9.00 Learning

Professor John Gabrieli
Recent Research on Effective Study

• Test First, Study Later

• Testing Yourself on Material More Useful Than Continued Study

(ok to have wrong answers)
LEARNING

• how behavior changes within the lifespan of an individual
• everything we know that is not genetically given
• how to predict the future on the basis of past experience
• to imbue the world with meaning
• learning about learning through scientific psychology
LEARNING

1. Classical Conditioning

2. Operant Conditioning

3. Limits to Conditioning
Ivan Pavlov (1849-1936)

• Nobel Prize for reflexes of digestion - food in mouth provokes specific salivation to prepare for digestion - salivation reflexes

"But Professor, there's a revolution going on with shooting in the streets."

"What difference does it make when you've work to do in the laboratory? Next time there's a revolution, get up earlier!"

• cut esophagus so food could not go to stomach
• placed food in dog's mouth, stomach secreted plenty of gastric juice
• sight of food or sight of feeder - psychic secretions or conditioned reflex
PAVLOVIAN CONDITIONING

A modification of Pavlov's method

Image by MIT OpenCourseWare.
• Unconditioned Stimulus (UCS) – food
• Unconditioned Response (UCR) - salivating (food)
• Conditioned Stimulus (CS) – bell
• Conditioned Response (CR) – salivating
• new association!!
  bell (CS) & salivating (CR)
• law of association by contiguity (Aristotle)
Classically Conditioning a Salivation Response

1. Before conditioning
   - Unconditioned stimulus: Food
   - Unconditioned response: Salivation

2. Before conditioning
   - Neutral stimulus: Whistle
   - No conditioned response: No salivation

3. During conditioning
   - Stimulus combination: Whistle + Food
   - Unconditioned response: Salivation

4. After conditioning
   - Conditioned stimulus: Whistle
   - Conditioned response: Salivation


Image by MIT OpenCourseWare.
Ivan Pavlov & His Dogs

• http://www.youtube.com/watch?v=hhqumfpxuzl
• how to predict the future on the basis of past experience
  bell---food---salivation
• to imbue the world with meaning
  bell---means that food is near
  (any UCS worked)
Water Demo
• Unconditioned Stimulus (UCS) - water in face
• Unconditioned Response (UCR) - flinching to water
UCS-UCR association is built-in reflex
• Conditioned Stimulus (CS) - hearing “CAN”
• Conditioned Response (CR) - flinching to “CAN”
• new association !!
CAN (CS) & flinching (CR)
Balloon Demo
• Unconditioned Stimulus (UCS) - balloon noise
• Unconditioned Response (UCR) - flinching
UCS-UCR association is built-in reflex
• Conditioned Stimulus (CS) - needle touching balloon
• Conditioned Response (CR) - flinching to needle
• new association !!
  needle (CS) & flinching (CR)
PROPERTIES OF CLASSICAL CONDITIONING

• extinction
• generalization gradient
• discrimination training
  black (CS+) & gray (CS-) squares
• second-order conditioning
  bell (CS)
  bell (US) & black square (CS)
• is temporal contiguity the basis of classical conditioning?
EXTINCTION

GENERALIZATION

Image by MIT OpenCourseWare.
Acquisition, Extinction, and Spontaneous Recovery in Classical Conditioning

PROPERTIES OF CLASSICAL CONDITIONING

• extinction

• generalization gradient

• discrimination training
  \( \text{black (CS+)} \) & \( \text{gray (CS-)} \) squares

• second-order conditioning
  \( \text{bell (CS)} \)
  \( \text{bell (US)} \) & \( \text{black square (CS)} \)

• is temporal contiguity the basis of classical conditioning?
Second Order Conditioning

- **CS₁** (Tone) → **CR** (Salivation)
- **CS₂** + **CS₁** (Tone) → **CR** (Salivation)

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Rescorla's Procedure for Demonstrating the Importance of Contingency

© 1996 HarperCollins College Publishers
- **cognitive conditioning:** *Blocking*
  contiguity vs. contingency

<table>
<thead>
<tr>
<th>CS1</th>
<th>CS1 + CS2</th>
<th>CS2</th>
</tr>
</thead>
<tbody>
<tr>
<td>tone (food)</td>
<td>tone + light (food)</td>
<td>light (food)</td>
</tr>
</tbody>
</table>

*less conditioning to CS2*

<table>
<thead>
<tr>
<th>CS1+</th>
<th>CS2</th>
</tr>
</thead>
<tbody>
<tr>
<td>tone + light (food)</td>
<td>light</td>
</tr>
</tbody>
</table>

*more conditioning to CS2*
Demo
• how to predict the future on the basis of past experience
  bell---food---salivation
• to imbue the world with meaning
  bell---means that food is near
  (any UCS worked)

Why do we work hard? (where is the UCS?)
LEARNING

1. Classical Conditioning
2. Operant Conditioning
3. Limits to Conditioning
INSTRUMENTAL/OPERANT CONDITIONING

operate as instruments to produce desired effect

E. L. Thorndike (1898)
puzzle box - cat had to unlatch door by pulling latch - trial and error - fewer errors over time - where is US?
consequence of response
• Law of Effect
  consequence of a response determines whether it is strengthened or weakened

Reward - Strengthened
No Reward - Weakened
Punishment - Very Weakened
4.9 Puzzle box

4.10 Learning curve of one of Thorndike's cats
consequence of a response determines whether it is strengthened or weakened
John B. Watson (1878-1958)

- University of Chicago/Johns Hopkins
- "mind" unobservable
- behaviorism
- study behavior = observable actions, not the mind
- identify environmental conditions
- no fundamental difference between animals and humans
- describe lawful relations between environment-behavior reflexes

stimuli---------responses
(environment) (behavior)
Fear Conditioning

Classical Conditioning of a Phobia: Little Albert

http://www.youtube.com/watch?v=0FKZAYt77ZM
B. F. Skinner (1904-1990)

