behavior
(chapter 51)

ethology

study of how animals behave in their natural habitat

genes & environment

nature-versus-nurture issue is not about whether genes or environment influence behavior, but that both are involved
two causes of behavior . . .

- *Proximate*
  - mechanistic
  - genetic
  - triggered by environmental stimuli

- *Ultimate*
  - evolutionary significance for a behavior
  - why favored by natural selection?

proximate $\rightarrow$ ultimate?
fixed action pattern (FAP) . . .

- sequence of behaviors essentially unchangeable and usually carried to completion once initiated
- $A \rightarrow B \rightarrow C \rightarrow D \rightarrow ???$
  - triggered by an external sensory stimulus
    - sign stimulus
      - usually obvious
  - generally occurs same way every time

Many animals tend to use a relatively small subset of the sensory information available to them and behave stereotypically
proximate $\rightarrow$ ultimate?
Female with swollen belly appears.

Male (with red belly) swims zigzag to female.

Male swims toward nest.

Female follows.

Male shows entrance to nest.

Female enters nest.

Male prods female’s tail with trembling movements.

Female spawns and leaves.

Male enters nest and fertilizes eggs.
imprinting . . .

• recognition, response, and attachment of young to a particular adult or object

  – Konrad Lorenz
  – geese isolated after hatching could no longer imprint

proximate $\rightarrow$ ultimate?
concepts of behavior . . .

1) genetic components to behavior

2) development of behavior

3) natural selection & behavior

4) behavioral ecology
genetic components to behavior . . .

innate behavior

*instinct*

• developmentally fixed
  – due to genetic programming

• environmental differences among individuals does not appear to alter the behavior
movements . . .

- **kinesis**
  - change in *activity rate* in response to a stimulus
  - e.g. sowbugs are more active in dry areas and less active in humid areas
- **taxis**
  - automatic, oriented *movement*
  - to or away from a stimulus
  - e.g. phototaxis, chemotaxis, and geotaxis
- **migration**
  - regular *movement* of animals
  - over relatively long distances
signals, communications . . .

• **signal**
  – behavior that causes a change in the behavior of another animal

• **communication**
  – transmission, reception, response
e.g. singing, howling, tactile, electrical, chemical

pheromones -
chemicals released by an individual that brings about mating and other behaviors
genes, mating, & parenting . . .
development of behavior . . .

• **learning**
  – habituation
  – spatial learning
  – cognitive maps
  – associative learning
  – cognition & problem solving
learning is experience-based modification of behavior

- modification of behavior resulting from specific experiences
  - e.g. alarm calls of vervet monkeys
- **sensitive period** in song birds
  - individuals reared in silence performed abnormal songs
  - if recordings of proper songs played early in life
    - normal songs developed
canaries exhibit open-ended learning where they add new syllables to their song as they get older
Why has natural selection favored a multi-song behavior? . . .

proximate → ultimate?
. . . because it’s advantageous for males attracting females

. . . and we all know what that can lead to . . .
• learning versus maturation
  – maturation – improvement of behavior perhaps due to ontogenetic changes in neuromuscular systems
  • e.g. flight in birds
    – as a bird continues to develop its muscles and nervous system, it is able to fly
    – not true learning
concepts of behavior . . .

1) genetic components to behavior
2) development of behavior
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development of behavior . . .

• learning
  – habituation
  – spatial learning
  – cognitive maps
  – associative learning
  – cognition & problem solving
• **habituation**
  – loss of responsiveness to unimportant stimuli or stimuli that do not provide appropriate feedback
  • “cry-wolf” effect
    ➢ *remember the vervet monkey warning calls*
    ➢ *human induced habituation can be very bad for wild animals*
development of behavior . . .

- **learning**
  - habituation
  - spatial learning
  - cognitive maps
  - associative learning
  - cognition & problem solving
• **spatial learning**
  - behavior modification in response to environmental spatial structure
development of behavior . . .

• learning
  – habituation
  – spatial learning
  – cognitive maps
  – associative learning
  – cognition & problem solving
cognitive maps

- internal codes of spatial relationships of objects in the environment
- not just simply using landmarks within a familiar area
• e.g. bird migration behavior
  – piloting
• animal moves from one familiar landmark to another until it reaches its destination
- **orientation**
  - detect directions
  - travel in particular paths until reaching destination

- **navigation**
  - most complex
  - determine one’s present location relative to other locations
  - detect compass directions
  - cues
    - magnetic field, sun, stars, chemicals, etc.

![Map of Europe with migration routes](image)
development of behavior . . .

• learning
  – habituation
  – spatial learning
  – cognitive maps
  – associative learning
  – cognition & problem solving
• **associative learning**
  – ability of many animals to learn to associate one stimulus with another

• **classical conditioning**
  • arbitrary stimulus associated with reward or punishment
  • e.g. Pavlov’s dog

• **operant conditioning**
  • trial-and-error learning
  • animal associates one of its own behaviors with reward or punishment
development of behavior . . .

• learning
  – habituation
  – spatial learning
  – cognitive maps
  – associative learning
  – cognition & problem solving
• cognition
  – connects nervous system function with behavior
  – ability of an animal’s nervous system to perceive, store, process, and use information gathered by sensory receptors in order to make judgments about its environment
concepts of behavior . . .

1) genetic components to behavior

2) development of behavior

3) natural selection & behavior

4) behavioral ecology
natural selection and behavior . . .

• must increase survival to be beneficial
• e.g.

  cost-benefit and the foraging theory
  mating behavior
foraging... learning!
natural selection favors mating behavior that maximizes the quantity or quality of mating partners

mating systems and parental care

sexual selection
mating systems . . .

– **promiscuous**
  - “free for all”
  - relatively weaker bond pairing

– **monogamous**
  - one male mating with one female
  - relatively stronger bond pairing
  - **polygamous** - individual of one sex mating with several of other sex
    » **polygyny** - single male, many females
    » **polyandry** - single female, many males
• *certainty of paternity* can influence mating systems and parental care
  – if the male is unsure if offspring are his, parental investment is likely to be lower
parental investment. . .

time and resources needed for offspring rearing
generally lower in males . . .
capable of producing more gametes (which are also smaller), therefore making each one less valuable

. . . and higher in females
fewer, larger gametes, a process which is energetically more expensive, thus making each gamete more valuable

sexual selection . . .

females are usually more discriminating
looking for “Mr. Right” with his better genes (ultimate )
concepts of behavior . . .

1) genetic components to behavior
2) development of behavior
3) natural selection & behavior
4) behavioral ecology
behavioral ecology . . .

- behavior as an evolutionary adaptation
  - ultimate causes
- animals behave in order to maximize their fitness

an idea valid only if genes influence behavior
altruistic behavior . . . why???

social behaviors usually selfish

why help one another?
  especially if consequence = death!!

**altruism**

behavior that might decrease your fitness
  but, increase fitness of others

others = family $\rightarrow$ related $\rightarrow$ carry *some* of your genes

**inclusive fitness**
Hamilton rule . . .

assumption: natural selection favors altruistic acts

\[ B = \text{recipient benefit} \]
\[ C = \text{altruist cost} \]
\[ r = \text{coefficient of relatedness} \]

*probability a particular gene will be inherited by a related individual*
- siblings = 50%
- nieces = 25%
- cousins = 12.5%

**do only if**

\[ rB > C \]