NEW UPDATED COURSE

Zoo 403 ANIMAL BEHAVIOR

HANDOUTS (1-72)

BS ZOOLOGY

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Animal Behavior

ZOO 403 HANDOUTS

Introduction

Behaviour can be defined as an expressed course of action produced in organisms in response to stimulus from a given situation.

It could simply be considered as what the animal does. The fundamental explanation of behavioural activity must begin with a stimulus and end with a response.

Stimulus: Any change in the biotic and abiotic environments capable of eliciting or causing some sort of reaction or response in a living organism. For example, temperature, pressure, radiation, gravity, or activities of other organisms within the immediate environment.

Approaches to behavioural studies

i. **Vitalistic approach**

Behavioural activities are explained in terms of what animals are seen to do in relation to changes in the environment. It involves total rejection of any study of the animal outside its natural environment. The technique is non-scientific since all the observations relate to past events which cannot be tested experimentally.

ii. **Mechanistic approach**

It is an experimental approach and involves the study of particular aspects of behaviour under controlled conditions in a laboratory. It was pioneered by Pavlov and used extensively in psychological study. It may be criticized on the basis of the artificiality of the experimental conditions and the way in which results are interpreted.

iii. **Ethological approach**

Ethology is the scientific study of animal behaviour. It explains responses observed in the field in terms of stimuli eliciting the behaviour. This was pioneered by Lorenz, von Frisch and Tinbergen. Ethologists have so far tried to answer questions about animal behaviour from four major areas:

1. **The evolutionary history:**

-How did various forms of behaviour evolved? i.e. (Innate/instinctive/genetic or learned?)

-How does the behaviour compare with similar behaviour in related species?

2. **Development:**

- How does behaviour change with age?
- What are the early experiences necessary for the behaviour to expressed?
- How does courtship behaviour develop during the individuals' life?
- Does the male in domestic fowl learn the waltz dance?
- Does he practice dancing?
- Is he successful in directing the female?

3. Causation:

-What are the stimuli that elicit the response?

-How has it been modified by recent learning?

3. Function:

-How does the behaviour impact on the animal's chances of survival and reproduction?

Topic-01 Animal Behavior: Basics

Animal Behavior

The sum of responses made by an animal to the external and internal stimuli is called behavior.Behavior is based on physiological systems and processes of the animal.

Ethology

The scientific study of animal behavior in their natural environment is called as ethology.

Examples of Behavior

The behaviors may be as simple as moving towards or away from light to the complex behaviors e.g.

- Territory defense
- Courtship and mating
- Liking, disliking and fighting or caring
- Migration and navigation
- Building hives, nests or dens
- Producing voices or songs
- Recognition and communication
- Procuring food
- Learning and memorizing

Behavior is Subject to Natural SelectionMost of the animal behaviors are essential for survival and reproduction.So the development of behavior has remained subject to substantial natural selection. Natural

selection contributed to the anatomical development of nervous system as well as enhancing the physiological features that contributed to the evolution of complex behavioral patterns.

Objectives of Ethology

1. Understanding the stimuli that elicit behavior.
2. Understanding the physiological mechanisms that mediate the response.
3. Understanding how an animal's experience during growth and development influence the response.
4. Understanding how the behavior aids in survival and reproduction.
5. Understanding the behavior's evolutionary history.

Topic-02 Scientific Approaches to Study Animal Behavior

Behavioral scientists have taken two complementary approaches to understand animal behavior.

1. Neuroethological approach
2. Ethological approach

Neuroethological Approach

The neuroethological approach involves bringing the animal into the laboratory and observing its behavior in a very simplified set of well-defined circumstances.

Simplified Set of Circumstances

In the laboratory:

- there are no predators
- the number and sex of conspecifics (members of the same species) are controlled by the experimenter
- there are unusual lights, smells and sounds
- the animal is often limited to a relatively small and confined space

Study of Behavior with Neuroethological Approach

- The neuroethological approach focuses on the study of neuronal responses generated during the manifestation of an animal’s behavior.
- In some cases, the nervous system of animal is exposed surgically to allow the experimenter to record from neurons while behavior is going on.
- Studies under these reduced conditions are useful for obtaining answers to many questions about behavior.
- However, the results from such experiments can be difficult to translate into an understanding of how animals deal with challenges in their everyday lives in natural environment.

Ethological Approach

- The ethological approach is to go into the field and observe the animal's behavior in its natural environment.
- Observing animals in their normal state is an ancient practice.
- However, for a physiologist, these natural conditions raise severe problems that differ from those created by laboratory conditions.

While observing an animal in its natural setting, it is impossible to record activity from the animal's nervous system that is involved in producing behavior.

Lesson no. 5-6 Nervous System and Behaviour

Neuron transfer the signals in the form of nerve impulse or action potential.

Neuron's plasma membrane is the key factor for the nerve impulse. Changes in this membrane permeability and the subsequent movement of ions produce a nerve impulse that travels along the plasma membrane of the dendrites, cell body, and axon of each neuron.

Resting membrane potential

A "resting" neuron is not conducting a nerve impulse.

The plasma membrane of a resting neuron is polarized; the fluid on the inner side of the membrane is negatively charged with respect to the positively charged fluid outside the membrane. The difference in electrical charge between the inside and the outside of the membrane at any given point is due to the relative numbers of positive and negative ions in the fluids on either side of the membrane, and to the permeability of the plasma membrane to these ions. The difference in charge is called the resting membrane potential. All cells have such a resting potential, but neurons and muscle cells are specialized to transmit and recycle it rapidly. The resting potential is measured in millivolts (mV). A millivolt is 1/1,000 of a volt. Normally, the resting membrane potential is about -70 mV, due to the unequal distribution of various electrically charged ions. Sodium (Na) ions are more highly concentrated in the fluid outside the plasma membrane, and potassium (K) and negative protein ions are more highly concentrated inside.

The Na and K ions constantly diffuse through ion channels in the plasma membrane, moving from regions of higher concentrations to regions of lower concentrations. (There are also larger Cl+ ions and huge negative protein ions, which cannot move easily from the inside of the neuron to the outside.) However, the concentrations of Na and K ions on the two sides of the membrane remain constant due to the action of the sodium potassium ATPase pump, which is powered by ATP. The pump actively moves Na ions to the outside of the cell and K ions to the inside of the cell. Because it moves three Na molecules out for each two K molecules that it moves in, the pump works to establish the resting potential across the membrane. Both ions leak back across the membrane down their concentration gradients. K ions, however, move more easily back to the outside, adding to the positive charge there and contributing to the membrane potential of -70 mV.

Action potential

Changing the resting electrical potential across the plasma membrane is the key factor in the creation and subsequent conduction of a nerve impulse. A stimulus that is strong enough to initiate an impulse is called a threshold stimulus. When such a stimulus is applied to a point along the resting plasma membrane, the permeability to Na ions increases at that point. The inflow of positively charged Na ions causes the membrane potential to go from -70 mV toward 0. This loss in membrane polarity is called depolarization.

When depolarization reaches a certain level, special Na channels (voltage-gated) that are sensitive to changes in membrane potential quickly open, and more Na ions rush to the inside of the neuron. Shortly after the Na ions move into the cell, the Na gates close, but now voltage-gated K channels open, and K ions rapidly diffuse outward. The movement of the K ions out of the cell builds up the positive charge outside the cell again, and the membrane becomes repolarized. This series of membrane changes triggers a similar cycle in an adjacent region of the membrane, and the wave of depolarization moves down the axon as an action potential. Overall, the transmission of an action potential along the neuron plasma membrane is a wave of depolarization and repolarization. After each action potential, there is an interval of time when it is more difficult for another action potential to occur because the membrane has become hyperpolarized (more negative than -70 mV) due to the large number of K ions that rushed out. This brief period is called the refractory period. During this period, the resting potential is being restored at the part of the membrane where the impulse has just passed. Afterward, the neuron is repolarized and ready to transmit another impulse. A minimum stimulus (threshold) is necessary to initiate an action potential, but an increase in stimulus intensity does not increase the strength of the action potential. The principle that states that an axon will "fire" at full power or not at all is the all-or-none law. Increasing the axon diameter and/or adding a myelin sheath increases the speed of conduction of a nerve impulse. Axons with a large diameter transmit impulses faster than smaller ones. Large diameter axons are common among many invertebrates (e.g., crayfishes, earthworms).

Most vertebrate axons have a diameter of less than 10 µm; however, some fishes and amphibians have evolved large, unmyelinated axons 50 µm in diameter. These extend from the brain, down the spinal cord, and they activate skeletal muscles for rapid escapes. Regardless of an axon's diameter, the myelin sheath greatly increases conduction velocity. The reason for this velocity increase is that myelin is an excellent insulator and effectively stops the movement of ions across it. Action potentials are generated only at the neurofibril nodes. In fact, the action potential "jumps" from one node to the next node. For this reason, conduction along myelinated fibers is known as saltatory conduction (L. saltire, to jump). It takes less time for an impulse to jump from node to node along a myelinated fiber than to travel smoothly along an unmyelinated fiber. Myelination allows rapid conduction in small neurons and thus provides for the evolution of nervous systems that do not occupy much space within the animal.

Transmission of the action potential between cells

After an action potential travels along an axon, it reaches the end of a branching axon terminal called the end bulb. The synapse (Gr. synapsis, connection) is the junction between the axon of one neuron and the dendrite of another neuron or effector cell. The space (junction) between the end bulb and the dendrite of the next neuron is the synaptic cleft. The neuron carrying the action potential toward a synapse is the presynaptic ("before the synapse") neuron. It initiates a response in the receptive segment of a postsynaptic ("after the synapse") neuron leading away from the synapse. The presynaptic cell is always a neuron, but the postsynaptic cell can be a neuron, muscle cell, or gland cell. Synapses can be electrical or chemical. In an electrical synapse, nerve impulses transmit directly from neuron to neuron when positively charged ions move from one neuron to the next. These ions depolarize the postsynaptic membrane, as though the two neurons were electrically coupled. An electrical synapse can rapidly transmit impulses in both directions. Electrical synapses are common in fishes and partially account for their ability to dart swiftly away from a threatening predator. In a chemical synapse, two cells communicate by means of a chemical agent called a neurotransmitter, which the presynaptic neuron releases. A neurotransmitter changes the resting potential in the plasma membrane of the receptive segment of the postsynaptic cell, creating an action potential in that cell, which continues the transmission of the impulse.

When a nerve impulse reaches an end bulb, it causes storage vesicles (containing the chemical neurotransmitter) to fuse with the plasma membrane. The vesicles release the neurotransmitter by exocytosis into the synaptic cleft.

