What is Learned?

Lecture 9
Classical and Instrumental Conditioning Compared

**Classical**
- Reinforcement Not Contingent on Behavior
- Behavior Elicited by US
- Involuntary Response (Reflex)
- Few Conditionable Behaviors

**Instrumental**
- Reinforcement Contingent on Behavior
- Behavior Emitted by Organism
- Voluntary Responses ("Spontaneous")
- Many Conditionable Behaviors
Avoidance Learning
Solomon & Wynne (1953)

- Dog Placed in One Side of Apparatus
- Overhead Lights Deliver CS
- Floor Grid Delivers US
  - After CS-US Interval
- Vault Barrier
  - Escape After US Onset
  - Avoidance Before US Onset
Two-Factor Theory of Avoidance Learning
Mowrer (1947); critiqued by Seligman & Johnston (1973)

- Light $\implies$ Shock
  - Respond During Shock $\implies$ Escape
  - Respond Prior to Shock $\implies$ Avoidance

- Classical Conditioning
  - Anticipatory Fear Conditioned to Light

- Instrumental Conditioning
  - Reinforce Escape/Avoidance
    - Cessation of Shock US
    - Cessation of Light CS
The Stimulus-Response Theory of Learning

• Association between Stimulus and Response
  – Pavlov: CS = Bell; CR = Salivation
  – Thorndike: CS = Puzzle Box; CR = Paddle Press
  – Skinner: CS = (Illuminated) Key; CR = Keypeck

• Reinforcement
  – Pavlov: US = Meat Powder
  – Thorndike: Reward = Escape
  – Skinner: Reinforcement = Food Pellet
Assumptions of S-R Learning Theory

• Association by Contiguity
  – Co-Occurrence in Space, Time

• Arbitrariness (Equipotentiality)
  – Any Stimulus, Any Response

• Empty Organism
  – Organism as “Black Box” Collecting Ss, Rs

• Passive Organism
  – Metaphor of “Conditioning”
Taste-Aversion Learning
(Bait Shyness)
Garcia & Koelling (1966)

• Compound CS
  – “Bright, Noisy, Sweet” Water

• US
  – Foot Shock (Immediate Pain)
  – X-Rays (Delayed Nausea)

• Avoidance Test of Conditioning
  – Choose Water Source
    • Bright, Noisy Water
    • Sweet Water
Taste-Aversion Learning
Garcia & Koelling (1966)

- CS1: Light
- CS2: Noise
- CS3: Taste

All Subjects

Group 1
- US1: Shock
- UR1: 

Group 2
- US2: X-Ray
- UR2: 

All Subjects

Preference Test of Conditioned Fear
(Avoidance of Water Source)
Garcia & Koelling (1966)
Implications for S-R Learning Theory

• Arbitrariness
  – Taste-Nausea, Sight/Sound-Shock

• Empty Organism
  – Internal Structure Shaped by Evolution

• Association by Contiguity
  – CS, CR Distant in Space, Time

• Law of Exercise
  – One-Trial Taste-Aversion Learning
Species-Specific Defense Reactions
Bolles (1970)

• Escape/Avoidance Learning in Pigeons
  – Easy: Flap Wings, Stretch necks
  – Impossible: Key Peck

• Escape/Avoidance Learning in Rats
  – Easy: Jump Up, Run
  – Hard: Lever Press

• Avoidance Learning Capitalizes on Species-Specific Repertoire of Defensive Reactions
  – Built In by Evolution
The Preparedness Principle (Belongingness)
Seligman (1970); Rozin & Kalat (1971)

By Virtue of Its Evolutionary History, Each Species is Predisposed to Learn Certain Associations

- Prepared
- Unprepared
- Contraprepared
Constraints on Learning

• Biological
  – Evolutionary History

• Cognitive
  – Internal Representation of CS ➔ CR
“Standard Paradigm”
for Classical Conditioning

- CS (Conditioned Stimulus)
- US (Unconditioned Stimulus)
- CR (Conditioned Response)
- Bell
- Food
- Drops of Saliva
- Time
Delay Conditioning

CS | Bell
US | Food
CR | Drops of Saliva
Time

Drops of Saliva
Trace Conditioning

CS

US

CR

Time

Bell

Food

Drops of Saliva

Drops of Saliva

Drops of Saliva

Drops of Saliva
Simultaneous Conditioning

- CS (Conditioned Stimulus)
- US (Unconditioned Stimulus)
- CR (Conditioned Response)

Bell
Food
Drops of Saliva

Time
Backwards Conditioning

- **CS**: Bell
- **US**: Food
- **CR**: Drops of Saliva
- **Time**
Conditioned Inhibition in Backwards Conditioning

• Fear Conditioning
  – Tone ==> Shock
  – CR = Heart Rate Acceleration
    • Physiological Index of Fear

• Standard Paradigm
  – HR Acceleration During Tone
    • Conditioned Fear Response

• Backward Paradigm
  – HR Deceleration During Tone
    • Inhibition of Fear Response
Contiguity vs. Contingency in Conditioning
Rescorla (1967, 1988)

- **Contiguity**
  - CS *Co-Occurs* with US

- **Contingency**
  - CS *Predicts* US

- **Standard Paradigm**
  - CS, US both Contingent and Contiguous

- **Delay, Trace Conditioning**
  - CS, US Contingent but Not Contiguous

- **Simultaneous Conditioning**
  - CS, US Contiguous but not Contingent

- **Backwards Conditioning, Extinction (Below Zero)**
  - CS Predicts *Absence* of US
Informational Value of the CS

• When the US is Contingent on the CS, then the CS Provides Information About the US
• Conditioning Occurs Because the CS Provides Information about US
• Conditioning Does Not Occur When the CS is Not Informative

What Happens When the Information in the CS is *Redundant*?
Conditioned Emotional Responses

- Tone CS $\rightarrow$ Footshock US
- CR: Heart Rate Acceleration
- Paradigmatic Variations
  - Standard Paradigm
  - Delay, Trace Paradigms
  - Simultaneous Paradigm
  - Backwards Paradigm
    - Safety Signal
The Blocking Experiment (1)
Kamin (1969)

Initial Conditioning with Compound CS

- CS1
- CS2
- US

Noise
Light
Shock

Test Conditioning with Light CS Alone

- CS2
- CR
- Test

Light
Fear
The Blocking Experiment (2)
Kamin (1969)

Phase 1: Conditioning with Noise CS1 (1)
Phase 2: Add Light CS2 Simultaneous with CS1 (2)

1
CS1
US
Noise
Shock

2
CS1
CS2
US
Noise
Light
Shock

Test
CS2
CR
Light
Fear

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The Blocking Effect
Kamin (1969)

Test Response to Light

Sequence of Conditioning Trials
“Unblocking” the Blocking Experiment

Phase 1: Conditioning with Simple CS
Phase 2: Add Light CS2 Preceding CS1

Phase 1: Conditioning with Simple CS
1. CS1 → Noise
   US → Shock

Phase 2: Add Light CS2 Preceding CS1
2. CS1 → Noise
   CS2 → Light
   US → Shock

Test
- CS2 → Light
- CR → Fear

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Predictability, Surprise, and Conditioning
Kamin (1969)

• Conditioning Only Occurs When the US Surprises the Organism
• Organism Searches Environment for Predictors of US
• Irrelevant, Redundant Stimuli are Ignored
• Classical Conditioning Involves the Formation of Expectations
  – CS predicts US
Implications for S-R Learning Theory

- Association by Contiguity
  - Association by *Contingency*
- Empty Organism
  - Expectations, Surprise
- Passive Organism
  - Actively Engaged in Predicting Events