

## Chapter 51 Animal Behavior

## I. Types of Behavior—An Overview

- A. Behavior is action—a response to a stimulus.
  - 1. Proximate causes determine how actions occur.
  - 2. Ultimate causes determine why actions occur.
  - 3. Learning is defined as a change in behavior that results in a specific experience in the life of an individual.
    - a. Example: Spiny lobsters spend the day hiding in cracks and holes in the coral reef and at night, they emerge and wander in search of food.
    - b. Example: This figure is an excellent example of a way to summarize general observations about behavior.
- B. Fixed action patterns (FAPs) are highly stereotypical behavior patterns.
  - 1. FAPs have three characteristics:
    - a. There is almost no variation in how they are performed.
    - b. They are species specific.
    - c. Once the sequence of actions begins, it typically continues until completion.
  - 2. FAPs are examples of innate behavior—types of behavior that are inherited and show little variation based on learning.
  - 3. Hypothesis: Territorial defense in European robins is a FAP that is released by the sight of orange feathers.
  - 4. Example: Marla Sokolowski discovered an important behavioral trait controlled by a single gene. She noticed that some fruit-fly larvae tended to move away from food after eating, while others remained in place. By breeding "rovers" and "sitters" that possessed other distinct genetic markers, Sokolowski and colleagues were able to map the gene responsible for the behaviors.
- C. What Is the Adaptive Significance of FAPs?
  - 1. Natural selection cannot produce adaptations to unusual or "trick" situations.
  - 2. Even though the sign stimuli that release FAPs are extremely simple, they are exceptionally important for the individual's fitness—its ability to survive and produce offspring.
- D. Conditional strategies are behavioral responses that depend on conditions. Example: Female fish that change their sex and become male. In some coral-reef fish, a group of female fish live inside a boundary dominated by one large male fish. When that male dies, the largest female fish changes sex and becomes dominant.

## II. Learning

- A. Simple types of learning consist of classical conditioning and imprinting.
  - 1. In classical conditioning, individuals are trained by experience to give the same response to more than one stimulus—even a stimulus that has nothing to do with the normal response.
  - 2. Upon hatching, ducklings and goslings adopt as their mother the first moving thing they see; this is called imprinting.
  - 3. Imprinting occurs only during a critical or sensitive period.
- B. Birdsong is an example of more complex types of learning.

1. Depending on the species involved, song-learning behavior falls at various locations along the learning continuum.
  2. Example: Song learning is innate in certain species (phoebes), but in other species it has to be learned during a certain critical period (white-crowned sparrows).
- C. Can Animals Think?
1. Cognition can be defined as the recognition and manipulation of facts about the world.
  2. Example: New Caledonian crows have the ability to make tools and solve complex problems, which suggests that they can think.
  3. Hypothesis: Crows appear to understand facts about size and shape of raw materials and the location of food, and they recognize that if materials are chosen or manipulated in a certain way, the resulting structure can be used as a tool to acquire food.
- D. What Is the Adaptive Significance of Learning?
1. Inflexible behavior is adaptive when mistakes would be costly, as when a kangaroo rat jumps to avoid a rattlesnake.
  2. Innate behavior is advantageous when opportunities to learn are few.
  3. Learning tends to have an important influence on behavior if individuals have the opportunity to make mistakes without dying and if they have parents or other sources from which to learn.
    - a. Example: Norway rats are extremely adept at learning to navigate mazes.
    - b. Example: Scrub jays cache seeds and other types of food in storage areas and are proficient at remembering where they are.

### III. How Animals Act: Hormonal Control

- A. Genes create the potential for a certain behavior, but this potential is realized through the interaction of the nervous and endocrine systems, which initiate and modify behaviors.
- B. Examples of the Interaction among Neurons, Hormones, Environment, and Behavior
1. Sexual behavior in *Anolis* lizards
    - a. Males become active in January and begin establishing territories.
    - b. Females lay an egg every 10-14 days; by the end of the breeding season, females will lay an amount of eggs equal to twice their body mass.
    - c. At the proximate level, these seasonal changes in behavior are caused by the sex hormones testosterone and estradiol.
    - d. What environmental cues trigger hormonal secretion?
      - (1) Researchers captured inactive *Anolis* lizards and placed them in five treatment groups in the laboratory, all in springlike environmental conditions:
        - (a) Females alone
        - (b) Females in groups
        - (c) Females paired with males
        - (d) Females with groups of males
        - (e) Females with groups of castrated males
      - (2) Control: Females in the wild, who were inactive and in winter conditions
      - (3) Experiment: Check the ovaries of females in all groups to determine when they begin to produce eggs.
      - (4) Results: Two types of stimulation are necessary to produce the hormonal changes that lead to sexual behavior in female lizards.
        - (a) Springlike light and temperature conditions
        - (b) Exposure to males displaying courtship behavior

- i. Males displaying their dewlaps stimulated females.
- ii. Males lacking a dewlap did not stimulate females.