One common neurotransmitter is the chemical acetylcholine; another is norepinephrine. (More than 50 other possible transmitters are known.) When the released neurotransmitter (e.g., acetylcholine) binds with receptor protein sites in the postsynaptic membrane, it causes a depolarization similar to that of the presynaptic cell. As a result, the impulse continues its path to an eventual effector. Once acetylcholine has crossed the synaptic cleft, the enzyme acetylcholinesterase quickly inactivates it. Without this breakdown, acetylcholine would remain and would continually stimulate the postsynaptic cell, leading to a diseased state. You have probably created a similar diseased state at the synapses of the fleas on your dog or cat. The active ingredient in most flea sprays and powders is parathion. It prevents the breakdown of acetylcholine in the fleas, as well as pets and people. However, because fleas are so small, the low dose that immobilizes the fleas does not affect pets or humans.

Topic-07 Neurosensory Basis of Behavior

Role of Nervous System in Behavior

Nervous system plays an essential role for the human and other animal's behaviors.

The behavior of an organism is manifested in response to the stimuli from the environment. The stimuli act as sensory input for the nervous system. In response to the sensory input, nervous system produces motor output that controls the contraction of muscles.

All behavioral acts are generated by this motor output of the nervous system.

Complexity of Behaviors

Some of these input-output relations are simple and predictable reflexes. Other kinds of behavior are highly dependent on information stored from past experience, and therefore are less predictable to an observer.

Neuronal Networks Underlie All Behaviors

The hardware underlying all behavior is composed of neuronal networks i.e. interconnecting circuits of neurons.

Lower animals with simple behavioral patterns have simple neural network.

The neural circuitry is more complex in animals with a centralized nervous system.

As the interneurons of the CNS increase, the behavioral potential of animal also increases.

Higher animals with complex CNS have developed the ability to learn from experience and to associate combinations of stimuli.

The complex behaviors, learning and memory have neurophysiological basis, rooted in the vast array of neural circuitry lying between the afferent sensory pathways and efferent motor pathways.

Topic-08 Neuronal Plasticity

Although the basic architecture of the nervous system is established during embryonic development, the behavioral patterns can modify with experience. This capacity of nervous system to change with experience is known as neuronal plasticity.

Neuronal plasticity is of premier importance for the survival of any organism.

Examples of Neural Plasticity

- Learning, memory and development of motor skills and habits.

- Neural plasticity lies behind human intelligence.
- The ability of all higher animals to respond to stimuli in diverse ways, different from fixed and programmed reflexes.
- Behavioral plasticity, virtually demonstrated by all animals.

Mechanism of Neuronal Plasticity

Much of the reshaping of the nervous system occurs at synapses.

The mechanisms that underlie synaptic plasticity are currently the subject of many experiments.

Modifying Synapses—Synaptic Plasticity

Synaptic plasticity may take place as a result of developmental events over the course of a lifetime.

Synaptic connections that are established in embryos are later refined into adult patterns.

Later, changes in synaptic strengths result in learning and memory at mature synapses.

Changes in mature synapses involved in learning and memory depend on a retrograde (reverse) signal that is sent from the postsynaptic neuron to the presynaptic neuron.

Mechanisms of Synaptic Plasticity

Change in mature synapses i.e. synaptic plasticity occurs by two types of mechanisms:

(1) Presynaptic mechanisms:

Involve changes in the functioning of presynaptic terminals.

For example, a change in the amount of transmitter released from presynaptic terminals.

(2) Postsynaptic Mechanisms:

Involve changes in the postsynaptic neurons.

For example, a change in the postsynaptic apparatus that results in altered amplitude of depolarizations.

Topic-15 Inborn, Innate or Instinctive Behaviors

Inborn, Innate or Instinctive Behaviors

The inborn or innate behaviors are developmentally fixed particular complex behaviors exhibited by most members of a species.

These behaviors are built-in part of the nervous system at the time of birth or develop at an appropriate point in maturation.

Such behaviors are also known as instinctive behaviors which are different from reflexes, which are simple responses of an organism to a specific stimulus.

Genetic Basis of Instinctive Behaviors

Innate behaviors are closely controlled by genes with little or no environmental influence.

The responses to particular stimuli or situations are determined by neural programmes which are encoded by the hereditary material. These programmes contain information for anatomical and physiological organization of the nervous system.

Exhibition of Instinctive Behaviors

Innate behaviors do not have to be learned or practiced.

They are performed in a reasonably complete form even when they are exhibited first time by the individual, without prior exposure or experience.

The innate behaviors can often be modified through experience but only to a limited extent.

Examples

- A human new born will turn to suckle when brought near the mother's breasts.
- Sea turtles, newly hatched on a beach, will automatically move toward the ocean.
- A marsupial climb into its mother's pouch upon being born.
- Animal fighting, animal courtship behaviors, internal escape functions and building of nests are also instinctive behaviors.

Importance of Innate Behaviors

Innate behaviors usually involve basic life functions that are important in the survival.

They are especially important for those animals that have short life spans and poorly developed nervous coordination.

Innate Behaviors in Higher Animals

The role of instincts in determining the behavior of animals varies from species to species.

In animals with more complex neural systems, there is greater role of cerebral cortex and social learning, so instincts play a lesser role.

Lesson no. 21-26 Animal Orientation, Kinesis and Taxis

Orientation is spatial arrangement of animals in the environment. Kinesis and taxis are the part of orientation.

1. Taxis

Taxis is the simplest type of innate or stereotyped behaviour. It is an orientation of an animal (directed either towards or away) in response to the source of stimulus. If the orientation is towards the stimulus it is called as positive taxis and if it is away from the stimulus it is known as negative taxis.

Taxes are usually named after the stimuli. Hence there are phototaxis, chemotaxis, thermotaxis, geotaxis etc. A plant or animal that move towards light shows positive phototaxis. Certain burrowing animals like rodents or planaria that more away from the source of light exhibits negative phototaxis.

Example for positive phototaxis

The protozoan, Euglena response to a variety of stimuli and is very sensitive to light. It swims towards light; hence it shows positive phototaxis. This behaviour is of distinct advantage to the animal because light is

necessary for assimilation of CO2 by the chlorophyll. If a dish a containing Euglena is covered on one half and the other half is exposed to light it is seen that euglena will avoid the dark region and will aggregate in the bright region of the dish.

It is seen that euglena will orient itself parallel to the source of light. It is able to respond positively to the source of light stimulus due to the presence of the paraflegellar body, a photoreceptor located in front of the eyespot or stigma. When the shadow of the eye spot falls on the paraflagellar body it will turn its head till the photoreceptor organ is directed towards the source of light and the animal will move towards the light source. If the position of the source of light is changed, once again the euglena will turn its head so that light falls on the paraflagellar body and the animal orients itself towards the source of light.

Example for negative phototaxis

Maggots that are about to pupate moves away from light source towards a dark location hence they show negative phototaxis. When maggots are kept on a surface illuminated by a beam of light, it will move away from the source of light more or less in a straight line. However, it will often move its head from side to side measure the intensity of light with its single light receptor located on the head. If the intensities on both the sides are equal, then the animal's body is oriented along the beam of light. By comparing successive light intensities, the maggots are able to orient itself so as to crawl away from the light source. The periodic lateral movement of the head ensures the animal that it is on the right track, that is away from the light source.

2. Kinesis

Kinesis is a type of locomotory behaviour in relation to the source of stimulus. The animal responds to the variation in the intensity of the stimulus and not the source of direction of the stimulus. To respond to such stimulus, the animal only requires sense organs sensitive to variation in stimulus intensity.

There are two types of kinesis

a. Orthokinesis

b. Klinokinesis

Ortho kinesis:

It is a response that involves changes in the speed of movement of the whole body in response to stimuli like humidity, preserve and diffused light.

For example, Wood louse, Porcellerio scaber, a small crustacean that live in damp areas, and they tend to lose water from their body fairly rapidly when exposed to low humidity. When wood lice are kept at the junction in a choice chamber where one side has high humidity and the other half has low humidity. It is noticed that after a short while the wood lice begin to move and the speed of movement and the rate of turning is greatest in the driest part of the chamber and least in the humid part. This increased and apparently random movement is an attempt by the animal to remain in the most favorable environment.

Klinokinesis:

In Klinokinesis the speed of locomotion remains constant but the rate at which the animal changes direction depends on the intensity of the stimulus.

For example, a planaria changes its direction ever so often as it crawls. If the light intensity above the animal is increased, it changes direction more frequently but moves at the same speed. The 7 increase in rate of turning falls after sometime but increases again with a further increase in the intensity of light.

3. Reflexes

A simple movement of a part of the animal in response to a stimulus is called reflex. It is a quick, innate and immediate response of a part of the body to an external or internal stimulus, which has great adaptive and survival value to the organism. Reflexes are inherited and unlearned behaviour found in all members of the species. The knee-jerk, constrict of pupil of eye in the bright light, blinking of eye, peristalsis, coughing etc. in man, flight in birds, web spinning in spiders are all examples of reflexes. A reflex action requires a reflex arc which consists of a sensory organ (receptor), a sensory nerve (afferent nerve), the spinal cord or brain, an intermediate motor or efferent nerve and a motor organ or effector.

A reflex action thus involves the sense organs and nervous system. The stimulus is received by the receptor or sense organ which sets up a sensory impulse. This impulse is transmitted to the central nervous system (brain and spinal cord) through the intermediate nerve. This motor impulse is transmitted to the effector or motor organ, muscles and glands which either contract or secrete in response to the stimulus. Many pattern of animal behaviour are complex combinations of simple reflex.

Advantages of reflex

1. Enables the animal to respond immediately to harmful stimuli hence it has great adaptive and survival value.

2. Since many of the reflex actions are controlled by the spinal cord, it relieves the brain from too much work.

4. Fixed Action Pattern

A fixed action pattern (FAP) is a sequence of unlearned, innate behaviour that is unchangeable. Once initiated; it is usually carried to completion. It is hardwired, however, not purely genetic, may improve with experience. FAP is triggered by an external sensory stimulus known as “sign stimulus”.

This term is often associated with Konrad Lorenz, who is the founder of the concept. Lorenz identified six characteristics of fixed action patterns.

These characteristics state that fixed action patterns are stereotyped, complex, species-characteristic, released, triggered, and independent of experience.

Examples of FAPs

1. Male three-spined stickleback fish

Male three-spined stickleback fish have red bellies. A male perceives other males with red bellies, coming to their nesting territories as invaders. So they start showing off aggressive attacking behavior. It attacks anything with red underside even unrealistic models and objects. Red underside is a sign stimulus. Aggressive attacking behavior is an instinct (fixed action pattern).

2. Communication in bees

Honey bee dancing is also one of the most fascinating behaviors in animal life. The dance is performed by a worker bee that has returned to the honey comb with pollen or nectar, the dances, constitute a language that “tells” other workers where the food is. By signaling both distance and direction with particular movements, the worker bee uses the dance language to recruit and direct other workers in gathering pollen and nectar.

