CHAPTER 5
learning
What is Learning?

- Learning: any relatively permanent change in behavior brought about by experience or practice
  - When people learn anything, some part of their brain is physically changed to record what they have learned.
  - Any kind of change in the way an organism behaves is learning.
Ivan Pavlov

• Ivan Pavlov: Russian physiologist (person who studies the workings of the body) who discovered classical conditioning through his work on digestion in dogs
  – Was more interested in how spit digests food
• Classical conditioning: learning to make a reflex response to a stimulus other than the original, natural stimulus that normally produces the reflex
Classical Conditioning Concepts

- **Unconditioned stimulus (UCS):** a naturally occurring stimulus that leads to an involuntary response
  - *unconditioned* means “unlearned” or “naturally occurring.”
- **Unconditioned response (UCR):** an involuntary response to a naturally occurring or unconditioned stimulus
Classical Conditioning Concepts

• Conditioned stimulus (CS): stimulus that becomes able to produce a learned reflex response by being paired with the original unconditioned stimulus
  – *conditioned* means “learned”
  – neutral stimulus (NS) can become a conditioned stimulus when paired with an unconditioned stimulus
Classical Conditioning Concepts

- Conditioned response (CR): learned reflex response to a conditioned stimulus
  - sometimes called a conditioned reflex
  - CS: ice cream truck
  - CR: salivation when one hears ice cream truck bell
  - May not be as strong as UCR, but the same
Classical Conditioning

UCS
Loud Noise

UCR
Startle

CS
Bunny Rabbit

UCS
Loud Noise

UCR
Startle

CS
Bunny Rabbit

CR
Startle
Classical Conditioning

UCS
Car Crash

UCR
Racing Heart

CS
Squealing Brakes

UCS
Car Crash

UCR
Racing Heart

CS
Squealing Brakes

CR
Racing Heart
Classical Conditioning Concepts

- Acquisition: repeated pairing of the NS and the UCS; the organism is in the process of acquiring learning
  - basic principles that researchers have discovered:
    - CS must come before UCS
    - CS and UCS must come very close together in time—ideally, only several seconds apart
    - neutral stimulus must be paired with the UCS several times, often many times, before conditioning can take place
Classical Conditioning Concepts

- CS is usually some stimulus that is distinctive or stands out from other competing stimuli.
- Stimulus generalization: tendency to respond to a stimulus that is similar to the original conditioned stimulus with the conditioned response.
Figure 5.2 Strength of the Generalized Response
An example of stimulus generalization. The UCS was an electric shock and the UCR was the galvanic skin response (GSR), a measure associated with anxiety. The subjects had been conditioned originally to a CS tone (0) of a given frequency. When tested with the original tone, and with tones 1, 2, and 3 of differing frequencies, a clear generalization effect appeared. The closer the frequency of the test tone to the frequency of tone 0, the greater was the magnitude of the galvanic skin response to the tone (Hovland, 1937).
Stimulus discrimination: tendency to stop making a generalized response to a stimulus that is similar to the original conditioned stimulus because the similar stimulus is never paired with the unconditioned stimulus
Classical Conditioning Concepts

• Extinction: disappearance or weakening of a learned response following the removal or absence of the unconditioned stimulus (in classical conditioning) or the removal of a reinforcer (in operant conditioning)
  – Suggested that this happens because new learning has taken place
    ▪ Ex. Dogs learned to no longer salivate because it no longer predicted food
Spontaneous recovery: reappearance of a learned response after extinction has occurred

- Pavlov waited a few weeks before using metronome
- Upon return, dogs began to salivate
- Quick recovery of the CR shows that the CR may still be retained
  - It is just suppressed or inhibited by lack of association with UCS
Figure 5.3  Extinction and Spontaneous Recovery
Higher-order Conditioning

• Higher-order conditioning
  1. strong conditioned stimulus is paired with a neutral stimulus
  2. neutral stimulus becomes a second conditioned stimulus
Figure 5.4 Higher-Order Conditioning

Stage 1
Metronome (CS₁)  UCR (salivation)  Conditioning  Metronome (CS₁)  CR (salivation)
US (food)

Stage 2
Metronome (CS₁)  CR (salivation)  High-Order Conditioning  CS₂  CR (salivation)
Conditioned emotional response (CER): emotional response that has become classically conditioned to occur to learned stimuli

- examples: fear of dogs; the emotional reaction that occurs when seeing an attractive person
- CERs may lead to phobias—irrational fear responses.
Figure 5.5 Conditioning of “Little Albert”
After “Little Albert” had been conditioned to fear a white rat, he also demonstrated fear to a rabbit, a dog, and a sealskin coat (although it remains uncertain if stimulus generalization actually occurred as this fear was to a single rabbit, a single dog, etc.). Can you think of any emotional reactions you experience that might be classically conditioned emotional responses?
Classical Conditioning

