary schools (middle/high) there are no other police support programs emphasized.

The concept of the SRO did not gain momentum nationwide until the mid-1990s, due to numerous outbreaks of school violence. Part Q of Title I of the Omnibus Crime Control and Safe Streets Act of 1968, as amended, defines the SRO as "a career law enforcement officer, with sworn authority, deployed in community-oriented policing, and assigned by the employing police department or agency to work in collaboration with school and community based organizations" (Girourard, 2001, p. 1). Each high school and middle school has one SRO placed on site. School administrators hope that the presence of the SRO will deter violent behavior and alleviate community fears.

Ida M. Johnson, a criminal professor at the University of Alabama, conducted a study (1999) that examined the effectiveness of the School Resource Officer program in nine city high schools and 18 middle schools. Johnson's research design included four questionnaires and interview schedules which were given to two key persons of the SRO program, principals, and teachers. Again, the overall goal of the SRO program is to provide a safe school environment. Johnson’s study revealed that the placement of police officers in city schools was effective in reducing school violence and disciplinary infractions. The data showed a decrease in major offenses, from 3,267 in 1994-95 before the placement of an SRO, to 2,710 in 1995-96 after the placement of an SRO (Johnson, 1999). It is important that the community and law enforcement agencies work together in the
resolution of school violence and disciplinary problems with the ultimate goal of enhancing overall school effectiveness.

Problem Statement

Juvenile violence is on the rise throughout many high schools (Hill & Drolet, 1999; Elliot et al., 1998). Because of this increase, California’s policy makers have enacted new legislation, namely Proposition 21, which will impose mandatory adult court jurisdiction over children who are 14 years and above when accused of capital offenses. The implementation of Proposition 21 will prosecute young delinquents as adults. According to Dilulio (2000), Proposition 21 deters juveniles from receiving any type of rehabilitative services and results in them being placed into correctional facilities with hardened and sophisticated adult felons. Such legislation will deprive our nation’s youth from receiving a second chance in becoming good law-abiding citizens, and may prohibit youths from receiving a full education. School communities should then reinforce proactive measures to reduce juvenile delinquency and, using police-school partnerships, may strongly offset the effects of Proposition 21.

The purpose of this research is to assess if current high schools SROs are continuing to be effective in reducing school violence and disciplinary problems in correlation with school crime data and demographics. The evaluation of the SRO program will focus on the following research questions:

1. What are the perceived problems at schools as identified by SROs?
2. What goals and objectives are being accomplished in the SRO/school partnership effort?
3. What improvements would SROs like to see in the SRO/school partnership effort?

Methodology

Use of the SRO program, according to previous studies, has reduced the frequency of school violence. This researcher intends to study the impact of the SRO program in a northern California school district at the high school level. The district examined was Modesto City School district; a total of six high schools were examined. Each high school includes more than 800 students and one SRO.

Research Design

To conduct this research, a question survey instrument was used to gather demographic information, and one question was used for each of the stated goals of the SRO program. Questions included:
• whether they have fostered educational programs;
• met basic qualifications;
• SRO perceptions about being an authoritarian figure as a deterrent for disciplinary behavior;
• whether school administrators are notifying SROs in all cases involving the possession, sale or distribution of controlled substances;
• how they rate the school site they are assigned to in school safety.

This study's data collection method used a five-point response scale, "yes" and "no" and open-ended questions to collect data. The survey instrument included a confidentiality statement, which assures SROs complete confidentiality, only using the aggregates to analyze findings. The questionnaire was self-administered to six SROs. Racial demographics of each high school were placed into graphs (see Figures 1-6). School crime data was gathered from Modesto City School District office of Child Welfare and Attendance for 2000-2001 and 2001-2002. A comparative analysis of the data was placed into a table and categorized by the type of offenses that occur during the academic year with the presence of the SRO for each high school (see Table 2). A final source of data gathered was suspension and expulsions for each high school from the Child Welfare and Attendance office of Modesto City School District (see Table 3).

Procedure

This research was conducted in a northern California school district and examined a total of six high schools SROs between June 29, and July 15, 2003. SROs were able to ask questions of the researcher or state any opinions after the completion of the questionnaires, and received the researcher's contact information for any future questions.

Data Analysis

A comparative analysis was conducted between the SROs responses and school crime data. Each SRO is assigned to one high school. This researcher numerically labeled each SRO in relation to their school. For instance, SRO (1) represents school (1) from each of the tables and figures. Due to the small sample size, statistical analysis was run only on the combined survey responses using frequencies and percentages to analyze the data.

This researcher used the SRO program goals as the independent variables, and the frequency of school violence, suspensions, and expulsions as the dependent variables. Other variables this researcher analyzed were the demographics of the participating high schools, and
whether current levels of school crime has increased or decreased with the placement of an SRO, in comparison to 2000-2001 and 2001-2002 school data.

Findings

The six SROs that were examined were 100% male with a mean age of thirty-three. Of the six SROs, four were Caucasian (67%) and two were Hispanic (33%). Interestingly, high schools with a mostly Caucasian student body were assigned an SRO of the same ethnicity. The two Hispanic SROs were assigned to school sites that comprised the majority of Hispanic student body (see Figure 3 and 5). This indicates that law enforcement officials tried to keep the same racial make up of the SRO to that of the student body.

The majority of the SROs have been an SRO for two years and have been in their current school site for two years (n=4; 67 percent). Only two of the SROs have been an SRO for approximately four years (n=2; 33 percent). The mean number of years each SRO has been in law enforcement was 7.5 years, with the majority (n=5; 83 percent) completing some four-year college courses. None of the SROs have completed a Bachelors degree.

Assessment of Goal and Objective Fulfillment

The SROs’ responses were measured in a five-point scale that measured whether certain goals and objectives of the SRO program were being fulfilled.

Question 1: Foster educational programs and activities that will increase student’s knowledge of and respect for the law. The majority of the SROs (n=4; 67 percent) perceived that the goal was somewhat achieved. The two SROs that have been an SRO for approximately four years believed the goal was totally achieved. One may conclude that the majority of the SROs would eventually perceive the goal as totally achieved with more experience years as an SRO.

Question 2: To encourage SROs to attend extra curricular activities held at schools, when possible, such as PTA meetings, athletic events and concerts. The majority of the SROs (n=5; 83 percent) perceived the goal as somewhat achieved. One SRO stated that his department made no effort to have SROs attend extra curricular activities, thus felt the goal was not addressed. This finding was interesting as each of the SROs are administered from the same police department. One may conclude that there is insufficient awareness of this goal of the SRO program or it is not strongly stipulated. This goal is very important to address, as when
students attend football games and concerts the presence of the SRO should be there to help maintain safety measures.

**Question 3:** To act swiftly and cooperatively when responding to major disruptions and flagrant criminal offenses at school, such as: disorderly conduct by trespassers, the possession and use of weapons on campus, etc. All SROs (N=6) perceived the goal as totally achieved, which enhances school safety.

**Question 4:** To report serious crimes that occur on campus and to cooperate with law enforcement officials in their investigation of crimes that occur at school. The majority of the SROs (n=4; 67 percent) agreed that the goal was totally achieved, and only two SROs believed that the goal was somewhat achieved.

**Question 5:** To encourage SROs to provide traffic control and crossing guards at schools when deemed necessary for the safety and protection of students and the general public when the regular traffic control officer or crossing guard is absent. The SROs had mixed opinions regarding this goal. One SRO concluded that the goal was unachievable, as the school would want the SRO to provide traffic control everyday. Two of the SRO stated no opinion. This finding is inconsistent as there is a wide range of opinions, only showing that the SROs do not necessarily perceived this as a major effort of the SRO program.

**Question 6:** To assist the school administrator in developing and implementing plans and strategies to prevent and handle dangerous situations. Four out of the six SROs stated the goal was somewhat achieved (n=4; 67 percent) and two of the SROs had no opinion (33%).

**Question 7:** The level of achievement experienced in the SRO/school partnership effort. This resulted in a 50/50 response of the SROs as totally achieved and somewhat achieved. One may conclude that SROs perceived the SRO program as fully achieving stated goals.

**Assessing the Basic Qualifications of School Resource Officers**

In this section of the survey SROs were asked whether they meet certain qualifications that would ensure complete competence of the role of an SRO.

**Question 8:** Prior to your placement as an SRO, had you been a commissioned officer, with at least two years experience in law enforcement. All SROs (N=6) responded "yes."

**Question 9:** Did you receive any type of training prior to your placement as an SRO, such as School Resource Officer Certification class? Only two SROs out of the six reported that he received no prior training. The SROs who had no prior training were the SROs who have been an
SRO for the longest time (4 years). One may conclude that when the SRO program gain momentum is when they started requiring SROs to take a School Resource Officer Certification class.

**Question 10:** Do you feel you possess sufficient knowledge of the applicable federal and state laws, city and county ordinances, and board of education policies and regulations? This resulted in a 50/50 response in strongly agree and agree from the SROs. SROs should have a strong knowledge of certain laws in order to accurately punish inappropriate behavior and ensure safety measures.