In 1973, Karl von Frisch was awarded the Nobel Prize for his research on the honey bee waggle dance. He and his students carried out decades of research in which they carefully described the different components of each dance.

Their experiments typically used glass-walled observation hives and paint-marked bee foragers. First, they trained the foragers to find food at sources placed at known distances from the colony. When the bees returned from gathering food from those sources, they carefully measured both the duration and angle of the dances the foragers performed to recruit other bees to help gather food. Their findings led them to the concept of a dance language.

When a food source is very close to the hive (less than 50 meters), a forager performs a round dance. A round dance, communicates distance ("close to the hive," but not direction.

Food sources that are at intermediate distances, between 50 and 150 meters from the hive, are described by the sickle dance. This dance is crescent-shaped and represents a transitional dance between the round dance and a waggle dance. The waggle dance or wag-tail dance, is performed by bees foraging at food sources that are more than 150 meters from the hive. This dance, communicates both distance and direction. While running the straight-line course of the dance, the bee's body, especially the abdomen, wags vigorously from side to side. This vibration of the body produces a tail-wagging motion. At the same time, the bee emits a buzzing sound, produced by wingbeats at a low audio frequency of 250 to 300 hertz or cycles per second.

3. Herring gull experiment by Niko Tinbergen

Releasers (red spot on the bill) initiate behaviour automatically. From birth, herring gull chicks peck at a red spot on their parent's bill in order to get food. They will also readily peck at red dots on the end of a wagging pencil, and a wagging model with the red spot on its head. Herring gull chicks respond poorly to stationary models and models with no spot.

Laysan albatross feeding chick

Topic-28-29 Habituation and Imprinting

Learning Behaviors

Most behaviors are variable with experience. Such behaviors are known as learning behaviors. Habituation and imprinting are two of the many examples of learning behaviors.

Habituation

Habituation is one of the simplest forms of learning.

In habituation, an animal learns to ignore a repeated, irrelevant stimulus.

It is defined as a loss of responsiveness to stimuli that convey little or no new information.

Example

Many mammals and birds recognize alarm calls of members of their species.

However, if these calls prove fake repetitively, they stop responding (the "cry-wolf" effect).

An example of learning by habituation is observed in squirrels.

When one squirrel feels threatened, the others hear its signal and go to the nearest refuge.

However if the signal comes from an individual who has caused many false alarms, its signal is ignored.

Significance

By habituation to unimportant stimuli, an animal conserves energy and time that are better spent on other important functions.

Imprinting

Imprinting is the formation of a long-lasting behavioral attachment to a particular individual or object at a specific stage in life.

It is a type of learning in which a very young animal fixes its attention on the first object with which it has visual, auditory or tactile experience and thereafter follows that object.

Sensitive or Critical Period

Imprinting usually forms only during a specific sensitive period, also called a critical period, a limited developmental phase when certain behaviors can be learned.

During the sensitive period, the young imprint on their parent and learn the basic behaviors of their species, while the parent learns to recognize its offspring.

Examples

Among gulls, the sensitive period for a parent to bond with its young lasts one to two days. If bonding does not occur, the parent will not care for the infant, leading to death for the offspring.

Another example comes from the classic experiment of Konard Lorenz who conducted experiments with geese. He made the goslings to imprint on him. These goslings followed him as though he was their mother.

Topic-30 Associative Learning

A learning that involves making associations between experiences.

Example

If a white-footed mouse bites a brightly colored caterpillar that tastes bad, the mouse avoids attacking insects of similar appearance in future.

The ability to associate one environmental feature (such as a color) with another (such as a foul taste) is called associative learning.

Types of Associative learning

Associative learning can be divided into two types:

- Classical conditioning
- Operant conditioning

Classical Conditioning

In classical conditioning, an arbitrary stimulus becomes associated with a particular outcome.

Example

Russian physiologist Ivan Pavlov carried out early experiments in classical conditioning, demonstrating that if he always rang a bell just before feeding a dog, the dog would eventually salivate at the bell's sound alone, in anticipation of food.

Operant Conditioning

In operant conditioning, also called trial-and-error learning, an animal learns to associate one of its own behaviors with a reward or punishment and then tends to repeat or avoid that behavior.

Example

A predator may learn to avoid certain kinds of potential prey if they are associated with painful experiences.

Similarly, an animal may repeat an action that has resulted in a surprise finding of food. For example, in a classic experiment, a rat was trained through repeated trials to obtain food by pressing a lever

Topic-31 Insight learning

This is the highest form of learning which does not result from immediate trial and-error learning but may be based on information previously learned by other behavioral activities.

In insight learning, the animal uses cognitive or mental processes to associate experiences and solve problems.

The classic example is the work of Wolfgang Kohler (1887–1967) on chimpanzees that were trained to use tools to obtain food rewards. One chimpanzee was given some bamboo poles that could be joined to make a longer pole, and some bananas were hung from the ceiling. Once the chimp formed the longer pole, it used the pole to knock the bananas to the cage floor. Kohler believed that the animal used insight learning to get the bananas.

Insight learning is widely regarded as the most advanced form of learning. Responses produced by insight are those resulting from a rapid appreciation of relationships in which animals solve problems too quickly to have gone through a trial-and-error process. The animal seems to arrive at a solution by reasoning (defined as 'the ability to combine spontaneously two or more separate or isolated experiences to form a new experience, which is effective for obtaining a desired end). A common experimental procedure used to test for reasoning involves an animal's ability to make detours in a maze. Shepard found that once rats had learned a maze, they quickly capitalized on newly created short-cuts (created by removing partitions, so that what was previously a blind alley became a quicker route to the goal box). Tool use, e.g. chimpanzees reaching bananas high up in their cage by piling boxes on top of each other or joining lengths of stick together, provides another possible instance of reasoning

Topic-33 Spatial Learning and Cognitive Maps

Spatial Learning

Every natural environment shows some spatial variation, e.g. in the locations of nest sites, hazards, food, and prospective mates. Consequently, an organism's fitness may be enhanced by the capacity for spatial learning, the establishment of a memory that reflects the environment's spatial structure.

Example

The behavior of a female digger wasp, which nests in small burrows dug into sand mounds. When a wasp lefts her nest to go hunting, she covers the entrance with sand. Upon her return, she flies directly to her hidden nest, despite the presence of hundreds of other burrows in the area. The wasp locates her nest by learning its position relative to visible landmarks, or location indicators.

This visual learning of object maps is proved by experimentally disturbing the landmarks that confuses the wasp.

Cognitive Maps

Some animals guide their activity by a cognitive map, a representation in the nervous system of the spatial relationships between objects in an animal's surroundings. Rather than relying solely on moving from landmark to landmark, animals using cognitive maps can navigate more flexibly and efficiently by relating landmark positions to one another.

Example

The Clark's nutcracker birds store thousands of pine seeds in fall at thousands of hiding places called caches, distributed over an area as large as 35 km2. During the winter, the birds relocate many of their caches.

By experimentally varying the distance between landmarks, researchers demonstrated that birds can identify the halfway point between landmarks. Such behavior suggests that nutcrackers employ an abstract geometric rule, which we can approximate as "Seed caches are found halfway between particular landmarks". Such rules are a fundamental property of cognitive maps and reduce the amount of detail required to remember an object's location.

Topic-34 Cognition and Problem Solving

Cognition

Cognition is the process of intellect, represented by awareness, understanding, reasoning, recalling memories and judgments.

It is the most complex form of learning.

Cognition is exhibited characteristically by primates. Many mammals, cephalopods and insects also exhibit cognition.

Problem Solving

Problem solving is a cognitive activity of devising a method to proceed from one state to another in the face of apparent obstacles.

Problem solving capacity of an animal depends on the information processing ability of a nervous system.

Examples

If a chimpanzee is placed in a room with several boxes on the floor and a banana hung high out of reach, the chimp can “size up" the situation and stack the boxes, enabling it to reach the food.

Such problem-solving behavior is highly developed in some mammals, especially primates and dolphins.

Notable examples have also been observed in some bird species, especially ravens, crows, and jays.

Many animals learn to solve problems by observing the behavior of other individuals. Young wild chimpanzees, for example, learn how to crack oil palm nuts with two stones by copying experienced chimpanzees.

Lesson no. 40 Behavioral Rhythms

Biological Clocks

Animals respond rhythmically to cyclic fluctuations in their environment like changes in seasons and daily light and dark periods. The rhythmic behaviors of animals are controlled by the biological clocks which regulate the daily and seasonal cyclic activities of animals. These clocks have a molecular genetic basis as genes for keeping time sense have been identified in many animals including human beings.

These biological clocks may be:

Circadian clocks

Circannual clocks Lunar clocks

These clocks are influenced by dark and light periods and lunar cycles.

Circadian Clock and Circadian Rhythms

The most important biological clock is the circadian clock that regulates and coordinates daily behavioral activities of all animals.

The output of this clock is a circadian rhythm that is exhibited as a daily cycle of rest and activity.

The clock is normally synchronized with the light and dark cycles of the environment. However, it can also maintain rhythmic activity under constant environment conditions, such as during hibernation.

Circannual Rhythms

Some behaviors, such as hibernation, migration and reproduction, reflect biological rhythms linked to the yearly cycle of seasons are called circannual rhythms.

A circannual rhythm spans events that repeat on a 12 month basis corresponding to the tilt of earth's spin axis resulting in seasonal changes.

Circannual rhythms influence the animal physiology by changing the periods of day light and darkness as well as temperature in the environment.

Lunar Cycles and Tidal Rhythms

The lunar cycles are controlled by the phase of the moon whose gravitation pull determines the timing of tidal rhythms in marine environments.

The courtship and reproductive behaviors of many marine animals are linked to the timing of the new and full moon.

Timing the behavior to the lunar cycle links their reproduction to the times of greatest tidal movement.

The tides disperse larvae to deeper waters, where they complete early development in relatively safer environment.

Lesson no. 41 Biological Rhythms:

A biological rhythm is any cyclic change in the level of a bodily chemical or function. It includes cyclic pattern of physiological changes or changes in activity in living organisms, most often synchronized with daily, monthly, or annual changes in the environment.

Biological rhythms can be internal (endogenous) controlled by the internal biological clock e.g. body temperature cycle; or External (exogenous) - controlled by synchronizing internal cycles with external stimuli, e.g.

sleep/wakefulness and day/night. These stimuli are called zeitgebers - from the German meaning “time givers”. These stimuli include environmental time cues such as sunlight, food, noise, or social interaction. Zeitgebers help to reset the biological clock to a 24hour day.

Circadian Clock/ Biological Clocks

In humans (and other mammals), a circadian clock is located in the suprachiasmatic nuclei (SCN). The SCN is in the hypothalamus. It is a tiny cluster of about 10 thousand nerve cells. The internal mechanism by which such a rhythmic phenomenon occurs and is maintained even in the absence of the apparent environmental stimulus is termed a biological clock. When an animal that functions according to such a clock is rapidly translocated to a geographic point where the environmental cycle is no longer synchronous with the animal's cycle, the clock continues for a time to function synchronously with the original environmental cycle.

