Chapter 7 - Operant Conditioning

Schedules and Theories of
Reinforcement

Lecture Outline

- Schedules of reinforcement
  - Continuous vs. intermittent schedules
  - Four basic intermittent schedules
  - Other simple schedules of reinforcement
  - Complex schedules of reinforcement
- Theories of reinforcement
  - Drive reduction theory
  - The Premack principle
  - Response deprivation hypothesis
  - Behavioral bliss point approach

Now that we have discussed reinforcement . . . .

- It is time to discuss <u>how</u> reinforcements can and should be delivered
- In other words, there are other things to consider than just what the reinforcer should be.
- If you were going to reinforce your puppy for going to the bathroom outside, how would you do it?
  - Would you give him a doggie treat every time? Some of the time?
  - Would you keep doing it the same way or would you change your method as you go along?

Schedules of Reinforcement

- A schedule of reinforcement is

  - Each particular kind of reinforcement schedule tends to produce a

  - In other words, it is what you have to do to get the reward!
    - Example: Does a dog have to roll over just once to get a reward, or does he have to roll over more than once before he's given his reward?

Continuous vs. Intermittent Reinforcement

- **<u>Continuous</u>**
  - A *continuous reinforcement schedule (CRF)* is one in which
    - Example: every time the dog rolls over he gets a treat
        every time a child hangs up her coat she gets praised

  - Useful for strengthening newly learned behaviors or when using shaping procedures to train a behavior.
  - Leads to

  - Not very common in a natural environment.

Continuous vs. Intermittent Reinforcement

- **<u>Intermittent</u>**
  - An *intermittent reinforcement schedule* is one in which

    - Example: every third time the dog rolls over he gets reinforced.
  - Useful for

  - They can be based on the number of responses made (ratio) or the time between reinforcement (interval)
  - They can also be fixed or variable.
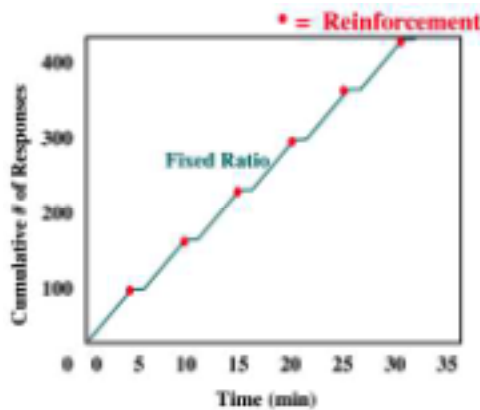
Four Basic Types of Intermittent Schedules

- **Ratio Schedules-**
- **Interval Schedules-**

  – **Fixed Ratio**

  – **Fixed Interval**

  – **Variable Ratio**

  – **Variable Interval**

Fixed Ratio Schedule

- **Fixed ratio schedule (FR)** - reinforcement is given after a

  – Examples:
    - FR4 schedule - a salesperson receives a bonus after every 4 sales
    - FR1 schedule - take a break after reading a chapter in the text
    - FR50 schedule - a rat received a food pellet after every 50 bar presses.
    - "piecework" - paid by number of pieces sewn together
  – Schedules can be

Fixed Ratio Schedule

- Characteristic pattern:
  -
  -

- Higher ratio requirements produce

  - e.g., FR50 has longer break before responding again than FR25
- Can *stretch* the reinforcement ratio (e.g., FR1, FR2, FR4, FR6, FR10)
- **Ratio strain** – when requirement increases too quickly behavior becomes
  - Movement from "dense" to "lean" schedules should be done gradually.

* = Reinforcement

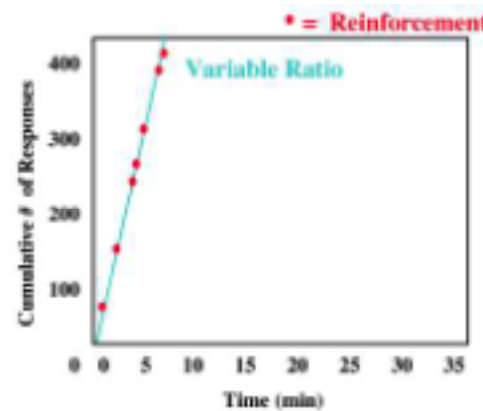Fixed Ratio

Cumulative # of Responses / Time (min)