**Question 11:** Possess even temperament and set a good example for students. Three of the SROs strongly agree (n=3; 50 percent), while three SROs (n=3; 50 percent) agree. This finding shows that SROs do feel that they do set a good example and are a role model for students to follow as none disagreed. Having the SROs possess even temperament allows for students to not see the SRO as a mean officer fully equipped to act with force, it would allow for a better relationship to be establish with the students.

**Question 12:** Possess communication skills that would enable you as an officer to function effectively within the school environment. The majority of the SROs (n=5; 83 percent) strongly agree. It is important for SROs to have sufficient communication skills in order to effectively communicate with school officials and students.

**Evaluating the Duties of School Resource Officers**

**Question 13:** To protect lives and property for the citizens and public school students of the county. The majority of the SROs responded totally achieved (n=4; 67 percent).

**Question 14:** To enforce federal, state and local criminal laws and ordinances, and to assist school officials with the enforcement of board of education policies and administrative regulations regarding students conduct. The majority of the SROs responded no opinion (n=3; 50 percent). Two SROs believed the duty was totally achieved (n=2; 33 percent). The responses showed that not all state laws are fully enforced. SROs and school administrators hold the majority of discretion whether they want to take action on a student.

**Question 15:** To investigate criminal activity committed on or adjacent to school property. The majority of the SROs responded the duty was somewhat achieved (n=4; 67%) and only two responded the duty was totally achieved (n=2; 33 percent). This clearly demonstrates that the SRO alone cannot fully investigate all criminal activity, not enough men power, as there is only one SRO assigned per school.
**Question 16:** To counsel public school students in special situations, such as suspected of engaging in criminal misconduct, when requested by the principal or by the parents of a student. SROs responded with a wide range of responses, which no assessment was made from this question.

**Question 17:** To provide security for special school events or functions, such as PTA meetings, at the request of the principal or Safety Manager. The majority of the SROs (n=4; 67 percent) responded that the duty was totally achieved. This demonstrates that SROs are strongly cooperating with the principal or safety manager in ensuring school safety.

*Analyzing the SRO Role As an Authority Figure*

In this section, SROs were asked four questions regarding their perception of the SRO role as a deterrent for inappropriate behavior.

**Question 18:** The presence of an authoritarian figure on school grounds deter youth from committing any disciplinary behavior. Three SROs strongly agree (n=3; 50 percent) and two SROs agree (n=2; 33 percent). Only one SRO completely disagree (n=1; 17 percent). This demonstrates that some SROs feel that having a law-abiding officer on school grounds causes some students to think twice because of their presence and the power they hold.

**Question 19:** Percentage of time SROs feel they spend on the following roles: law enforcement officer, law-related education teacher, and law-related counselor. The majority of the SROs (n=5; 83 percent) gave the role of law enforcement officer the highest percentage of time (60-75%). Only one SRO gave the law-related counselor the highest percentage (75%). The majority of the SROs (n=5; 83 percent) second highest percentage went to the role of a law-related counselor (10-35%). The role of the law-related education teacher received the lowest percentile from the SROs (5-20%). This finding reflects that SROs typically do more of a law enforcement role in their assigned schools. An SRO’s main role is to ensure safety and enforce laws, which is why SROs would spend more time as a law enforcement officer.

**Question 20:** Do you feel you improve the school’s perception as a safe learning environment and deter misconduct by remaining highly visible in the halls, cafeteria, lunch area, and gymnasium? The majority of the SROs (n=4; 67 percent) responded agree. The two other SROs responded strongly agree (n=2; 33 percent). None disagree, demonstrating that they do feel when their presence is highly visible they deter misconduct and enhance the safety of the environment.

**Question 21:** During the past year, have you ever witnessed a school fight where the subjects could clearly see your presence, yet still engaged in
the fight? The majority of the SROs responded "no" (n=4; 67 percent). Two of the SROs responded "yes" (n=2; 33 percent). The two SROs that responded "yes" stated that they have witnessed a fight between 1-2 times during the school year where the subjects could clearly see their presence. This shows that some students might not be deter from the presence of a law-abiding officer to engage in misconduct.

**SROs Perceptions of School Problems**

SROs were asked to report what they felt were the greatest problems in the school they are assigned to. Each of the SROs responses were individually compared to the crime data of the school they are assigned to (see Table 2).

**Question 22:** Do you feel school officials have fully notified you (the SRO) in all cases involving the possession, sale or distribution of controlled substances at school or school activities? Only one SRO (n=1; 17 percent) disagreed, while the majority (n=3; 50 percent) agreed. School administrators hold the majority of discretion in whether to inform the SRO about the problem, as one SRO cannot foresee all school problems.

**Question 23:** How serious are the following problems around your school? The majority of the SROs (n=4; 67 percent) ranked the presence of gangs and gang recruitment of students as the most serious problems at their assigned schools. Some of the SROs perceived school problems were inconsistent with the school crime data (see Table 2). For example, SRO (5) ranked the availability of drugs and alcohol as not a serious problem at his school, however his perception was inconsistent with the school crime data. School (5) showed the greatest number of drug/alcohol offenses compared to the rest of the schools. Most of the SROs perceptions were consistent with the school crime data. SRO (4) ranked availability of drug/alcohol and presence of weapons as the least serious problems at his school. School (4) had the least amount of offenses of drug/alcohol and presence of weapons from all six schools.

**SROs Ratings in Overall School Safety**

**Question 24:** How many times would you say you have initiated a juvenile petition or criminal warrant during the past year? The majority of the SROs (n=3; 50 percent) responded 10 or more initiated juvenile petitions or criminal warrants.

**Question 25:** How would you rate the communication level you received from school administrators in regards to truancy issues, safety issues, class disruption, and any criminal activities occurring on campus? The majority of the SROs (n=3; 50 percent) rated the communication level as above average and only one SRO (n=1; 17 percent) rated the
communication level as high. This shows that the communication level is highly maintained between the SROs and school administrators.

**Question 26:** How would you rate the pervasiveness of school violence on your school site? The majority of the SROs (n=4; 67 percent) responded average for the pervasiveness of school violence for their assigned school. Only one SRO (1) rated his assigned school below average (n=1; 17 percent).

**Question 27:** What type of grade would you give your school site in overall school safety? The majority of SROs gave their school site a grade of "B" in overall school safety (n=4; 67 percent). This demonstrates that schools are ensuring an adequate measure in school safety.

**Does the Placement of the SRO Reduce School Violence?**

The findings of this study and those of Johnson's (1999) study of the SRO program were not in agreement. The incident data of this study revealed that the placement and presence of SROs in Modesto City School District high schools did not have a positive effect on overall school violence (see Table 2). The total number of major offenses in the six schools increased from 1547 in 2001 to 2409 in 2002, with the presence of an SRO. The only offense that decreased with the presence of an SRO was assault with a deadly weapon from 156 in 2001 to 82 in 2002. Interestingly, data revealed that suspensions and expulsions have decreased with the placement of an SRO (see Table 3). Total number of suspensions decreased from 4147 to 1915 in 2001 and 2002. Total number of expulsions decreased from 191 to 173 in 2001 and 2002.

Based on the SROs' responses from the SRO questionnaire, SROs are fulfilling almost all of the stated goals and duties of the SRO program. Being that this study did not show a positive effect on school violence with the presence of the SRO program, the SRO program should still be maintained. High schools in the Modesto City School District are continuing to experience school violence and they need the visibly of enforcement to alleviate community fears. More SROs should be assigned to high schools in order to have a major impact in deterring overall school violence. Having one SRO is not enough visibly more men power is required to maintain a high level of enforcement at schools.

**Limitations**

Limitations of this study include its reliance on a small sample of SROs for a single school district. Statistical results from this sample of convenience cannot be applied to a larger population of SROs. SROs' perceptions of the program should be explored on a larger scale,
nationwide. Future studies should include a large sample of students perceptions of the subject (SRO), as students are the ones who are greatly affected in overall school violence.

The magnitude or strength of overall school violence can be affected, positively or negatively, by a number of other factors that are not the focus of this study. Other factors that may influence school violence are competence of the teacher, peer group influence, parental influence, and the crime rate of the surrounding community. These and other questions might be included in future studies.

Conclusion

School violence will continue to be a major concern in secondary schools, and thus, the SRO program should be maintained. Although the SRO program evaluated in this study showed no significant positive effect on the decline of rate of crimes committed at high schools, it is nevertheless an attempt to deal with the problem. SROs provide a sense of safety and order in our schools for our young and upcoming adults when they are impressionable and apt to go astray. In order to enhance the effectiveness of the SRO program several SROs stated that they would like to see more officers assigned for each school. Again, it is difficult for one officer to be the sole deterrent for youth violence. The SRO program needs growth, and more resources should be allocated.
References


Table 1 is not included in the journal.

Table 2 is on the next page.

