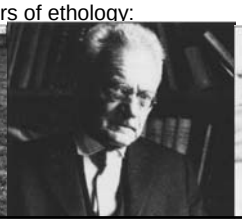
Animal Behavior

Chapter 51

What Is Behavior?

- **Behavior** is what an animal does and how it does it.
  - **Learning** is also considered a behavioral process.
  - Pioneers of ethology:


Proximate vs. Ultimate Causes

- The scientific questions that can be asked about behavior can be divided into two classes:
  - Those that focus on the immediate stimulus and mechanism for the behavior.
  - Those that explore how the behavior contributes to survival and reproduction.

Proximate and Ultimate Questions

- **Proximate**, or "how", questions about behavior focus on the environmental stimuli that trigger a behavior.
  - Focus on the genetic, physiological, and anatomical *mechanisms* underlying a behavioral act.

Proximate and Ultimate Questions

- **Ultimate**, or "why", questions about behavior address the evolutionary significance of a behavior.

Ethology

- **Ethology** is the scientific study of animal behavior, particularly in natural environments.

Behavioral Ecology

- The modern scientific discipline of **behavioral ecology** extends observations of animal behavior by studying: how such behavior is controlled and how it develops, evolves, and contributes to survival and reproductive success.

Sociobiology

- Human culture is related to evolutionary theory in the distinct discipline of **sociobiology**.
  - Human behavior, like that of other species is the result of interactions between genes and environment.

Ethology – basic concepts

- Lorenz and Tinbergen (1938) examined egg rolling behavior in the greylag goose.
  - If the egg slipped away, she continued the motion.
  - Once started, the behavior must be completed in a specific way.
    - **Stereotypical behavior**

Fixed Action Patterns

- A **fixed action pattern (FAP)** is a sequence of unlearned, innate behaviors that is unchangeable.
  - Once initiated, it is usually carried to completion.

Fixed Action Patterns

- A FAP is triggered by an external sensory stimulus known as a **sign stimulus**.
  - The egg, for example.

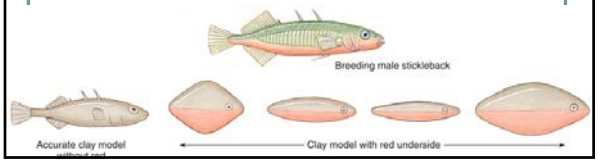
Fixed Action Patterns

- In male sticklebacks, the sign stimulus for attack behavior, is the red underside of an intruder.

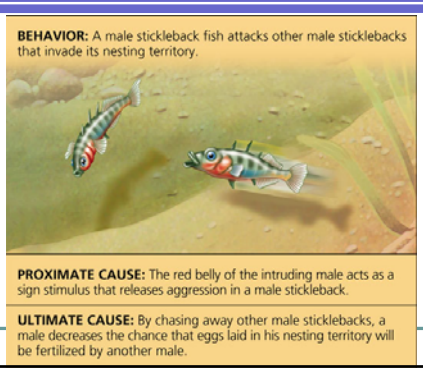
(a) A male three-spined stickleback fish shows its red underside.

Fixed Action Patterns

- When presented with unrealistic models, as long as some red is present, the attack behavior occurs.
- No attack occurs with the realistic model that lacks red.



Fixed Action Patterns



Fixed Action Patterns

- Male English robins will attack a bundle of red feathers placed in their territory, but will ignore a stuffed juvenile (no red).

Fixed Action Patterns

- There are costs involved with attack behavior.
  - Inappropriate attack responses can be costly.
  - Red items are not common in the environment.

Control of Behavior

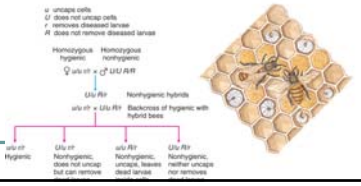
- Biologists study the ways both genes and the environment influence the development of behavioral phenotypes.
- Behavior that is developmentally fixed is called **innate** behavior and is under strong genetic influence.
- Does not need to be practiced.