- CS: Sight of Dog
- UCS: Dog Bite
- UCR: Frightened
- CR: Frightened
Classical Conditioning

UCS: Kiss
UCR: Racing Heart

CS: Sight of Significant Other
CR: Racing Heart

UCS: Kiss
UCR: Racing Heart
Vicarious conditioning

- Vicarious conditioning: classical conditioning of a reflex response or emotion by watching the reaction of another person
  - This is interesting because they don’t have to experience the UCS
  - Children crying example
Taste Aversion

- Conditioned taste aversion: development of a nausea or aversive response to a particular taste because that taste was followed by a nausea reaction
  - Usually occurs after only one association
  - May not even be the food that causes it
Other Conditioned Responses

• Biological preparedness: the tendency of animals to learn certain associations, such as taste and nausea, with only one or few pairings due to the survival value of the learning
  
  • Ex. If an animal eats something that makes them sick, they are likely to avoid that food in the future, which increases their chances of survival and passing on their genes to future generations
Why Classical Conditioning Works

- Stimulus substitution: original theory in which Pavlov stated that classical conditioning occurred because the conditioned stimulus became a substitute for the unconditioned stimulus by being paired closely together.
  - Problem: Why wouldn’t conditioning work if CS is presented after the UCS?
Cognitive perspective: modern theory in which classical conditioning is seen to occur because the conditioned stimulus provides information or an expectancy about the coming of the unconditioned stimulus

- If CS comes after UCS, it can’t provide any information about when UCS is coming
Operant Conditioning

• Classical conditioning: leaning that occurs with reflexive, involuntary behavior
• Operant conditioning: the learning of voluntary behavior through the effects of pleasant and unpleasant consequences to responses
Thorndike’s Puzzle Boxes

- Hungry cats placed inside of puzzle box
- Had to press a lever to get out
- Bowl of food placed outside box
- Cat moved around until it found the lever
  - Lever is stimulus
  - Pushing lever is response
  - Escaping is the consequence
- Cats were faster after more trials
Operant Conditioning

- Thorndike’s law of effect
  - if a response is followed by a pleasurable consequence, it will tend to be repeated
  - if a response is followed by an unpleasant consequence, it will tend not to be repeated
This is one of the earliest “learning curves” in the history of the experimental study of conditioning. The time required by one of Thorndike’s cats to escape from the puzzle box gradually decreased with trials but with obvious reversals.
Skinner’s Contribution

• Skinner was a behaviorist; he wanted to study only observable, measurable behavior
  – Originally wanted to be a novelist
• Gave “operant conditioning” its name
  – operant: any behavior that is voluntary, needed to operate in the world
• Learning depends on what happens after the response: the consequence
Reinforcement Videos

- Skinner Box
  - http://www.youtube.com/watch?v=PQtdTdTdDr8
- Big Bang Theory
  - http://www.youtube.com/watch?v=qy_mIEnnlF4
Reinforcement

Reinforcement: any event or stimulus, that when following a response, increases the probability that the response will occur again

- primary reinforcer: any reinforcer that is naturally reinforcing by meeting a basic biological need, such as hunger, thirst, or touch

- secondary reinforcer: any reinforcer that becomes reinforcing after being paired with a primary reinforcer, such as praise, tokens, or gold stars
Positive and Negative Reinforcement

- Positive reinforcement: the reinforcement of a response by the addition or experience of a pleasurable stimulus
- Negative reinforcement: the reinforcement of a response by the removal, escape from, or avoidance of an unpleasant stimulus
  - example: taking aspirin for a headache is negatively reinforced: removal of headache!
### Table 5.1
Comparing Two Kinds of Conditioning

<table>
<thead>
<tr>
<th>OPERANT CONDITIONING</th>
<th>CLASSICAL CONDITIONING</th>
</tr>
</thead>
<tbody>
<tr>
<td>End result is an increase in the rate of an already occurring response.</td>
<td>End result is the creation of a new response to a stimulus that did not normally produce that response.</td>
</tr>
<tr>
<td>Responses are voluntary, emitted by the organism.</td>
<td>Responses are involuntary and reflexive, elicited by a stimulus.</td>
</tr>
<tr>
<td>Consequences are important in forming an association.</td>
<td>Antecedent stimuli are important in forming an association.</td>
</tr>
<tr>
<td>Reinforcement should be immediate.</td>
<td>CS must occur immediately before the UCS.</td>
</tr>
<tr>
<td>An expectancy develops for reinforcement to follow a correct response.</td>
<td>An expectancy develops for UCS to follow CS.</td>
</tr>
</tbody>
</table>
Schedules of Reinforcement

