BLY 122 Lecture Notes (O'Brien) 2005

Chapter 47—Behavior

I. Causes of Behavior
   A. PROXIMAL CAUSATION
      1. Describes how actions occur in terms of the neurological, hormonal, and skeletomuscular mechanisms that enable the behavior to be performed in the first place.
      2. Views behaviors in terms of their immediate cause and effect.
      3. Example—Birdsong results when specific environmental cues stimulate the release of sex hormones that trigger the brain to cause the syrinx to vibrate, thus producing song.
   B. ULTIMATE CAUSATION:
      1. Describes why actions occur in terms of their adaptive value and effect on reproductive success.
      2 Views behaviors in an evolutionary sense.

II. The Role of Genes & Environment in Behavior (Nature vs Nurture)
   A. Genes and alleles undoubtedly influence most behaviors, but they do not dictate or determine them.
      1. Alcohol Abuse in Humans
         a. Alcoholism tends to run in families, but is the cause genetic or environmental?
         b. Cross-fostering Experiments
            (1) Definition—Young are raised by non-relatives in randomly assigned environments.
            (2) If cross-fostered offspring show the same type of behavior as their genetic parents, then the trait has a strong genetic basis.
            (3) If cross-fostered offspring behave more like their foster parents, then the trait has a strong environmental basis.
         c. Cross-fostering experiments demonstrated that there are two kinds of alcoholism. (**Fig. 47.1**)
            (1) Teen-onset alcoholism has a strong genetic component, regardless of environmental conditions.
            (2) Adult-onset alcoholism is heavily influenced by alcohol abuse in the environment.
      2. In rare cases, a behavior is controlled by a single gene. Example—fruit-fly behavior after feeding.
         a. Some flies move away from their food after feeding ("rovers"), while others remain in place ("sitters").
         b. Breeding experiments enabled the researchers to map the gene responsible for this behavior.
            (1) They named the locus *foraging* (*for*).

(2) Rovers have the *for*^{R} allele, while sitters have the *for*^{S} allele; heterozygotes behave like rovers.

B. The external environment also has a strong influence on genes and behaviors.
   1. Alleles create a predisposition for a certain behavior, but they do not dictate or determine it. Why?
      a. Genes produce proteins that must be expressed.
      b. Expression depends on regulatory molecules, including hormones and other signals.
      c. The amount, timing, and duration of these signals affect the amount of protein produced.
      d. Proteins produced by one gene often interact with other proteins produced by other genes.
   2. The external environment also influences genes.
      a. "Condition-dependent behavior"—Individuals have the genetic tools to act in several different ways.
      b. Example—female fish that change their sex to become male when the dominant male in the population dies.
         (1) The “size-advantage hypothesis” (**Box 47.2**) proposes that switching sex provides the largest female with greater reproductive success.
         (2) The genetic makeup of the fish gives it the capacity to be male or female, but the physical and social environment dictates which behavior is exhibited.

III. Neural and Hormonal Control of Behavior
   A. Genes create the potential for a behavior, but the nervous and endocrine systems initiate and modify most behaviors. Behaviors are realized only through their nervous and hormonal mechanisms.
   B. Examples of the interaction between neurons, hormones, and behavior.
      1. Birdsong in canaries
         a. Male canaries sing only in the spring and are silent in fall and winter.
         b. Hypothesis—Neurons in song centers die each fall and are replaced by new neurons each spring.
            (1) This hypothesis contradicted accepted dogma that vertebrate brains grew few or no new neurons
            (2) Females injected with testosterone and radioactive thymidine to label newly synthesized DNA, which is present in new cells.
               (*a*) Radioactive thymidine was found in song center neurons.
               (*b*) Conclusion—Testosterone caused the song centers to produce new neurons.
            (3) Are the new neurons active in producing song?
               (*a*) Paton and Nottebohm link activity to new neurons.
                  i. Measured electrical activity in specific song center neurons.
                  ii. Injected horseradish peroxidase to stain the active neurons.
               (*b*) Result—Many active neurons also had radioactive thymidine.
               (*c*) Conclusion—New neurons were functioning in the song center. (**Figs. 47.4 and 47.5**)
      2. Sexual behavior in *Anolis* lizards

