

Chapter Outline

45.1 Behavior Has a Genetic Basis

- A. **Behavior** Can be Observed and Described
1. **Mechanistic questions** are answered by describing how an animal is biologically organized and equipped to behave.
 2. **Survival value questions** ask how the behavior helps animals exploit resources, avoid predators, or secure a mate.
 3. Behavior is an observable coordinated response to environmental stimuli.
- B. Inheritance of Migratory Behavior in Birds
1. Migratory birds that are caged and prevented from migrating exhibit migratory restlessness.
 2. Peter Berthold noted that German blackcap warblers migrate to Africa; Cape Verde warblers do not migrate.
 - a. If the migratory behavior was inherited, crossbred birds might show an intermediate behavior.
 - b. Hybrids of German and Cape Verde birds perch-hopped while the Cape Verde birds did not.
 3. Andreas Helbig studied the same warbler species for migration patterns.
 - a. German blackcaps fly southwest to Spain and Africa; Austrian blackcaps fly southeast to Israel and Africa.
 - b. Hybrids in a funnel cage left directional marks showing they were intermediate in flight paths.
 4. Both of these results support the hypothesis that behavior has at least some genetic basis.
- C. Feeding Behavior of Garter Snakes
1. Steven Arnold tested the garter snake (*Thamnophis elegans*) for food preference.
 2. Inland populations are more aquatic and feed on frogs and fish; they refused to feed on slugs.
 3. Coastal populations are more terrestrial and feed on slugs.
 4. The hybrid newborn garter snakes had an intermediate acceptance of slugs.
 5. Work with smell receptors and tongue flicks showed that physiological differences underlie the behavior.
- D. Egg-laying Behavior of the Sea Slug *Aplysia*
1. Sea slug behavior shows endocrine involvement in behavior.
 2. Following copulation, the slug extrudes long strings of eggs and uses its head movements to attach the eggs to rocks.
 3. Scientists isolated an egg-laying hormone (ELH) that causes the animal to lay eggs even if it has not mated.
 4. ELH is a small protein of 36 amino acids that excites the reproductive tract and causes egg expulsion.
 5. Recombinant DNA studies isolated the ELH gene and showed it controls the egg-laying behavior.
- E. Behavior: Nature or Nurture?
1. Twin studies in humans have been used to probe the nature-versus-nurture question.
 2. Fraternal twins in same family are often different; identical twins reared apart are often similar.
 3. 50% of differences in personality traits appear inherited; 50% appear to be due to environmental influence.

45.2 Behavior Undergoes Development

- A. **Fixed Action Patterns (FAPs)**
1. FAPs are always performed the same way and they are elicited by a **sign stimulus**.
 2. Many behaviors formerly thought to be fixed action patterns are found to have developed after practice.
 3. Jack Hailman found that the environment is influential in the development of behavioral responses.
 - a. Laughing gull chicks beg food from parents by pecking at the parents' beaks; however, their accuracy improves with practice.
 - b. The chicks first peck at any beak model; later they only peck at models resembling the parents.

- c. This interaction between chicks and parents suggests there is *learning*.
- B. Operant Conditioning and Imprinting
 1. **Learning** is defined as a durable change in behavior brought about by experience.
 2. **Operant conditioning** is one of many forms of learning.
 - a. In the case of the chicks, there was a gradual strengthening of stimulus-response connections.
 - b. This resulted from reinforcing a particular behavior;
 - c. B. F. Skinner was famous for his studies in operant conditioning, always rewarding animals for the proper response.
 3. **Imprinting**, another form of learning, involves a **sensitive period**.
 - a. Chicks, ducklings, and goslings follow first moving object they see after hatching (usually their mother).
 - b. Douglas Spaulding first observed imprinting; Konrad Lorenz did more extensive work.
 - c. A **sensitive period** is the only period during which a particular behavior such as imprinting, develops.
 - d. Eckhard Hess found that mallard ducks could switch imprinting from humans to female mallards; vocalization is important.
- C. Song Learning in Birds
 1. Work by Peter Marler shows that young birds learn to sing in part from older birds.
 2. Song learning in birds involves a *sensitive period* when an animal is primed to learn; songs heard outside this period have no effect.
 3. Those neurons critical to song production fire when a song of the same bird dialect is heard.
 4. The brain of a bird is primed to respond to acoustic stimuli during the sensitive period; they can learn other species' songs since social influence is very strong.
- D. Human Studies
 1. Swiss psychologist Jean Piaget assigned four stages to child development.
 2. First sensorimotor stage (first two years) involves nonverbal hands-on learning.
 3. Second stage lasts from two to seven years; children assign and manipulate words.
 4. In third stage, from 7 to 12, child begins to classify objects by similarities and differences.
 5. After 12 years, child uses formal logic and experiments with many modes of thinking.