- Partial reinforcement effect: a response that is reinforced after some—but not all—correct responses tends to be very resistant to extinction

- Continuous reinforcement: reinforcement of each and every correct response
Schedules of Reinforcement

• Fixed interval schedule of reinforcement: interval of time that must pass before reinforcement becomes possible is always the same
  – Ex. Taking a break after every hour of studying
Schedules of Reinforcement

• Variable interval schedule of reinforcement: the interval of time that must pass before reinforcement becomes possible is different for each trial or event
  – Ex. Someone tells you when you can take a break from studying
Schedules of Reinforcement

• Fixed ratio schedule of reinforcement: number of responses required for reinforcement is always the same
  – Take a break after doing 15 reps on a weight machine
Schedules of Reinforcement

• Variable ratio schedule of reinforcement: schedule of reinforcement in which the number of responses required for reinforcement is different for each trial or event
  – Ex. Trainer tells you when to take a break
Punishment

- Punishment: any event or object that, when following a response, makes that response less likely to happen again.
- Punishment by application: the punishment of a response by the addition or experiencing of an unpleasant stimulus.
- Punishment by removal: the punishment of a response by the removal of a pleasurable stimulus.
### Four Ways to Modify Behavior

<table>
<thead>
<tr>
<th></th>
<th><strong>REINFORCEMENT</strong></th>
<th><strong>PUNISHMENT</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Positive (Adding)</strong></td>
<td>Something valued or desirable</td>
<td>Something unpleasant</td>
</tr>
<tr>
<td></td>
<td><strong>Positive Reinforcement</strong></td>
<td><strong>Punishment by Application</strong></td>
</tr>
<tr>
<td></td>
<td>Example: getting a gold star for good behavior in school</td>
<td>Example: getting a spanking for disobeying</td>
</tr>
<tr>
<td><strong>Negative (Removing/Avoiding)</strong></td>
<td>Something unpleasant</td>
<td>Something valued or desirable</td>
</tr>
<tr>
<td></td>
<td><strong>Negative Reinforcement</strong></td>
<td><strong>Punishment by Removal</strong></td>
</tr>
<tr>
<td></td>
<td>Example: avoiding a ticket by stopping at a red light</td>
<td>Example: losing a privilege such as going out with friends</td>
</tr>
<tr>
<td>EXAMPLE OF NEGATIVE REINFORCEMENT</td>
<td>EXAMPLE OF PUNISHMENT BY REMOVAL</td>
<td></td>
</tr>
<tr>
<td>----------------------------------</td>
<td>----------------------------------</td>
<td></td>
</tr>
<tr>
<td>Stopping at a red light to avoid getting in an accident.</td>
<td>Losing the privilege of driving because you got into too many accidents.</td>
<td></td>
</tr>
<tr>
<td>Mailing an income tax return by April 15 to avoid paying a penalty.</td>
<td>Having to lose some of your money to pay the penalty for late tax filing.</td>
<td></td>
</tr>
<tr>
<td>Obeying a parent before the parent reaches the count of “three” to avoid getting a scolding.</td>
<td>Being “grounded” (losing your freedom) because of disobedience.</td>
<td></td>
</tr>
</tbody>
</table>
Problems with Punishment

- Severe punishment
  - may cause avoidance of the punisher instead of the behavior being punished
  - may encourage lying to avoid punishment
  - creates fear and anxiety
  - Only weakens the response
  - May model aggressive behavior
  - May cause children to act out for attention
How to Make Punishment More Effective

1. Punishment should immediately follow the behavior it is meant to punish.

2. Punishment should be consistent.

3. Punishment of the wrong behavior should be paired, whenever possible, with reinforcement of the right behavior.
Operant Stimuli and Stimulus Control

- Discriminative stimulus: any stimulus, such as a stop sign or a doorknob, that provides the organism with a cue for making a certain response in order to obtain reinforcement

- Ex. A police car is a discriminative stimulus for slowing down and a red stoplight is a cue for stopping (negative reinforcement)
Operant Stimuli and Stimulus Control

• Shaping: reinforcement of simple steps, leading to a desired complex behavior
  – Ex. Dog jumping through a hoop
• Successive approximation: small steps, one after another, that lead to a particular goal behavior
Extinction occurs if the behavior (response) is not reinforced.

- One way to deal with a child’s temper tantrum is to ignore it; lack of reinforcement for the tantrum behavior will eventually result in extinction.

