

## Overview

- Biological background
- Types of learning
- Modern versions of learning

## What *is* learning?

- What goes with what
- Profiting from experience\*
- Storing information in memory
  - Without [necessarily] acting on it immediately

## Non-learning influences on behaviors

## Fixed-action patterns

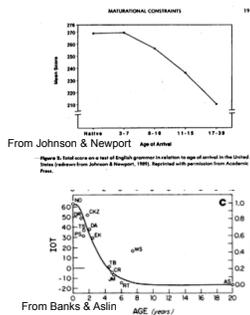
- **Non-learned** behaviors
- Organism does reflexively
- Initiated by **releasers**
- Once initiated, run from start to finish

## Fixed-action patterns

- Babies:
  - Grasping, head-turning, sucking
  - All aid in nursing
- Adults: yawning?
- Birds:
  - Greylag goose and egg-rolling
  - Oystercatchers and larger eggs
    - "supernormal" stimulus

## Critical periods

- Learning happens in a limited time window with extra plasticity
- Halfway between built-in behaviors and flexible learning
- Found in humans, animals
- Language
- Stereo vision



## Critical periods

- Another critical period: Imprinting
  - Baby duck: Follows moving object
  - Mama duck, person, wooden duck
    - Very quickly learns to prefer it

## Critical periods

- And another critical period:
- Birdsong learning
  - Some birds are 'born with' song
  - Others **learn** their species' song
    - E.g. white-crowned sparrow
  - Often compared to (human) language acquisition

## Critical periods

- Birdsong learning
  - White-crowned sparrow (Marler, 1970)
  - Must hear species' song between 10 & 50d
  - Doesn't actually sing till 150-200d
  - Raised in lab:
    - Can learn from recording of w.-c. s. song
    - *Can't* learn from song sparrow song (diff. species)

## Critical periods

- Birdsong learning
  - Marler, 1970:
    - Crude 'template' of species-typical song
    - Hooked into intrinsic feedback/reinforcement system
    - Like human speech, which also isn't linked to an extrinsic reward
      - I.e., it must be internally rewarding

## Critical periods

- Language acquisition
  - Critical period for learning language[s]?
    - The island experiment
    - Umm, illegal.
  - Test case: late learners of ASL

## Critical periods

- Language acquisition
  - Late ASL learners (Newport & Suppalla, 1989)
    - ASL first language
    - Acquired at different ages
    - 10+ years experience using ASL
  - *Better performance the earlier it was acquired*
  - Johnson & Newport (1990)
    - Similar results with L2 learners of English

## Critical periods

- Language acquisition
  - Newport (1990): “Less-is-more” hypothesis
    - Language [sign] elements a, b, c
    - Meaning elements m, n, o
    - Many ways to combine ( $7 * 7 = 49$ )
    - Kids have worse working memory so they can only consider small # of combinations
      - Much more likely to be right
  - Cochran, McDonald, & Parault (1999)
    - Concurrent task = better generalization

## Other constrained learning

- Some things very difficult to condition to some stimuli (Bolles 1970)
  - Run away from shock, press bar for food
  - Sweetness & nausea, click & pain
  - ~~Vice versa~~
- Species-specific constraints
  - Pigeons learn visual cues to illness

## Behaviorism & learning

- Very quantitative
- In the end, couldn't fully account for all real-world learning
- Still useful in some contexts today
  - Drug treatment
  - Chemotherapy & food aversions
  - *Learning rules* in many computational models