45.3 Behavior Is Adaptive

- A. Behavioral Traits Evolve
 1. Since genes influence behavior, behavior has genetic basis and can evolve.
 2. Behavior evolves to adapt the individual to survive to reproduce; therefore it improves their ability to
 - capture resources and avoid predators.
 3. The reproductive behavior of males and females is related to their anatomy and physiology.
 - a. Males produce sperm in great quantity and compete with other males to inseminate as many females as possible.
 - b. Females who produce few eggs are selective about their mates; this is called **sexual selection**.
- B. Female Choice
 1. Courtship rituals prepare the sexes for mating; they allow for mate recognition and help a female choose a mate.
 2. Gerald Borgia studied the reproductive behavior in satin bowerbirds.
 - a. The **good genes hypothesis** contends that females choose mates based on traits for improving the survival of offspring.
 - b. The **run-away hypothesis** states that females chose mates on basis of traits that attract them to females; the trait can then become exaggerated until it is a handicap.
 - c. The more aggressive males kept their bowers in better condition and were chosen as mates by more females.
 3. Bruce Beehler studied raggiana birds of paradise for sexual selection.
 - a. The males gather in a *lek*, an assembly area where males display courtship behavior.
 - b. The male raggiana is polygynous (has more than one mate) and does not help raise the offspring.
 - c. Since healthy raggiana are parasite free, selection for more feathery males may be related to health.
 - d. An experiment by Anders Moller showed that barn swallow males reared in nests sprayed with mite-killer had longer tails, and females prefer them.

C. Male Competition

1. A benefit versus cost analysis can be applied to competition between males for mates.
2. Baboons have a dominance hierarchy.
 - a. A **dominance hierarchy** is a ranking within a group where the higher ranking individuals acquire more resources.
 - b. Dominance is determined by confrontation where one animal gives way to the other.
 - c. Male baboons are larger and have large canine teeth; they decide when the troop moves, and they defend it.
 - d. Females mate with dominant males when ovulation is near; the dominant males then protect all young.
 - e. The drawbacks to being large and in danger are outweighed by chance of fathering young.
 - f. The subordinate males have less chance to mate but they do have avenues to have some offspring.
3. Red deer stake out a territory.
 - a. **Territoriality** involves defending a particular area against competitors.
 - b. T. H. Clutton-Brock studied reproductive success among red deer on the Scottish island of Rhum.
 - c. A stag competes for females that form a harem that mates only with him.
 - d. A stag remains at peak fighting ability for only a short time; one stag can only father about two dozen offspring.

45.4 Animal Societies

A. Degrees of Sociality

1. Some animals are largely solitary and join with a member of the opposite sex only to reproduce.
2. Others pair, bond, and cooperate in raising offspring.
3. **Society** members are organized in a cooperative manner extending beyond sexual or parental behavior.

B. Communicative Behavior

1. **Communication** is an action by a sender that influences the behavior of a receiver.
2. When the sender and receiver are members of the same species, signals will benefit both the sender and the receiver.
3. Chemical Communication
 - a. These signals are chemicals (e.g., pheromones, urine, and feces) and have the advantage of working both night and day.
 - b. A **pheromone** is a chemical released to cause a predictable reaction of another member of the same species.
 - c. Female moths attract males with tail gland pheromones; cats mark territory with urine, etc., and antelope mark twigs with eye gland secretions.
 - d. Studies of human underarm secretions showed females may have a pheromone causing menstrual synchrony; the steroid androstenol is suspected.
4. Auditory Communication
 - a. Auditory (sound) communication has advantages.
 - 1) It is faster than chemical communication.
 - 2) It is effective both night and day.
 - 3) It can be modified by loudness, pattern, duration, and repetition.
 - b. Male crickets have calls for reproduction.
 - c. Birds have various songs for distress, courting and marking territories.
 - d. Whale songs have six basic themes for sexual and group identification.
5. Language is the ultimate auditory communication.
 - a. Only humans can produce many different sounds and assemble them in many different ways.
 - b. Nonhuman primates are limited to about 40 distinct vocalizations with limited meaning.
 - c. Chimpanzees using artificial language cannot advance beyond the level of a 2-year-old child.
 - d. Chimps appear incapable of using language to reason or of using grammar.
6. Visual Communication
 - a. Visual signals are most often used by species that are active during the day.
 - b. Contests between males make use of threat postures and may prevent fighting.
 - c. Defense and courtship displays are exaggerated and always performed in same way so the meaning is clear.
7. Tactile Communication
 - a. Tactile communication occurs when one animal touches another.

