**Animal Behavior Notes Guide 2019**

**Concept: Discrete sensory inputs can stimulate both simple and complex behaviors**

-A behavior is the nervous system’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to a stimulus and is carried out by the muscular or the hormonal system

-Behavior is subject to natural selection

-Niko Tinbergen identified four questions that should be asked about animal behavior

1) What stimulus elicits the behavior, and what physiological mechanisms mediate the response?

2) How does the animal’s experience during growth and development influence the response?

3) How does the behavior aid survival and reproduction?

4) What is the behavior’s evolutionary history?

-Behavioral ecology integrates proximate and ultimate explanations for animal behavior

-Proximate causation addresses “how” a behavior occurs or is modified, including Tinbergen’s questions 1 and 2

-Ultimate causation addresses “why” a behavior occurs in the context of natural selection, including Tinbergen’s questions 3 and 4

Fixed Action Patterns

-A fixed action pattern is a sequence of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, innate behaviors that is unchangeable

-Once initiated, it is usually carried to completion

-A fixed action pattern is triggered by an external cue known as a sign stimulus

-Tinbergen observed male stickleback fish responding to a passing red truck

-In male stickleback fish, the stimulus for attack behavior is the red underside of an intruder

-When presented with unrealistic models, the attack behavior occurs as long as some red is present

Migration

-Environmental cues can trigger movement in a particular direction

-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a regular, long-distance change in location

-Animals can orient themselves using

-The position of the sun and their circadian clock, an internal 24-hour clock that is an integral part of their nervous system

-The position of the North Star

-The Earth’s magnetic field

Behavioral Rhythms

-Some animal behavior is affected by the animal’s circadian rhythm, a daily cycle of rest and activity

-Behaviors such as migration and reproduction are linked to changing seasons, or a circannual rhythm

-Daylight and darkness are common seasonal cues

-Some behaviors are linked to lunar cycles, which affect tidal movements

Animal Signals and Communication

-In behavioral ecology, a \_\_\_\_\_\_\_\_\_\_\_\_\_ is a behavior that causes a change in another animal’s behavior

-Communication is the transmission and reception of signals

Forms of Animal Communication

-Animals communicate using \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, chemical, tactile, and auditory signals

-Fruit fly courtship follows a three step stimulus-response chain

-1. A male identifies a female of the same species and orients toward her

-Chemical communication: he smells a female’s chemicals in the air

-Visual communication: he sees the female and orients his body toward hers

-2. The male alerts the female to his presence

-Tactile communication: he taps the female with a foreleg

-Chemical communication: he chemically confirms the female’s identity

-3. The male produces a courtship song to inform the female of his species

-Auditory communication: he extends and vibrates his wing

-If all three steps are successful, the female will allow the male to copulate

-Honeybees show complex communication with symbolic language

-A bee returning from the field performs a dance to communicate information about the distance and direction of a food source

Pheromones

-Many animals that communicate through odors emit chemical substances called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-For example,

-A female moth can attract a male moth several kilometers distant

-A honeybee queen produces a pheromone that affects the development and behavior of female workers and male drones

-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

-Pheromones can be effective at very \_\_\_\_\_\_\_\_\_\_\_\_\_ concentrations

-Nocturnal animals, such as most terrestrial mammals, depend on olfactory and auditory communication

-Diurnal animals, such as humans and most birds, use visual and auditory communication

**Concept: Learning establishes specific links between experience and behavior**

-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ behavior is developmentally fixed and does not vary among individuals

Learning

-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the modification of behavior based on specific experiences

Imprinting

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a behavior that includes learning and innate components and is generally irreversible

-It is distinguished from other learning by a sensitive period

-A sensitive period is a limited developmental phase that is the only time when certain behaviors can be learned

-An example of imprinting is young geese following their mother

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

-The imprint stimulus in greylag geese is a nearby object that is moving away from the young geese

Spatial Learning and Cognitive Maps

-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ learning is a more complex modification of behavior based on experience with the spatial structure of the environment

-Niko Tinbergen showed how digger wasps use landmarks to find nest entrances

Associative Learning

-In \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ learning, animals associate one feature of their environment with another

-For example, a white-footed mouse will avoid eating caterpillars with specific colors after a bad experience with a distasteful monarch butterfly caterpillar

-Classical conditioning is a type of associative learning in which an arbitrary stimulus is associated with a reward or punishment

-For example, a dog that repeatedly hears a bell before being fed will salivate in anticipation at the bell’s sound