Table 3. High School Suspension and Expulsions

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Light Intensity on an Ecological Friend: A Study on Bats

Brittney Z. Gandy

Abstract
This study highlights the effects of light upon bats, and its role in bat conservation overall. The observation takes place within a created transect, by way of automobile. The bats were detected and their echolocation frequencies were analyzed using the Anabat bat detector system. The bats of this study exist in the rural and urban areas of the Sacramento Valley, and provide valuable results for conclusions about North American bats in general. The results allow scientists to either further enhance or more readily eliminate the possibility of light intensity and predation contributing to the decline in activity, and, furthermore, the population, of North American bats. This study serves as a significant step in bat conservation, and as a compliment to the enhancement of human life.

Introduction
Over time, through what Darwin described as "survival of the fittest," evolution determines which organisms remain on this earth. The most important organisms in a given period in time typically remain and survive, while the others become extinct by various mechanisms. "In this climate of evolving concepts … all organisms affect each other to some degree. The most intimate associations may be represented by eukaryotic cells and their putative endosymbionts, the mitochondria and their plastids, inseparable partners in the structure of what biologists regard as one living unit, yet in origin are perhaps separate species" (Findley, 1993, p. 3). Thus, all species are interrelated: as one "living unit," though each is different, bird, mouse, man, bat, each live and affect one another.

Though all species are related, bat species appear to be one of the most unknown and neglected simply because they stand as a mysterious mammal. Bats are of great ecological and economic benefit to all of mankind through their production of nitrogen–rich guano (Agosta, 2002), their predation of harmful, nocturnal insects, and hence their role in our economy. For this reason, the conservation of this ecological friend is important.

As the only mammal that can fly, bats remain a subject of unknown curiosity to many people. Fenton (1992) recognizes bats as one of "the
world's most fascinating animals...Despite the fact that bats rank among the world's most interesting and important mammals, they remain the most scientifically neglected, frequently misunderstood and needlessly persecuted by the public" (p. xi).

Bats serve an advantage to humans. They are "the primary predators of vast numbers of night flying insects...They pollinate flowers and disperse seeds essential to the maintenance of whole ecosystems, and bat-dependant plants produce crops valued in the hundreds of millions of dollars annually in cash-poor developing countries" (Fenton, 1992, p. xi). Bats also produce guano, a substance that is rich in nitrogen. Nitrogen is used in production and in many other ways. In addition, nitrogen composes about 79% of the air that we breathe. Though oxygen is the most important element, it only makes up 21% of the air. (Carbon dioxide composes less than 1% of the air we breathe.) Thus, for the importance of breathing, nitrogen must be in constant production. In addition, "insectivorous bats are major consumers of nocturnal insects, many of which are economically important pests...This presents both ecological and economic rationales for their protection" (Agosta, 2002, p. 180). As a result, for decades, conservation scientists have been studying methods for bats' protection.

Many observers may not understand that "nearly a thousand kinds of bats compromise almost a quarter of all mammal species" (Fenton, 1992, p. xi). This is the case for species, not the number presently living. Biological researchers have recorded a continuous decline in bat population for a number of decades. Scientists continue to prove that habitat change, as well as pesticides, greatly contribute to extinction (Agosta, 2002). "Because many species produce only a single young each year and live in conspicuous colonies numbering from thousands to millions, they are exceptionally vulnerable to extinction...They are increasingly threatened by habitat loss and pollution" (Fenton, 1992, p. xi).

Other studies conclude that light intensity affects the behavioral patterns of bats (Dalton, 2002). Thus far, most researchers report that when a habitat is changed, such as a forest being moved, bats become disturbed. This disturbance leads to a low reproductive rate, which in turn affects the population rate. The reproduction rate of bats is highly relevant to a stable population, because groups of bats only produce one young per year. Various researchers have conducted studies to determine the reason for such a large worldwide decline in bat population.
Rationale
As with most creatures of special concern, bats remain on the list among those for which extensive research is still needed to fully understand their behavior. Understanding conservation of bats requires scientists to understand the possible causes of the decline. Agosta (2002) argues that it is "difficult to draw conclusions regarding species-specific conservation needs." However, in order to comprehend the plausible explanation for declines in population, researchers must focus on more "species-specific" information (Agosta, 2002, p. 192). Therefore, research is not only conducted on different species of bats, but different causes and effects are tested to determine behavioral changes of bats. In turn, these effects may contribute to the decline in the population of bats, and alter their behavioral patterns in their natural environments.

Over the past four decades, scientists have noted an overwhelming decline in the population of bats. An argument exists concerning the specific reasons for decline. Many scientists associate bat population decline with habitat alteration and the use of pesticides, while others attribute this decline to human disturbance, especially light intensity. One study concluded that in many human disturbances of bat caves (size of tour groups, noise, and light intensity), light intensity affected bat behavior the most. Many other studies have also noted behavioral or activity changes in bats when exposed to a certain amount of artificial and non-artificial light.

While previous studies have claimed that bats are not affected by light, others present valuable results which indicate that sunlight, moonlight, streetlight, and artificial light affect bats. Bats are known to be nocturnal mammals, which display a variance in activity when exposed to certain amounts of light at different times; however, the cause of this decrease in activity during light continues to be a question that scientists strive to answer. Researchers have noted that predation, insect population, pigmentation, and previous adaptation, all stand as possible causes for this activity change. This study focuses upon the effects of light intensity of rural and city bats in the Sacramento Valley.

Literature Review
Effect of light on bats: One effect considered to alter bat behavior is light. Although a number of scientists have presented valuable research supporting that bats are affected by light (Dalton, 2002), others have provided results that suggest bats do not alter behavior in association with light (Brigham & Hecker, 1999). Each region of the world contains its own combination of bat species, which have different reactions to light. Thus, researchers attribute the various bat responses to light to changes in
evolution, short-term adaptation to current environment, risk of predation, competition for food, and hypothermia.

In studying habitat use, diet, and the effects of roost disturbance by insectivorous bats, especially the Big Brown Bat (Eptesicus fuscus), Agosta (2002) determined that more narrow research was needed to make general statements about his own study, and aid in successfully conserving bats (p. 189). Through studying Big Brown Bat habitat associations, food habits, the use and effects on bats of pesticides, roost selection, actual dwellings of bats (tree cavities, buildings, caves, and mines), as well as human impacts to roosts, Agosta (2002) revealed that habitat use was among the least important factors (p. 192).

Some researchers predict that behavioral changes occur in response to availability of food/insect abundance. Based upon this theory, Hickley, Acharya, Brian, and Pennington (1996), argue that "food and roosts are potentially limiting resources that may affect community structure of bats" (p. 325). These authors focused their study on bats that fed around streetlights. They explained that the behavior of bats that fed around streetlights did not alter according to the light emitted by the streetlight itself, but that it did alter because of the partitioning of resources. In observing Vespertilionid bats (Lasiurus cinereus and Lasiurus borealis), Hickey et al (1996) discovered that if more insects were present, bat activity increased as a whole. However, if there were fewer insects, then the bats decreased their activity. Thus, the bats were in competition for food rather than in competition to hide from predators and/or other proposed reasons. "No consistent evidence of temporal resource partitioning was found in 4 years of observation" (Hickey et al. 1996, p. 325). This finding supports the proposal that the bats feeding and behavior was determined by the abundance of insects. Because the amount of available insects flying around the streetlights was variable, the partitioning of feeding was inconsistent.

Echolocation calls are sounds that bats emit as a form of orientation, and could be used as a means of communication. Each particular species has its own frequency combined with a pattern for echolocation calls. Therefore, if two bats have calls of similar frequencies, one can differentiate the two by the pattern of their calls. The bat detector can detect feeding in the midst of an echolocation call; however, the calls frequency is used to determine species, not the feeding. The intensity of the streetlight did not affect bat feeding behavior; thus, the study conducted by Hickey, Acharya, and Pennington (1996) suggests that the behavior of insectivorous bats that feed around streetlight depends upon the abundance of food, insects that fly around the light (mostly moths), rather than the
light itself.

Many researchers have found substantial correlations between light intensity and bat behavior (Dalton, 2002, Reith, 1982, Rydell, 1992). In studying the effects of cave tours on breeding Myotis velifer, Mann, Steidl, and Dalton (2002), concluded that increased artificial light affected the behavior of the bats. The authors concluded that "designing cave tours to minimize short-term effects on bats will require careful consideration of cave lighting and tour frequency, route location, and noise levels" (Mann, Steidl, and Dalton, 2002, p. 618). Not all results are completely valid because, as the authors explain, human activity in caves can adversely affect bats.

In the Kartchner Caverns in Arizona, Mann et al (2002) studied "about 1,000" cave Myotis velifer to test their hypothesized effects, which were positive correlations between tour groups, noise, light intensity, and color of light with increased activity levels. They predicted that bat activity would increase in response to the size of tour group, noise, and light at brighter colors. The researchers found that the highest light intensity had the greatest effect. Bats responded mostly through higher levels of activity to the full white light. Testing four levels of light intensity, the researchers "quantified four behavioral responses of bats: number of takeoffs, number of landings, activity level, and vocalization intensity" (p. 620), which were responses of bat disturbances. Displayed in their results, Mann, Steidl, and Dalton (2002 p. 620) found that bats responded most to light intensity and color treatments used during experimental tours. In general, all responses were highest during full-white light and lowest during the no-light level.

