Chapter 6: Introduction to Operant Conditioning

Lecture Overview

- Historical background
  - Thorndike – Law of Effect
  - Skinner's learning by consequences
- Operant conditioning
  - Operant behavior
  - Operant consequences: Reinforcers and punishers
  - Operant antecedents: Discriminative stimuli
- Operant contingencies
- Positive reinforcement: Further distinctions
  - Immediate vs. delayed reinforcement
  - Primary & secondary reinforcers
  - Intrinsic and extrinsic reinforcement
- Shaping & Chaining

Classical vs Operant Conditioning

- In classical conditioning the response occurs at the end of the stimulus chain
  - For example:
    - Shock → Fear
    - Tone : Shock → Fear
    - Tone → Fear
  - Study of reflexive behaviors

Classical vs Operant Conditioning cont.

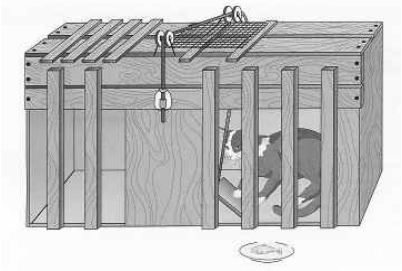
- Operant conditioning – study of goal oriented behavior
  - Operant conditioning refers to changes in behavior that occur
- Operant Behaviors – behaviors that are influenced by
- Operant Conditioning – the effects of those

Historical Background

- Edwin L. Thorndike, 1898
  - Interest in animal intelligence
  - Believed in systematic investigation
  - Formulated the *Law of Effect:*
    - Behaviors that lead to a satisfactory state of affairs are strengthened or "stamped in"
    - Behaviors that lead to an unsatisfactory or annoying state of affairs are weakened or "stamped out"

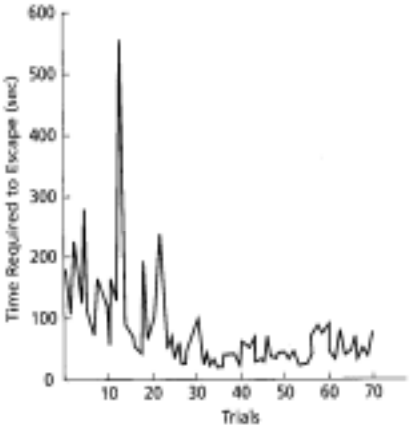
Thorndike's Puzzle Box Experiment

- Placed a hungry cat in a puzzle-box (cage) and a small amount of food was placed just outside the door
- To get to the food, the cat could open the door by pressing a lever
- Initially, the cats tried a number of behaviors to escape before stumbling across correct response
- Thorndike was interested in how long it took the cat to escape when placed *back* in the box
- DV = the latency for the cats to escape across a number of trials



Thorndike's Puzzle Box Results

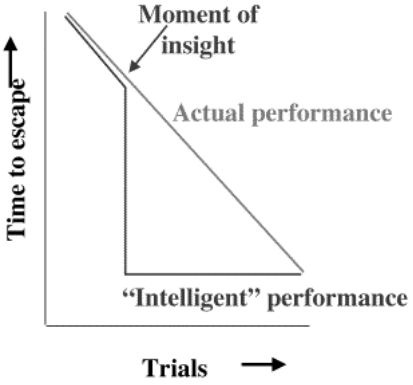
- Trial 1 - more than 150 seconds to escape
- Trial 40 = 7 seconds
- Behaviors that opened the door were followed by consequences (escape, food)
- Operant conditioning – the organism's behavior changed because of the consequences that followed it



Results for 1 cat over a number of trials

Thorndike's Puzzle Box Conclusions

- Thorndike argued that the behavior was not *insight* or intelligent, because the cats would have escaped from the cage immediately on every trial after discovering the "solution"
  - What he observed was a steady decline in the frequency of behaviors other than the "correct" one
  - Even showing the cat what to do did not affect escape latency