#### IV. Communication

##### A. Modes of Communication

1. Communication is defined as any process in which a signal from one individual modifies the behavior of a recipient individual.
2. A signal is any information-containing behavior.
3. Communication can be acoustic, visual, olfactory, or tactile.
4. Experiment: Biologists used a speaker to play recordings of red-winged blackbird songs in existing territories.

##### B. A Case History: The Honeybee Dance

1. Example: Karl von Frisch suspected that successful food finders communicate the location of food to other individuals.
2. He observed bees displaying a "round dance" that contained information about the location of food. Workers got the information about the location of food through the dancer's movements.
3. He also observed a "waggle dance" that tells the length of distance the workers must fly, as well as the direction.
4. Von Frisch was able to confirm that the dancing bees were varying their orientation of the waggle, thus communicating the position of the food relative to the sun.

##### C. Honesty and Deceit in Communication

1. Deceiving individuals of another species
  - a. The anglerfish has an appendage that looks remarkably like a minnow and that dangles near its mouth.
  - b. Predatory *Photinus* fireflies can mimic the pattern of flashes by females of several other species.
  - c. Individuals increase their fitness by providing inaccurate or misleading information to members of a different species.
2. Deceiving individuals of the same species
  - a. In some cases, natural selection has also favored the evolution of lying to the same species.
  - b. A male bluegill will imitate a female and get close to another male while he is courting an actual female. Though the male bluegill thinks he is courting two females, while he does this, the female mimic secretly fertilizes the real female's eggs but does not have to care for them.
  - c. Lying works only when it is relatively rare. If deceit becomes extremely common, then natural selection will strongly favor individuals that can detect and avoid or punish liars.

#### V. Orientation, Navigation, and Migration

##### A. Variations in Movement

1. A movement that results in a change in position is called orientation.
2. The simplest type of orientation is called taxis, which involves positioning the body toward or away from a stimulus.
3. Phototaxis is orientation toward light; phonotaxis is orientation toward sound.
4. Hunting bats emit high-pitched sounds and listen for the echo from a flying insect.

##### B. Migration: Why Do Animals Move with a Change of Seasons?

1. Migration is defined as the long-distance movement of a population associated with a change of seasons.
  2. Arctic terns nest along the Atlantic coast of North America, fly south along the coast of Africa to wintering grounds off Antarctica, and then fly back along the eastern coast of South America.
  3. Many of the monarch butterflies native to North America spend the winter in the mountains of central Mexico or southwest California.
  4. Salmon that hatch in rivers along the Pacific Coast of North America and northern Asia migrate to the ocean when they are a few months to several years old. They return to the stream where they hatched to mate and then die.
- C. Navigation: How Do Animals Find Their Way?
1. Piloting, or using familiar landmarks, is used by many species to find their way. Young offspring follow their parents during migrations and appear to memorize the route.
  2. Homing pigeons can always find their way back home, but if their eyes are covered, they fail to navigate only the final stage, suggesting they may use piloting for the final part of a journey.
  3. To determine where north is, animals appear to use the Sun during the day and stars at night.
  4. During cloudy conditions, birds appear to use Earth's magnetic field to orient.

## VI. The Evolution of Self-Sacrificing Behavior

- A. Two Goals of Analyzing the Ultimate Causation of Behavior
1. Why does a particular behavior help produce more offspring?
  2. What is the evolutionary origin of the behavior?
- B. Altruism and Kin Selection
1. Altruism is an act that has cost to the actor, in relation his or her ability to survive and reproduce, and a benefit to the recipient of the altruistic act.
  2. The coefficient of relatedness is a measure of how closely the actor and beneficiary are related. Hamilton's rule states that if the benefits of altruistic behavior are high, if the benefits are dispersed to close relatives, and if the costs are low, then alleles associated with altruistic behavior will be favored by natural selection and will be spread throughout the population.
  3. Kin selection is natural selection that acts through benefits to relatives.
  4. Individuals can pass their alleles on to the next generation not only by having their own offspring but also by helping close relatives produce more offspring. This is called Hamilton's rule.
  5. Reciprocal altruism is an exchange of fitness benefits that are separated in time.