

## Psychology 105

### Chapter 5 - Learning

Spring 2008

## Learning - Outline

- Definitions of Learning
- Major types of Learning
  - Exposure Effect
  - Classical Conditioning
  - Operant Conditioning
  - Cognitive Approaches to Learning
    - Learning Using Insight
    - Cognitive Maps
    - Observational Learning
  - Other topics in learning

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## Definitions of Learning

- Learning is a relatively permanent change in behavior or mental processing that is a result of experience.
- Learning refers to the relatively permanent change in a subject's behavior to a given situation brought about by his (or her) repeated experiences in that situation, provided that the behavior change cannot be explained on the basis of
  - native response tendencies,
  - maturation, or
  - temporary states of the subject (e.g., fatigue, drugs, etc.). (Hildegard and Bower)

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## Types of Learning - Habituation and the Exposure Effect

- **Habituation:** ceasing to respond after repeated exposure to a stimulus
- **Exposure Effect:**
  - Demonstrating a preference for stimuli which have been presented in the past (prior exposure)
  - Seen in humans; basis of much advertising and political campaigning
  - AKA Propaganda Effect



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## Types of Learning - Classical Conditioning

**Classical conditioning is:**

- a basic type of learning in which
  - a stimulus that produces an innate reflex
  - becomes associated with a neutral stimulus,
  - which acquires the power to elicit the same response.



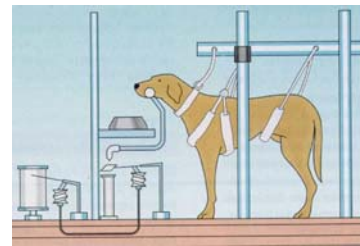
Ivan Pavlov

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## Classical Conditioning - Pavlov's Setup

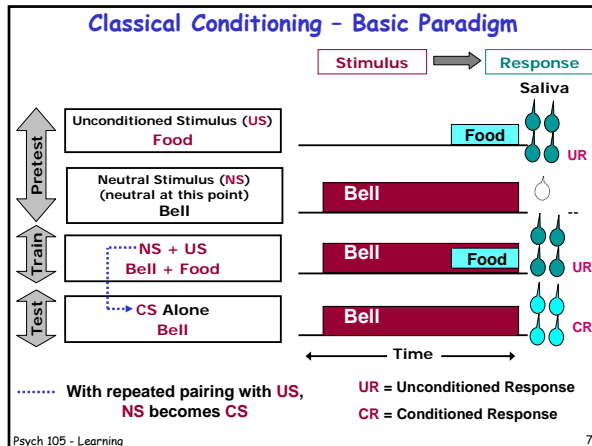
- **Video 06 - Pavlov**
- First described by Ivan Pavlov, 1901



- Initially showed that by ringing a bell just before the food was presented, dog came to salivate to bell alone

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### Classical Conditioning Demo

➤ In classical conditioning, we see an increase in responding to a stimulus that comes about as a result of pairing that stimulus with a biologically important event.

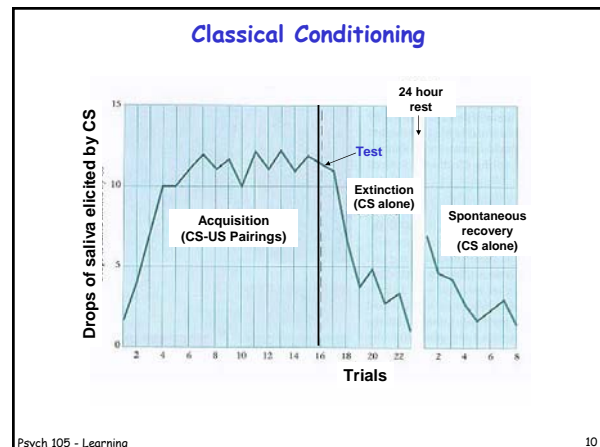
Stimulus: "Pavlov" paired with (associated with)  
Biologically Important Event: sour food in mouth  
↓  
New response to "Pavlov": salivation