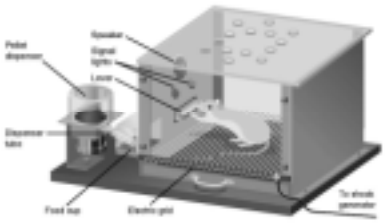


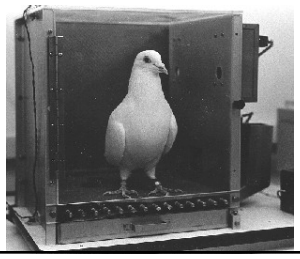
Thorndike's Law of Effect

- Thorndike reasoned the response that opened the door was gradually strengthened, whereas responses that did not open the door were gradually weakened
- He suspected that similar processes governed all learning
- Law of effect
  - Behaviors leading to a desired state of affairs are strengthened, whereas those leading to an unsatisfactory state of affairs are weakened

Skinner

- Skinner systematized operant conditioning research using the *Skinner Box*
- He devised methods that allowed the animal to repeat the operant response many times in the conditioning situation
- Studied lever pressing in rats & pecking in pigeons
- In Skinner's experiments the DV = response rate





Skinner

- Skinner believed behavior could be classified into two subcategories
  1. Respondent behavior
  2. Operant behavior
- Proposed that voluntary behaviors are controlled by their consequences (rather than by preceding stimuli)
- Operant conditioning
  - The future probability of a behavior is affected by the consequences of the behavior

Operant Behavior

- Operant behavior
  - The consequences that follow a certain response, affect the future probability (or strength) of the response

    Press Lever → Food

    Press Lever → Shock
  - Operant behaviors are elicited by the organism (voluntary)
  - Operant behavior defined as a *class* of response
    - e.g., class =
    - But *exact* response could be (fast, slow; hard; soft)
    - Easier to predict class of behavior than exact response

Reinforcers & Punishers

- Operant Consequences: Reinforcers & Punishers
  - For an event to be a reinforcer, it must
    1.
    2.
  - For an event to be a punisher, it must
    1.
    2.

Reinforcers & Punishers

- Symbols in operant conditioning

  Press Lever (R) $\rightarrow$ Food (S^R)

  Press Lever (R) $\rightarrow$ Shock (S^P)

- Terminology
  - Reinforcement and punishment refer to
  - Reinforcers and punishers refer to

Operant Conditioning

- Operant antecedents: Discriminative stimuli
  - Discriminative stimuli (S^D) – signal that when present responses are reinforced; when absent responses are not reinforced

    Light (S^D) : Press Lever (R) → Food (S^R)

  - Discriminative stimuli for punishment (S^P) – signal that when present responses are punished; when absent responses are not punishment

    Light (S^D) : Press Lever (R) → Shock (S^P)

  - Discriminative stimulus (antecedent), operant behavior (response), & consequence = *three-term contingency*

Operant Conditioning

- Discriminative stimulus
  - The animal is trained to give the target behavior only when a particular stimulus is presented.
  - Behavior is reinforced in the presence of the desired stimulus but not in the presence of other stimuli

Kids at school:	swearing	→	approval
	S^D		S^R (reinforcer)
Grandparents:	swearing	→	approval removed
	S^D		S^P (no reinforcer)

Operant Consequences

- The consequences of the behavior can either be appetitive or aversive
  - Appetitive: a consequence that the organism wants
  - Aversive: a consequence the organism wants to avoid
- Contingencies of reinforcement or punishment involve the

4 Types of Contingencies

- **Reinforcement**
  - Positive
    - –
  - Negative
    - –
- **Punishment**
  - Positive
    - –
  - Negative
    - –

Positive Reinforcement

- Positive reinforcement
  - Presentation of an appetitive stimulus following a response

    Press Lever (R) → Food (S^R)
  - The consequence of food leads to <u>increase</u> in lever pressing
  - Examples:
    - Praise from a teacher after asking a good question
    - Reward money for returning a lost item

Negative Reinforcement

- Negative reinforcement
  - Removal of

    Press Lever (R) → Escape/Avoid Shock (S^R)
  - The consequence of escaping the shock leads to <u>increase</u> in lever pressing
  - Negative reinforcement involves escape & avoidance
    - Escape –
      - Example: Take an aspirin → muscle pain goes away
    - Avoidance –
      - Example: Take an aspirin before exercising → prevents muscle pain

Positive Punishment

- Positive punishment
  - Presentation of an aversive stimulus following a response

    Press Lever (R) → Shock (S^P)
  - The consequence of shock leads to decrease in lever pressing
  - Examples:
    - Squirt water on cat when they sharpen claws on furniture

Negative Punishment

- Negative punishment
  - Removal of an appetitive stimulus following a response

    Press Lever (R) → Food Removal (S^P)
  - The consequence of food removal leads to decrease in lever pressing
  - Examples:
    - Taking a toy away from a child who misbehaves with it.