The Genetics of Behavior

- Hereditary transmission of behavior is often complex.
- Occasionally, a behavior will follow Mendelian rules.

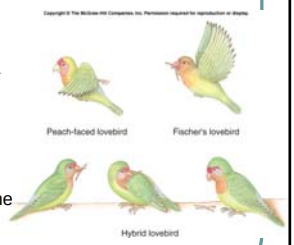
The Genetics of Behavior

- "Hygienic" bees uncap hive cells and remove rotting larvae.
  - Controlled by two genes.
  - Homozygous recessive individuals show the trait.



The Genetics of Behavior

- Hybrids may show intermediate or confused behavior.
- Each species of *Agapornis* has its own method of carrying nest-building material.
  - In the bill
  - Tucked into feathers on the back
  - Hybrids tried both, but performed both incorrectly.



Learning

- **Learning** is the modification of behavior based on specific experiences.
- Learned behaviors range from very simple to very complex.

Habituation

- **Habituation** is a loss of responsiveness to stimuli that convey little or no information.
- If a noxious stimulus is applied, the animal becomes **sensitized** to the stimulus.

Imprinting

- **Imprinting** is a type of behavior that includes both learning and innate components and is generally irreversible.

Imprinting

- Imprinting is distinguished from other types of learning by a **sensitive period** – a limited phase in an animal's development that is the only time when certain behaviors can be learned.

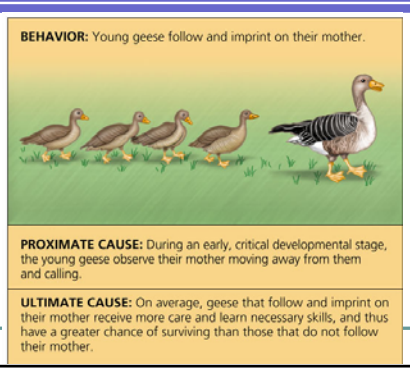
Imprinting

- An example of imprinting is young geese following their mother.

Imprinting

- Konrad Lorenz showed that when baby geese spent the first few hours of their life with him, they imprinted on him as their parent.

Imprinting

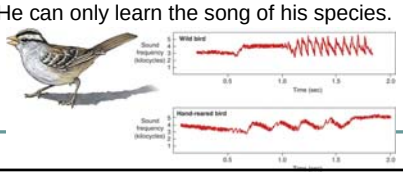


Imprinting

- Conservation biologists have taken advantage of imprinting in programs to save the whooping crane from extinction.

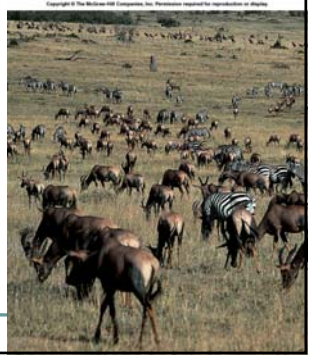
Imprinting

- Young male white crowned sparrows learn their song by listening to their father.
  - A bird raised in isolation will have an abnormal song.
    - If he hears a recording of the song during a critical period, he will learn it – even the local dialect.
  - He can only learn the song of his species.



Social Behavior

- **Social behavior** includes any interaction resulting from a response of one animal to another animal of the same species.



Selective Consequences of Sociality

- Benefits of social behavior:
  - Defense (passive and active) from predators
  - Easier to find a mate
  - Synchronize reproductive behavior (increases likelihood of offspring survival)
  - Parental care increases survival of offspring

Selective Consequences of Sociality

- More benefits:
  - Cooperative hunting
  - Huddling to avoid severe weather
  - Division of labor

Selective Consequences of Sociality

- Learning new techniques.
  - One macaque, Imo, discovered the ease of removing sand by washing sweet potatoes.
    - Behavior spread through the troop.
  - She also found that if she threw wheat mixed with sand into the water, the wheat floats, while sand sinks.
    - This behavior also spread.

Selective Consequences of Sociality

- Disadvantages include:
  - Camouflage may be less effective
  - Not enough food to support numerous individuals.

