Chapter 6: Learning
How Nurture Changes Us
C. Brown  Unit 7

Defining Learning

- A relatively ____________ in knowledge or behavior that results from ______________.
  - Adaptation by learning is flexible.
  - Humans adapt to life’s demands by learning.
  - The key to learning is ______________.

Lecture Preview

- Discuss classical conditioning and how complex behaviors can arise from it
- Distinguish classical from operant conditioning, and the principles of reinforcement
- Explore the basis of observational and insight learning
- Discuss biological influences on learning
- Evaluate learning fads

Basic Terminology

- **Learning** - change in an organism’s behavior or thought as a result of experience
- **Habituation** - process by which we respond less strongly over time to repeated stimuli
- **Sensitization** - process by which we respond more strongly over time (especially for dangerous, irritating stimuli)
  - Eric Kandel earned the Nobel prize for his studies of habituation and sensitization in *Aplysia* (the sea slug)

Aplysia: A Model for Habituation and Sensitization

Association

- We learn by association
  - Our minds naturally connect events that occur in sequence
- **Associative Learning**
  - learning that two events occur together
    - two stimuli
    - a response and its consequences
Classical or Pavlovian Conditioning

- We learn to associate two stimuli

Classical Conditioning

- Ivan Pavlov
  - 1849-1936
  - Russian physician/neurophysiologist
  - Nobel Prize in 1904
  - studied digestive secretions

Ivan Pavlov (1849-1936)

- Discovered ‘________________’: instances of salivation when food was not present.
- He directed his study to the investigation of psychic secretions in order to more fully understand ____________

Learning Classical Conditioning

- A type of learning in which an organism comes to associate one stimulus with another (also called Pavlovian conditioning).
- Classical Conditioning involves learning that one event predicts another.
- This type of learning involves
  - An unconditioned stimulus
  - An unconditioned response
  - A conditioned stimulus
  - A conditioned response

Classical Conditioning

- An _____________________ (US)
  - A stimulus (an event) that triggers an unconditioned (involuntary) response.
  - Examples: food, loud noises, painful stimuli
  - In Pavlov's experiments, the US was the food.

- An _____________________ (UR)
  - An unlearned response to an unconditioned stimulus (a reflex).
  - Examples: salivation to food, jumping when hearing a loud noise, moving away from something painful
  - In Pavlov's experiments, salivation to the food

- A _____________________ (CS)
  - A neutral stimulus (an event) that comes to evoke a classically conditioned (learned) response due to being presented shortly before the US.
  - In Pavlov's experiments, the CS was the bell.

- A _____________________ (CR)
  - A learned response to a classically conditioned stimulus.
  - In Pavlov's experiments, salivation to the bell was the CR.
**Classical Conditioning**

**Pavlov's Apparatus**

Pavlov classically conditioned dogs to salivate. Salivation was measured by a pen attached to a slowly rotating cylinder of paper.

**Classical Conditioning**

**Pavlov's Discovery**

Before Conditioning

- **Unconditioned Stimulus (US)** elicits **Unconditioned Response (UR)**
  - Meat powder leads to salivation
  - Neutral stimulus elicits no particular response
  - Bell leads to orienting response only, no salivation

During and After Conditioning

- **Conditioning**: Neutral Stimulus is Paired with the Unconditioned Stimulus
  - Bell rings, then meat powder is delivered
  - This procedure is repeated several times
- **After Several Trials of pairing the bell with the food**
  - When Bell rings, dog salivates
  - The Bell is now a Conditioned Stimulus (CS)
  - Salivation is a Conditioned Response (CR)

**Classical Conditioning**

**Pavlov's Discovery**

<table>
<thead>
<tr>
<th>UCS (passionate kiss)</th>
<th>UCR (sexual arousal)</th>
</tr>
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<tbody>
<tr>
<td>CS (onion breath)</td>
<td>UCS (passionate kiss)</td>
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<tr>
<td>CS (onion breath)</td>
<td>CR (sexual arousal)</td>
</tr>
</tbody>
</table>

**PRS**

- Through the process of classical conditioning onion breath can make you sexy.
  - A. True
  - B. False
  - C. I’m sexy just the way I am!
Classical Conditioning

Basic Principles

- Formation of a learned response to a stimulus through presentation of an unconditioned stimulus
- Elimination of a learned response by removal of the unconditioned stimulus
- Re-emergence of an extinguished conditioned response after a rest period

Classical Conditioning

- **Acquisition** - learning phase during which a CR is established
- **Extinction** - gradual decrease and elimination of the CR when the CS is presented repeatedly without the US

Spontaneous Recovery

Following the passage of time the subjects appear to have ______ that the conditioned response has been extinguished (The CS elicits the CR, but the response is ________).

