Basic cognitive processes - 1

Psych 414
Prof. Jessica Sommerville

Learning goals

• Identify:
  – Key learning processes
  – How perception forms the bedrock for cognition
  – How memory develops during infancy
  – Methods for measuring perception, learning and memory

• Appreciate:
  – How we can capitalize on response modalities to assess the state of cognition in infancy.
  – Why “what constitutes cognition?” is a difficult question.

Learning processes

• Conditioning
  – Classical conditioning
  – Operant conditioning
• Habituation
• Perceptual learning
• Statistical learning
• Imitation
• Analogical reasoning
Classical conditioning

- Pairing of a neutral stimulus with a stimulus that leads to a reflexive response
  - New stimulus produces behavior by itself
- Present in newborns
    - Breast milk (UCS) --> Sucking (UCR)
    - Pair forehead stroking (NS) with breast milk (UCS)
    - Forehead stroking (CS) --> sucking (CR)
- Occurs most easily when association between UCS and UCR has survival value

Operant (instrumental) conditioning

- Learning about the consequences of one’s own actions
  - Act on the environment
  - Subsequent stimuli will either increase or decrease the probability of that behavior occurring again
- Positive reinforcer increases occurrence of response (contingency)

Operant conditioning

- Present in newborns but initially limited to sucking and head-turning responses
  - Newborns produce head turns for sucrose
- Range of responses increases with age
  - Infants between 2 and 6 months of age learn contingency relations between leg kicking and mobile moving
- Limited by spatial and temporal proximity of behavior and response
Habituation

- **Habituation** = decrease in response due to repetitive stimulation
- Indicates that learning has occurred (recognition)
  - Infant has formed a memory representation of stimulus
- **Recovery** = increase in response to novel stimuli
  - Infant can distinguish between two different stimuli
- Habituation and recovery are *adaptive*; enables infants to attend to things they know the least about
Habituation

- Evident in 3rd trimester
  - Decrease in HR to repeated sounds
- Age-related changes
  - Infants habituate more quickly with age
- Aspects of habituation performance related to later IQ ($r \approx .4$)
  - Speed of habituation
  - Recovery to novelty

Perceptual learning

- **Differentiation** = extracting invariant (stable) elements from the environment
- **Affordances** = possibilities for action that objects or environments offer
  - Depend on the properties of an object and the capabilities of the user
  - E.g., a hammer is “poundable”
- Involved in intermodal perception (matching information across the senses)
  - Some aspects innate
  - Develops rapidly during infancy


- Based on locomotor experience infants, infants discover which slopes afford crawling
Statistical learning

• Forming associations between events that occur in a statistically predictable pattern
• Available to infants early on across a range of different stimuli
  – Speech sounds (8 months)
  – Visual shapes (2-, 5- and 8- month-olds)

(Adapted from Kirkham et al., 2002)

Statistical learning (Kirkham et al., 2002)

- Habituation
  ![Habituation images]

Statistical learning (Kirkham et al., 2002)

- Test
  ![Test images]

- Familiar
  ![Familiar images]

- Novel
  ![Novel images]
Imitation

- Reproduction of witnessed behavior
- Present in newborns (Meltzoff & Moore, 1977; 1983)
  - Infants watched experimenter model facial gestures
    - Tongue protrusion, mouth opening, or lip pursing
  - Given opportunity to respond
  - Naïve observer coded infants’ response

Imitation

- Infants reproduce increasingly complicated actions as they get older
  - Facial gestures (newborns)
  - Object-directed actions (~6 months)
  - Action sequences (~13 months)
- Imitate after increasingly long delays
  - 24 hrs at 6 to 9 mos.; 8 months at 21-29 mos.
- Generalize actions to an increasingly wide array of contexts
  - 6 months one type of change; 14 months across a change in context and object size and shape
  - Facilitated by practice

Analogue reasoning

- Transferring a problem solving solution from 1 situation to another based on underlying task structure
- Evident by at least 1 year of age
Analogical reasoning
(Chen et al., 1997)

- Trained to solve a problem
- 13 month-olds transfer across problems
- 10 month-olds do so after multiple training exemplars, or in cases of high perceptual similarity

Infant perception

- Visual perception
- Auditory perception
- Intermodal perception

Visual perception: Methods

- Visual habituation
- Visual preferences
- Visual scanning patterns
- Reaching paradigms
Visual Habituation/Dishabituation

Looking time (in seconds)

Visual preference paradigm

Examples of scrambled faces used by Fantz (1961)

Reaching paradigms

From Vishton et al., submitted
Object perception

- **CONSTANCY:** Infants are sensitive to size and shape constancy from early on
  - 6 to 20 week olds habituate to changes in absolute size but not retinal size (McKenzie & Day, 1992)
  - After habituating to one shape presented at varying angles, newborns look longer at novel shape vs. old shape at new angle (Slater & Morrison, 1985)
- **SEGREGATION:** Infants understand that objects are separate from their background surfaces. But:
  - Have difficulty identifying two objects as distinct in the absence of motion cues prior to 6 months (txt p. 38-39)