Circadian rhythm: A rhythm with a 24-hour cycle is called a circadian (from Latin Circa, “about”; di, “day”—i.e., “about a day”), solar day, daily rhythm. Circadian rhythms are physiological and behavioral rhythms which include: – sleep/wakefulness cycle – body temperature – patterns of hormone secretion – blood pressure – digestive secretions – levels of alertness

Two specific forms of circadian rhythms commonly discussed in research are morning and evening types. There is a direct correlation between the circadian pacemaker and the behavioral trait of morningness - eveningness. People considered morning people rise between 5 a.m. and

7 a.m. go to bed between 9 p.m. and 11 p.m., whereas evening people tend to wake up between 9 a.m. and 11 a.m. and retire between 11 p.m. and 3 a.m. Majority of people falls somewhere between the two types of circadian rhythms. Evidence has shown that morning types have more rigid circadian cycles evening types who display more flexibility in adjusting to new schedules. One theory is that evening types depend less on light cues from the environment to shape their sleep/wake cycle, and therefore exhibit more internal control over their circadian rhythms.

Circadian Organization in Non-Mammalian Vertebrates: Non-mammalian vertebrates (fish, amphibians, reptiles and birds) have more complex circadian systems than mammals. While the suprachiasmatic area remains a site of circadian pacemakers, it is, unlike in mammals, not the only such site. The pineal organ, which in mammals is a purely secretory organ, is directly photosensitive in other vertebrates (with the exception of snakes) and is a site of a circadian pacemaker. Retinae of the eyes are also sites of circadian pacemakers in at least some non- 102 mammalian vertebrates. Thus, the non-mammalian circadian system is composed of multiple pacemakers (eyes, pineal, SCN). These structures communicate with each other neutrally and humorally and provide a single synchronized output in the rhythmic behavior of the animal.

Entrainment:

The natural, endogenous period of circadian rhythms, as measured in constant conditions, is almost never exactly 24 hours. In the real world, however, the light-dark cycle provided by the Earth's rotation around its axis is exactly 24 hours long. Utility of biological clocks is in retaining a constant phase between environmental cycles and activities of the organism. Thus, a mechanism must exist to synchronize the internal clock to the environmental cycle, in other words, to force the biological clock to assume a period of exactly 24 hours. The phenomenon of synchronization of biological rhythms by external cues is called entrainment.

Freerun: The length of the period of a biological rhythm in the absence of environmental cue is called freerun.

Ultradian rhythms:

Ultradian rhythms are defined as an endogenous rhythm pattern that occurs on a shorter time scale than circadian rhythms. As a result of the brief cycle time the frequency of occurrence is much higher. A prime example of an ultradian rhythm is feeding patterns. For the average person this cycle repeats about 3 times a day. Unlike diurnal rhythms ultradian rhythms are share no overlapping relationship with circadian rhythms.

Infradian rhythms:

Infradian rhythms are defined as an endogenous rhythm pattern that a cycle has duration longer than circadian rhythms, i.e. more than 24 hours per cycle. Due to the longer time frame for each cycle the frequency of occurrence in these cycles is lower than that of the circadian rhythms. The female menstrual cycle is an example of an infradian rhythm. It is a cyclical biological event that occurs in a fairly regular pattern on a monthly basis. Similar to the ultradian cycle, the infradian rhythms are not directly linked to circadian rhythms.

Circannual rhythms:

It includes bird migrations, reproductive activity, and mammalian hibernation. Daily cycles or circadian rhythms are in part a response to light or dark cycles, and circannual cycles in part responses to changes in the relative length of periods of daylight.

A mechanism for governing biological seasonality is the circannual clock. In many organisms (even when kept in constant conditions in the laboratory), certain events, e.g., reproductive maturation and behaviour, occur with a precise rhythm whose period is close to (usually a little shorter than) 365 days.

Deletion of the SCN in rodents does not eliminate circannual rhythms, for instance, suggesting that circannual clock is a separate mechanism from the circadian clock and is also located elsewhere in the brain or body of the animal. Not much is known about the physiology of circannual rhythms.

Freerunning circannual rhythms have periods too different from 365 days to be accurate on their own. They have to be entrained to the actual year, in a 104 manner similar to the way circadian rhythms need to be entrained to the day/night schedule. Circadian rhythms can be entrained by a large variety of cues (e.g., temperature cycles, noise, social cues, etc.), but by far the strongest cue is light.

Lesson no. 42 Navigation and Migration

Migration is a regular, long-distance change in location. It involves animal navigation over long distances through unfamiliar territories and environments they have not previously encountered.

Many animals seasonally migrate in response to various environmental stimuli involving seasonal droughts or harsh weather conditions of summer and winter.

Migratory behavior is observed in a wide variety of birds, fishes, butterflies, grey whales and many other animals.

Cues Used in Migration and Navigation

The navigational abilities of animals rely on several different sensory cues that guide in orientation and finding their way to the destination.

Many of these cues are difficult to detect and study as they are generally unavailable to human beings.

During navigation, animals may use:

Sun compass

Celestial cues

Earth's magnetic field

Visual, auditory and olfactory cues

Sun Compass

Many migrating animals track their position relative to the sun.

The sun's position relative to Earth changes throughout the day.

Animals adjust for these changes by means of a circadian clock, an internal mechanism that maintains a 24-hour activity rhythm or cycle.

Celestial Cues

Nocturnal navigators can use the North Star, which has a constant position in the night sky.

Earth's Magnetic Field

Many long-distance migrants, e.g. birds and fishes, navigate by sensing their position relative to Earth's magnetic field.

Visual, Auditory and Olfactory Cues

Many birds also use particular landmarks, odors, sounds, and additional visual cues such as the plane of polarized light to find their way to reach their destination.

Lesson no. 43 Competition for resources

Competition is the struggle among organisms to survive in a habitat with limited resources (species searching for the same kinds of food). Competition happens when organisms in an ecosystem have similar needs.

- Organisms with different needs can live and survive together in a habitat with little competition.
- Competition increases when the amount of available resources is low.
- Members of the same species compete for available resources.
- All organisms compete for resources (not just animals).

Competition occurs

- Within species (intraspecific competition)

Can limit population size

Can affect patterns of spatial dispersion

Competition occurs

- Between species (interspecific competition)

Can limit population size

Can affect patterns of spatial dispersion

Can influence patterns of diversity

Can act as a selective force on traits

What do organism compete for?

- Organisms compete for the resources they need to survive:

Air

Water Food space

Animals and plants that have specific life history requirements, like cavity-nesting birds, or animals with obligate feeding behaviors, have a more difficult time competing. These resources can be limiting factors for where organisms are distributed, and competition for them can be fierce.

Lesson no. 44 Habitat Selection

Habitat is a place where an organism makes its home. A habitat meets all the environmental conditions an organism needs to survive. For an animal, that means everything it needs to find and gather food, select a mate, and successfully reproduce.

- To live in a habitat an animal must first have access to the habitat.
- Once the animal has access to the habitat it must be able to tolerate the conditions of the habitat and find the resources that it needs to survive in that habitat.
- Animals must be able to tolerate at least two kinds of factors in the habitat. These factors are abiotic factors and biotic factors.

Abiotic factors are non-biological factors such as temperature, humidity, salinity and pH to name a few.

Biotic factors are biological factors such as competition, predation, and disease.

Resources required for survival

The animal has to find the resources that it needs to survive. These recourses include: shelter, food, protection, mates, space for breeding, feeding, resting, roosting, courtship, grooming, sleeping etc.

- Animals have to compete for recourses too. Two species or more occur in a single habitat, which they strive for survival, shelter, food; space etc. there may be considerable competition, predation, diseases, allelopathic agents (antibiosis/ poisoning) in the existing habitat.
- Every available space cannot play a role of habitat for all species at a time due to certain antagonistic factors. Therefore, the animals select the habitat which fulfils its niche and keeps it away from other antagonistic factors.

Birds are ideal for studies of habitat selection as they are highly mobile, often migrating thousands of miles (and in the process passing over an enormous range of environments), and yet ordinarily forage, breed, and winter in very specific habitats. For Example

The small migrant songbirds

Male Henslow's Sparrows foraging

Female Red-eyed Vireos seeking their food .

Lesson no. 45 Foraging Behavior

The behavior that includes all activities of an animal related to search, recognize and capture food items is called foraging behavior.

Foraging Choices for Animals

Foraging behavior of animals includes the following choices:

1. What items should be included in the diet?

2. If food occurs in patches, what path should an animal take between patches, and how should it locate new patches of food?

3. If the food in a patch is depleted, when should the animal depart from that location and seek another patch of food?

Hummingbirds and various species of bees that visit clumps of flowers to obtain nectar must make each of these decisions.

Owls that forage for small rodents in different habitats, including fields and forests, must make similar decisions.

Evolution of Foraging Behavior

As nutrition is essential for an animal's survival and reproductive success, natural selection has operated to refine behaviors that enhance the efficiency of feeding.

Example

The fruit fly (Drosophila melanogaster) provides an example of simple genetic variation that explains the evolution of foraging behavior.

Variation in a gene called forager (for) dictates the food search behavior of fruit fly larvae.

The larvae carrying the forR ("Rover") allele travel nearly twice as far while feeding as larvae with the fors ("sitter") allele.

Experiments revealed that the enzyme encoded by the forager locus is involved in signal transduction pathways and is more active in forR than in fors larvae.

These results indicate that changes in processing of environmental information can substantially alter behavior.

Lesson no. 46 Foraging Model: Risk and Reward Balance

Gains and Costs of Foraging

There are energy gains and costs in finding and consuming food:

Energy gain from food

Energy expenditure in foraging

Risk of predation while foraging

Optimal Foraging Model

Behavioral ecologists apply a model of cost-benefit analysis to study the foraging strategies of animals.

This model concludes that animal foraging behaviors reflect a compromise between competing selective pressures i.e. the benefits of nutrition and the costs of obtaining food.

Optimal Energy Expenditure

This model analyzes the energy needed to search food, energy needed to pursue and handle food and energy required to digest the food.

For an animal, the energy gain from a given food item must exceed the energy costs.

According to the optimal foraging model, natural selection favors a foraging behavior that minimizes the costs of foraging and maximizes the benefits.

Balancing Risk and Reward

One of the most significant potential costs to a forager is risk of predation.

Maximizing energy gain and minimizing energy costs are of little benefit if the behavior makes the forager a likely meal for a predator.

Animal's foraging behaviors reflect more safety from predation risk and not the hunger for more food gain.

Lesson no. 47 Specialists and Generalists

Species Diversity can be broadly divided into:

Generalist species

Specialist species

Generalist species

Species that can live in many different types of environments, and have a varied diet are considered generalists.