## Behaviorism & learning

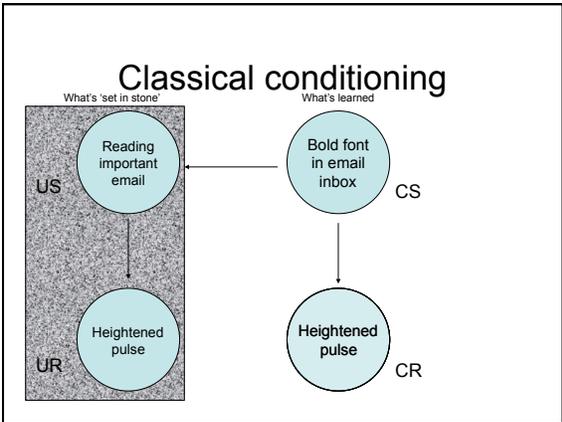
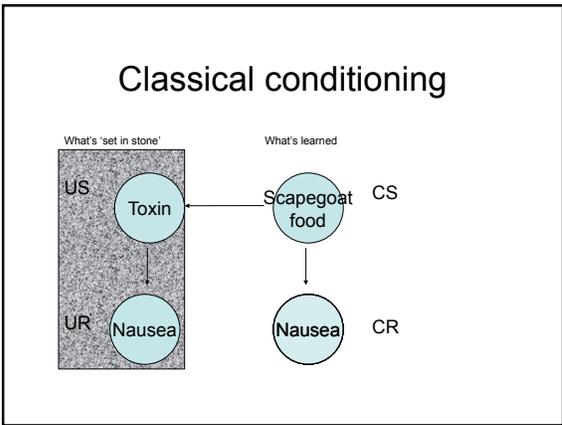
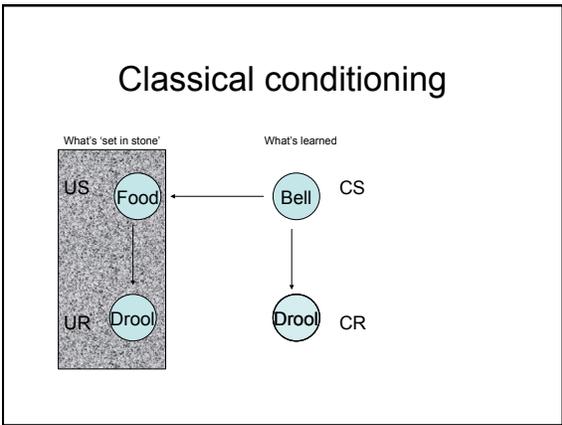
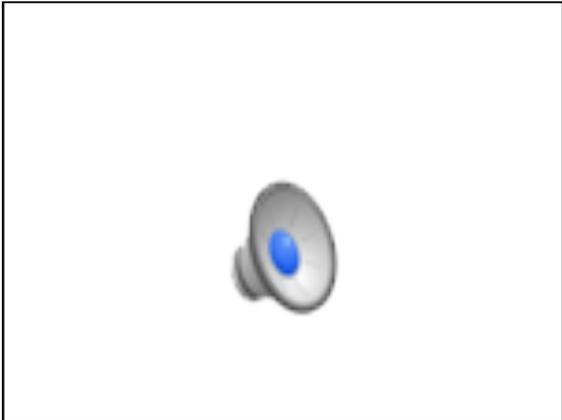
- Habituation
- **Classical conditioning**
- **Operant conditioning**
  - Also “trial and error learning” or “instrumental learning”

## Habituation

- Decline in organism's reaction as stimulus loses novelty
- Don't react to stable, consequence-free event
- May also contribute to ease of learning the right associations
  - Unusualness heuristic

### Classical conditioning

- Pavlov
- Terms:
  - Unconditioned stimulus
  - Unconditioned response
  - Conditioned stimulus
  - Conditioned response



### Classical conditioning

- **Extinction**
  - CR can go away if US/CS relationship broken
- **Blocking**
  - Kamin, 1969
    - Two CS's
    - Simultaneous: both elicited CR
    - One conditioned first: only first one elicited CR

## Classical conditioning

- **Predictiveness** of the CS is crucial for C.C. to occur (not simple cooccurrence)
  - Rescorla (1967)

Group	Prob. US follows CS	Prob. US by itself	Learning?
1	.80	.80	N
2	.80	.40	Y
3	.40	.40	N
4	.40	0	Y

## Classical conditioning

- Stimulus substitution?
  - CS takes place of US
  - Too simple
- Adaptation
  - Sometimes the CR is opposite of UR
  - **Compensatory response model**
    - Dinitrophenol: + O<sub>2</sub>, + temp
    - Conditioned response: - O<sub>2</sub>, - temp

## Classical conditioning

- **Compensatory response model**
  - Explanation for drug tolerance?
  - Need increasing doses to get effect
    - CR in opposite direction counteracts drug
  - Heroin: Gutierrez-Cebollada et al. (1994)
    - Addicts admitted to hospital for OD
      - 50% had injected normal dose in unusual environment
    - Addicts admitted for unrelated stuff (controls)
      - All in familiar environment
    - No CS -> *lower tolerance*

## Classical conditioning