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### Learning - Classical Conditioning Terms and Definitions

- **Acquisition** - initial learning phase, in which US comes to be associated with the NS, over several trials: The NS becomes a CS
- **Test** - phase in which CS on its own reliably elicits a response (CR)
- **Extinction** - after some number of trials in which the US is not present, the CS loses its ability to elicit the CR
- **Spontaneous recovery** - after a period of no trials, the CS again elicits the extinguished CR, usually in weaker form

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### Classical Conditioning - Aversive Conditioning

- The famous Little Albert study by Watson and Raynor: classical conditioning of a human
  - Little Albert (9 mos.) showed no fear, only interest, to rats. (Baseline)
  - W&R banged a pot when a rat was present → startle/fear response
  - Little Albert showed distress whenever a rat was presented, tried to crawl away
  - Fear generalized to other fuzzy stimuli, remained strong a month later
  - Little Albert's response called a **Conditioned Emotional Response (CER)**
- Conditioned fear is considered to be a major factor in the development of phobias and anxiety disorders

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### Classical Conditioning - Pavlov

Pavlov: "All learned behavior, whether acquired in school or outside it, is nothing more than a long chain of conditioned reflexes."

- Challenges to Pavlov:
  - Some stimulus-response combinations are readily learned; others are resistant (Garcia - see text)
  - What an organism can learn is in part due to its genes and evolutionary history
  - Awareness of relationship between CS and UR is necessary for conditioning to happen (Rescorla)
- Pavlov's Contributions:
  - Demonstrated classical conditioning and studied its parameters
  - Demonstrated that behavior could be experimentally studied in a laboratory

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## Behaviorism

- **Behaviorism:** School of Psychology that holds that
  - Behavior is completely determined by environment and genetic influences
  - Psychology should study behavior (not mental operations or states)
  - Psychology should only be concerned with observable events
  - Psychology's goal should be the prediction and control of behavior, and not the study of intangibles like emotions
- Strong force in American academic psychology for the first half of the 20<sup>th</sup> century, into the 1960s.
- Started with Pavlov; Watson and Skinner became leading proponents
- Focused most of its efforts on various forms of learning

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## Types of Learning - Operant Conditioning

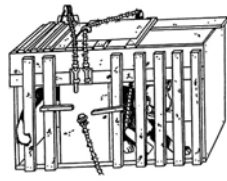
- **Operant conditioning** is a
  - form of behavioral learning
  - in which the patterns of rewards, punishments, and other consequences of a behavior
  - increase or decrease the likelihood that the behavior they follow will recur in the future

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## Thorndike - Learning by Trial and Error

- Thorndike studied animal behavior in lab, in situations designed to isolate behaviors of interest
- When cats learn to escape from puzzle boxes, is it by insightful learning or trial and error?
- Results suggested trial and error: accidental successes are 'stamped in' by favorable consequences.



From Thorndike, 1898



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## Thorndike's Laws

**Law of Effect:** "A response will be strengthened if it is followed by a 'satisfier' and weakened if it is followed by an 'annoyer.'"

- Simplified: Rewarded behavior is likely to recur; punished behavior is likely to decrease or go away.
- **Law of Exercise:** Other things being equal, the more frequently a response is connected to a stimulus, the stronger the connection between stimulus and response.
  - Simplified: When a response that follows a stimulus is rewarded frequently, the response is more likely to recur following that stimulus.
- Thorndike believe that what is learned is an association between response and reward.

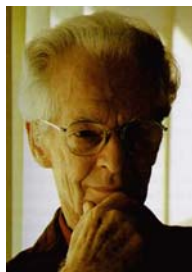
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## Operant Conditioning

- B. F. Skinner, influenced by Thorndike and Watson, sought to understand the effects of the consequences of behavior:

- What conditions induce behavior to be acquired, to increase in frequency, and to persist?
- What conditions induce behavior to decrease in frequency and to stop?