Many earlier studies focused upon the effects of moonlight to determine a light intensity-behavior relationship. For example, Reith (1982) used bat detectors under varying lunar conditions, in shadows and exposed areas, to study the response of Myotis yumanensis (an insectivorous bat) to moonlight in New Mexico. He explained that studies have shown that bats avoid moonlight; however, this in itself was species specific. Due to the inability of that particular bat detector to determine vocalizations of one species from another species, Reith (1982) could not specify the results to one particular species. Though he could not determine vocalization specifics, he could determine increased and decreased vocalizations, which is valuable when trying to determine changes in activity. In the majority of the study, bat activity decreased as moonlight increased.

Reith (1982, p. 687) explains that "moonlight did cause Myotis yumanensis to fly in shadows." This activity was dependent upon size.
distribution of the bats, as well as predators of bats. Reith (1982) suggests that predators, including hawks, owls, frogs, nighthawks, and poorwills, would more easily attack bats during times, or in areas when light is abundant. Thus, bats would be more active in the darker areas; hence, flying in the shadows would serve as a form of protection from predation. The smaller bats would have to completely avoid the predators, whereas the larger bats may be able to ward off the predators, better avoid them, or defend themselves.

Studying forest-dwelling insectivorous bats, Brigham and Hecker (1999) emphasized that, "one component of illumination important to many nocturnal mammals is the lunar cycle." The researchers expressed that, "changes in intensity of light should not directly affect activity by these bats. However, some studies anecdotally report that lunar illumination suppresses activity by increasing risk of predation" (Hecker and Brigham, 1999, p. 1197). Other studies displayed that there was no effect on bats due the moonlight and light intensity. The scientists researched to "assess if overall activity of bats differed with respect to lunar illumination and if bats exhibited a more subtle behavioral response to moonlight in the form of a shift between habitats" (Brigham and Hecker, 1999, p. 1197). They predicted that if bats exhibit low levels of activity during bright nights (a great amount of lunar illumination), then the decline in activity was due to risk of predation. Brigham and Hecker (1999) used a total number of recorded bat passes per night as an index to total nightly activity of bats, and measured intensity of moonlight using a light meter. They suggested a correlation between the amount of lunar illumination and the height the bats flew within the forest. Opposite to their prediction, bats were more active in the canopy on bright nights (Brigham and Hecker, 1999). The relationship between the height of forest flight and moonlight was established; however, no valid evidence was found to verify that bats reduced activity due to risk of predation.

Brigham and Hecker (1999, p. 1199) include in their article that, "flying bats are difficult to catch, and owls, which are likely the only potential predators of bats, are probably not agile enough to catch them on a regular basis (Baker, 1962)." They note that variation in the distribution of flying insects may affect behavior of bats rather than the light itself. The researchers argue that the, "most likely explanation for the interaction of height and moonlight is that bats adjust the use of microhabitats to match distribution of prey," (Hecker and Bringham, 1999, p. 1200). They concluded that moonlight had no overall effect on activity, but that there was a shift in concentration of activity depending upon levels of lunar light.
Hecker and Bringham (1999, p. 1200) note that their, "hypothesis remains to be evaluated with precise data on diet and availability of insects in relation to the lunar cycle."

Not only was bat departure and landing affected by this intensity of light, foraging behavior was affected as well. Observations highlight that when there is a larger percentage of exposed moonlight, bats feed at a lower rate and feed in darker areas, shadows, and corners. Elangovan and Marimuthu (2001) performed a study that determined that moonlight influenced the foraging behavior/activity of a megachiropteran bat Cynopterus sphinx. The two measured the activity by monitoring departure from roost and feeding habits. "Feeding bouts were recorded every hour between 18:00 and 5:00," (Elangovan and Marimuthu, 2001, p. 347).

Elangovan and Marimuthu (2001) found the amount of feeding was negatively correlated with percent moonlight each night...[thus] feeding occurred more during the dark part of the night. The insectivorous Myotis lucifugus was the only bat that did not follow this pattern. Typically, "when there is an increase in moonlight, animals reduce the use of open space and restrict their foraging activity to the periods of darkness," (Elangovan and Marimuthu, 2001, p. 347). Observations were made for three lunar cycles. When activity occurred frequently with moonlight, it was during the new moon, as opposed to the full moon. In viewing data results, there is a linear decrease in the number of feeding bouts with an increase in percentage of moonlight. Elangovan and Marimuthu (2001) attribute this "lunar phobia," to pressure from predation and conspecifics.

In an earlier study with the similar moonlight/light intensity relationship expectations-to see a change in activity with more intense light-Burns, Flores, Linhart, Crespo, and Mitchell (1992) found similar results with their study of the common vampire bat and its behavioral changes due to moonlight. Uniquely, vampire bats, "leave their roosts at dark...[they] leave when darkness is complete and they take a preliminary flight to check moonlight," (p. 366). They found the most activity occurs during the absence of moonlight. Using lunar tables, Burns et al. (1992) predicted when vampire bats would leave their roosts. According to the table, the predictions were generally correct-activity was low during nights when moonlight was at a high percentage, and activity was low when moonlight was at a low percentage. Thus, vampire bats reduce activity with increased percentage of moonlight.

Though the majority of current scientists rely on bat detectors to record the results of their experiments, other methods do exist and are
highly effective. Of these include netting devices, neurotransmitter devises, and ultraviolet, heat-sensitive devises. Carter, Menzel, Chapman, Miller, and Lee (1999) developed a new method to study bat activity patterns through neurotransmitters and an automated receiving system (ARS). These ARSs have a wide range of recorders, ranging, "from simple drum recorders to computer- integrated automated systems," (Carter, Menzel, Chapman, Miller, and Lee, 1999, p. 598). The patented ARS could be utilized in most of the studies discussed here. Its ability ranges from successfully measuring temperature dependence, sex dispersal, roost patterns, activity patterns, and habits, along with time of takeoff in relation to light intensity and daylight versus moonlight. Therefore, though researchers most commonly use bat detectors to measure the effects of light intensity upon bats and bat departure relative to daylight, other methods prove to be successful.

In following some of these study patterns relative to daylight, biological researchers note the difference in activity in daylight versus moonlight. While many studies have determined that moonlight causes an alteration in bat behavior, scientists attribute some substantial behavior change to daylight, and claim that bats wait until after sunset for departure, in attempt to avoid the daylight. Many studies have emphasized this tendency of bats-avoiding daylight, and leaving their roosts after sunset. In researching Tadarida femorosacca, Gould (1961) found that this species did not leave the day roost until after sunset. "These findings were compared with light intensity readings from a pyrheliometer, a horizontal surface recorder, located at a solar radiation laboratory. Over the course of a year, Gould (1961) concluded that light intensity did have an effect on the emergence time (departure time) of bats. The study measured the emergence of bats against the time of day during certain seasons, due to the fact that each season has a different average time of sunset. Recorded data from this experiment reflected the emergence time during each month. In the winter months, when the sun sets sooner, the bats left earlier in the evening between 6:00-8:00 PM; however, in the summer months, when the sun set later in the day, the bats did not emerge until a later time in the evening between 7:30-9:00 PM. Thus, daylight and sunset did affect the bats and their time of departure from their roosts.

Continuing this idea, and agreeing that bats do leave their roosts in darkness rather than daylight, Hays, Speakman, Rydell, Webb, Hays, Hulbert, and McDevitt (2000) argue that the, "vast majority of bat species fly and feed almost exclusively during periods of darkness," (p. 75). They concluded that, "perhaps there was differential predation risk between the
brightest and darkest part of the day … [and] … the bats may have been entrained to emerge at given light levels by their behavior at other times of year," (p. 75). Hays et al. (2000) explains that this reduction in activity to light may affect the bats. The low reproductive rates of these bats drew the researchers to this conclusion (Hays et al. 2000), which is important to the study of bat conservation overall. If light intensity reduces activity and reduces energy, and reproduction suffers as a result, then light intensity has a direct effect on the declination of bat population.

Most researchers attribute the previously explained bat behavior to the fear of predation; however, Bhatnagar and Hilton (1994) conducted a study with results that concluded bat pineal pigmentation to be the cause of the avoidance of light. All bats have one of three types of hair, skin, and eye pigmentation- pineal Melanin, Lipofucin, and Hemosiderin. Melanin protects against damage, induced by ultraviolet radiation, to DNA. Bhatnagar and Hilton (1994) found that bats with more pigmentation avoided light more, while bats with little pigmentation or no pigmentation were more active in the daylight than their more pigmented counterparts. Thus, Bhatnagar and Hilton conclude that bat behavior in daylight is correlated to pigmentation. Bats with a large amount of pigmentation avoid sunlight more. There is an unknown relationship as to why bats without pigment do not avoid light. Scientists suggest that this particular type of bat has another mechanism to protect its DNA from the sun's radiation; thus, it does not need to avoid the sunlight.