- Generalists can eat a variety of foods
- Thrive in a range of habitats.
- They have broad niches.
- They can thrive in rapidly changing environmental conditions.

Examples of Generalist species

- Raccoons (Procyon lotor) are an example of a generalist species. They can live in a wide variety of environments, including forests, mountains, and large cities, which they do throughout North America. Raccoons are omnivores and can feast on everything from fruit and nuts to insects, frogs, eggs, and human trash.
- Other examples of generalist species include bobcats, coyotes, cockroaches, rats, mice, flies, white-tailed deer and humans, etc.

Specialist species

Specialist species are animals that require very unique resources. Often, these species have a very limited diet, or need a specific habitat condition to survive.

- Specialist species evolved to fit a very specific niche.

- Environmental disruptions like effects from climate change or habitat loss have a strong effect on specialists.
- They cannot adapt to use other food sources or habitats as quickly as generalist species.
- The number of specialist species is declining due to human activities.

Examples of Specialist species

- Tiger salamanders can only reproduce in wetland habitats. They also require an abundance of insects and worms for their diet.
- Koala (Phascolarctos cinereus) are native to Australia. They feed only on the leaves of the eucalyptus tree. Therefore, their range is restricted to habitats that support eucalyptus trees.
- Canada lynx (Lynx canadensis) a carnivore only feed on snowshoe hare. It inhabits the forested and mountainous areas where their prey is present.

Lesson no. 48 Mating Behaviors and Systems

Mating Behavior

Mating behaviors of animal species evolved through sexual selection, a form of natural selection.

Mating behavior enhances reproductive success of a species.

Mate Choice

The mating behavior involves mate choice. Mate choice includes:

Seeking or attracting mates

Choosing among potential mates Competing for mates

Mating Systems

Mating systems of different species vary.

They are of three types:

Monogamous mating system

Polygamous mating system

Promiscuous mating system

Monogamous Mating Systems

In monogamous relationship, one male mates with one female during a breeding season. The mates usually remain together for a longer period.

Monogamy is rare in most animal groups. It is specifically found in groups exhibiting nesting behaviors and parental care.

In birds it is most frequent as more than 90% are monogamous.

In a few bird species such as swans and geese, partners are chosen for life and often remain together throughout the year.

In others, seasonal monogamy is more common

Polygamous Mating Systems

In polygamous system, an individual of one sex mates with several of the other.

Polygamous relationships are of two types:

Polygynous Systems

Polyandrous Systems

Polygynous Systems

Polygynous systems involve an exclusive relationship of one male with two or more females

Polygynous species are generally dimorphic, with males being showier and often larger than females

Polyandrous Systems

In polyandrous systems, one female has an exclusive relationship with two or more males.

Polyandrous species are also dimorphic with females generally more ornamented and larger than males.

Promiscuous Mating System

In this system, a member of one sex within the social group mates with any member of the opposite sex.

This system involves no strong pair-bonds or lasting relationships.

Among promiscuous species, males and females are often so much alike morphologically that they may be difficult or impossible to distinguish based on external characteristics.

Lesson no. 49 Sexual Selection and Mate Choice

Sexual Selection

Sexual selection among the members of a species can take the form of:

Intersexual selection

Intrasexual selection

Intersexual Selection

Intersexual selection involves mate choice.

In this selection, members of one sex choose mates on the basis of particular characteristics of other sex, such as appearance, color or courtship songs.

Intersexual selection has led to sexual dimorphism in secondary sexual characteristics, such as the ornate plumage of birds, or the antlers of deer, or the manes of lions.

Such selective characters correlate in general with the mate's health and vitality.

Purpose of mate choice is to choose a healthy partner that is likely to enhance the reproductive success.

Mate choice patterns vary among species. In some, females make choice for their mates while in others, males make selections among the available pool of females.

Intrasexual Selection

Intrasexual selection involves competition between members of the same sex for access to members of the opposite sex.

Intrasexual selection usually occurs between males and may take the form of male-to-male combat or fight.

Such species or individuals have developed better weapons for competition e.g. horns, antlers etc.

There are two main types of competition over females, scramble and contest competition.

Scramble involves a race to get to the female first and grab her. Male body size and vigor contributes to success.

Contest is a more typical form of competition where the male with the best fighting technique, largest body size or the largest weapons will win the female.

Lesson no. 50 Dominance Hierarchies

Dominance Hierarchy is a form of animal social structure in which a linear or nearly linear ranking exists, with each animal dominant over those below it and submissive to those above it in the hierarchy. Dominance hierarchies are best known in social mammals, such as baboons and wolves, and in birds, notably chickens.

Dominance hierarchies are a common among organisms.

- Some individuals will behave more dominantly toward others; these interactions result in a rank or status order.
- In some species, social ranks do not change (e.g. in insects such as bees), but most social mammals like humans and other primates have adaptable roles, where one individual can move through many social ranks over a lifetime.

he study of animal sociality is called sociobiology, which E. O. Wilson (1975) defines as “the extension of population biology and evolutionary theory to social organization”.

Dominance hierarchies impact the survival and reproduction of individuals by regulating access to food, mates, and shelter. As such, the stability of a dominance hierarchy can affect whether a population prospers or collapses.

Dominance hierarchy is relatively stable from day to day. Direct conflict is rare; an animal usually steps aside when confronted by one of higher rank. Temporary shifts occur; for instance, a female baboon mated to a high-ranking male assumes a high rank for the duration of the pair bond. An individual weakened by injury, disease, or senility usually moves downward in rank.

Lesson no. 51 Examples of Dominance Hierarchies

Dominance hierarchies involve a ranking of individuals in a group (a “pecking order”). Alpha, beta rankings exist. The alpha organisms control the behavior of others.

1. Dominance Hierarchy in Monkeys

- The troop always has a dominant male (alpha male).

- The crowning of alpha male occurs with threats and attack.
- The threat posture is seen in a typical male is an open mouth with teeth exposed, ears are held against head.
- The head and body is held stiff.
- The attack includes biting and manual biting.
- There will not be much injury caused to other.
- Staring is also a part of competition.
- The male stares at another male with head held forward and brow protruded.
- The loser walks away.
- The dominant male moves around majestically with its tail raised in the form of S letter.
- The subordinate male assumes a crouching or subdued position.

2. Dominance Hierarchy in wolf packs

- Dominance is highly organized in these species
- These animals hunt in groups and are keenly aware of their own status in relation to the other individuals present within the group.
- Dominant wolves are referred to as alphas.
- There are commonly both alpha males and females.
- The alpha status assures a wolf the highest priority in getting every resource e.g. food.
- These factors determine the survival of a particular individual and their ability to pass on their genes.

3. Dominance Hierarchy in Lion prides

- In lion prides, an alpha male or sometimes multiple alpha males (that are closely genetically related) hold dominant positions in the pride.
- An animal in the alpha position spends much of his time in scent marking the territory and patrolling its boundaries in order to prevent rival males from infringing upon the territory.
- The alpha male will be having priority over the choice of food and mating, thereby enhancing his overall fitness.
- Female lions also vary in dominance status.
- Dominance can be determined in part by age and hunting prowess.
- The alpha status regularly changes over when an animal becomes sick, older, or simply when a stronger animal moves in and successfully challenges the leader.

Lesson no. 52 Agonistic Behaviors

Agonistic behaviors are confrontation behaviors involving aggression, threat displays, attacks and fights between animals.

Agonistic behaviours are seen in many animal species because resources including food, shelter, and mates are often limited.

These behaviors are usually used only to intimidate the enemies and are rarely lethal

Agnostic behaviors seem to be antisocial but these are necessary to maintain social order.

Types of Agonistic Behaviors

Agnostic behaviors are important in the maintenance of territories and dominance hierarchies.

So they are of two types:

Territorial Behaviors

Dominance hierarchies

1. Territorial Behaviors

Territorial ownership and defense is an important aspect of sociality in animal populations e.g. insects, crustaceans, fishes, amphibians, lizards, birds, and mammals, including humans.

A territory is a fixed area in which an animal spends most of its time and defends it from intruders of the same species.

Purposes of Territorial Behaviors

Territorial behavior has multiple purposes:

Breeding place: Many male birds and mammals occupy a breeding territory. The male

actively defends his area against other males. He attracts a female in his territory and performs courtship and mating without interference.

Food source: Some animals occupy territories that contain abundant food supply.

Shelter: Purpose of some territories is to provide shelter to the animal from

predators and unfavorable climate.

2. Dominance Hierarchies

Dominance hierarchies exist in many vertebrate groups.

The organization of group of animals in such a way that some members of the group have greater access to resources like food or mates than others is called dominance hierarchies.

Some animals are present near the top of the order. They have first choice of resources.

The animals present near the bottom do not get sufficient resources.

Lesson no. 53 Examples of Agonistic Behaviors

Any social behaviour related to fighting. It includes threats, displays, retreats, placation, and conciliation.

Examples

1. Western gorilla (Gorilla gorilla)

- Male displays a wide range of both vocal and gestural communications when threatened by an opponent.
- A silverback (alpha male) will start hooting, throwing, chest pounding, leg kicks, and sideways running when approached by another male.
- This is done to intimidate the opponent and show physical abilities without actually making any physical contact.

2. Sheep

- Often viewed as non-aggressive, gregarious animals but they do show agonistic behaviour.
- Aggressive behaviour include shoving with shoulders, running together and butting.
- Play butting occurs in young lambs and more damaging aggression in ewes and rams.
- Most fighting is during breeding season.
- Threat postures include: striking the ground, tooth grinding, lateral body presentation, sniffing, mounting and chasing.
- Aberrant aggression: Some ewes show aberrant aggression towards their lambs or alien lambs.
- Wool picking with teeth is common in confined sheep.

3. Chickens

- Chickens show threats associated with fighting, leaping and wing-flapping.
- The major aggressive act is pecking.
- Submissive behaviour are described as retreat.
- Aberrant behaviour can be found among confined chickens.
- Cannibalism could be influenced by diet and management procedures.

4. Cattle

- Pre-fight behaviour – Active or passive avoidance leads to fight.
- Close contact, head lowered, ready to fight and butting or active fighting.
- Butting could be regarded as a non-retaliated blow with the head, while fighting involves reciprocal butts, circling and pushing.
- The end of the fight begins with one animal showing submissive behaviour.
- Aberrant agonistic behaviour include naval sucking, fence and pen chewing (aggression towards inanimate objects) and ear sucking.

5. Black mamba (Dendroaspis polylepis)

- Agonistic fighting for black mambas involves a wrestling match.

- Opponents attempt to pin each other's head repeatedly to the ground.
- Fights normally last a few minutes but can extend to over an hour.
- The purpose of fighting is to secure mating rights to receptive females nearby during the breeding season.

