Genetic influences

Nongenetic influences

Mechanisms (perceptual, motivational, learning, motor, etc.)

Behavioral capacities

Lifetime reproductive success

Next generation

Developmental programs

Genetic influences

Nongenetic influences
Exteroceptive and interoceptive information

Perceptual processes

Short-term acquisition

Long-term storage

Storage, consolidation

Retrieval

Physiological activation

Behavioral activation

Response selection

Associative learning

Perceptual processes

Exteroceptive and interoceptive information
## Classes of Learning Phenomena

<table>
<thead>
<tr>
<th>General</th>
<th>Associative/Cognitive</th>
<th>Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nonassociative</strong></td>
<td><strong>Associative/Cognitive</strong></td>
<td><strong>Specific</strong></td>
</tr>
</tbody>
</table>
| • Habituation  
  • Short term  
  • Long term? | • Classical conditioning  
  • Instrumental conditioning | • Human language  
  • Song learning  
  • imprinting |
| • Sensitization  
  • Short term  
  • Long term? | • Rule learning  
  • Social learning | |
| • Working memory | | |
ASSOCIATIVE LEARNING: Classical (or Pavlovian) conditioning
Classical or Pavlovian conditioning

- An associative form of learning.
- Pairing of two stimuli endows one of them with the ability to act as a signal for the other.
Classical or Pavlovian conditioning
Conditioned taste aversion (CTA)

Training:

Testing:
Fear conditioning

http://go.owu.edu/~deswartz/introduction.html
Basic components

(1) Early in training

CS

↓

US → UR

(2) Late in training

CS → CR

Salivary conditioning (dogs)

(1) Early in training

Metronome

↓

Food → Salivation

(2) Late in training

Metronome → Salivation

Eye-blink conditioning (rabbits, rats, humans)

(1) Early in training

Tone

↓

Airpuff → Blink

(2) Late in training

Tone → Blink

Conditioned taste aversion (rats)

(1) Early in training

Saccharin

↓

Poison → Nausea

(2) Late in training

Saccharin → Nausea

Morphine tolerance (rats)

(1) Early in training

Context

↓

Mor-induced hypoalgesia → Hyperalgesia

(2) Late in training

Context → Hyperalgesia

Fear conditioning (rats)

(1) Early in training

Light

↓

Pain → Activity

(2) Late in training

Light → Freezing
Patelar reflex (humans)

(1) Early in training
Light
   ↓
   Tendon hit → Kick

(2) Late in training
Light → Kick

Autoshaping (pigeons)

(1) Early in training
Keylight
   ↓
   Food → Pecking

(2) Late in training
Keylight → Pecking

Goal tracking (rats)

(1) Early in training
Light
   ↓
   Food → Goal approach

(2) Late in training
Light → Goal approach

Conditioned suppression (rats)

(1) Early in training
Tone
   ↓
   Pain → Suppression of operant baseline

(2) Late in training
Tone → Baseline suppression

Flavor preference (fetal rats)

(1) Early in training
Nipple (stimulation of oral cavity)
   ↓
   Milk → Ingestion

(2) Late in training
Nipple → Wiping reflex reduction

Alarm reaction (zebra fish)

(1) Early in training
Morpholine odor
   ↓
   Alarm substance → Alarm reaction

(2) Late in training
Morpholine → Alarm reaction
ASSOCIATIVE LEARNING:
Instrumental (or operant) conditioning
Instrumental or operant conditioning

• An associative form of learning.

• Pairing of a response with an outcome changes the future strength of the response.
Thorndike’s puzzle box
Maze learning

Video
Skinner box: Basic components

[Diagram of a Skinner box with a mouse, light, lever, water dispenser, food dispenser, and electric grid labeled.]
Basic contingencies in instrumental learning

Table 7.9
*Instrumental Arrangements.*

<table>
<thead>
<tr>
<th>Name</th>
<th>Reinforcer</th>
<th>Contingencies</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive reinforcement</td>
<td>Appetitive</td>
<td>R → O</td>
<td>noR → noO</td>
</tr>
<tr>
<td>Punishment</td>
<td>Aversive</td>
<td>R → O</td>
<td>noR → noO</td>
</tr>
<tr>
<td>Omission training</td>
<td>Appetitive</td>
<td>R → O averted</td>
<td>noR → O presented</td>
</tr>
<tr>
<td>Escape conditioning</td>
<td>Aversive/Appetitive</td>
<td>R → O ends</td>
<td>noR → O continues</td>
</tr>
<tr>
<td>Avoidance conditioning</td>
<td>Aversive/Appetitive</td>
<td>R → O averted</td>
<td>noR → O presented</td>
</tr>
</tbody>
</table>

Note. The prototypical reinforcers or outcomes (O) are food (appetitive) and shock-induced pain (aversive). In each case, the arrangement involves one outcome when the response occurs and another when it fails to occur.
ASSOCIATIVE LEARNING: Comparing and integrating classical and instrumental conditioning
(a) Classical conditioning

Stimulus 1 (CS) → Response 2 (CR)

Stimulus 2 (US) → Response 1 (UR)

(b) Instrumental conditioning

Stimulus 1 (SD) → Response 1 (Ri)