-Operant conditioning is a type of associative learning in which an animal learns to associate one of its behaviors with a reward or punishment

-It is also called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_-and-error learning

-For example, a rat that is fed after pushing a lever will learn to push the lever in order to receive food

-For example, a predator may learn to avoid a specific type of prey associated with a painful experience

Cognition and Problem Solving

-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a process of knowing that may include awareness, reasoning, recollection, and judgment

-For example, honeybees can distinguish “same” from “different”

-Problem solving is the process of devising a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to overcome an obstacle

-For example, chimpanzees can stack boxes in order to reach suspended food

-For example, ravens obtained food suspended from a branch by a string by pulling up the string

Social Learning

-Social learning is learning through the observation of others and forms the roots of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-For example, young chimpanzees learn to crack palm nuts with stones by copying older chimpanzees

-For example, vervet monkeys give and respond to distinct alarm calls for different predators

-Culture is a system of information transfer through observation or teaching that influences behavior of individuals in a population

-Culture can alter behavior and influence the fitness of individuals

**Concept: Selection for individual survival and reproductive success can explain most behaviors**

-Behavior enhances survival and reproductive success in a population

Foraging Behavior

-Natural selection refines behaviors that enhance the efficiency of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-Foraging, or food-obtaining behavior, includes recognizing, searching for, capturing, and eating food items

Evolution of Foraging Behavior

-In Drosophila melanogaster, variation in a gene dictates foraging behavior in the larvae

-Larvae with one allele travel farther while foraging than larvae with the other allele

-Larvae in high-density populations benefit from foraging farther for food, while larvae in low-density populations benefit from short-distance foraging

-Natural selection favors different alleles depending on the density of the population

-Under laboratory conditions, evolutionary changes in the frequency of these two alleles were observed over several generations

Optimal Foraging Model

-Optimal foraging model views foraging behavior as a compromise between benefits of nutrition and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of obtaining food

-The costs of obtaining food include energy expenditure and the risk of being eaten while foraging

-Natural selection should favor foraging behavior that minimizes the costs and maximizes the benefits

-Optimal foraging behavior is demonstrated by the Northwestern crow

-A crow will drop a whelk (a mollusc) from a height to break its shell and feed on the soft parts

-The crow faces a trade-off between the height from which it drops the whelk and the number of times it must drop the whelk

Researchers determined experimentally that:

-the total flight height (which reflects total energy expenditure) was minimized at a drop height of
5 m

-The average flight height for crows is 5.23 m

Balancing Risk and Reward

-Risk of predation affects foraging behavior

-For example, mule deer are more likely to feed in open forested areas where they are less likely to be killed by mountain lions

Mating Behavior and Mate Choice

-Mating behavior includes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or attracting mates, choosing among potential mates, competing for mates, and caring for offspring

-Mating relationships define a number of distinct mating systems

Mating Systems and Sexual Dimorphism

-The mating relationship between males and females varies greatly from species to species

-In many species, mating is promiscuous, with no strong pair-bonds or lasting relationships

-In \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ relationships, one male mates with one female

-Males and females with monogamous mating systems have similar external morphologies

-In polygamous relationships, an individual of one sex mates with several individuals of the other sex

-Species with polygamous mating systems are usually sexually dimorphic: males and females have different external morphologies

-Polygamous relationships can be either polygynous or polyandrous

-In polygyny, one male mates with many females

-The males are usually more showy and larger than the females

-In polyandry, one female mates with many males

-The females are often more showy than the males

Mating Systems and Parental Care

-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the young are an important factor constraining evolution of mating systems

-Consider bird species where chicks need a continuous supply of food

-A male maximizes his reproductive success by staying with his mate and caring for his chicks (monogamy)

-Consider bird species where chicks are soon able to feed and care for themselves

-A male maximizes his reproductive success by seeking additional mates (polygyny)

-Certainty of paternity influences parental care and mating behavior

-Females can be certain that eggs laid or young born contain her genes; however, paternal certainty depends on mating \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-Paternal certainty is relatively low in species with internal fertilization because mating and birth are separated over time

-Certainty of paternity is much higher when egg laying and mating occur together, as in external fertilization

-In species with external fertilization, parental care is at least as likely to be by males as by females

Sexual Selection and Mate Choice

-Sexual \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ results from sexual selection, a form of natural selection

-In intersexual selection, members of one sex choose mates on the basis of certain traits