6. Frill-necked lizard

- It uses its frill as a way to display size and aggression.

It displays bright orange and red scales.

Males fight and display frills often during the mating seasons.

Lesson no. 54 Social Organization

A society is a group of individuals belonging to the same species and organized in a cooperative manner. The members of a social organization are:

interdependent variously specialized in function and survival depends on cooperation in the group.

A social organization is a large group of members who:

intercommunicate extensively exhibit division of labour bear some relatively permanent social relationship to one another

Such organization exists in both invertebrates and vertebrates.

Examples

- Among vertebrates, arthropods such as ants, bees and termites have well organized colonies.
- A well-established social organization is seen in primates such as monkeys, baboons, langurs etc.

Origin of Social Organization

- The social organization could have been originated due to the following reasons:

1. The offspring chose to stay with their parents for protection, obtain food, learning, communication, survival, etc.

2. When two adults choose to stay together. It can be for survival, sharing of work, mating, protection from predators, social behaviour like altruism and kin selection Size and composition of a social organization

We can understand the organization size and composition with the help of an example of Bonnet Monkey.

- The Bonnet monkey, Macaqua radiate is the most common macaque of south India.
- It can be easily recognized by a cap of brown hair that appears like a baby’s bonnet (cap).
- There is sexual dimorphism and males are larger than female with distinct canines.
- They live in groups called troops and live in forests, villages and also in cities.
- A troop consist of 30 individuals with both males and females of different age groups.

It includes:

a. Infants: They have chocolate colour hair

b. Juveniles: between 1-2 years with brown hair

c. Seniors: between 2-3 years with brown hair

d. Sub adults: 3-5 years old males and 2-3 years old females

e. Adults. 4 years old males and 3 years old females. Have brown hair on the back and white hair on belly. The older individuals have yellowish grey hair.

Lesson no. 55 Advantages of Social Organization

There are many benefits of living in social organization. Few of them are discussed here:

1. One obvious benefit for social aggregations is defense, both passive and active, from predators.

Examples:

Musk-oxen that form a passive defensive circle when threatened by a wolf pack are much less vulnerable than an individual facing the wolves alone.

A breeding colony of gulls, alerted by the alarm calls of a few, attack predators in group; this collective attack is certain to discourage a predator more effectively than individual attacks.

Members of prairie dogs, although divided into social units called coteries, cooperate by warning each other with a special bark when danger threatens. Thus they get benefit from each other.

2. Sociality offers several benefits to animals' reproduction. It facilitates encounters between males and females, which, for solitary animals, may consume much time and energy. Sociality also helps synchronize reproductive behavior through the mutual stimulation that individuals have on one another.

Examples:

Large colonies of gulls produce more young per nest than do small colonies. Furthermore, parental care that social animals provide their offspring increases survival of the brood.

3. There is improved protection of limited recourses against other groups of the same species and related species. Members help each other in protecting territory, food material and mates against other groups. Social living provides opportunities for individuals to give aid and

to share food with young other than their own. Such interactions within a social network have produced some intricate cooperative behavior among parents, their young, and their kin.

4. There is increased chance of foraging success. In other words, more individuals finding food is better than one.

Examples:

All the lions in the pride cooperate with each other in foraging and protection, though there is still serious competition among the males. Male lions work together to defend the other lions in the pride. Female lions work together to hunt.

5. There is reduction in predation pressure by improved detection and repulsion of enemies.

6. There is more care of offspring through communal feeding and protection.

Examples:

An infant yellow baboon (Papio cyanocephalus) “jockey rides” its mother. Later, as the infant is weaned, the mother-infant bond weakens and the infant will be refused rides.

7. Of the many other advantages of social organization, cooperation in hunting for food; huddling for mutual protection from severe weather; opportunities for division of labor, which is especially well developed in the social insects with their caste systems; and the potential for learning and transmitting useful information through the society.

Lesson no. 56 Disadvantages of Social Organization

There are some disadvantages of living in social organization. Few of them are discussed here:

1. There is increased competition within the group for food, mate, nest sites, nest material and other limited recourses.

2. Increased risk of infection due to outbreak of disease or epidemic.

3. Increased risk of exploitation of parents.

4. Increased inbreeding will weaken the progeny.

- Increased Sickness and Disease

Animals that live in close proximity to one another face higher risks of infection than do individual animals.

Diseases and parasites can be passed between animals living too closely together, and this can dramatically decrease a group's numbers.

Some animals might die as a direct result of the sickness itself, but latent effects of infection can come in several forms, such as decreased mobility, making it difficult to escape from predators, as well as decreased vision and sense of smell, making it harder to find food.

- Increased Competition for Food

The bigger the animal group, the more competitive the hunt for food becomes.

Predators who hunt in large packs or prides tend to expend more energy than needed in capturing prey, as the element of surprise is not so easy to come by.

Predators often scavenge as a result, and many go hungry. Sizable assemblies of animals put pressure on food resources, and unequal distribution of food among animals can lead to increased aggression, starvation, and death.

- Increased Competition for Mates

In group, where there are more males than females; direct, aggressive competition to find a mate can become the norm.

Ritualized fighting and displays of violence and aggression can ensue before and even after finding a mate. The ultimate battle here is not necessarily for survival in the strictest sense but in the passing on of genes and reproductive success.

Lesson no. 57 Social Organization in Insects

All species show some degree of social organization; many species nest in a system of tunnels, in the soil, under a dome, hill or excavated earth, sand, or debris. Colonies range in size from a few dozens to half a million or more individuals. Typically, they include three castes: winged, fertile females, or queens; wingless, infertile females, or workers; and winged males. The familiar examples are of social organization in insects are:

ants, bees, and wasps (order hymenoptera), termites (order isoptera),

Silkworms

Many of these species live in colonies with thousands or even millions of individuals.

Ants

- The most highly developed social insects.
- Each colony contains at least one queen. Ants defend their nest by biting and stinging.
- Ants secrete pheromones detected by other ants through antennae. This process called chemoreception; the primary communication vehicle that facilitates mate attraction, kin and non-kin recognition.
- Ants send tactile signals by touching and stroking each other's bodies with their antennae and forelegs.
- Majority of ants form underground nests called formic aria. It consists of numerous chambers connected by galleries. The Chambers are used as granaries for storing seeds for rearing progeny.
- Ants fall into four main castes:

QUEEN: Fertile females with reproductive system. They are larger than all other castes. Two pairs of membranous wings and mandibles are present. Their sole duty is to lay eggs. They may have life span of 15 or even 30 years. The ant colony has several queens.

KINGS: Fertile males with well reproductive system, smaller than the queens and soldiers but larger than workers. They have two pairs of wings and mandibles are reduced. They serve to fertilize the queens.

WORKERS: These are sterile females with reduced, non functional reproductive system. They are smaller than all other castes. Their mandibles are well developed but eyes are small. They repair nest ,collect and store food.

SOLDIERS: They are modified workers.

They are smaller than queen in size. They are wingless with large heads and powerful mandibles. They defend the colony from the enemies. They also crush seeds and fruits.

Termites

- They are social insects but less advanced that ants colonies.
- The termite colony has three class of individuals and each class includes both sexes.
- Termites digest wood and paper. Some species of termites build nests up to 6 meters in height.
- Termites use pheromones for communication.
- They use pheromones for trail, alarm, aggregation and mating.
- Trail pheromones is produced by termites when they are trying to get other member of the colony to follow then to a particular area perhaps a new food source for the colony.

Termites dislike daylight. Some species lives in nests called termitaria.

Termites are categorized as:

- Fertile castes
- Sterile castes

Fertile castes also known as sexual castes. It is of 3 types:

LARGE WINGED FORMS: These are king and queen. The sole duty of queen is to lay eggs.

SHORT WINGED FORM: These are supplementary kings and queens. The wings are short, pad like and vestigial.

WINGLESS FORM: Wings are absent. The ocelli are absent.

Sterile Castes: These are wingless, eyeless and colorless. The sex organs are rudimentary. It is of 3 types:

WORKERS: They are dimorphic. They are trimorphic in some cases. They construct, repair the nest collect and distribute food.

SOLDIERS: They are larger than the workers. The soldiers defend the colony by killing the intruders with their mandibles.

NASUTES: The nasutes also called the proboscideans. They possess large head prolonged into rostrum.

Honey bee

They live in hives which is often constructed in a hollow tree. The individuals forming a colony are of 3 castes:

QUEEN: The queen is fertile female. She is unable to form hive. Her duty is to lay eggs.

DRONES: The drones are males. They do not work in hives.

WORKERS: They are sterile females. Young workers stay in the hives and called the house bees.

Scout bees fly from the colony in search of pollen and nectar. It successful in finding good supplies of food "dances" on the honeycomb.

Yellow wasp

Also known as Polistes. The wasp has 3 castes: queens, drones and workers.

Single queen prepares a nest in spring. The queen lay eggs and the egg hatch into apodous larvae.

The workers have a powerful sting and are a source of great annoyance to men.

Drones are produced from unfertilized eggs. They fertilize the young queens.

In winters the young queens hibernate and the nest perishes. The queens start new colonies next spring. The adult wasp feed on insects, fruit juices and nectar.

Lesson no. 58 Social Organization in Birds

The term social organization includes:

- Physical structure: the size of the group and its composition in respect to age, sex and degrees of relatedness of group members.
- Social structure: all of the relationships among individuals in the group and their consequences for spatial distribution and behavioral interactions.
- Group cohesion: the duration of association of the members of the group and the frequency of fission in which one or more members leave the group.

Social Organization in Chicken

- There is also a social organization in chicken called the pecking order. It is a system by which birds arrange their social standing in the flock.
- The higher ranked birds will get the best food, water and roosts while the lower placed birds will get the leftovers.
- This method of organization places each member of the flock on a 'hierarchy ladder'. At the top of the ladder will be the head rooster (or hen if no rooster is present).
- It is a flexible structure and within the flock there are usually three different types of social order going on:

Rooster to Rooster

Hens to Hens

Roosters to Hens

- A rooster may go up the ladder if he mounts a successful campaign against the leader. He becomes the new chicken-in-charge! And the defeated roosters go down the ladder, as do weak or sickly birds.
- Hens have their own order. The matriarchs of the flock will be up to the top of the ladder, with less dominant birds at the bottom.
- In this system the older, stronger and savier hens will be at the top.
- Young pullets just coming to point of lay, will try to 'move up' the social ladder quickly.
- If a hen tries to challenge; she will earn glares, pecks and feather pulling from the higher 'ranked' hens.
- The serious games of the pecking order start when chicks are around six weeks of age.
- Chicks will start rushing at each other, bumping chests and flaring feathers. These are all methods used to intimidate flock mates at any stage of life. By the time they leave the brooder, they will have their own pecking order sorted out.

Social Organization in Starling

Starlings normally fly in loose flocks, but when under attack by a peregrine falcon, they fly as close together as possible.