Variable Ratio Schedule

- **Variable Ratio (VR):** Reinforcer given after

  - VR10 schedule, on average every 10 responses are reinforced but number of responses might vary between 1 and 20
  - Examples
    - VR6 schedule - a gambling machine pays off every 6 spins on average, but payoff trial cannot be predicted
    - VR50 schedule - a food pellet is dispensed on average every 50 bar-presses, but exact trial cannot be predicted
    - Salesperson working on commission

Variable Ratio Schedule

- Characteristic pattern:
  -

  -

Other facts about Variable Ratio Schedules

- Behaviors on this type of schedule tend to be
  - This includes unwanted behaviors like begging, gambling, and being in abusive relationships
  - "Stretching the ratio" means starting out with a very dense, rich reinforcement schedule and

    - The spouse, gambler, or child who is the "victim" must work harder and harder to get the reinforcer

Four Basic Types of Intermittent Schedules

- **Ratio Schedules**- reinforcement given after a number of non-reinforced responses

  – **Fixed Ratio**

  – **Variable Ratio**

- **Interval Schedules**- reinforcement given for a responses that occurs after a certain amount of time has passed

  – **Fixed Interval**

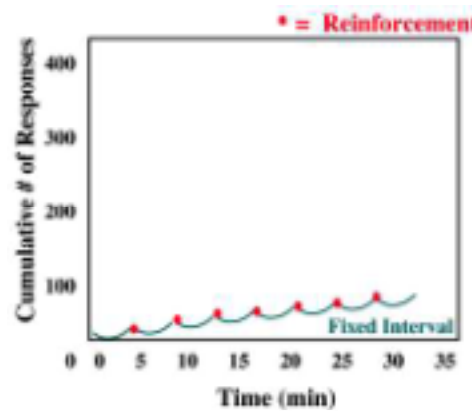 – **Variable Interval**

Fixed Interval Schedule

- **Fixed Interval (FI):** Reinforcement obtained on

  – Example
    - FI 2min – a rat receives food on the first lever press following a 2 minute interval
    - FI75min - glancing at the clock during class. After 75 minute interval, you are rewarded by being allowed to leave.

Fixed Interval Schedule

- Characteristic Pattern:
  - "scallop pattern" - FI schedules produce an upwardly curved rate of responding

    - Example: study more and more as a test approaches.
  - noticeable

    - Example: don't study much after a test has just occurred.

* = Reinforcement

Cumulative # of Responses

400

300

200

100

0 0   5   10   15   20   25   30   35

Time (min)

Fixed Interval
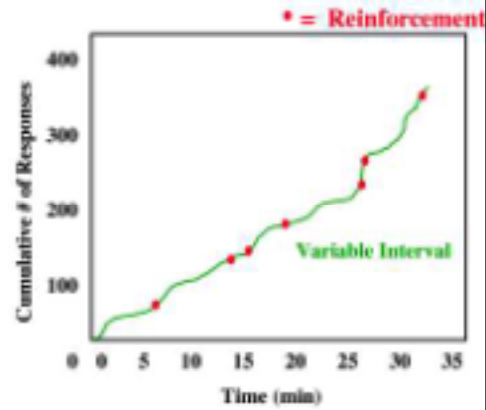
Variable Interval Schedule

- **Variable Interval (VI):** Reinforcer given for the

  - VI 30 sec schedule- on average the first response after every 30 seconds is reinforced but the time of reinforcement might vary between 1 sec & 1 min
  - Examples
    - VI 2min - a food pellet is dispensed on the first bar-press following a 2 minute interval (on average) but exact time bar-press cannot be predicted
    - VI 15min – Hilary's boyfriend, Michael, gets out of school and turns on his phone some time between 3:00 and 3:30 (the average is after 15 minutes) – the "reward" of his answering his phone puts her calling behavior on a VI schedule, so she calls every few minutes until he answers

Variable Interval Schedule

- Characteristic Pattern:
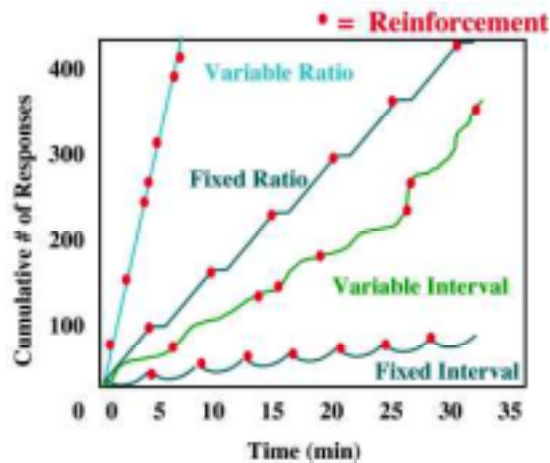 -
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    - Example: Presses of the "redial" button on the telephone are sustained at a steady rate when you are trying to reach your parents and get a "busy" signal on the other end of the line.