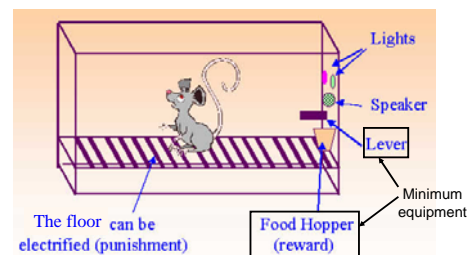
B. F. Skinner

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## Operant Conditioning - Skinner Box

- **Skinner box:** A simple paradigm for studying operant conditioning (A.K.A. *operant chamber*)



Video: [Conditioning a Pigeon](#)

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### Operant Conditioning - Definitions

- **Operant** - any voluntary, observable behavior
- "Operant behaviors are actions that individuals take to meet the demands of their environments." (Skinner)
- **Reinforcer** - any condition (presentation or removal of stimulus) that happens after a response (operant) and increases the likelihood of recurrence of the response
- **Shaping** - rewarding behaviors that are more and more like the desired response, until the desired response is happening frequently
  - Video clip: [Teach dog to push ball with nose](http://www.youtube.com/watch?v=yCyCIsIEKEs)  
<http://www.youtube.com/watch?v=yCyCIsIEKEs>
  - Uses Click as **secondary reinforcer** (later slide)
  - Illustrates **shaping** of desired behavior
- **Extinction** - when reinforcement is stopped, behavior decreases in frequency, and eventually stops (extinguishes)
  - **Extinction burst** - brief **increase** in response rate after reinforcement is stopped

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### Operant vs. Classical Conditioning

Classical Conditioning	Operant Conditioning
There are <u>no consequences</u> for the behavior	<b>Consequences are used to control</b> the behavior
The response <b>COMES AFTER</b> the stimulus (US or CS)	The response <b>COMES BEFORE</b> the stimulus (reward or punishment)
The organism is essentially <b>PASSIVE</b> (the response is reflexive)	The organism is <b>ACTIVE</b> and <b>OPERATES ON</b> the environment
Learning: association between stimuli (US and CS)	Learning: association between behavior and consequences
Adaptive value: respond to stimuli that signal occurrence of other stimuli	Adaptive value: association between behaviors and rewarding or aversive outcomes

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### Operant Conditioning - Reinforcement Types - 1

Term	Description	Examples
Positive Reinforcement	<b>Add (+)</b> a desirable stimulus → <b>Increases</b> behavior	Teach dog a trick using food
Negative Reinforcement	<b>Remove (-)</b> an aversive stimulus → <b>Increases</b> behavior	Putting up umbrella (behavior) stops rain in face (aversive stimulus) Taking an aspirin relieves a headache Fanning yourself gives relief from heat <i>Escaping an aversive stimulus may lead to avoiding it later</i>

NEGATIVE REINFORCEMENT IS **NOT** THE SAME THING AS PUNISHMENT!!!

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### Operant Conditioning - Reinforcement types - 2

- **Primary reinforcers** - stimuli with innate biological value to the organism, satisfy biological drives
  - food, water, sex, sleep, relief from pain, relief from loud noise, novel stimulation
- **Secondary reinforcers** - stimuli with no innate reinforcing power of their own (neutral stimuli), which acquire ability to reinforce behavior through pairing with primary (or other secondary) reinforcers
  - Just about any stimulus that can be paired with a primary reinforcer: click, light, tone, token, money, good grades, "star for good behavior", MONEY!!!
  - Click, used in clicker training dog in video

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### Operant Conditioning - Schedules of Reinforcement