Response 1 (Ri) → Stimulus 2 (O)

Stimulus 2 (O) → Response 2 (Rc)
The Master/Yoked design

This design is used mainly in experiments on omission training (appetitive) and on avoidance training (aversive).
The Master/Yoked design

**Trials when master animal responds**

Master

\[ S^D \rightarrow R_i \rightarrow \text{Nothing} \]

Yoked

\[ "S^D" \rightarrow R \rightarrow \text{Nothing} \] or \[ "S^D" \rightarrow \text{No R} \rightarrow \text{Nothing} \]

**Trials when master animal does not respond**

Master

\[ S^D \rightarrow \text{No } R_i \rightarrow O \]

Yoked

\[ "S^D" \rightarrow R \rightarrow \text{"O"} \] or \[ "S^D" \rightarrow \text{No R} \rightarrow \text{"O"} \]
Omission training in sexual conditioning

O: receptive female released into the arena

S: red and green lights

R: move away from the female area

<table>
<thead>
<tr>
<th>Group</th>
<th>Pretraining</th>
<th>Acquisition</th>
<th>Omission</th>
</tr>
</thead>
</table>
| Exp (master) | Habituation to the apparatus and procedure  | Light→Copulation 5 TPS  
ITI mean: 10 min  
S dur: 30 s  
O dur: 30-240 s | L→App→Nothing  
L→noApp→Copul |
| Yoked  | Habituation to the apparatus and procedure  | Light→Copulation 5 TPS  
ITI mean: 10 min  
S dur: 30 s  
O dur: 30-240 s | L→App→as Master  
L→noApp→as Master |
Crawford & Domjan (1993, Experiment 2)

No differences between groups.
Omission training on magazine approach

Magazine approach may result from:
- Only from Pavlovian contingencies (CS elicited)
- Only from instrumental contingencies (reinforced)
- From a mixture of Pavlovian and instrumental contingencies

Magazine approach increases under omission (master) contingencies.

Therefore, it is in part a Pavlovian response.

But its strength is greater in yoked than in omission (master).

Is magazine approach increased in yoked condition?
- Pavlovian responses (CS elicited)
- plus
- Instrumental responses (reinforced)

Or is magazine approach reduced in omission (master)?
- Pavlovian responses (CS elicited)
- minus
- Competing instrumental responses (reinforced)
Magazine approach as a Pavlovian CR

Auditory  Light

Magazine

Feature-positive discrimination: A-, LA+
Feature-negative discrimination: A+, LA-

Harris et al. (2013, Exp 3a and 3b)
**Magazine approach as a Pavlovian CR**

**Hypothesis 1**: response rate elevated in Yoked because of superstitious instrumental conditioning of magazine responses. The Omission (Master) condition explicitly eliminates these pairings. 
**Thus**: Yoked increases magazine entries.

**Hypothesis 2**: the Omission schedule reinforces responses incompatible with magazine entry because those responses are reinforced. 
**Thus**: Omission decreases magazine entries.

---

**Exp 3a: feature L signals Y**

- **LA → yoked**
- **A → omission**
- **B → yoked**

**Hypothesis 1 correct**: discrimination easy 
(Y on L should increase magazine entries)

**Hypothesis 2 correct**: discrimination hard 
(O doesn’t do anything for L)

---

**Exp 3b: feature L signals O**

- **LA → omission**
- **A → yoked**
- **B → yoked**

**Hypothesis 1 correct**: discrimination hard 
(Y doesn’t do anything for L)

**Hypothesis 2 correct**: discrimination easy 
(O reduce magazine entries on L)

---

L: light. A and B: auditory stimuli, counterbalanced.

---

**Harris et al. (2013, Exp 3a and 3b)**
Conclusion: given that the discrimination where the feature (L) signals omission is easier, the implication is that omission suppresses magazine because it reinforced incompatible responses (hypothesis 2). There was no evidence that yoked animals were learning via superstitious reinforcement. Thus, responding in the yoked condition is controlled by an S-S association (i.e., it is Pavlovian).

Harris et al. (2013, Exp 3a and 3b)
Implications of omission data

• Classical conditioning seems to depend on an association between stimuli (or between stimulus and response):

  Light → Food | Light → Salivation
  S → O         | S → R

• Instrumental conditioning seems to depend either on an association between stimulus and response, or between a response and a stimulus, or a combination:

  Lever → Lever pressing | Classic learning theory
  S → R                  | Thorndike (1911), Hull (1943)

  Lever pressing → Food | Hierarchical learning theory
  R → O                 | Rescorla (1990)

  Light → Food
  Light → Lever pressing
  S → O
  S → R

  Two-factor learning theory
  Mowrer (1947), Gray (1975)
Experimental neurosis in dogs: I. Pavlov

https://www.youtube.com/watch?v=7QTA8qcKEiE
Instrumental conditioning in pigeons and humans: B. F. Skinner

http://www.youtube.com/watch?v=I_ctJqjIrHA
Social reinforcement (and punishment): O. H. Mowrer

https://archive.org/embed/0885_Competition_Dominance_Hierarchies_in_Rats_20_22_06_15