Patterns of Responding

	FR	VR	FI	VI
Response rate	High	High	Increasing	Moderate
Post reinforcement pause	Yes	No	Yes	No

Practice Identifying Schedules of Reinforcement

- Students' visits to the university library show a decided increase in rate as the time of final examinations approaches.

- Every time you put money in the vending machine you receive your candy bar.

- Fred has a boss who checks on his work periodically (usually roughly every 2 hours). Because Fred doesn't know exactly when the next 'check-up' might come, he generally works hard at all times in order to be ready

- You have to email your friend Bob about 3 times before he'll email you back. After your third email on average, though, he usually responds.

Other Simple Schedules of Reinforcement

- Response rate schedules

- Non-contingent schedules

Other Simple Schedules of Reinforcement

- Response rate schedules
  - Intermittent schedules of reinforcement produce different patterns of responding
  - With a response rate schedule, reinforcement is directly related to
    - DRH
    - DRP
    - DRL
    - DRI
    - DRO
  - Differential reinforcement –

Response rate schedules

- Differential reinforcement of high rate (DRH)
  - A minimum number of responses

  - Reinforcement is contingent on

  - Maintains a high rate of responding (higher than any other schedule used)
  - Examples
    - A rat receives food if it performs 60 lever presses in a one minute period
    - A child is taken to the movies if he tidies up all of his toys within 10 minutes

Response rate schedules

- <u>Differential reinforcement of paced responding (DRP)</u>
  - Responses are reinforced only if responding

  - Reinforcement is provided for responding at a rate that is
  - Example
    - Reinforce a rat for 10 consecutive bar-presses if each is separated by an interval of between 1.5 s and 2.5 s

    - In autism too little eye-contact during social interactions is problematic; but don't want too much eye contact because it might be perceived as threatening. Reinforce eye-contact behavior if it occurs at an appropriate rate during a social interaction.

Response rate schedules

- <u>Differential reinforcement of low rate (DRL)</u>
  - Responses are reinforced only if

  - Maximum number of responses during the time period are rewarded
  - Encourages
  - Used to reduce the frequency of a behavior
  - Useful when some of the behavior is tolerable but less would be better
  - Example
    - Calling out correct answers in class is rewarded if it only occurs once every 15 minutes

Response rate schedules

- Differential reinforcement of zero behavior (DRO)
  - Reinforced if specified period has elapsed

  - Also called differential reinforcement of *other* responding
  - Used to
  - Example
    - Reward a child if she has not sucked her thumb in 60 seconds

    - Reward a child for sustaining on-task behavior for 5 minutes

Response rate schedules

- Differential reinforcement of incompatible behavior (DRI)
  - Similar to DRO, but rewarded for performing a behavior that is

  - Used to
  - Example
    - If trying to eliminate disruptive classroom behavior
    - reward a child for sitting quietly

Other Simple Schedules of Reinforcement

- Non-contingent schedules of reinforcement
  - Reinforcer is obtained

  - Two basic types:
    - Fixed time schedule
    - Variable time schedule

Non-contingent schedules - Fixed Time Schedule

- Fixed time schedule
  - Reinforcer is delivered

  Example
  Reward a child with a trip to the movies once a week irrespective of whether she has been good or bad (FT 1-week schedule)

Non-contingent schedules - Variable Time Schedule

- Variable time schedule
  - Reinforcer is delivered following

    Example
    Reward a child with a trip to the movies on average once a week irrespective of whether she has been good or bad (VT 1-week schedule). The interval might vary between 1 day and 3 weeks

Non-contingent schedules - superstitious behavior

- What happens when reinforcement occurs randomly, regardless of a person or animal's behavior?
- Weird Stuff! - Superstitious behaviors