Social Coordination vs. Cooperation

- **Socially coordinated behavior** occurs when an individual adjusts its behavior when others are present.
  - Agonistic & competitive encounters
  - Territoriality

Social Coordination vs. Cooperation

- **Cooperative behavior** occurs when an individual performs activities that benefit others because this will ultimately be beneficial.
  - Cooperative foraging
  - Cooperative breeding behaviors

Agonistic or Competitive Behavior

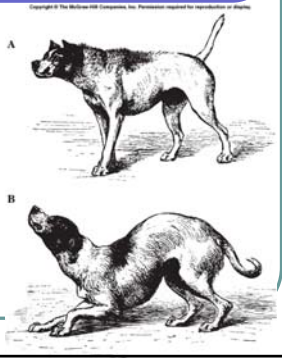
- When resources are limited, **competition** for the limiting resource occurs.
  - Food, water, mates, shelter
  - **Aggressive** or **agonistic** behavior includes physical action or threat that causes another to abandon something.

Agonistic or Competitive Behavior

- **Ritualized threat displays** get the meaning across usually without injury.

Agonistic or Competitive Behavior

- The loser of a ritualized battle will indicate submission to end the encounter quickly.
- Many species set up a dominance hierarchy or pecking order (first observed in chickens).



Territoriality

- **Territory** – a fixed area from which others are excluded.
- **Territoriality** is observed when individuals defend an area that includes a limited resource.
  - **Intraspecific** – exclude only members of the same species.
  - **Interspecific** – exclude any individual that might be after the resource being guarded, regardless of species.

Territoriality

- When territories are first established, there may be more frequent aggressive encounters.
- Songbirds use their song to establish their territory.

Territoriality

- Sea birds defend only a nesting site – so their territories may be quite small.
- Others defend foraging areas as well – these territories are larger.

Home Range

- A **home range** differs from a territory in that it is not defended.
  - Includes the total area an individual utilizes in its activities.
  - An animal may have a larger home range that includes a smaller, defended territory.

Mating Behavior

- Mating behavior is the product of a form of natural selection call **sexual selection**.
- The mating relationship between males and females varies a great deal from species to species.

Mating Systems

- In many species, mating is promiscuous, with no strong pair-bonds or lasting relationships.
- In **monogamous** relationships, one male mates with one female.

Mating Systems

- In **polygyny**, one male mates with many females.
  - The males are often more showy and larger than the females.

Mating Systems

- In **polyandrous** systems, one female mates with many males.
  - The females are often more showy than the males.

Mating Systems

- **Resource-defense polygyny** – males gain access to females indirectly by holding critical resources.
  - Bullfrogs
- **Female-defense polygyny** – females aggregate and can be defended by a male.
  - Elephant seals

Mating Systems

- **Male-dominance polygyny** occurs when females select mates from an aggregation of males.
  - A **lek** is a communal display ground where males try to attract females.
  - Sage grouse

Inclusive Fitness

- **Inclusive Fitness**
  - Many social behaviors are selfish.
  - Natural selection favors behavior that maximizes an **individual's** survival and reproduction.

Altruism

- On occasion, some animals behave in ways that reduce their individual fitness but increase the fitness of others.
- This kind of behavior is called **altruism**.

Altruism

- In naked mole rat populations, nonreproductive individuals may sacrifice their lives protecting the reproductive individuals from predators.

Inclusive Fitness

- Altruistic behavior can be explained by **inclusive fitness** – the total effect an individual has on proliferating its genes by producing its own offspring ***and by providing aid that enables close relatives to produce offspring***.

Hamilton's Rule and Kin Selection

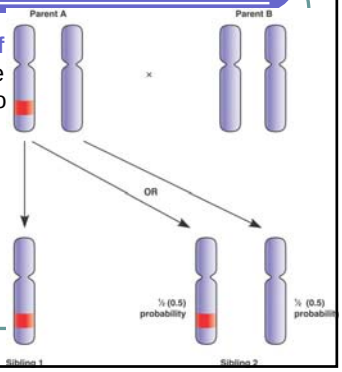
- Hamilton proposed a quantitative measure for predicting when natural selection would favor altruistic acts among related individuals.