Practice Examples

- A professor has a policy of exempting students from the final exam if they maintain perfect attendance during the quarter. His students' attendance increases dramatically.

- Cindy is a very quiet, introverted, hardworking 5th grader who gets straight A's but who never volunteers in class, has only one friend and, in general, seems to be scared to death of people. Her teacher is particularly impressed with Cindy's performance on an arithmetic test and announces to the class that since Cindy got the highest grade, she will lead the pledge of allegiance everyday for a week. Cindy's performance on the next arithmetic test is quite poor. The number of correct answers she gives drops to the lowest she has ever had.

- You check the coin return slot on a pay telephone and find a quarter. You find yourself checking other telephones over the next few days.

More Practice Examples

- Your father gives you a credit card at the end of your first year in college because you did so well. As a result, your grades continue to get better in your second year.

- Zachary gets into so much trouble in one afternoon (he pour out all his sister's perfume, climbs out the window onto the roof, and many other similar things in a short period of time.) His mother tells him that he cannot go on the camping trip that his best friend invited him on. He stops misbehaving.

- Your hands are cold so you put your gloves on. In the future, you are more likely to put gloves on when it's cold.

Operant Contingencies

- Behavior modification is *often* more effective with *positive* reinforcement than with punishment

  Example

  If attempting to stop a child's tantrums, it is better to positively reinforce behavior when the child is *not* misbehaving, than to punish the child when she is misbehaving. The attention he receives during the punishment might also be rewarding.

Positive Reinforcement-Further Distinctions

- Immediate vs. delayed reinforcement
- Primary & secondary reinforcers
- Intrinsic and extrinsic reinforcement

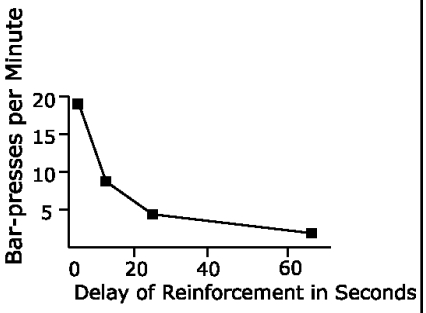
Positive Reinforcement-Further Distinctions

- Immediate vs. delayed reinforcement
  - The more immediate the reinforcer, the stronger its effect on behavior
- Dickinson, Watt & Griffith (1992)
  - Rats were trained to press a lever to obtain food
  - Dickinson et al., delayed the time between pressing lever and obtaining food between 2 & 64 seconds

Immediate vs. delayed reinforcement

- An increase in the delay of food for just a few seconds resulted in considerably less responding
- Responding almost ceased by 64 seconds
- Results initially interpreted as a memory deficit – i.e., the rats forgot which response produced the food

- Subsequent studies have shown that rats have excellent memory
- The problem is that the rats could not figure out *which* response produced the food
- Reinforcement delay allowed rats time to engage in other behaviors



Immediate vs. delayed reinforcement cont.

- The immediacy of the reward is an important factor in
- Logan (1965)
  - Trained hungry rats to run through a maze to get food
  - At one exit the rats would get an immediate reward of a small amount of food
  - At another exit they would get a large amount of food after a brief delay
-

Immediate vs. delayed reinforcement cont.

Example 1

You initiate a behavior management strategy to increase eye-contact in a child with autism. It is best to immediately reinforce the occurrence of eye-contact; delaying the reinforcement enables the child to engage in some other inappropriate behavior (e.g., self stimulation), which could inadvertently be reinforced by the delay.