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. (**Figs. 47.6a and 47.6b**)
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) Inactive *Anolis* lizards captured and placed in five treatment groups in the laboratory, all in spring-like 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. (**Fig. 47.7**)
(*a*) Spring-like 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. The Adaptive Consequences of Behavior
A. Why does behavior occur at all, and what might its function be (ultimate causation)?
B. Evolutionary significance of behavior—Is behavior linked to natural selection?
1. Hypothesis—The sitting behavior in fruit flies is an advantage at low population densities because sitters conserve energy and grow faster. Roving behavior is favored at high population density because it increases the chance of finding uneaten food
2. Predictions of the Hypothesis
a. Sitters should survive better and reproduce more at low population density.
b. At low population density, the for^S allele should increase in frequency relative to the for^R allele.
3. Experiment—Place fruit flies in jars at different population densities, remove random samples of offspring to start each new generation, produce 74 generations.
a. Results—The average roving distance, after feeding, of the flies in the low-density jars decreased; the average roving distance of flies in high-density jars increased. (**Fig. 47.8**)
b. Conclusion—The results support the hypothesis that sitters reproduced more at low population density and rovers reproduced more at high population density.
4. Some variations in behavior allow individuals to survive better and produce more offspring than other individuals not exhibiting the behavior
a. Over time, alleles associated with the advantageous behavior will increase in frequency in the population.

b. Behaviors that are favored by natural selection in a certain environment are called adaptations.

C. Flexible Behavior

1. In most species, individuals have the capacity to act in several different ways. Are these decisions that they make adaptive?
2. Example—Hummingbird behavior in defending feeding territory.
   a. Less “energy-expensive” defensive behaviors include calls and displays.
   b. More energy-expensive defensive behaviors are chasing and fighting. (**Fig. 47.9**)
   c. Hypothesis—Hummingbirds decide which defense behavior to use depending on the value of their territory: if they have just depleted nectar from the flowers, the territory is less valuable.
   d. Prediction—Call and display tactics will be used if nectar has recently been depleted.
   e. Experiment—Place feeders in the wild that release only small amounts of food at a time.
   f. Result—Just after feeding, hummingbirds used calls and displays much more frequently than other behaviors. (**Box 47.3**)
3. Conclusion—Hummingbirds choose among behaviors depending on current conditions, and in an adaptive manner.

D. Selfish Behavior

1. Are most behaviors performed for the benefit of the individual or for the benefit of the species?
2. SELFISH BEHAVIORS Behaviors that somehow benefit the individual performing them.
3. Example—Infanticide behavior in lions and langur monkeys. (**Fig. 47.10a and 47.10b**)
   a Roving males, after taking over a new territory, often kill infants fathered by other males.
   b Hypothesis—Incoming males receive a reproductive benefit from infanticide because mothers of dead infants come into estrus sooner (S. Hrdy).
   c In lion prides, infanticide causes females to enter into estrus an average of 8 months sooner; therefore, males that commit infanticide do better reproductively than those that do not.
4. Selfish behaviors do not exist for the good of the species. They exist because *alleles* that encourage selfish behavior tend to *increase in frequency* in the population.

E. Kin Selection and the Evolution of Cooperation

1. There are many examples of altruistic behavior in nature.
2. ALTRUISM: Any behavioral act that has a cost to the actor in terms of survival or reproductive ability and a benefit to the recipient.
3. Summary—Alleles associated with altruistic behavior can be favored by natural selection and spread in a population if:
   a The benefits of altruistic behavior are high.

b The benefits are dispersed to close relatives.
c The costs to the actor are relatively low.

4. KIN SELECTION—Individuals can pass their genes on to the next generation not only by having their own offspring, but also by helping close relatives produce more offspring.
5. An example: Alarm-calling behavior of prairie dogs. Individuals are more likely to give alarm calls if relatives are present. (**Fig. 47.11**)