-Intrasexual selection involves competition between members of the same sex for mates

Mate Choice by Females

-Female choice is a type of intersexual competition

-Females can drive sexual selection by choosing males with \_\_\_\_\_\_\_\_\_\_\_\_\_\_ behaviors or features of anatomy

-For example, female stalk-eyed flies choose males with relatively long eyestalks

-Ornaments, such as long eyestalks, often correlate with health and vitality

-Mate-choice \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a behavior in which individuals copy the mate choice of others

-For example, in an experiment with guppies, the choice of female models influenced the choice of other females

Male Competition for Mates

-Male competition for mates is a source of intrasexual selection that can reduce variation among males

-Such competition may involve agonistic behavior, an often ritualized contest that determines which competitor gains access to a resource

Applying Game Theory

-In some species, sexual selection has driven the evolution of alternative mating behavior and morphology in males

-The fitness of a particular phenotype (behavior or morphology) depends on the phenotypes of other individuals in the population

-Game theory evaluates alternative strategies where the outcome depends on each individual’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and the strategy of other individuals

-For example, each side-blotched lizard has a blue, orange, or yellow throat

-Each color is associated with a specific strategy for obtaining mates

-Orange-throat males are the most aggressive and defend large territories

-Blue-throats defend small territories

-Yellow-throats are nonterritorial, mimic females, and use “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_” strategies to mate

-Like rock-paper-scissors, each strategy will outcompete one strategy but be outcompeted by the other strategy

-The success of each strategy depends on the frequency of all of the strategies; this drives frequency-dependent selection

**Concept: Inclusive fitness can account for the evolution of behavior, including altruism**

-Animal behavior is governed by complex interactions between genetic and environmental factors

-Selfless behavior can be explained by inclusive fitness

Genetic Basis of Behavior

-A master regulatory \_\_\_\_\_\_\_\_\_\_\_\_\_\_ can control many behaviors

-For example, a single gene controls many behaviors of the male fruit fly courtship ritual

-Multiple independent genes can contribute to a single behavior

-For example, in green lacewings, the courtship song is unique to each species; multiple independent genes govern different components of the courtship song

-Differences at a single \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can sometimes have a large effect on behavior

-For example, male prairie voles pair-bond with their mates, while male meadow voles do not

-The level of a specific receptor for a neurotransmitter determines which behavioral pattern develops

Genetic Variation and the Evolution of Behavior

-When behavioral variation within a species corresponds to environmental variation, it may be evidence of past evolution

Altruism

-Natural selection favors behavior that maximizes an individual’s survival and reproduction

-These behaviors are often selfish

-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, or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-For example, under threat from a predator, an individual Belding’s ground squirrel will make an alarm call to warn others, even though calling increases the chances that the caller is killed

-For example, in naked mole rat populations, non-reproductive individuals may sacrifice their lives protecting their reproductive queen and kings from predators

Inclusive Fitness

Altruism can be explained by inclusive fitness

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ fitness is the total effect an individual has on proliferating its genes by producing offspring and helping close relatives produce offspring

Hamilton’s Rule and Kin Selection

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

-Three key variables in an altruistic act

-Benefit to the recipient (B)

-Cost to the altruistic (C)

-Coefficient of relatedness (the fraction of genes that, on average, are shared; r)

-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ selection is the natural selection that favors this kind of altruistic behavior by enhancing reproductive success of relatives

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

-In a group, most of the females are closely related to each other

-Most alarm calls are given by females who are likely aiding close relatives

-Naked mole rats living within a colony are closely related

-Nonreproductive individuals increase their inclusive fitness by helping the reproductive queen and kings (their close relatives) to pass their genes to the next generation

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

-Reciprocal altruism is limited to species with stable social groups where individuals meet repeatedly, and cheaters (who don’t reciprocate) are punished

-Reciprocal altruism has been used to explain altruism between unrelated individuals in humans

-In game theory, a tit-for-tat strategy has the following rules:

-Individuals always cooperate on first encounter

-An individual treats another the same way it was treated the last time they met

That is, individuals will always cooperate, unless their opponent cheated them the last time they met

Evolution and Human Culture

-No other species comes close to matching the social learning and cultural transmission that occur among humans

-Human \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is related to evolutionary theory in the distinct discipline of sociobiology

-Human behavior, like that of other species, results from interaction between genes and environment

-However, our social and cultural institutions may provide the only feature in which there is no continuum between humans and other animals