Acquisition and Extinction

Classical Conditioning

Temporal Relations in Classical Conditioning

- In delayed conditioning, the CS precedes the US. 
  - Easiest conditioning
- In simultaneous pairing, the CS and US occur together.
- In backward pairing, the CS follows the US.
  - Most difficult
The most potent paradigm for classical conditioning is Delayed Conditioning.

True/False

Classical Conditioning

Generalization & Discrimination

- The tendency to respond to a stimulus that is similar to the conditioned stimulus
- In classical conditioning, the ability to distinguish between different stimuli

Classical Conditioning

Higher-Order

Conditioning

- With repeated pairing, a neutral stimulus can be linked with a CS.
- The bell (CS) is paired with a black square.
- This neutral stimulus becomes a CS.
- In the example, the black square elicits salivation.
- One CS was used to create another CS.

Nausea Conditioning in Cancer Patients

UoS (drug) → UCR (nausea)

CS (waiting room) → CR (nausea)
Applications of Classical Conditioning to Daily Life

1) Advertising - pairing positive USs with product CSs
   - when we've experienced a CS alone many times, it's difficult to classically condition it to another stimulus (e.g., highly known vs. novel brands)

Applications of Classical Conditioning to Daily Life: Little Albert

- Led to the conditioning model of phobias
- Classical conditioning also offers a way to get rid of phobia
  - Mary Clover Jones (1924) successfully treated three-year-old Peter, who had a phobia of rabbits, by slowly introducing a rabbit paired with candies
  - Similar ________________ is still the main behavioral treatment for irrational fears

Applications of Classical Conditioning to Daily Life

2) Acquisition of fears: Little ______
   - Watson & Reyner (1920) sought to disprove the Freudian view of phobia, reflecting deep-seated unconscious conflict
   - They recruited an infant, Albert, and paired a white rat (CS) with a loud clanging metal noise (UCS)
   - Five days later, Albert exhibited fear of the rat, and similar stimuli, including a rabbit, dog, furry coat, and Santa Claus mask (generalization of phobia)

Applications of Classical Conditioning to Daily Life

3) Acquisition of fetishes
   - Fetishism - experiencing sexual attraction to nonliving things
     - Domjan (2004) paired a white terry cloth cylinder with a receptive female quail
     - After 30 trials, about half the male quail tried to mate with the cylinder alone
     - Suggests that pairing neutral objects with sex could lead to fetishes

Classical Conditioning

- Observed in humans
  - Fish
  - Crabs
  - Cockroaches
  - Flat worms
- Does not require much of a nervous system.

What is learned during classical conditioning?

- If learning involved a stimulus-stimulus connection where the CS becomes a substitute for the UCS, the CR and UCR should be identical.
- This is not always true!
  - Insulin (UCS) acts to deplete blood sugar levels (UCR).
  - CS (injection supplies) evoke a CR (surge in blood sugar levels) which is ________________________ to the UCR.
  - If a diabetic patient then discovers that he is out of insulin, the surge in blood sugar levels induced by the CS may pose serious health problems.
What is learned during classical conditioning?