Social Organization in Pied Flycatcher

A male pied flycatcher defends a territory against other males. The female chooses a male on the basis of the quality of his territory and the suitability of the nest site it contains. Males that had a low density of birch trees in

their territories and nest sites high up in the trees with thick trunks giving safety to the nest were the ones that obtained mates first.

Nesting and Parental Care in Birds

95% of bird species are socially monogamous i.e., a male and female bird will pair for at least the length of the breeding season or, in some cases, for several years or until the death of one mate. Monogamy allows for care of the fledglings by both parents. Some birds are polygamous; they have many mates in a breeding season. Birds eggs are usually incubated by the parents. Most birds have an extended period of parental care after hatching. The length and nature of parental care varies widely amongst different orders and species.

Lesson no. 59 Social Organization in Mammals

Social organization can also be observed in variety of mammalian species.

Examples:

1. Black Tailed Prairie dog

It is the highly social animal and the social units are called Coteris.

Coterie is composed of one adult male, several females and young ones.

Without dominant hierarchy.

Everything inside the premises of coterie are shared by all members.

Hostility with neighbors always exist.

Two syllable call used to claim the territorial ownership.

They become familiar to each other and start recognizing a member of same territory.

In a coterie, dog watch out for danger, produce alarm calls.

2. Meerkats

They are active and social animals

Live in groups that include 2-30 individuals, although the average pack size is around 1015 individuals. Groups are called mobs.

Each mob may consist of up to three families living together. Each family group consists of a breeding pair and their offspring.

Each mob comprises on nearly equal numbers of either sex.

Members take turns at jobs such as looking after pups and keeping a lookout for predators.

Meerkats are a cooperatively breeding species —typically the dominant 'breeders' in a mob produce offspring, and the nonbreeding, subordinate 'helpers' provide altruistic care for the pups.

Meerkats have a clear dominance hierarchy with older individuals having a higher social status.

3. Elephants

1. Several levels of social system can be observed in elephants: Family, kin and Bachelor’s herd.

2. Mostly 10-20 members are there.

3. amily consists of grandmothers, daughters, sons, grandsons and granddaughters.

4. Females bond socially for nearly 50 years.

5. Kinship involves several family groups living in same vicinity, occasion and mingle peaceably. They are not together except during the migration times.

6. At their maturity, bulls leave their family and join Bachelor herds, all male herd. It is dominated by ritual dominance, and dominant male gets a female in estrus.

4. Primate societies

Variety of social organization exists in primates. The group could comprise of one male and a group of females called harem, a multi male group or a large troupe.

1. Solitary ones are the lemurs, loris and tarsiers. They are arboreal, nocturnal and feeding on insects. They make contacts during the breeding season.

2. White handed gibbons are monogamous species. A pair lives with their offspring. The offspring move away after they become sexually mature. They are territorial.

3. The gelada baboons show variation in social organization depending on the availability of food. There are single male herds. There are herds with “single” male and a “harem” of females.

4. The mountain gorilla lives in small groups, headed by a single male and includes other males as well. They are not territorial.

5. Some of the smallest primate societies are seen in the gibbon and orangutan. Orangutan is an exceptionally solitary animal while the gibbons live as small family units, the father, mother and their offspring. Some of the largest groups are to be found in the terrestrial primates-baboon troops range up to 90.

Lesson no. 60 Territoriality and Defense

Territoriality

A territory is an area defended against other members of the same species. It provides food, water supplies, nesting areas and refuges from danger. Territoriality uses a great deal of an individual’s energy. In addition, an individual might die defending a territory, thus miss a reproductive opportunity.

Examples of Territorial Behaviour

- Spraying behavior is a way for an individual to mark its territory.
- The red breast of the robin (visual)
- Bird songs or the calls of gibbons (auditory)
- Through the deposit of scent marks (olfactory)
- Bears, dogs, cats, lemurs, etc. use scent-marking to signal the boundaries of their territories.

Territories are usually used for:

1. Feeding

2. Mating

3. Rearing of young

4. Combination of all activities

Types of Territories

Mating Territory: places of mating for the partner.

Breeding Territory: The breeding territory is relatively small. It usually contains only a nesting or mating site.

Feeding Territory: It tends to be larger than the breeding territory because it must contain sufficient food to support the owner of the territory and any mate or offspring that may also be residing there.

Multi- purpose Territory: This type of territory is generally the largest as it includes aspects of both breeding and feeding territories.

Salient Features of a Territory

1. Definite home and home range

Territorial behaviour varies widely. Most animals have a definite home. The area the animal covers regularly in search of food and mates is the home range. This area is not defended. The part of the home range defended against others of the same species is the territory. Aggressive behaviour is used to hold on territories.

2. Adaptive Features of Territoriality

Ensures enough space for each animal – if in short supply and needed for breeding, keeps population down.

- By spreading out reduces the spread of disease and parasites. Also harder for predators to find them. Most successful males hold best territories and so ensure best genes are passed on to offspring. Once territories are established the resources have been divided.

The losers will spread out and look for food elsewhere rather than go on fighting.

3. Food and security

Territories ensure enough food for the animals and their families. Territories ensure a safe, protected nest or home for the young or at least a place to breed in the case of communal breeding grounds. Animal now has an area with which it can become familiar, can learn where food, water and protection from predators is located. Territorial behaviour is set. Defenders and intruders know their roles.

4. Marking and Defending Territories

- Vocalizations – e.g. birds singing on boundaries of their areas at dawn and dusk
- Scent – e.g. marking with urine (dogs and cats) or faeces
- Scent glands – special glands produce chemo markers. e.g. on rump, between horns (deer), wrists (lemur), behind ears (cats)
- Physical gesturing – crabs wave claws at edge of territory

Advantages of territory

Territorial behavior forms an important part of social behavior.

Territory provides a base which the male can advertise himself to female, and attracted the female.

Provides a protected place for courtship, mating and parental care to young.

Provided safety where young can live freely and without any interference.

Defensive Behaviour

Behavior showed by animals trying to avoid being harmed by another. This might involve:

defensive aggression: against a potential predator or against a member of its own

species, from its own group or an outside group animal escape behavior to avoid the source of harm Camouflage or inactivity highly conspicuous, as in the noise that a rattlesnake makes to indicate potential danger

if provoked or attacked

Types of Defensive Behaviour

1. Chemical defense

Examples

- Poison dart frog has poison glands secreted all over its body.
- Fire salamander makes a nerve poison, which it is secreted by the glands on its back.
- Bombardier beetle spray boiling hot and chemically toxic bodily fluids towards predator.
- Horned lizard, when attacked; it pressures its own sinus cavities until the blood vessels in its eyes burst, then sprays its attacker with blood from its eyes.

2. **Camouflage**

Examples

- Stick insect pretends to be a twig, in an attempt to avoid being seen by a bird or other predator.
- Polar bear blend into the white snow of the Arctic to avoid danger.
- Frogfish resembles a sponge and prey on the small fishes swimming nearby.
- Chameleon only change color when in imminent danger.

3. Actual Weapons

Examples

- The simple defense system of turtles is its shell. Predators cannot penetrate it.
- Hedgehogs have spikes that are enough to deter predators.
- Pufferfishes have the ability to inflate themselves into a balloon shape by swallowing water. Their bodies are also covered with thorny spikes, which stand out on inflation, providing a formidable defense against attack.

4. Mimicry

Examples

Lesson no. 61 Social Behaviors

Social behaviors consist of a set of interactions among individuals of the same species.

Sociality in Animals

A wide range of sociality occurs among animals.

Some animals rarely interact with one another. Such animals are called asocial animals e.g. mosquitoes and polar bears.

Social animals live together in large groups or form tightly knit colonies.

Examples of Social Animals

Ants and termites

Bees and wasps

Many birds

Wilderbeests

Wolves and Lions

Monkeys and gorillas Humans

Characters of Social Behaviors

Most social behaviors are based on cooperation, competition, conflict, exchange, or coercion or sacrifice.

Most social animals often cooperate with one another to conduct many tasks.

Many social behaviors are adaptive and increase animal's fitness and reproductive success.

Animals in groups show joint aggregation against predators.

Many social behaviors are agonistic and based on competition. Such behaviors are selfish and individuals benefit at the expense of others

Even in the absence of agonistic behavior, most adaptations that benefit one individual may indirectly harm others.

or example, superior foraging ability of one individual may leave less food for others.

Some behaviors are altruistic or unselfish in which an animal favors other at the expense of its own benefits.

Lesson no. 62 Social Behavior: Living in Groups

Animal populations are often organized into groups.

Groups may be:

Simple aggregation of individuals Complex animal societies

Aggregation

An aggregation is any form of gathering of animals or the process of coming together.

There is minimal interaction between members of an aggregation.

For example, several Drosophila flies living on a piece of rotting fruit.

Animal Societies

A stable group of individuals of the same species that maintains a close-knit cooperative social relationship is called animal society.

This association typically has complex social organization and extends beyond the level of mating and taking care of young.

Such societies are observable both in invertebrates and vertebrates.

Advantages of Social Grouping

Belonging to a group gives protection against predators.

Group members may warn each other about an intruder.

Cooperative hunting and search of food increases the feeding efficiency.

Social huddling in cold weather protects its members from harsh environment.

Members of a social groups help each other in finding mate and rearing of young.

Many insects have developed social grouping. These social groups have division of labor. Specific individuals perform specialized tasks of defense, food procurement and feeding of young.

Disadvantages of Social Groupings

Competition for resources (food, mates) develops between members of a social group.

Diseases and parasites spread more rapidly in a group of animals.

They interfere each other for reproduction and rearing of young.

Large congregations of animals are more susceptible to predation. During attacks, large groups have difficulty seeking hiding places.

Lesson no. 63 Altruism

Definition

Altruism is a selfless behavior in which an individual endangers his own survival or sacrifices some of its own reproductive potential to benefit another individual.

Evolutionary Basis

Altruism is an innate trait developed through the process of evolution in many animal species particularly in species with complex social structures e.g. primates, some other mammals and insects. However, there are wide individual variations in tendencies toward altruism.

Negates Darwinism Fitness Principle

Altruism is a different kind of social behavior which has been hard to explain within the framework of Darwinism and natural selection because it reduces the fitness of the altruist.

Significance of Altruism

In ethology, the costs and benefits of a behavior are measured in terms of reproductive fitness, or expected number of offspring.

So by behaving altruistically, an organism reduces the number of offspring it is likely to produce itself. However, by sacrificing its own favors to save others, it indirectly boosts the would-be number of offspring that other members of species are likely to produce.

Examples of Altruism

A belding's ground squirrel that sees a predator gives a high-pitched alarm call that alerts unaware individuals to retreat to their burrows. The squirrel that warns others becomes conspicuous and increases the risk of being killed by the predator. Similar behaviors are observed in crows and monkeys.