- b. Gull chicks peck at the parent's beak in order to induce the parent to feed them.
 - c. A male leopard nuzzles the female's neck to calm her and to stimulate her willingness to mate.
 - d. In primates, grooming (one animal cleaning the coat and skin of another) helps cement social bonds.
8. Honeybees combine tactile and auditory signals to indicate direction of a food source.
- a. A bee that has located a good source of pollen returns to the hive and conducts a waggle dance.
 - b. Karl von Frisch discovered that the dance consists of a figure-8 pattern with body waggles.
 - c. The number of waggles indicates the distance from the hive.
 - d. The angle of the middle run of the dance indicates the angle to fly relative to the sun.

45.5 Sociobiology and Animal Behavior

A. Sociobiology

1. **Sociobiology** applies the principles of evolutionary biology to the study of social behavior in animals.
2. It is based on a reproductive cost-benefit analysis of the value of living in a society.

B. Group Living

1. There are both benefits and costs to living in a social group.
2. Only if the benefits, in terms of reproductive success, outweigh the disadvantages will societies evolve.
 - a. Advantages to living in a social group might include help to avoid predators, to raise young, and to find food.
 - 1) A herd of impalas has more eyes to see approaching predators, etc.
 - 2) Many fish moving rapidly in a school can distract a predator.
 - 3) The Trumpet Manucode (a bird) pair bonds for life; both sexes are needed to raise the young.
 - 4) Weaver birds form giant colonies to protect them from predators.
 - 5) Primate members signal the group when they find a bountiful fruit tree.
 - 6) Lions working together can capture larger prey such as a zebra or buffalo.
 - b. There are also disadvantages to living in a social group.
 - 1) Disagreements occur between members over the best feeding places and resting sites.
 - 2) Among red deer, subordinate females are at a disadvantage in producing more prolific sons.
 - 3) Primate grooming may be necessary to keep them healthy since parasites spread easily in groups.

C. Altruism Versus Self-Interest

1. **Altruism** may decrease the direct fitness increasing the reproductive success of another member of group.
2. William Hamilton demonstrated that genes are passed in two ways.
 - a. Genes can be passed directly from parents to offspring.
 - b. Genes are also passed by relatives; helping a relative survive and reproduce passes your genes.
3. This genetic benefit of altruism involves **inclusive fitness**, the relative reproductive success of an individual plus that of its close relatives.
 - a. In social insects, altruism is extreme and is explained on the basis that it helps reproducing siblings survive.
 - b. Only the queen among an army ant colony reproduces; the three castes of ants have given up reproducing.
 - c. In social bees and wasps, the queen is diploid but the drone is haploid; therefore sterile female workers are 75 percent related to their nest mates but would be only 50 percent related to their own offspring if they reproduced; thus, it is an advantage to care for the queen and her offspring.
 - d. Male chimpanzees in Africa did not interfere with each other's matings because they shared genes.
4. Helpers at the Nest
 - a. In some species, bird offspring from one clutch of eggs may stay at the nest to help parents rear and feed the next batch of offspring.
 - b. For Florida scrub jays, the number of fledglings produced by an adult pair doubled when they had helpers.
 - c. Mammal offspring also help their parents; African jackals raise 1.4 pups alone; with helpers they raise 3.6.
 - d. Green Wood-hoopoes stay at the nest to help
 - 1) The helper contributes to the survival of its kin.
 - 2) The helper may then inherit a parental territory.
 - 3) Such helping involves a short-term sacrifice to maximize long term reproductive potential.

5. Application to Humans
 - a. Continuous human female sexual receptivity may help to ensure that the male stays around to care for young.
 - b. Tribal systems of more than one husband or wife provide for greater survival and success of genes, depending on whether the resources are plentiful or scarce.
 - c. The application of sociobiology to human populations is controversial; adopting unrelated children is not predicted.