*What is learned is an _______________ the CS is encountered it is a sure sign that the UCS will soon follow.*
*But the expectancy is not in the realm of normal cognition.*

- Concentration camp survivor experiences
  - Heart rate race
  - Dry mouth
  - Knowledge that Hitler is dead does not reduce these reactions

Transfer of Learning in Planaria

*McConnell (1955) gave light-shock (CS-UCS) pairings to planaria flatworms*
*Then fed those flatworms to other flatworms*
*Those that ate the shocked planaria learned faster, and McConnell became convinced he could transfer learning*
*The results could not be ____________ and McConnell closed his lab at University of Michigan, but had a normal career otherwise*
*Was targeted by the Unabomber - he didn’t like the idea of ____________ to transfer ideas into people’s heads*

Classical and Operant Conditioning

*In classical conditioning the stimuli that most strongly influence behavior immediately _____________ the response.*
*In operant conditioning the stimuli that most strongly influence behavior immediately __________ the response.*

Differences Between Operant and Classical Conditioning

<table>
<thead>
<tr>
<th>Classical</th>
<th>Operant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td>Elicited by UCS or CS</td>
</tr>
<tr>
<td>Reward</td>
<td>Independent of what the animal does</td>
</tr>
<tr>
<td>Body System</td>
<td>Often involves autonomic nervous system</td>
</tr>
</tbody>
</table>

Operant Conditioning

- We learn to associate a response and its consequence

Thorndike’s Puzzle Box

- Cat pulls string that opens trap door
- Box
- Cat food
- Top door
- Pull string that opens trap door
- Box
- Cat food
**Learning**
**Operant Conditioning**

**Thorndike's Law of Effect**
- Cats were put into puzzle boxes and the time to escape decreased over the number of attempts.

**Law of Effect**
- Responses followed by _______ outcomes are repeated, whereas those followed by ______ outcomes are not.

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**Operant Conditioning**

- B.F. Skinner (1904-1990)
  - elaborated Thorndike's Law of Effect
  - developed behavioral technology

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**Operant Chamber**

- Skinner Box
  - chamber with a bar or key that an animal manipulates to obtain a food or water reinforcer
  - contains devices to record responses

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**PRS**

- In operant conditioning the most important stimuli ______ the response, whereas in classical conditioning the most important stimuli ______ the response.
  - A. Precede/precede
  - B. Follow/follow
  - C. Precede/follow
  - D. Follow/precede

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**Operant Conditioning**

**The Principles of Reinforcement**

- The process by which organisms learn to behave in ways that produce reinforcement.
  - Any stimulus that increases the likelihood of a prior response.

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**Operant Conditioning**

**The Principles of Reinforcement**

- Any stimulus that decreases the likelihood of a prior response.
  - Using reinforcements to guide an animal or person gradually toward a specific behavior.
Operant Conditioning
Reinforcement & Punishment

<table>
<thead>
<tr>
<th>Present Stimulus</th>
<th>Increases Behavior</th>
<th>Decreases Behavior</th>
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<tbody>
<tr>
<td>Positive Reinforcement (give money)</td>
<td>Punishment (give chores)</td>
<td></td>
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<table>
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<tr>
<th>Remove Stimulus</th>
<th>Increases Behavior</th>
<th>Decreases Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Reinforcement (escape from chores)</td>
<td>Time Out “negative punishment” (take money)</td>
<td></td>
</tr>
</tbody>
</table>

Principles of Reinforcement

- __________ Reinforcer
  - innately reinforcing stimulus
  - i.e., satisfies a biological need
- __________ Reinforcer
  - stimulus that gains its reinforcing power through its association with primary reinforcer
  - secondary reinforcer

Schedules of Reinforcement

- Continuous Reinforcement
  - reinforcing the desired response each time it occurs
- Partial (___________ ) Reinforcement
  - reinforcing a response only part of the time
  - results in slower acquisition
  - greater resistance to extinction

Measuring Operant Behavior

- Cumulative record - a measurement of how responses are distributed over time.
- Extinction - the cessation of positive reinforcement. Extinction has been achieved when the _______ of the cumulative record is zero (horizontal).