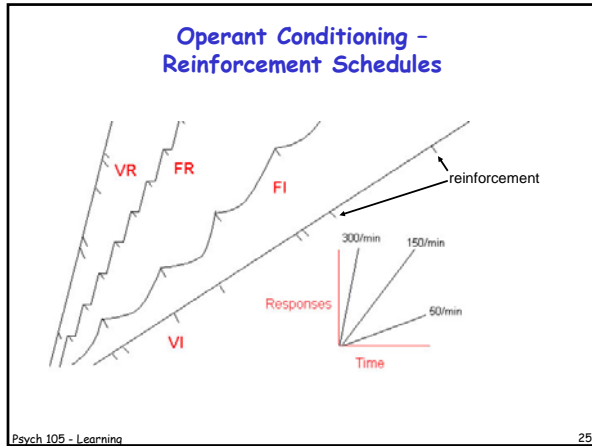
- **Schedule** - what is the rule for delivering reinforcement?
- **Continuous Reinforcement** - every correct/desired response is rewarded
  - Best for initially training or shaping a response
  - Provides immediate and consistent feedback
  - Leads to rapid extinction of response
- **Intermittent Reinforcement (partial reinforcement)** - some (but not all) correct/desired responses are rewarded
  - Best for maintaining a trained response
  - Response is more resistant to extinction (persists for a longer time after rewards stop)

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### Schedules of Reinforcement (Rft) (a schedule is a rule for delivering Rft)

Fixed Ratio (FR)	Reward appears after a <u>fixed number</u> of responses (FR5)	Factory worker paid after every five cases packed (Rft for 'pack' is 'pay')
Variable Ratio (VR)	Reward appears after a <u>variable number</u> of responses, varies from trial to trial (VR3)	Gambling wins; Baseball player gets a hit <u>on average</u> every 3 times at bat (Rft for 'swing' is 'hit')
Fixed Interval (FI)	Reward first response after a <u>fixed interval</u> of time, regardless of number of responses (FI 12 hr)	Feed dog for 1st 'beg' after 7 AM and 7 PM (Rft for 'beg' is 'food')
Variable Interval (VI)	Reward first response after a <u>variable interval</u> of time, regardless of number of responses (VI 10 min)	While watching, seeing shooting stars (Rft for 'watching' is 'seeing shooting star')

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- ### Applied Operant Conditioning
- #### Slot Machine
- Reinforcement schedule: Variable Ratio
  - Frequent small rewards maintain behavior between rare large payouts (a **compound schedule**)
  - Delay between response (pull lever) and reward (coins) is marked by whirring of the spinners
  - Lights and sounds accompanying a win act as **secondary reinforcers**
  - Other lights and sounds act as **discriminative stimuli**, which signal that reward is available now
- Dog free-style dancing** (video clip)  
(see <http://caninefreestyle.com> )
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### Operant Conditioning - Punishment

**Punishment** - any condition (presentation or removal of stimulus) that happens after a response (operant) and decreases the likelihood of recurrence of the response

Term	Description	Examples
Positive Punishment	<b>Add (+)</b> an aversive stimulus → <i>Decreases</i> behavior	<b>Spanking</b> child after child throws food on floor
Negative Punishment	<b>Remove (-)</b> a reinforcing stimulus → <i>Decreases</i> behavior	<b>Taking away crayons</b> after child draws on wall <b>Time-out</b> , stand in corner after back-talk <b>Taking away video games</b> after tracking in mud <i>Extinction (take away reward.)</i>

**PUNISHMENT IS NOT THE SAME THING AS NEGATIVE REINFORCEMENT!!!**

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### Comparison: Consequences of Behavior