The need for knowledge in the area of light affecting bats, and "species-specific" details extends an invitation for more research. Each of these studies plays a key role in the following observation. The observation took place after sunset, and before the moon was fully raised in order to examine the effect of light upon bats of a specified area. A study focused upon the effects of light upon city and rural bats in the Sacramento Valley would provide valuable information to research conducted on North American bats, and the behavioral changes (if any) caused by light intensity. According to Dr. Matina Kalcounis, of California State University, Sacramento, bats do not have any significant predators in the Sacramento Valley that are fast enough to catch them and cause harm (personal communication, March 10, 2003). Therefore, if the bats are affected by light, it is probable that the altered activity is not due to predation. Thus results may, in turn, be applied to whether these changes in activity are due to adaptation, size, feeding, or abundance of insects in the Sacramento Valley.
Problem Statement

In determining factors that lead to understanding bat conservation, such as the reason that bat activity declines in light, it is important to realize that more specific research is needed. Agosta (2002) explains that information obtained from more specific bat research should, "provide a wealth of research opportunities from which we may be able to draw some general conclusions about bat conservation as a whole" (p. 192). As previously noted, bats in the urban environments of the Sacramento Valley do not have credible predators (M. Kalcounis, personal communication, March 10, 2003). Therefore, researching effects of light intensity upon bats in the Sacramento Valley will aid in either eliminating or enlightening the assumption that bats decrease activity due to risk of predation. These results will allow scientists to make more general conclusions about North American bats. This information, in turn, can be utilized and expanded for scientists researching bats, their decline, and their conservation around the world.

From this observation, the expectation was to find a negative correlation between the activity of bats and light. While the light was intense, the bats were expected to decrease activity and leave their roosts when the environment was darker, as opposed to lighter. This negative correlation would agree with the work of most researchers; however, it would disagree with the reasoning of their results. Because urban bats in the Sacramento Valley do not have significant predators, predation could not be the reason that the bats were more active in darkness. This finding would allow scientists to further their studies and more readily eliminate the possibility that predation is the cause of this decline in activity, and continue to focus upon pesticides, habitat alteration, roost disturbances, and unknown adaptations as the cause of overall bat population declination.

In contrast, if the Sacramento Valley urban bats were not affected by the light, then predation is a very plausible explanation for reduced activity in light for bats in an area where predators are present. Usually, in areas where bat predators are high in existence, if bats fly in the light, their predators see them, and they are harmed, or serve as prey to that particular predator. However, because Sacramento Valley bats do not have predators, they would have no need to avoid the light. Thus, no decrease in activity in light would allow biological researchers the opportunity to continue to attribute predation as the cause for this reduction in activity. The question posed by the researcher is: "Does light intensity affect bat activity/behavior in rural bats differently than it affects urban bats in the Sacramento Valley?"
Methodology

In the world of biological sciences, the majority of experiments take place either in the laboratory or in the field. Biological experiments allow humans the opportunity to conserve much needed animals by determining what variables are causing declination, such is the case with the bat. Bats have been in an extreme decline for a number of decades. Experiments and observations allow biologists to determine what may be the causes of this exponential decline. If scientists are able to isolate and cease the variable(s) that are causing such a decline in bat population, they will be able to conserve this much needed animal.

This observation focused on the effects of artificial light (including lights from streetlights, traffic lights, and house lights) upon bats, some of which are in an urban environment and some of which are in a rural, remote environment (where only natural sun or moonlight is mostly present). The observation took place in the Sacramento Valley, specifically in Folsom, California. This observation will allow scientists to draw general conclusions about North American bats, and gain "species-specific" details about the behavioral changes displayed by bats in the presence of artificial light. The results serve as a step toward understanding factors that affect bat population and toward their conservation.

Research Design

In this observation, the development of a transect served as an appropriate method. A transect is a path or a course, along which one can alter independent variables in order to measure the effects upon the dependant variable. The transect permitted the researcher to view results in an isolated area without actually capturing the bats and putting them in isolation, which assigns biased results and more variation of the dependant variable. Therefore, the method used in this research allowed the collection of true data and the observation of normal bat behavior. In testing the effects of light upon urban verses rural bats in the Sacramento Valley, a transect allowed variance of light, while the measurement devices recorded biosonar activity and echolocation calls. The four-mile transect used consisted of two miles of a rural, dark area road and two miles of an artificially illuminated urban area road Folsom, CA, along Prairie City Road. The area in the middle of the transect, in which it alternates from dark to light or light to dark, was the transition state. Each night, the observation began 10-30 minutes after sunset. (The segment of minutes depends upon the type of moon for the given evening.)

The transect was followed and the data collected by means of automobile. Proven effective, the measurement of bat activity using a
created transect by means of automobile has helped scientists reach valuable conclusions in the past. Rydell (1991) used this method to measure seasonal bat use of illuminated areas. Later, in 1992, Rydell utilized this method to find a correlation between exploitation of insects and bat behavior around streetlights. Dr. Kalcounis and Dr. Lancaster of California State University, Sacramento, have also used this method a number of times to determine bat species in particular areas (personal communication, Monday, April 21, 2003).

The Anabat bat detectors transformed the echolocation calls, sounds that the bats emit for orientation and possible communication purposes, into frequencies audible to humans. Each particular species of bat has a characteristic pattern of timing and frequency to its echolocation call. This allows not only activity to be recorded, but also allows the species to be identified. Identifying species will in turn allow "species-specific" details to be determined. Thus, this research provides specifications among not only a region, which gives the opportunity to conclude activity of Northern American bats, but more importantly, of certain species of Northern American bats. The tape recorder serves as an additional instrument to the bat detector. From the detector, the tape recorder recorded the calls, such that the calls could later be audible, downloaded to the computer, and saved. Following a transect provides a simple way to alter only the variables the researcher is interested in, while not directly altering the dependent variable. Thus, outside factors are eliminated, resulting in more accurate data.

Utilizing a transect of both light and dark halves is a direct method of testing and answering the proposed research question: "Does light intensity affect bat activity/behavior in rural bats differently than it affects urban bats in the Sacramento Valley?" This does so by providing a lighted area verses a dark area in which recordings of the number of bat passes are taken. The researcher was able to conclude if there was a correlation between light and activity from the data collected by viewing the number of bat passes and differences in activity in the light verses the dark areas. Because the frequencies recorded by the bat detector are species-specific, the researcher was also able to determine whether a relationship existed between light verses dark area behavioral changes within the particular species present.

Variable Specifications

The dependant variables of this study are the activity level of the bats and the species present. The activity level is measured by the number of bat passes. The species which may be present is determined by the frequency
(pitch) of greatest intensity of the echolocation calls, depending upon the range of the bat detector. In this case, a broadband detector was utilized, allowing for a wider range of frequencies to be detected.

The independent variables are lighted path versus dark path. Throughout the 15 nights of data collection, alternating paths provided unbiased results. Half of the runs along the four-mile transect begin along the light end and transcend through to the dark end of the transect. The other half of runs transcend in the opposite direction. On these evenings, the recordings would begin at the dark end of the transect and transcend through to the lighted area. Therefore, the light/urban areas (illuminated by a small number of streetlights) have activity level recordings that are compared to the recordings from the dark/rural (minimal to no light) areas. As previously discussed, collecting data in this outdoor transect allows outside factors affecting the bats to be eliminated. In addition, recording the data from an automobile endures no direct contact with the bats, which otherwise could have an effect upon their behavior.

Within this observation, a number of factors remain constant to reduce any outside factors that may affect the results. These constant factors include the:

- length of the transect (course),
- bat detector used every time,
- time relative to sunset each day (The experiment began approximately 10-30 minutes after sunset, depending upon the type of moon out for the night.),
- researchers, remaining inside of the automobile while collecting the data, and
- method of tallying the number of passes on the spreadsheet.

In order to provide the best results possible, the researcher selected days when the weather was clear and sunny. Even so, the wind served as an uncontrollable factor that was present in the spring and summer evenings.

**Elements/Sampling Methods**

The participants of this study were a driver, to operate the car at approximately 25 miles per hour, and this researcher. The data was collected using an Anabat bat detector, a tape recorder, and a clipboard with a prepared spreadsheet. A small notebook was also used to track events. The bat detector emitted the transformed calls of the bats, such that the researcher could hear them and record the frequencies and patterns of the echolocation calls. Later, they were interpreted graphically. The tape recorder recorded the calls and signals from the detector. With this, the
researcher was able to amplify and hear the patterns of the calls and download them onto a computer program, allowing others to hear the echolocation calls as well.

The observation took place in the evening, relative to sunset. An almanac program called "Moonrise" by Dr. P. Sidell was used to determine the time of sunset each evening, as well as the phase of moon. The time the observation began depended upon the moon, as well as the sunset. A brighter moon and a later sunset would require the experiment to begin after the sun has begun to set. It has been suggested that bats follow a lunar cycle and exhibit a "lunar phobia" (Elangovan & Marimuthu, 2001).

In choosing a sample, the researcher chose urban versus rural areas in the Sacramento Valley to provide more species-specific details. The areas chosen were the outskirts of Folsom, CA, where bats are found, in addition to both light and dark roads in close proximity. Because researchers use species-specific determined factors to make more generalized conclusions among regions of the world, this observation provides information that gives scientists the opportunity to generalize the results to these particular species in North America.