Operant Conditioning

### TABLE 8.1
WAYS TO INCREASE BEHAVIOR

<table>
<thead>
<tr>
<th>Operant Conditioning Term</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive reinforcement</td>
<td>Add a positive stimulus</td>
<td>a hug, TV on</td>
</tr>
<tr>
<td>Negative reinforcement</td>
<td>Remove an aversive stimulus</td>
<td>seat belt turns off, buzzer</td>
</tr>
</tbody>
</table>
**Principles of Reinforcement**

- **Partial reinforcement** - behaviors that we reinforce only occasionally are slower to extinguish than those we reinforce continuously.
- **Schedules of reinforcement** - pattern of reinforcing a behavior:
  - **Fixed Ratio** - after regular number of responses
  - **Variable Ratio** - after specific number of responses, on average
  - **Fixed Interval** - after specific amount of time
  - **Variable Interval** - after an average time interval

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**Schedules of Reinforcement**

- **Fixed Ratio (FR)**
  - Reinforces a response only after a specific number of responses.
  - Faster you respond the more rewards you get.
  - Very high rate of responding, followed by a post-reinforcement pause.
  - Like piecework pay.

- **Variable Ratio (VR)**
  - Reinforces a response after an average number of responses.
  - Average ratios.
  - Like gambling, fishing.
  - Very hard to extinguish because of unpredictability.

- **Fixed Interval (FI)**
  - Reinforces a response only after a specific amount of time has elapsed.
  - Response occurs more frequently as the anticipated time for reward draws near.
  - Produces a scallop pattern in the cumulative record.

- **Variable Interval (VI)**
  - Reinforces a response at unpredictable intervals.
  - Produces slow steady responding.
  - Like pop quiz.
Operant Behavior

The more unpredictable and intermittent the reinforcement, the more the behavior is resistant to extinction.

What schedule of reinforcement should teachers use to reward the completion of work assignments in class?

What schedule of reinforcement is associated with slot machines?

What schedule of reinforcement maintains pestering behavior by children?

Discrimination

Many operant behaviors will be reinforced only in an appropriate context.

Stimuli that signal an appropriate context are called positive discriminative stimuli (S+).

Stimuli that signal an inappropriate context are called negative discriminative stimuli (S-).

_________________ is achieved when the response rate is high in the presence of S+, and low in the presence of S-.

Generalization

Discrimination and generalization are end points of the same process.

Once stimulus control has been achieved, the response rate will be high to novel stimuli that resemble S+, and low to those that resemble S-.

Stimuli that are somewhat similar to S+ result in intermediate response rates.

Superstitious Behavior

A response that is maintained by reinforcement which occurs ___________ of behavior (reinforcement is not contingent upon the performance of any response).

Reinforcement will increase the future probability of any behavior that happened to occur immediately prior to the delivery of the reinforcing event.

Skinner’s pigeons.
Learned Helplessness

Subjects can learn that the delivery of reinforcement and punishment is independent of behavior. Performance in new learning tasks is dependent upon prior experience with _______ rewards and punishment.

Revision 2006 PSB

PRS

The delivery of non-contingent rewards and punishers has no influence on how effort is distributed over time.

True/False

Revision 2006 PSB

Punishment

- Punishment
  - aversive event that decreases the behavior that it follows
  - powerful controller of unwanted behavior

Revision 2006 PSB

Punishment and Behavior Modification

- If punishment is too weak it may only temporarily suppress the response...children may develop a tolerance for punishment.
- If punishment must be used to suppress behavior, use it make it...use it following the inappropriate response...do not say "wait until your father gets home."
- Provide for an alternative behavior (which is incompatible with the inappropriate response) which will produce immediate reinforcement.
- Do not punish responses that are elicited by fear (stuttering).
- Realize that punishment may evoke aversive side effects.
- Extinction, or extinction combined with punishment may be the best way to eliminate behavior.
- Do not use punishment because you are frustrated, or you think it might make you feel better. Use punishment only if you must immediately suppress a response (e.g. a young child taunting its parents by dashes out into a busy intersection).

Revision 2006 PSB
Cooperative Group Challenge

Only six of the following are used

1. Positive reinforcement
2. Negative reinforcement
3. Punishment
4. Stimulus generalization
5. Discriminant stimulus
6. Extinction
7. Spontaneous recovery
8. Habituation

Q1

1. The process of _____ occurs when we respond less strongly over time to repeated stimulation.

Q2

2. _____ is the removal of a negative experience following a response, that serves to strengthen the probability of that response in the future.