	Increases Behavior	Decreases Behavior
Positive Stimulus (Add it) (+)	<b>Positive (+) Reinforcement</b> Bonus given (added) for working overtime leads to more hours worked → Adding desired stimulus leads to increased resp.	<b>Positive (+) Punishment</b> Getting speeding ticket (added) leads to less speeding (when the cops are around) → Adding aversive stimulus leads to decreased response
Negative Stimulus (Remove it) (-)	<b>Negative (-) Reinforcement</b> Headache gone (removed) after taking aspirin leads to more aspirin use → Removing aversive stimulus leads to increased response	<b>Negative (-) Punishment</b> Not getting dinner (removed) leads to staying out late less Withholding reward (removed) leads to extinction of response → Removing desired stimulus leads to decreased response

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- ### Corporal (Physical) Punishment
- Positive Physical Punishment is difficult to administer effectively
    - Must be immediate
    - Must be consistent (every occurrence; intermittent punishment is ineffective)
    - Limited in duration and intensity - just enough to stop behavior
  - Does not teach new, substitute behaviors
  - Power of punishment disappears when threat of punishment is removed - total control is needed
  - May have undesirable consequences
    - Often triggers aggression or fear
    - May lead to learned helplessness and depression
    - May inhibit learning of alternative response
    - May generalize to situation (e.g., cutting classes, leaving school)
  - Suppresses behavior; does NOT extinguish response
  - Corporal punishment has been outlawed in several European countries
- Given all this, why do people physically punish their children, their animals, each other?*
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### Alternatives to Corporal Punishment

What else can you do to eliminate undesired behavior?

- > First, **ANALYZE** the behavior and determine when it occurs, and what rewards are maintaining it.
- > **Extinction**: Stop rewarding the behavior
  - You need to figure out **all** of the stimuli that reward the behavior, could be more than one
- > **Reward incompatible behaviors** (behaviors that block the occurrence of the undesired behavior)
- > **Associate an aversive stimulus with the undesired behavior, and stop it when the behavior stops** (negative reinforcement)
- > **Withdraw a positive stimulus when the undesired behavior starts** (negative punishment)

### Cognitive views of Learning

**Cognitive Psychology**: Area of Psychology that holds that behavior cannot be solely accounted for by stimuli and responses; that internal processes must also be considered, and that these processes are valid object of study.

- > Insight Learning
- > Social Learning (Observational Learning)
- > Latent Learning and Cognitive Maps

### Insight Learning: Sultan (W. Kohler, 1920s)



1. The bananas are too high for Sultan to reach



2. The solution is in the boxes that are strewn about the room



3. Sultan stacked the boxes on top of each other...



4. ...climbed the platform and grabbed the bananas.

In similar problems, Sultan found other objects to construct a platform; in some cases using a table and a small ladder, and in one case Sultan pulled Kohler himself over and used the experimenter as a platform.

<http://bowland-files.lanccs.ac.uk/chimp/langaci/LECTURE44prob.htm>

### Insight: a crow

Video: [A tool-making crow](#): (Weir, et al., 2002)



<http://www.sciencemag.org/feature/data/crow/>

In the wild, crows are known to use twigs as tools. In this study, the crow repeated the behavior of bending a hook into a wire on 9 trials out of 10; the crow had no prior experience with wire.

### Observational Learning

- > Reinforcement isn't necessary for learning, nor is body movement
- > **Observational learning**: by watching someone else's behaviors and their consequences, a person (or animal) can acquire new responses
  - **Vicarious learning**
    - Phobias can be acquired by observation
    - "How to" acquired by observation and reading: yoga, knitting, cooking, carpentry...
  - **Modeling, Imitation**
    - Young infants stick out tongue in imitation of adult
    - 9 month old infants imitate novel play
    - 14 month old toddlers imitate TV
    - Children imitate parents' smoking, reading, eating, language...
  - **Mirror Neurons** fire when a behavior is observed and when the same behavior is executed