Procedure

Each night, the driver and the researcher traveled the four-mile transect, by means of automobile traveling approximately 25-miles per hour, while the data was collected. At the beginning of each experiment, beginning 10-30 minutes after sunset depending upon the type of moon out, the bat detector and the tape recorder were turned on, and the researcher held the detector out of the window. Alternating paths ensured unbiased data; therefore, one night, the collection of data began in the lighted end of the transect, and the research team traveled through to the dark end. The next night, the experiment began at the dark end of the transect, and the team traveled through to the light end. This alternating pattern was followed throughout the entire observation. Echolocation calls and bat passes were recorded using the Anabat detector and the tape recorder.

The spreadsheet was utilized to keep track of the number of bat passes per night, in each area (light or dark) that were audible with the bat detector. Each time a pass or call was heard, it was added to the number on the spreadsheet. At the same time, the detector emitted echolocation calls by the bats, the tape recorder recorded them. The tape recorder aids by allowing the echolocation calls to be clearly heard, frequencies identified, and calls with similar frequencies to be differentiated from one another using the Anabat computer software program.
Data Analysis

The goal was to determine if there was a positive or negative correlation between activity in light versus dark with the city bats, and activity in light versus dark with the rural bats. This was determined by observing habitats of one road of light versus dark areas at similar times, and comparing the number of passes in each area. In order to answer the proposed research question, several software programs were utilized to analyze the collected data.

A t-test was run using the collected data to determine if a significant statistical difference existed with the results of the two observed groups. A t-test is a method for determining one to one correlations. In theory and statistics, t must be greater than 2.00 in order for a significant difference to exist. In this case, a t-test was used to determine the relationship between light and urban/city bats, and another test was used to determine the same with the rural bats.

To analyze the data collected, in relation to species determination, this researcher used a software program called Anabat, which is a supplement to the Anabat detector. This software program is designed to display the data graphically to compare patterns of frequency change over time. This researcher used the Anabat program to graph the sequences and frequencies of the echolocation calls recorded during this project. With the recorded tapes and the other Anabat equipment, the calls were downloaded onto the program, allowing calls to be heard and frequencies determined for species identification. To determine if there is a relationship between activity level and species, a univariate test along with an ANOVA was run, which allowing this researcher to analyze and relate more than one variable. Specifically, it enabled this researcher to display the differences in activity among species and draw "species-specific" conclusions. The differences in activity among species in light versus dark areas are graphically displayed. (See tables 1.3 and 1.5.)

Findings/Results

The observation took place for a total of 15 nights. During this time period, a total of 829 echolocation calls were detected and recorded. Of the 829 calls, 274 calls (urban bats) occurred in the lighted area, and 555 calls (rural bats) occurred in the dark area. (See tables 1.1 and 1.2.) The earliest sunset time was 8:20 PM, and the latest sunset time was 8:34 PM. Different moons characterized different evenings. Two of the evenings had last quarter moons; six had new moons, two had first quarter moons, and five had full moons. There were more calls detected upon nights in which there was less moonlight, and less calls with a large amount of moonlight.
This researcher found a negative correlation between light intensity and the activity of bats. Less bat activity was detected in the areas with artificial light in comparison with the dark area. With the t-test results, the researcher concluded with a value of $t = -5.578$, displaying a significant difference in the two observed groups. Thus, this study proved to be relevant in a statistical matter. (See table 1.4 for complete t-test results.)

Within frequency group determination, the researcher noted the following major categories:

- 30 kHz and below
- 31-49 kHz
- 50 kHz and above

The largest group detected was with the group at 30 kHz and below. This occurrence was due to simple physics. The bats that echolocate at 30 kHz and below have much lower frequencies than their counterparts. A shorter frequency has a longer wavelength associated with it, in comparison to a high frequency, which has a shot wavelength. Sound travels as waves through air as a medium. Thus the calls that are emitted at lower frequencies can travel farther, and are detected more easily. Within the given range of detection, these bats would be heard more readily. One could detect these calls at a much wider range, displaying the same phenomenon as the results show, with more calls detected at lower frequencies, and less calls detected at higher frequencies. (See tables 1.3 and 1.5.)

Discussion

The results of this study support previous studies, which state that bats increase their activity in the darkness and exhibit a lunar phobia. In addition, the study also supports the idea that bat behavior is species-specific. From the results of this study, the researcher was able to interpret a plausible answer the research question: "Does light intensity affect bat activity/behavior in rural bats differently than it affects urban bats in the Sacramento Valley?" According to the data results, the answer is yes! As discussed earlier, because the bats have no credible predators in the Sacramento Valley, attributing the decrease in activity to predation could be a key factor. The bats in the sample area displayed more activity in the areas of darkness, as bats of many other geographical areas do. Therefore, predation cannot yet be eliminated; however, it is highly likely that the decrease in activity is due to another factor. Through this observation, the researcher was also able to confirm that bats have a definite peak time of activity. The peak time observed, in which the highest number of passes
would be detected, was 10-30 minutes after sunset, and somewhat before
the moon could completely rise enough to where its light would affect the
sky.

The occurrence of less activity in the presence of a full moon
supported the suggestion that bats have a unique lunar phobia. During
evenings with the least moonlight, the peak emergence time after sunset
would last much longer. However, during the nights in which there was
more moonlight exposed, especially nights of full moons, the peak time
would be much shorter. The peak times in these instances showed that the
bats would quickly come out and into exposure, and quickly return their
secluded areas, rather than spend more time out-seeming as if they were
very aware that the sun had just gone down and the bright moon would
soon be up.

Limitations

In conducting this study, a small number of limitations did apply.
Time was the largest limitation. Conducting such a study could have an
even greater impact with more altered independent variables, if more time
were available. Many studies of similar background usually occur within a
period of months or years.

Using the Anabat system was beneficial due to its simple setup;
however, a more detailed program would be more ideal to edit out more
noise and read more efficient calls. Some species of bats echolocate at
frequencies lower than 20 kHz. Using the Anabat program, the researcher
was not able to edit out the noise that occurs below 20 kHz in order to read
these calls in this group. Identifying species was not as absolute as desired.
One would have more success with identifying frequency groups and
species with a program that has more modification of calls and frequency
grouping. In addition, the Anabat program was more difficult to download
and perform call analysis due to the fact that one must run the program in
MS DOS, rather than in Windows. Working in this environment made it a
bit more difficult to be creative and extrapolate graphs for presentation
purposes. It would have been easier if the program was operable in
Windows.

Implications

In conducting this study, the researcher provided results and gained
information about bats in the specific geographic area. Additional research
is needed on other continents, due to the fact that they contain many
different species of bats. Each species’ response to light versus dark areas
may be different. Research is also needed to further break down responses
of rural and urban bats, possibilities for which include studying light verses dark responses with rural bats only or urban bats only.

One may also conduct a study based upon the peak times of activity. This researcher noted a pattern that the most significant peak emergence time appeared to be 10-30 minutes after sunset, especially 20 minutes after sunset. Future research might focus on narrowing this peak time down to exact minutes depending upon geographic area or species behavior. For the researcher, the importance of conservation and betterment of life overall is an important issue and this study stands as encouragement to others interested in related or similar topics.

**Conclusion**

The significance of this study lies in the conservation of this unique mammal. As mentioned earlier, the bat serves a great advantage to human life. The results of this study support the possibility of bats avoiding light for reasons other than predation alone. In providing credible advancements for science and confirming that bats avoid light in areas with or without predators, the researcher has aided in the future studies to preserve an ecological friend (the bat).
References


Table 1.4 Paired Samples Test (T-Test Results)

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Lower</th>
<th>Upper</th>
<th>t</th>
<th>df</th>
<th>Sig (2-tailed)</th>
</tr>
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<tr>
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<td></td>
<td></td>
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<td></td>
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<tr>
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<tr>
<td></td>
<td>-18.73</td>
<td>13.308</td>
<td>3.559</td>
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<td>.003</td>
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</table>
Table 1.5 Univariate Analysis of subjects (R squared=.546) (Adjusted R squared=.519)

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<tr>
<th>Source</th>
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<th>DF</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
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<td>192.878</td>
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<td>FREQ</td>
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<td>89.01</td>
<td>4.14</td>
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<td>153.615</td>
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<td>Total</td>
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<td>Corrected Total</td>
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Methodology for Carbohydrate Analysis in Atmospheric Aerosols

Andro Rios

Abstract

The purpose of this research is to develop a method to analyze potential carbohydrates, in the form of particulate matter in the atmosphere, that arise from biomass combustion using an instrumentation method called High Pressure Liquid Chromatography (HPLC). New methods development for chemical characterization is crucial to further the study of aerosols in the field of atmospheric chemistry because of the effects that aerosols have on climate, visibility, health and because of limitations of past methods. This researcher worked on a method by the use of chemical standards from the most common, naturally occurring carbohydrates, and performed acid catalyzed hydrolysis to break down the larger chained oligosaccharides into monosaccharides. Once the monosaccharides were obtained the samples were then injected and run through a special carbohydrate column using HPLC, which allows for the separation of glucose, galactose, fructose. Results show that only qualitative analysis can be performed using the acid catalyzed hydrolysis method. To obtain a quantitative analysis, further work must be done on developing a hydrolysis method that reduces the effects of the contaminants on the separation of the desired monosaccharides.