Q3

3. The reemergence of an extinguished conditioned response after a rest period is called _____.

Q4

4. A _____ is any stimulus that “signals” the presence of reinforcement.

Q5

5. Pavlov’s dogs eventually stopped salivating when the delivery of food was no longer associated with the ringing of the bell; this is the process of _____.
**Q6**

6. _____ is the consequence of a behavior that weakens the probability of that behavior in the future.

**What is Reinforcement?**

A stimulus or event which increases the future probability of the preceding response.

David Premack: a reinforcer is not a stimulus, but rather an opportunity to do something.

___________ principle: the opportunity to engage in a higher-probability behavior will reinforce any lower probability behavior (running/drinking).

**Principle**

William Timberlake: the key to reinforcement is are we spending as much time on an activity as we would like?

The opportunity to engage in a very rare activity (trimming our toe nails) can be reinforcing if we are in a state of disequilibrium for that behavior.

**Applied Behavioral Analysis (ABA)**

ABA - a set of techniques, pioneered by Ivar Lovaas at UCLA, and based on operant conditioning principles, that relies on the careful measurement of behavior before and after implementing interventions

- Shaping techniques with primary reinforcers
- Children with autism treated with ABA show significant progress in language and intellectual skills
- Before Lovaas, many of these children would have been institutionalized

**Operant Conditioning Using Reinforcement to Boost Job Performance**

All salesclerks were observed for a 20-day baseline period.

Then, half were given cash bonuses for good performance, half were not.

The ones given cash bonuses improved job performance.

**Condition Oneself to Break a Bad Habit**

- Identify specific target behavior to change
- Record _________
- Formulate a plan
  - To increase a behavior, use reinforcement
  - To extinguish behavior, avoid situations where it occurs or remove reinforcements
- Implement the plan, revise as needed
- Maintain the change
Observational Learning

- Learning that takes place when one observes and models the behavior of others.
- Studies of ____________
  - Children and others model both antisocial and prosocial behavior.

Observational Learning
The Process of Modeling Involves:

- One must pay attention to a behavior and its consequences.
- One must recall what was observed.
- Observers must have the motor ability to reproduce the modeled behavior.
- Observer must expect reinforcement for modeled act.

Biological Influences on Learning

- Conditioned taste aversion - classical conditioning can lead us to develop avoidance reactions to the taste of food
  - Requires only ____________
  - CS-UCS delay can be 6–8 hours
  - Very specific with little stimulus generalization
  - Challenges the concept of ______________ (e.g., don't develop CTAs to sounds)
  - Belongingness suggests that certain stimuli are more likely to go with certain responses

Biological Influences on Learning

- ______________ regarding phobias suggests that we’re evolutionarily predisposed to fear certain stimuli more than others
  - Monkeys are predisposed to become afraid of things such as toy snakes and alligators, but not toy flowers or rabbits
  - About half of dog phobics have never had direct negative experience with a dog
  - Classical conditioning does not account for all phobias
  - Tendency for animals to return to innate behaviors following repeated reinforcement: instinctive
    - Breland’s "coin washing" raccoons

Conditioned Taste Aversion Paradigm

Learning Fads: Do They Work?

- Sleep-assisted learning - listening to audio tapes while you sleep
  - Learn Morse code quicker?
  - Better controlled studies suggested that the tapes awoke the subjects, they were not really ____________

- Discovery learning - giving students experimental materials and asking them to figure out scientific principles on their own
  - Klahr (2004) - 3rd, 4th graders asked to figure out variables affecting how quickly a ball rolls down a ramp
  - Only 23% learned the principles using discovery learning, but 77% did with direct instruction
Learning Styles: Fact or Fictional Fad?

- Do all individuals have their own distinctive learning styles?
- Analytical or spatial or verbal learners?
- Findings not reliable
- Studies show tailoring learning methods to a particular style doesn't result in enhanced learning
- Most of us use a mixture of styles

Cooperative Learning

- One treatment for alcoholism is a drug (pill) called Antabuse® – it makes you very sick when you drink alcohol. Should this treatment work? Based on the principles we’ve discussed, why or why not?
- Meet with your study group, and discuss your recommendation. You have 60 seconds.