Superstitious Behavior

- Ono (1987)
  - Ps presented with 3 levers and a counter
  - Told "if you do something you might get points on the counter"
  - Not told what to do
  - Points delivered on FT or VT schedule (the exact behavior that produced the reward was unknown)
  -
    - e.g., lever pulling in set sequences; touching the counter; pulling lever then jumping
  - Also seen in animal studies (spinning in circles, visiting all 4 corners of the cage, etc.)
- Might also explain superstitious behavior in gamblers, sports people (rituals before free-throws)

Non-contingent schedules - poor performance

- Non-contingent reinforcement

  - Rachlin & Baum (1972)
    - Pigeons responding on a VI schedule for food (contingent reinforcement) also given non-contingent food reinforcements
    - Compared to control group (other pigeons on the VI schedule given the same quantity of food), the non-contingent reinforcement group responded less

  - Athletes on long-term contracts

Non-contingent schedules - good uses

- Giving noncontingent attention to children
  - Some bad behaviors like tantrums are used to try to get attention from caregivers
  - These behaviors can be diminished by giving attention noncontingently

- Children need *both* contingent AND non-contingent attention to grown up healthy and happy.

Complex Schedules of Reinforcement

- Complex schedules are combinations of two or more simple schedules
  - Conjunctive schedules
  - Adjusting schedules
  - Chained schedules

Complex Schedules - Conjunctive

- Conjunctive schedules
  - Requirements of

  - Example 1
    - A rat performs a bar-pressing task for a food reinforcer on a FR50 FI 1 min schedule. The reinforcer is contingent upon the rat performing 50 bar-presses *and* at least one bar-press following a 1 minute interval
  - Example 2
    - A student gets a high distinction on a learning and behavior course because she does well on the assignments and studies hard for the exam

Complex Schedules - Adjusting

- Adjusting schedules
  - Response requirement changes a function of

  - Example 1
    - A rat performs a bar-pressing task for a food reinforcer on a FR50 schedule. If the rat completes the bar-pressing task in 2 minutes, an FR70 schedule is employed so that 70 bar-presses are required in 2 minutes
  - Example 2
    - A student writes a 1000 word lab report for a first year assignment. Because the report met the required standard (i.e., the student passed the course) a 2500 word report is a requirement for a second year course.

Complex Schedules - Chained

- Chained schedules (chaining)
  - A sequence of 2 or more simple schedules each of which has its own S^D and the last of which results in the terminal reinforcer

  $$VI\ 30\text{-sec} \qquad\qquad VR20 \qquad\qquad FI\ 30\text{-sec}$$
  $$White\ Key: \underset{S^D}{Peck} \to \underset{R}{} \underset{S^R/S^D}{Green\ Key:} \underset{}{Peck} \to \underset{S^R/S^D}{Red\ Key:} \underset{R}{Peck} \to \underset{S^R}{Food}$$

  White Key : Peck $\to$ Green Key : Peck $\to$ Red Key : Peck $\to$ Food
  S^D R S^R/S^D R S^R/S^D R S^R

  - The keys act as discriminative stimuli

  - The red and green keys act as

Complex Schedules - Chained

- *Goal gradient*
  - Increase in
  - Responses in the early part of the chain are

  - Easy to observe if each link consists of the same reinforcement schedule

  FI 60-sec   FI 60-sec   FI 60-sec
  White Key : Peck $\to$ Green Key : Peck $\to$ Red Key : Peck $\to$ Food
  S^D R S^R/S^D R S^R/S^D R S^R

    - Slower rate of response and longer pauses on white key than green; strongest response on red key
    - Terminal reinforcer is
    - Earlier links

Complex Schedules - Chained

- *Backward chaining*
  - To establish a chained schedule

  - Can also have a chained schedule where each link in the chain consists of a *different* response

Barrier : Climb Over Barrier$\rightarrow$ Tunnel : Run Through Tunnel $\rightarrow$ Food
$\quad\ S^D \qquad\qquad\quad R \qquad\qquad\quad\ \ S^R/S^D \qquad\qquad\quad R \qquad\qquad\quad S^R$

  - Example
  - To train a child to dress himself.
    - Day 1 - shoes on $\rightarrow$ reward
    - Day 2 - socks on, shoes on $\rightarrow$ reward
    - Day 3 - pants on, socks on, shoes on $\rightarrow$ reward
    - Day 4 - undies on, pants on, socks on, shoes on $\rightarrow$ reward