Introduction

Atmospheric physical and chemical processes have become more important to the public in the last two decades because global warming, visibility problems, ozone layer holes, urban air pollution coupled with health effects, and acid rain are phenomena that result from gases and/or small particles emitted to the atmosphere from a variety of anthropogenic and natural sources (Jang, et al., 2002; Baird, 1998). The small particles, universally known as atmospheric aerosols, are a heterogeneous mixture of many different compounds (100-1000 in number) that are suspended in gas. They originate from all of the various sources of emissions that occur in any one geographical location (i.e. plant pollen, car exhaust, biomass burning emissions, personal care products, volcano emissions, etc.), (Baird, 1998). Although aerosols are well correlated with health effects, such as respiratory problems and ultimately mortality (Baird, 1998; Turpin, 1999), we do not know their molecular composition, or which compounds affect a population from a health standpoint, because of the heterogeneous
chemical mixture aerosols (Jang, et al., 2002; Turpin, 1999; Baird, 1998). Furthermore, the primary source of an aerosol is not the only contributor to its affects; an aerosol that might not have been a reagent towards a living organisms' respiratory system can undergo a UV light initiated 'secondary chemical reaction' that now changes its chemical reactivity into a more dangerous chemical specie.

The need to study the chemical composition of atmospheric aerosols is clearly justified by the lack of knowledge in total aerosol characterization, and is currently one of the major areas of aerosol research. Aerosol composition can be generally grouped into two major parts: those compounds that are water-soluble and those that are not (Rogge et al., 1993). These two groupings are referred to as the polar fraction for the water-soluble part of an aerosol and the non-polar fraction for the water insoluble part. The non-polar fraction of aerosols is currently the major area of study in the field of aerosol research due to the knowledge that poly-aromatic-hydrocarbons (PAH) are carcinogenic compounds that come from a variety of anthropogenic sources, in addition to biomass burning. Furthermore, the ease in analytical work to characterize the non-polar fraction of an aerosol has encouraged on-going research in that area. The only problem found in one study is non-polar fractions of aerosols comprised of no more than 50-60% of the total organic-based fraction of an aerosol sample (Rogge et al., 1993). The other 40-50% of the organic fraction was the polar-based organic mass, and it is this fraction that is the least studied (Rogge et al., 1993). The polar fraction is also important from the public health standpoint because it is the water-soluble fraction that is readily absorbed in lung tissue after inhalation, or into any other biological organ that could be exposed to it (Turpin, 1999).

Rationale

There is still a need to continue to work in total chemical characterization of atmospheric aerosols due to their relations to climate effects and public health. Much of the research being done in this area is still limited because methods for analyzing aerosols need to be developed. In response to the lack of analytical methods for identifying compounds in the water-soluble fraction, this research will help fill in a gap in atmospheric chemistry by devising an analytical method for aerosol characterization within the polar fraction. Carbohydrates are the chosen compounds for this study, due to their abundance in plant material and significant probability that they might be found at high concentrations from biomass combustion.
Literature Review

Organic atmospheric aerosol characterization and source emissions are two areas of research that were not thoroughly investigated until roughly the early 1990s. Thereafter, much work has been done in this field to further the study of aerosol characterization, and the most significant findings and methods are discussed here.

In the early 1990s, southern California researchers completed the first major work in the area of organic aerosol characterization that determined the major fractions of a typical aerosol sample in that geographical region (Rogge et al., 1993). The study was performed by collecting air samples in urban and non-urban settings over an extended period. Using an analytical method called Gas Chromatography-Mass Spectrometry (GC-MS), the group was able then to determine general chemical compositions. The findings included information that, in an urban sample, 60% of the total mass was composed of inorganic compounds, such as sulfate, nitrate, ammonium, and others; 15% was elemental carbon (basically soot); and 25% of total aerosol mass was organic compounds (Rogge et al., 1993).

The study went on to look at the organic fraction of the aerosol samples and determine the chemical composition of the organics. The only problem was that of the organic fraction, roughly only 50% was able to be analyzed using the GC-MS methods, and of that 50%, only 25% was able to be characterized, and even then some fractions were still not identifiable. Overall, 80 different organic compounds were found from that smaller fraction, and the possible emission sources of those compounds were given as well. This study showed how aerosols could contain hundreds of different compounds and that a single analytical method would clearly not be able to identify all of the organic compounds in an aerosol sample. Due to this finding, researchers began to develop methods that would test for specific groups or types of chemical species, or sample the atmosphere in a certain location where some background knowledge was already known about the predominant chemicals in that region. An area of aerosol research that is of interest is characterizing the composition of aerosols that exclusively originate from wood combustion (otherwise known as biomass burning).

Atmospheric aerosol research has shown that biomass burning is a major source of aerosols, particularly organic source emissions (Santos, 2002). Study and sampling in this area by researchers in the southeastern U.S., from 2000-2001, was able to attribute the percentage amount of aerosols stemming from various sources in this region, as follows: 25-66% biomass burning, 14-30% diesel exhaust, 5-12% meat cooking, and 0-10%
from gasoline exhaust (Zheng et al., 2002). In the biomass burning for source emissions research area, work is being done in characterizing the chemical composition of the aerosols, which a study has shown that part of the organic fraction of smoke particles are from the breakdown of cellulose, a major carbohydrate (Simoneit et al., 1999). The researchers were even able to determine that a major degradation product of cellulose is a compound called levoglucosan (or 1, 6 anhydro glucopyranose). This compound is so abundant in aerosols with origins from biomass burning that a tracking system in monitoring this compound in the atmosphere can be used for studying trends in the burning of large areas, such as forests or agriculture burns. These types of findings are leading atmospheric aerosol research to move towards the area of plant-derived or biogenic source particulates (Gelencser and Meszaros et al., 2000) that are largely of the water-soluble fraction, and possibly could be a significant part of the large uncharacterized fraction from the initial work done in this field.

Water-soluble organics in aerosols have been difficult to fully characterize, but are now known to be molecules that have very large structures, such as biopolymers (Krivacsy et al., 2001), which constitute a large fraction of the water-soluble (polar) organics (Zappoli et al., 1999). Characterization of water-soluble organics is difficult to analyze as a whole because one analytical method is not able to give the researcher information about all of the possible compounds that are in the water-soluble fraction. The main methods that have been used for characterization of atmospheric aerosols have been GC-MS (Brown et al., 2002; Gelencser et al., 2000; Rogge and Cass et al., 1993; Santos et al., 2002; Simoneit et al., 1999; Zheng et al., 2002), or Total Organic Carbon analysis (Krivacsy et al., 2001; Zappoli et al., 1999). GC-MS is used frequently because it enables researchers to know with a high level of confidence the compound that produces a chromatographic signal. Total Organic Carbon analysis is used because it can inform researchers regarding what percentage of the sample was from organic compounds, and what percentage was from inorganic compounds. Both methods are very powerful tools, but the GC-MS method requires much work in the preparation stages, including derivatizing a sample that includes chemical changes made to the sample in order for it to be analyzed by the method. Additionally, the polar organic fractions are not always easily analyzed with GC-MS due to their chemical composition and volatility. High molecular weight and low volatility molecules, such as biopolymers, are not identifiable using GC-MS so other methods that are quicker and easier must be used. High-Performance Liquid Chromatography (HPLC) is another separation method that has been used
for looking at large polar organic materials, such as carbohydrates and amino acids, in the food industry, and appears to be a much easier and cost efficient method for biopolymer analysis than the previous analytical methods discussed (Bonn, 1987; Stritz, 1991; Ding and Yu, 2002).

Problem Statement
This research will develop an analytical method to further the study for characterization of the water-soluble organic fraction in atmospheric aerosols with an HPLC method that might prove to be much easier and more specific in identifying a group of biopolymers (i.e. carbohydrates) that exist in aerosol form.

Methodology and Research Design
The theory of this method development consists of using acid catalyzed hydrolysis on carbohydrates in order to convert these larger polysaccharides into monosaccharides, such as glucose, fructose, and galactose. Figure 1 shows the general organic chemical reaction for acid catalyzed hydrolysis of a disaccharide into two monosaccharides.

\[
\text{Cellulobiose} \xrightarrow{\text{HCl}} \text{2 glucose molecules}
\]

Once the monosaccharides have been formed, a solid phase extraction procedure will be performed to remove contaminants and by-products from the hydrolysis reactions. The samples can then be analyzed using the HPLC carbohydrate column, which separates glucose, galactose and fructose.

Chemicals Used
1. Standard solutions in the concentration range of 10–25 ppm from the following carbohydrates were prepared from stock solutions obtained from the CSUS Chemical Services Center: Raffinose, Trehalose, Maltose, Lactose, Sucrose, Melibiose, Cellubiose, D-Glucose, Fructose, and Galactose.
2. Other non-carbohydrate chemicals used were hydrochloric acid,
methanol, ammonium sulfate, isopropanol, sulfuric acid, dichloromethane and acetonitrile.