In social insect colonies (ants, wasps, bees and termites), sterile workers devote their whole lives to caring for the queen, constructing and protecting the nest, foraging for food, and tending the larvae. Such behaviour is maximally altruistic

Similarly, worker bees sting intruders. This behavior helps defend the hive but results in the death of those workers.

Vampire bats regurgitate blood and donate it to other members of their group who have failed to feed that night, ensuring they do not starve.

Lesson no. 64 Examples of Altruism

Altruism in squirrel

- A squirrel on seeing a predator gives alarm calls to alert unaware individuals to hide safely
- Squirrel that warns becomes conspicuous increasing risk of its own predation
- Similar altruist alarming calls are observed in crows and monkeys

Altruism in social insects

- Social insects such as ants, wasps, bees and termites also shows altruism.
- In social insect colonies, sterile workers devote whole lives to:
- Care for queen
- Construct and protect the hive
- Foraging for food
- Tending the larvae
- This is maximally altruistic behavior.

Altruism in stinging bees

Worker bee stings intruders to help defend the hive—but result is death of stinging bee

Altruism in Vampire bats

Vampire bats regurgitate blood and donate it to other members of their group who have failed to feed that night, ensuring they do not starve

Altruism in Emperor penguins

Emperor penguins migrate miles in harsh conditions to bring back food for their young.

Altruism in Vervet monkeys

Vervet monkeys give alarm calls when predator approaches. Alarm calls attract attention of predator and others monkeys have more time to escape.

Lesson no. 65 Kin Selection and Inclusive Fitness

Kin Selection

Kin selection is an altruistic evolutionary strategy that favors the reproductive success of an organism's close relatives, even at a cost of organism's own survival and reproduction.

Kin selection is an instance of inclusive fitness, which combines the number of offspring produced by an individual itself and the number of individuals it can ensure by supporting other close relatives (siblings).

William Hamilton proposed the idea of kin (relatives) selection to explain how selection acting on related animals can affect the fitness of an individual.

Through kin selection, a gene carried by a particular individual pass to the next generation through a related individual.

The fitness of an individual is based on the genes it passes on as well as on those common genes that its relatives pass on.

For kin selection to be effective, the individuals of a group must be able to identify their relatives. This is the reason that it is found in animals with advanced social structures i.e. primates and social insects.

The altruistic kin selection behavior is most readily apparent in the act of parents sacrificing for their offspring. When parents sacrifice their own well-being to produce and aid offspring, this actually increases the fitness of the parents because it maximizes their genetic representation in the population.

Inclusive Fitness

Inclusive fitness is the measure of fitness of whole group of members of a species which may not be close relatives.

An organism's inclusive fitness is determined by its personal fitness, plus its weighted effects on the fitness of every other individual in the population. The weights are determined by the coefficient of relationship.

It is favored by natural selection that acts to maximize the fitness of group of individuals in the population, rather than thinking in terms of selfish genes trying to maximize their future representation in the gene-pool.

Helping behavior of individuals of a species for those who are not their close relatives is an example of inclusive behavior.

Lesson no. 66 Reciprocal Altruism

Some animals occasionally behave altruistically toward others who are not relatives.

A baboon may help an unrelated companion in a fight, or a wolf may offer food to another wolf even though they share no kinship.

Such behavior can be adaptive if the aided individual returns the favor in future.

This sort of exchange of aid is called reciprocal altruism.

Reciprocal altruism is limited largely to species with social groups stable enough that individuals have many chances to exchange aid (e.g. chimpanzees, humans).

It generally occurs when individuals are likely to meet again.

Cheating

Reciprocal altruism is also associated with negative consequences if favors are not returned to individuals who had been helpful in the past.

Such a pattern of behavior that does not reciprocate favors is referred to as “cheating” by behavioral ecologists.

It occurs as cheating may benefit the cheater substantially.

Game Theory and Tit for Tat Strategy

Game theory explains how reciprocal altruism dominates over cheating behavior. It involves a behavioral strategy called tit for tat.

In the tit-for-tat strategy, an individual treat another in the same way it was treated the last time they met.

Individuals adopting this behavior are always altruistic, or cooperative, on the first encounter with another individual and will remain so as long as their altruism is reciprocated.

When their cooperation is not reciprocated, individuals employing tit for tat will retaliate immediately but return to cooperative behavior as soon as the other individual becomes cooperative.

The tit for tat strategy has been used to explain the few apparently reciprocal altruistic interactions observed in animals-ranging from blood sharing between nonrelated vampire bats to social grooming in primates.

Lesson no. 67 Examples of Reciprocal Altruism

Reciprocal Altruism in Cleaner fish

Cleaner fish and their clients include other large fishes. The host fish allows the cleaner fish free entrance and exit and does not eat the cleaner, even after the cleaning is done. The host signals the cleaner it is about to depart the cleaner's locality, even when the cleaner is not in its body.

The host sometimes chases off possible dangers to the cleaner.

Reciprocal Altruism by Red-winged blackbird

Red-winged blackbird males help defend neighbor's nests. There are many theories as to why males behave this way.

1. Males only defend other nests which contain their extra-pair offspring.
2. Another is the tit-for-tat strategy of reciprocal altruism.
3. A third theory is, males help only other closely related males.

The tit-for-tat strategy of reciprocal altruism is highly accepted by researchers.

Reciprocal Altruism in Primates

Grooming and coalitions in female vervet monkeys is an example. Human social behavior also shows the reciprocal altruism; explains human emotions and ethics etc.

Reciprocal Altruism in Wolves

Wolf also shows reciprocal altruism by helping out other wolves that are not even the members of their pack.

Reciprocal Altruism in dolphins

There are cases reported about the reciprocal altruism by dolphins. The surfer, Todd Endris was surfing at Marina State Park off Monterey, California, when he was suddenly attacked by a great white shark. The shark peeled the skin off his back and was biting on his right leg.

A pod of bottlenose dolphins swam over and formed a protective ring around Endris, providing him a chance to escape from the shark and to swim back to shore where help was available.

Reciprocal Altruism in dolphins

Moko, a bottlenose dolphin in New Zealand, helped two whales who were stranded on the beach by directing them to open sea.

Lesson no. 68 Parental Care

Parental care caters the needs of the newborn and young offspring.

It is more evolved in animals whose newborns and young cannot care for their selves.

So, it has been an important factor in the evolution of mating systems.

Parental Care in Birds

Birds present an excellent example of parental care.

Most newly hatched birds cannot care for themselves.

They require a large, continuous food supply that is difficult for a single parent to meet.

To enhance the chances of viability of offspring, most birds are monogamous.

The male stays with and helps its mate till the offspring are able to fulfill their own needs.

Parental Care in Mammals

In mammals, lactating female nourishes the young and is involved in most of the caring behaviors. Males usually play no role in raising the young.

In some mammalian species, such as lions, males protect the females and young. In such species a male or small group of males takes care of many females at once in a harem.

Polygyny When no Parental Care

Mammals and birds whose young ones can feed and care for themselves almost immediately after hatching, males do not stay with their partner.

Males of these species can maximize their reproductive success by seeking other mates.

Therefore, polygyny is relatively common in such animals.

Male Parental Care: Certainty of Paternity

Certainty of paternity is an important factor influencing mating behavior and parental care of males.

Certainty of maternity of young born to or eggs laid by a female is not doubtful. However, certainty of paternity is relatively low in most species, even within a monogamous relationship.

Male parental care is found in very few species of birds and mammals. In such species, males engage in behaviors that appear to increase their certainty of paternity. These behaviors include guarding females, removing any sperm from the female reproductive tract before copulation, and introducing large quantities of sperm to displace the sperm of other males.

Lesson no. 70 Social learning

The type of learning that involves observing and copying others behavior is called social learning.

Example: young chimpanzees learn to crack palm nuts by copying the behavior of more experienced individuals.

Social Learning and Culture

Social learning forms the roots of culture. Culture is defined as a system of information transfer through social learning or teaching that influences the behavior of individuals in a population.

Cultural transfer of information can alter behavioral phenotypes and thereby influence the fitness of individuals.

Culture based changes in phenotype occur on a much shorter time scale than changes resulting from natural selection.

Social Learning Behaviors

Social learning behaviors are prevalent in animal kingdom, specially vertebrates.

Types:

Copying behaviors

Fine-tuned social learning

Copying Behaviors: Mate-Choice Copying

Mate-choice copying is a form of social learning behavior in which individuals in a population copy the mate choice of others.

In mate choice copy, an individual is attracted to a mate that is also attractive to most other individuals of opposite sex.

This behavior has been demonstrated in several fish and bird species.

Fine-tuned Social Learning

Fine-tuned learning with experience in humans is well known. A human baby starts to learn expressive words and accents that modify and improve with age.

Studies on vervet monkeys have demonstrated fine-tuned learning in animals.

Fine-Tuned Learning of Alarm Calls

Vervet monkeys produce a complex set of alarm calls. Their repertoire of calls includes giving distinct alarm calls for predators like leopards, eagles or snakes.

When a vervet sees a leopard, it gives a loud barking sound. When it sees an eagle, it gives a short double-syllabled cough. The alarm call for a snake is a “chutter”.

Upon hearing a particular alarm call, other vervets behave in an appropriate way: They run up a tree on hearing the alarm for a leopard. Look up on hearing the alarm for an eagle. Look down on hearing the alarm for a snake.

Infant vervet monkeys give alarm calls, but in a relatively undiscriminating way. For example, they give the "eagle" alarm on seeing any bird, including harmless birds. With age, the monkeys improve their accuracy. Infants learn how to give the right call by observing other members of the group and receiving social confirmation of correct calls from learned members.

Lesson no. 72 Evolution and Human Culture

Genetic Basis of Human Culture

Human culture and certain social behaviors are due to expression of genes that have been perpetuated by natural selection. So, human culture is related to Darwinian evolutionary theory.

However, an irrational interpretation of the genetic and evolutionary basis of human behavior may be misleading. It may be used to justify the status quo in human society, thus rationalizing social injustices and animal behaviors of human.

Plasticity of Human Behavior

Actually, the evolutionary explanation of human behavior does not make human behavior a rigid genetic model.

Just as the anatomical features of individuals vary extensively, so do the inherent behaviors.

Just like environment intervenes in the phenotypic expression of a genotype for physical traits, it is more significantly involved in the expression of behavioral traits.

As human have greater capacity for learning, human behavior is probably more plastic than that of any other animal.

Control of Instinctive Behavior by Culture

In the human cultural history, humans have built up a diversity of structured societies with institutionalized governments, laws, cultural values, and religions.

These institutions define what behavior is acceptable and what is not. Many of the instinctive behaviors that might enhance an individual's Darwinian fitness are considered unacceptable by law and are prohibited.

Perhaps these are the social and cultural institutions that make human behavior distinct and controlled than that of other animal societies.