### Bandura: Studies of Observational Learning

- > Do children imitate adult behaviors:
  - That they have never seen?
  - For which they have never been reinforced?
- > Preschool children observed M and F adult models' **AG**gressive behaviors towards a Bobo doll (**AG** group) or **NonAG**gressive behaviors, playing with tinkertoys, (**NAG** group)
  - Aggressive behaviors and verbalizations: hitting doll with hammer, kicking, "Sock him in the nose," throwing
- > **AG** group showed far more imitative and nonimitative aggressive behaviors than **NAG**
- > Same-sex model imitation scored higher aggression than cross-sex imitation

### Beating up the Bobo Doll

Adult Model			
Boy			
Girl			

<http://www.umm.maine.edu/resources/beharchive/beh450/StaceyPeabody/psy.html>

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### Cognitive Maps and Latent Learning

- **Cognitive Map:** Mental representation of physical space (latent learning - Edward Tolman)
  - Rats learn maze by exploration w/out reward
- **Latent Learning:** Demonstration that something has been learned, even though no explicit reinforcement has been presented
- **Implicit Learning:** Learning without conscious awareness of what, or even that, you have learned
- **Vicarious Trial and Error (VTE):** Mentally trying alternative behaviors before actually performing a physical response
- Issue raised is distinction between learning and performance

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### Tolman and Honzik's Study of Latent Learning

**Rats exploring maze**

Groups:

- 1 - Reinforced at end on each trial
- 2 - Reinforced beginning on day 11
- 3 - Never reinforced

*Rats reinforced beginning on day 11 made fewer errors after that than rats reinforced every day*

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### Summary Comparison: types of learning

**Classical Conditioning**

association

Stimulus → Response

**Operant Conditioning**

[association]      association

[Stimulus] → Response → Reinforcer

**Cognitive Learning**

[association]      [association]      [association]

[Stimulus] → Intervening → Response → [Reinforcer]

Variables:      [actual or      [actual or

observation,      vicarious]      vicarious]

VTE, insight,      expectation

Brackets mean [optional]

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### More Topics in Learning

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### Classical Conditioning - Generalization

- **Generalization** - CR is given to stimuli that are similar to the CS.
  - Example: CS is a 100 hz tone; CR is also given, in weaker form, to a higher-pitched 200 hz tone

**GENERALIZATION**

Acquisition:  
NS-1 (100 hz tone) + US (food)

Test:

CS-1 (100 hz tone)	→	Salivation
CS-2 (80 hz tone)	→	Less Salivation

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## Classical Conditioning - Discrimination

- **Discrimination** - by pairing US with one stimulus, and giving another stimulus without US, the subject learns to give the CR only to the stimulus paired with US
  - Example: Pair food (US) with a 100 hz tone (NS+). On some trials, present a 125 hz tone (NS-), with no US. After some training, subject will respond with CR to 100 hz tone, but won't respond to 125 hz tone

### DISCRIMINATION

#### Acquisition:

- NS+ (100 hz tone) + US (food)
- NS- (125 hz tone) + No US (nothing)

#### Test:

- CS+ (100 hz tone) → Salivation (CR)
- CS- (125 hz tone) → No Response

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## Classical Conditioning - Biological Preparedness

**Biological Preparedness** - Pavlov and Watson thought that *any* stimulus could become a CS for *any* response, however:

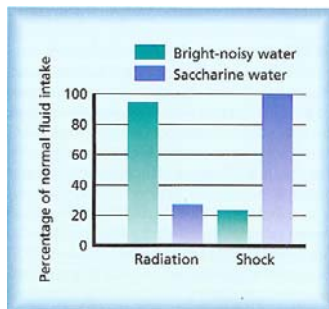
**Garcia effect - studies of conditioned taste aversion:**

- Demonstrated that classical conditioning of taste aversion was specific to the US-UR involved
- Demonstrated that CC could take place even with a long delay between CS and US

US	UR	CS (delivered with H <sub>2</sub> O)	Result
Radiation	Nausea	Saccharine flavor	Aversion to saccharine-flavored H <sub>2</sub> O
Radiation	Nausea	Bright light + loud noise	No aversion to H <sub>2</sub> O + light+noise
Shock	Fear	Saccharine flavor	No saccharine-flavored H <sub>2</sub> O aversion
Shock	Fear	Bright light + loud noise	Aversion to H <sub>2</sub> O + light+noise