Example 2

May explain why people smoke cigarettes. Short-term reinforcing properties (e.g., reduced anxiety) outweigh delayed reinforcing properties (e.g., live longer)

Primary & Secondary Reinforcers

- Primary Reinforcers
  - Primary reinforcers are those that do not require special training for their properties to be reinforcing
  - Naturally appetitive reinforcers are those that are necessary for the survival of the species (e.g., food, water, sex)
  - Effectiveness of primary reinforcers (e.g., food, water, sex) are influenced by deprivation & satiation
  - Researchers in the 1950s accumulated evidence that not all primary reinforcers were necessary for survival (and this type of primary reinforcer was NOT influenced by deprivation & satiation)

Primary Reinforcers cont.

- Butler (1954)
  - Monkeys placed in enclosed cage with two wooden doors
  - Blue door = can see experimental room for 30 seconds (visual stimulation)
  - Yellow door = opaque screen (no sensory stimulation)
  - Monkeys continually pushed blue door (one subject responded on every trial for 19 hours straight!!!)
  - Suggests that visual stimulation is also a primary reinforcer
  - Suggests that visual stimulation is not

Primary & Secondary Reinforcers

- Secondary reinforcers are learned by being associated with some other reinforcer
  - Examples: money, points to redeem for reward, tickets to redeem for prizes, prestige/status, etc.
- Wolfe (1936)
  - Trained 6 chimpanzees to place tokens (poker chips) in a machine ("chimp-o-mat") to obtain grapes& bananas, etc.
  - They had to operate a heavy lever to obtain tokens
  - Wolfe found that they would work as hard to obtain tokens as they would to obtain direct access to grapes
  - Chimps would also hoard their chips (save them for later)
  - Blue token for 2 grapes, and white token for 1 grape - chimps learned to value blue tokens more
  - When tested in pairs the dominant ape would push aside subordinate ape to work lever; dominant ape would also steal tokens from subordinate ape
  - Similar to humans!!!

Intrinsic and extrinsic reinforcement

- Operant *behaviors* can also become reinforcing

  Example

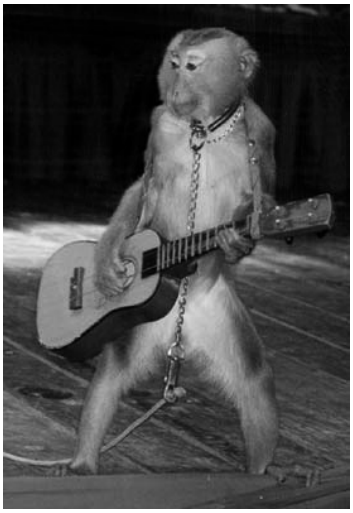
  Aid workers who visit foreign countries in times of crisis (R) are praised in the media for their work (S^R). Over time, the *act of helping* becomes reinforcing even in the absence of external praise.

Intrinsic vs Extrinsic Reinforcement

- Intrinsic reinforcement
  - Reinforcement is provided by the act of performing the behavior
  - Example: do quilting because you find is satisfying/enjoyable
- Extrinsic reinforcement
  - The reinforcement provided by the external consequences of the behavior
  - Example: Child who cleans up his room in order to receive praise from parents.
  - Example: Juggle balls 20 times in a row to receive 25 cents.

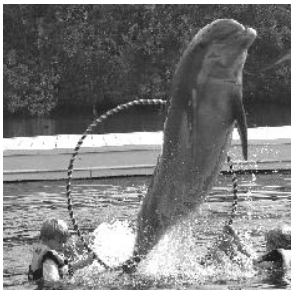
Problem with Reinforcement...

- Here's a problem:
  - What if you want to reinforce a behavior but it never appears to occur?
    - Example: reinforce a monkey for "playing" a guitar
  - If you can't reinforce a behavior until it occurs, how can you teach a complex behavior using operant conditioning?



Answer: Shaping

- Shaping involves rewarding *successive approximations* of the target behavior (e.g., dolphin jumping through a hoop)
  - At first the animal is reinforced for any behavior that vaguely resembles the target behavior (e.g., swimming near the hoop)
  - Next the animal is only reinforced if a closer approximation is given (e.g., touching the hoop)
    - Then swimming through the hoop -- then raise the hoop and must do a small jump, etc.
  - Finally the animal is only reinforced for performing the target behavior (i.e., jumping through the hoop)



Chaining

- Chaining -