**Instrument and Other Equipment Used**

1. The HPLC system used for this project contained a carbohydrate specialty column (Benson BC-100 Ca2+ 7.8 mm x 300 mm) to which the most polar species elute out sooner and the less polar species elute out later, a column pump (Waters M6000A), an injection valve loop of size 57 L (Rheodyne), and a column heater (Merck T6300) at 60°C. The detector used is an Aerosol Charge Detector (ACD), which was invented by Dr. Roy Dixon. Also a standard personal computer was used for the data collection using ChromPerfect, a chromatography software program for data analysis.

2. A standard laboratory vacuum oven (VWR Scientific 1410) with a liquid trap (Pyrex 134/45) connection.

3. A general laboratory oven (Lab-Line Instruments)

4. Solid Phase Extraction cartridges used consisting of an amino packing, (Alltech Associates); extractions were performed in 1mL-4mL portions.

**Procedure**

1. Standard solutions in the concentration range of 10-25ppm are first prepared for all the carbohydrates mentioned previously. The standards are then run on the HPLC in order to establish their respective retention times.

2. Disaccharides and oligosaccharides are then hydrolyzed by the acid catalyzed method. Standard solutions of 4 mL aliquots contain a 25ppm standard of the chosen carbohydrate and a 0.1 molar concentration of hydrochloric acid. These solutions are then put in an oven at 84°C for 24 hours.

3. Upon hydrolysis, the 4mL aliquots are put through a solid phase extraction cartridge to remove ions and other contaminants that would interfere with the HPLC analysis. The solid phase extraction entails a preparatory stage for evaporation of the aqueous solution using a vacuum oven. The analytes and contaminants are then re-dissolved in either isopropanol or methanol for the solid phase extraction procedure. The actual cartridge is first conditioned with 3-5ml of a dichloromethane/methanol mixture of 80:20. The sample is then put into the cartridge where both analytes and contaminants stay in the solid phase. A slightly more polar solvent is passed through, such as methanol, to extract the analytes. Most of the ion contaminants continue to stay attached to the solid phase.
4. After the solid phase extraction has been performed, the sample can then be injected and run through the HPLC carbohydrate column for analysis. Depending on the type of carbohydrate used, the most predominant peaks should be glucose, galactose, or fructose.

5. Data is then collected using the ChromPerfect software for analysis.

Results and Discussion

Using the methods described in the Procedures section for hydrolysis of the chosen carbohydrates into glucose, galactose and fructose, a qualitative analysis was obtained (Table 1).

Table 1

<table>
<thead>
<tr>
<th>Carbohydrate to be analyzed</th>
<th>Number of monosaccharide peaks after hydrolysis</th>
<th>Types of monosaccharide peaks</th>
</tr>
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<tbody>
<tr>
<td>Malibiose</td>
<td>2</td>
<td>Galactose, Glucose</td>
</tr>
<tr>
<td>Sucrose</td>
<td>2</td>
<td>Glucose, Fructose</td>
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<tr>
<td>Maltose</td>
<td>1</td>
<td>Glucose</td>
</tr>
<tr>
<td>Lactose</td>
<td>2</td>
<td>Galactose, Glucose</td>
</tr>
<tr>
<td>Cellbiose</td>
<td>1</td>
<td>Glucose</td>
</tr>
<tr>
<td>Raffinose</td>
<td>3</td>
<td>Galactose, Glucose, Fructose</td>
</tr>
<tr>
<td>Trehalose</td>
<td>1</td>
<td>Glucose</td>
</tr>
</tbody>
</table>

Figure 2 shows an ideal chromatogram of three monosaccharide peaks that would result when Raffinose is hydrolyzed. This figure also shows the chromatogram of glucose, galactose, and fructose standards at 25ppm concentrations. The glucose peak is at 9.24 min, galactose is at 10.36 min, and fructose is at 11.56 min.
Upon hydrolysis in 0.1M HCl, Figure 3 shows the data obtained of raffinose hydrolysis from the HPLC. There is an obvious difference between Figure 2 and Figure 3. Figure 2 clearly shows the three monosaccharide peaks, while in Figure 3, the chromatogram has two additional peaks that are interfering with the analyte signals. These two other peaks located at 5.91 min and 8.84 min are contaminant peaks, and the larger one at 5.43 min is due to the ions that are formed after the hydrolysis reaction. Performing a solid phase extraction to the sample immediately after the hydrolysis reaction usually solves contamination problems. So, a solid phase extraction was performed on all samples and the contaminant peaks were considerably reduced, but the analyte peaks were reduced as well. Figure 3 also shows the chromatogram of acid-catalyzed hydrolysis for Raffinose into the monosaccharide constituents. The glucose peak is at 9.43 min, galactose is at 10.60 min, and fructose is at 11.83 min.

Figure 4 shows an example of the resulting chromatogram for a raffinose hydrolysis sample after put through a solid phase extraction. Notice how different the peak on the chromatogram in the 5 min region appears in Figure 4. This is due to the solid phase extraction that removed the ion contaminants that appeared on the chromatogram from Figure 3. The glucose peak in Figure 4 is also drastically reduced and the galactose and fructose peaks are not even detected. The reason behind this situation is due to how solid phase extraction works for removing compounds. Solid phase extraction removes most water-soluble species such as ions, but since the monosaccharides are also extremely water-soluble it is understandable to see why they are not detected in Figure 4. This figure also shows the resulting chromatogram of a raffinose hydrolysis sample after put through a solid phase extraction.
The other carbohydrates that were subjected to solid phase extraction showed almost the exact same results as Figure 4, so their chromatograms are not included here due to the fact that neither quantitative nor qualitative information can be obtained. However, Figures 5-10 show the resulting chromatograms of the acid catalyzed reactions from the remaining carbohydrates that were analyzed in Table 1. These chromatograms show the qualitative information that can be obtained when solid phase extraction is not performed.

Figure 5. Maltose hydrolysis non-extracted, glucose peak is at 9.28 min.

Figure 6. Trehalose hydrolysis non-extracted glucose peak is at 9.22 min.
Figure 7. Lactose hydrolysis non-extracted, glucose and galactose peaks are at 9.19 min, and 10.30 min respectively.

Figure 8. Cellobiose hydrolysis non-extracted, glucose peak is at 9.24 min.

Figure 9. Melibiose hydrolysis non-extracted, glucose and galactose peaks are at 9.28 min and 10.41 min respectively.
Figure 10. Sucrose Hydrolysis non-extracted, glucose and fructose peaks are at 9.16 min and 11.52 min respectively.

Notice the various monosaccharides that result in each of the chromatograms in Figures 5-10 when the oligosaccharides are subjected to acid catalyzed hydrolysis. Some of the chromatograms show a large glucose peak but no galactose or fructose, this is due to the fact that the oligosaccharide was only composed of glucose constituents. Similar results can be seen of other chromatograms, and Table 1 serves as a guide to the monosaccharide makeup of the various carbohydrates analyzed.

Limitations

Although the acid catalyzed hydrolysis method does not work as well for a quantitative determination of carbohydrate analysis (and the quantitative problem is really only where the glucose peak is concerned) the qualitative information obtained is quite accurate and reliable. The quantitative analysis problem can be addressed by limiting the amount of ion contaminants that appear in the chromatogram by using a lower molar concentration of acid (this results in a higher pH) coupled with a higher oven temperature for the reaction completion. Also various acids and strengths can be used, and even adopting a higher HPLC column temperature can improve the efficiency of the column resulting in narrower peaks and thus greater separation.

The carbohydrates analyzed during this research are some of the most naturally occurring oligosaccharides found in the plant kingdom, but this researcher purposefully left out cellulose, the most abundant polysaccharide found in plants and the most abundant polymer found on earth. The reason for this is due to the fact that cellulose will not breakdown into its monosaccharide constituents readily using the acid-catalyzed method, nor is it water soluble, or even very soluble in most solvents. For these reasons, cellulose was not used and poses as the biggest limitation to the carbohydrate
analysis method using acid catalyzed hydrolysis. To remedy this limitation, another similar method needs to be developed using enzymes as the catalyst for carbohydrate hydrolysis. An enzymatic-catalyzed hydrolysis method would work for all of the oligosaccharides already researched, and more importantly it will work for the study of cellulose originating from biomass combustion. The enzymatic hydrolysis would not produce as much ion contamination on the HPLC chromatogram, which even furthers the motivation for its development.

Conclusion

Given the already mentioned limitations, this researcher intends to continue work and further the development to resolve the problems for those limitations. The first area to pursue will be to work on the enzymatic-catalyzed hydrolysis of the polysaccharide cellulose, and the further development of a 'cleaner' acid catalyzed hydrolysis of the oligosaccharides from Table 1. Once the enzymatic method has been developed and incorporated, then actual sampling of the atmosphere near forest fires or regions that receive smoke from those biomass combustion areas will be undertaken in order to quantify the concentrations of carbohydrates that exist in aerosol form.
References