Hamilton's Rule and Kin Selection

- The three key variables in an altruistic act are:
  - The benefit to the recipient.
  - The cost to the altruist.
  - The coefficient of relatedness.

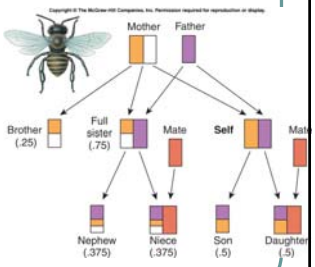
Hamilton's Rule and Kin Selection

- The **coefficient of relatedness** is the probability that two relatives may share the same genes.



Hamilton's Rule and Kin Selection

- In honey bees, most of the females in a colony do not reproduce.
- Female workers can increase their overall fitness by caring for sisters rather than reproducing on their own.



Hamilton's Rule and Kin Selection

- Natural selection favors altruism when the benefit (B) to the recipient multiplied by the coefficient of relatedness (r) exceeds the cost (C) to the altruist.
  - rB > C
- This inequality is called **Hamilton's rule**.

Hamilton's Rule and Kin Selection

- **Kin selection** is natural selection that favors this kind of altruistic behavior by enhancing reproductive success of relatives.

Hamilton's Rule and Kin Selection

- An example of kin selection and altruism is the warning behavior observed in Belding's ground squirrels.

Reciprocal Altruism

- Altruistic behavior toward unrelated individuals can be adaptive if the aided individual returns the favor in the future.
- This type of altruism is called **reciprocal altruism**.
  - Vampire bats

Animal Communication

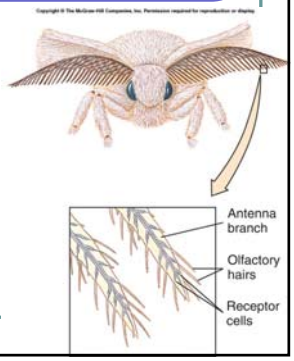
- In behavioral ecology, a **signal** is a behavior that causes a change in another animal's behavior.
- **Communication** is the reception of and response to signals.

Animal Communication

- Animals communicate using visual, auditory, chemical, tactile, and electrical signals.
- The type of signal used to transmit information is closely related to an animal's lifestyle and environment.

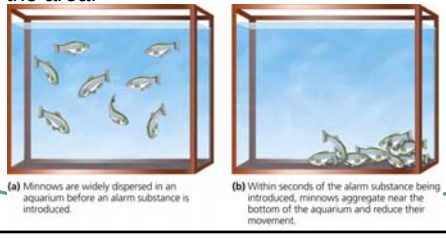
Chemical Communication

- Many animals that communicate through odors emit chemical substances called **pheromones**.
  - Female silkworm moths produce an attractant that is picked up by receptors on the antennae of males.



Chemical Communication

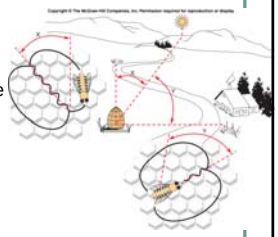
- When a minnow or catfish is injured, an alarm substance in the fish's skin disperses in the water, inducing a fright response among fish in the area.


(a) Minnows are widely dispersed in an aquarium before an alarm substance is introduced.

(b) Within seconds of the alarm substance being introduced, minnows aggregate near the bottom of the aquarium and reduce their movement.

Language of Honey Bees

- Honey bees use dances to communicate the location of food resources.
  - **Round dance** – conveys information about food close to the hive.
  - **Waggle dance** – indicates that a rich food source is farther from the hive and uses the position of the sun relative to the food source. The tempo conveys information about distance.



Communication by Displays

- Animals frequently use ritualized displays to communicate.
- Blue-footed boobies use pair-bonding displays.
  - Intense after a period of separation.

Animal Cognition

- **Cognition** is the ability of an animal's nervous system to perceive, store, process, and use information gathered by sensory receptors.

Animal Cognition

- Problem solving can be learned by observing the behavior of other animals.