- consequences of responses
- operant response is an action that operates on environment to produce some consequence
- *Beyond Freedom and Dignity*
- operant behavior

classical conditioning CS *elicits* CR
instrumental conditioning CRs are *emitted* - CRs = operants
create the CRs
OPERANT CONDITIONING

• novel response?
  successive approximations & shaping

high lever
  • click & pellet
  • location, click & pellet
  • face lever, location, click & pellet
  • stretching body upward, face lever, location, click & pellet
  • touch lever with paws, stretching body upward, face lever, location, click & pellet
  • press high lever, touch lever with paws, stretching body upward, face lever, location, click & pellet
INSTRUMENTAL/OPERANT CONDITIONING

operate as instruments to produce desired effect

- Law of Effect
  
  *consequence of a response determines whether it is strengthened or weakened*

  - Reward - Strengthened
  - No Reward - Weakened
  - Punishment - Very Weakened

http://www.learner.org/resources/series138.html?pop=yes&pid=1529

11:37
REINFORCEMENT

- Primary Reinforcers
  - food, thirst, pain
- Secondary Reinforcers
  - money, attention, praise, admission, promotion
- Positive (increase behavior)
- Negative (decrease behavior, escape)
- Punishment
- Partial Reinforcement
Partial-reinforcement effect

More resistant to extinction
LEARNED HELPLESSNESS

Seligman & dogs

*Phase 1*
Yoked in hammock with shocks:  
Group A could stop by pushing panel near nose  
Group B could not stop equal number & duration of shocks

*Phase 2*
avoidance learning in shuttle box  
CS - tone  
jump within 10 secs to avoid shocks  
Group A - learns  
Group B - does not learn

*motivational deficits* - slow to initiate known actions  
*emotional deficits* - listless, frightened, distress  
*cognitive deficits* - poor learning in new situations
Avoidance of Shock by Dogs
Depression & People?

how we explain life to ourselves
internal-external
global-specific
stable-unstable
LEARNING

1. Classical Conditioning

2. Operant Conditioning

3. Limits to Conditioning
LIMITS TO CONDITIONING

- preparedness
- latent learning
- contingency
- reward value
- delayed gratification
- when reward harms
- language
Results of Garcia and Koelling’s Experiment - Taste Aversion

<table>
<thead>
<tr>
<th>Type of Aversive Stimulus</th>
<th>Type of Water</th>
<th>Received Shock</th>
<th>Received X-ray/lithium chloride</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bright-noisy water</td>
<td>Avoided bright-noisy water, but not sweet water</td>
<td>No evidence of classical conditioning</td>
<td></td>
</tr>
<tr>
<td>Sweet water</td>
<td>No evidence of classical conditioning</td>
<td>Avoided sweet water, but not bright-noisy water</td>
<td></td>
</tr>
</tbody>
</table>
Characteristics of the Conditioned Stimulus and the Unconditioned Stimulus Affect the Acquisition of the Conditioned Response

After exposure to X-rays, rats avoided flavored water, not light and noise.

After being shocked, rats avoid light and noise, not flavored water.

### Graph

- **X rays**
  - Light and noise (blue)
  - Flavored water (green)

- **Electric shock**
  - Light and noise (blue)
  - Flavored water (green)

<table>
<thead>
<tr>
<th>Unconditioned stimuli</th>
<th>Percentage of normal fluid intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>X rays</td>
<td>100</td>
</tr>
<tr>
<td>Electric shock</td>
<td>100</td>
</tr>
</tbody>
</table>
Preparedness

Picture - CS
snakes/spiders or flowers/mushrooms

Shock - US

UR - GSR (sweat)

Better conditioning for snakes/spiders
Preparedness

Little Albert Study
rat - worked
wooden block, piece of cloth
did not work
LATENT LEARNING

3 groups of rats in goal maze
• food reward every day
• no rewards
• no rewards for 10 days; then reward
Latent Learning

Tolman & Honzik (1930)

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CONTINGENCY

• 2-month-old infant/crib/color mobile
• moving head, switch in pillow/smile & coo
• second group/no control/no smile, no coo despite equal number of mobile turns
Reward Value

• negative contrast

What happens when you switch to a worse reward?
Fig. 1. Group average running speed plotted in blocks of two days. (The dashed curves represent performance of the Constant reward control groups; the solid curves represent performance of the Contrast group in $S^+$ and in $S^-$.)
DELAYED GRATIFICATION

• 4-5 year-old children – 653 children of faculty and graduate students
• two snacks
  one or two marshmallows
• wait 15 minutes to get two – 30% waited 15 minutes
• correlated 10 years later with behavioral problems, academic and social success (210 SAT points for 30 sec vs. 15 min delay)
WHEN REWARDS HARM

rat & running wheel
  run for fun
run for food - no longer will run for fun

preschoolers draw for fun
gold stars (conditioned reinforcer)
no gold stars, no drawing
Is Language Learning A Conditioned Skill?

• 1 month - switch inside rubber nipple - hooked to tape recorder - when baby sucks, tape plays - *ba ba ba* vs. *pa pa pa* - may not be in their own language (Kikuyu/Spanish) and which their parents may be unable to distinguish (Czech, Hindi, Inslekampx)
• at 4 days, a French baby prefers French to Russian, Italian, backwards French
• correction/reinforcement?
  2-year-old: "Mamma isn't boy, he a girl."
  Mother" "That's right."
• generative - sentences are produced that are unique
• everybody learns it without training
• overgeneralizing - "My teacher holded the rabbit."
9.00SC Introduction to Psychology
Fall 2011

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