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## Garcia Effect - Biological Preparedness



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## Garcia Effect - Biological Preparedness

- For **taste aversion** to develop
  - the US (radiation) had to be paired with a taste (saccharine)
  - lights/tones were not effective as CSs
  - several hours could elapse between taste and US
- For a **fear response** to develop
  - the US (shock) had to be paired with light/tone
  - taste of saccharine was not effective as CS
  - US had to follow CS by no more than a few seconds

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## Classical Conditioning - Applications

### Applications:

- **Phobias:** systematic desensitization
- **Immune system:** conditioned response can suppress immune system without a drug; conditioned response enables using less of an immunosuppressant drug
- **Aversion therapy** to treat alcoholism, substance abuse, violence ("A Clockwork Orange");
- **Conditioning a strong, specific taste, like licorice, to delivery of chemotherapy:** prevents generalization of nausea to prior meals
- **Conditioning coyotes to avoid sheep** by placing poisoned (illness-inducing) lamb meat in sheepskins

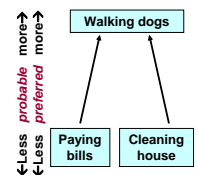
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## Operant Conditioning: Premack Principle

- **Premack Principle:** The opportunity to engage in a more probable response will reinforce (increase the probability of) a less probable response
- Organisms have a hierarchy of responses; ability to make responses higher on the hierarchy can reward responses lower on the hierarchy
- A segment of my hierarchy:

- "reward" myself for paying bills or cleaning house by walking the dogs.
- Trainers reward drug-sniffing dogs for finding drugs by giving them the opportunity to play fetch



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### Applications of Operant Conditioning

- Behavior Modification - eating disorders, smoking, alcoholism, delinquency, aggression
- Classrooms - praise, A, gold star
- Mental institutions - token economy
- Autism - shaping and training appropriate behaviors
- Training Animals - service animals, circus, pets, entertainment
- Programmed Learning - Teaching Machines and individualized learning
- Raising Children

### Behaviorism

Watson: "Psychology as the behaviorist views it is a purely objective branch of natural science. *Its theoretical goal is the prediction and control of behavior.* Introspection forms no essential part of its methods, nor... interpretation in terms of consciousness."

Skinner: Everything we do and are is determined by our history of rewards and punishments. All we need to know are the external causes of behavior and observable results of that behavior; these will yield a comprehensive picture of the organism as a behaving system. (paraphrased)

### And its downfall...



Stimulus, Response! Stimulus, response!  
Don't you ever think?

### Some Neural Mechanisms of Learning

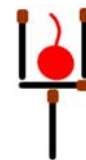
- Synaptic modification, either more neurotransmitter or more receptors in frequently used pathways
- Long-Term Potentiation (increase in sensitivity of frequently stimulated connections between neurons)
- Increased numbers of connections between neurons (between terminal buttons and dendrites)
- Several parts of brain involved
- Mirror neurons - fire during observation of someone else doing task as well as during performance of actual task

### Physical Punishment

- Do you think that positive punishment is effective in teaching children what behaviors are acceptable? Why?
- What are the pluses and minuses of delivering physical punishment (spanking, striking)?
- What other forms of behavioral control would also be effective? Do you think they are as effective as punishment?
- Why is physical punishment so frequently used on children, animals, even adults?
- Where physical punishment is outlawed (several European countries), what means of modifying undesirable behavior will work?

### A Problem Requiring Insight

- Touching and moving only TWO matches, rearrange the picture so that the cherry is OUTSIDE the glass, and the glass retains its configuration (a glass with a centered stem).



More matchstick puzzles: <http://www.jimloy.com/puzz/match.htm>