- Operantly conditioned responses also can be generalized to stimuli that are only similar—not identical—to the original stimulus (just like classical conditioning).
Spontaneous recovery (reoccurrence of a once-extinguished response) also happens in operant conditioning.
Instinctive drift: tendency for an animal’s behavior to revert to genetically controlled patterns

- Each animal comes into the world (and the laboratory) with certain genetically determined instinctive patterns of behavior already in place.
- These instincts differ from species to species.
- There are some responses that simply cannot be trained into an animal regardless of conditioning.
Behavior Resistant to Conditioning

- Raccoons commonly dunk their food in and out of water before eating. This “washing” behavior is controlled by instinct, and is difficult to change even using operant techniques.
Behavior Modification

- Behavior modification: use of operant conditioning techniques to bring about desired changes in behavior
  - Ex. Teacher using behavior modification to make students more attentive
- Token economy: type of behavior modification in which desired behavior is rewarded with tokens
Behavior Modification

• Time-out: form of mild punishment by removal in which a misbehaving animal, child, or adult is placed in a special area away from the attention of others
  – essentially, the organism is being “removed” from any possibility of positive reinforcement in the form of attention
Behavior Modification

• Applied behavior analysis (ABA): modern term for a form of behavior modification that uses shaping techniques to mold a desired behavior or response
  – Ex. Teaching social skills to children with Autism
  – Skills are broken down into simplest steps, taught through reinforcement
Biofeedback and Neurofeedback

• Biofeedback: use of feedback about biological conditions to bring involuntary responses such as blood pressure and relaxation under voluntary control.

• Neurofeedback: form of biofeedback using devices (EEG, fMRI) to provide feedback about brain activity in an effort to modify behavior.
Cognitive Learning Theory

• In the early days of learning, researchers’ focus was on behavior.
• In the 1950s—and more intensely in the 1960s—many psychologists were becoming aware that cognition, the mental events that take place inside a person’s mind while behaving, could no longer be ignored.
Latent Learning

- Edward Tolman: early cognitive scientist
  - best-known experiments in learning involved teaching three groups of rats the same maze, one at a time (Tolman & Honzik, 1930b)
Latent Learning

- **Edward Tolman’s Maze Experiment**
  - **Group 1**
    - rewarded each time at end of maze
    - learned maze quickly
  - **Group 2**
    - in maze every day; only rewarded on 10th day
    - demonstrated learning of maze almost immediately after receiving reward
  - **Group 3**
    - never rewarded
    - did not learn maze well
Latent Learning

- Latent learning: learning that remains hidden until its application becomes useful
Figure 5.9 A Typical Maze
This is an example of a maze such as the one used in Tolman’s experiments in latent learning. A rat is placed in the start box. The trial is over when the rat gets to the end box.
In the results of the classic study of latent learning, Group 1 was rewarded on each day, while Group 2 was rewarded for the first time on Day 11. Group 3 was never rewarded. Note the immediate change in the behavior of Group 2 on Day 12 (Tolman & Honzik, 1930).
Insight - Kohler

Insight: the sudden perception of relationships among various parts of a problem, allowing the solution to the problem to come quickly

- cannot be gained through trial-and-error learning alone
- “Aha” moment
Learned Helplessness: Seligman

- Learned helplessness: tendency to fail to act to escape from a situation because of a history of repeated failures in the past
- Seligman’s dog experiments
Figure 5.11 Seligman’s Apparatus
In Seligman’s studies of learned helplessness, dogs were placed in a two-sided box. Dogs that had no prior experience with being unable to escape a shock would quickly jump over the hurdle in the center of the box to land on the “safe” side. Dogs that had previously learned that escape was impossible would stay on the side of the box in which the shock occurred, not even trying to go over the hurdle.
Learned Helplessness and Depression

• The concept of learned helplessness has been extended to explain some behaviors characteristic of depression

• Depressed people seem to lack normal emotions and become somewhat apathetic
  – They often stay in unpleasant work environments or bad marriages or relationships rather than trying to escape or better their situation
Observational Learning: Bandura

- Observational learning: learning new behavior by watching a model perform that behavior
- Learning/performance distinction: learning can take place without actual performance of the learned behavior
Figure 5.12 Bandura’s Bobo Doll Experiment
In Albert Bandura’s famous Bobo doll experiment, the doll was used to demonstrate the impact of observing an adult model performing aggressive behavior on the later aggressive behavior of children. The children in these photos are imitating the adult model’s behavior even though they believe they are alone and are not being watched.
http://www.youtube.com/watch?v=hHHdovKHDNU

BOBO DOLL EXPERIMENT
Four Elements of Observational Learning

1. Attention
   - To learn anything through observation, the learner must first pay attention to the model.

2. Memory
   - The learner must also be able to retain the memory of what was done, such as remembering the steps in preparing a dish that were first seen on a cooking show.
Four Elements of Observational Learning

3. Imitation
   – The learner must be capable of reproducing, or imitating, the actions of the model.

4. Motivation
   – The learner must have the desire to perform the action.
Questions?