PATTERNS OF BEHAVIOUR

Behaviour: an internally directed system of adaptive activities that facilitate survival and reproduction.

Ethology: is the scientific study of animal behavior, particularly when that behaviour occurs in the context of an animal's natural environment.

TYPES OF STIMULI

(a) Internal Stimuli

Examples:

- (i) Hunger signals a need for more energy and causes an animal to search for food
- (ii) Thirst signals a loss of internal fluid and causes an animal to look for water
- (iii) Pain warns an animal that some part of its body may be subject to injury causing it to take some action to avoid injury

(b) External Stimuli

Examples:

- (i) The sound of a predator can cause an animal to hide or run away to avoid being caught
- (ii) The sight of potential mate can trigger courtship behaviors
- (iii) Changes in day length can trigger reproductive behaviors or migration

TYPES OF BEHAVIOR

1. Innate / instinctive behaviour: natural, inborn patterns of behaviour e.g. suckling in newborns.

- 2. Learned behaviour: behaviour acquired through experience / practice.
- 3. Complex behaviour: blend of innate and learned components.

INNATE BEHAVIOR

Natural, inborn behaviour that is genetically programmed hence inherited. It does not involve a single clear cut category of behavior but rather it is a collection of responses that are predetermined by inheritance.

Note:

- 1. Since innate behavior is encoded in DNA, it is subject to genetic change through mutation, recombination, and natural selection.
- 2. Just like physical traits, innate behaviors are phylogenetic adaptations that have an evolutionary history.

Advantages of innate behaviour

- (i) Innate responses are generally rapid organisms can react quickly to their environments (predators etc.) e.g. the earth worm quickly / rapidly withdraws into its burrow, away from the danger.
- (ii) Innate behaviour suits species that have short lifespans they don't have time to learn behaviors
- (iii) Suits species with no parental care/solitary lifestyles as they can't learn behaviours from other members of the species

CATEGORIES OF INNATE BEHAVIOUR

1. Reflex: a simple, automatic response of a body to a stimulus that involves no conscious control e.g. Pull hand away from hot surface, baby feeding, horse tail swatting at flies.

Reflexes enable bodies to respond quickly to a stimulus protecting them from harm *Escape reflex:* involuntary responses which follow a specific pattern in response to a given stimulus.

Example: Earthworms withdraw underground in response to vibrations on the ground

- **2. Orientation behaviors:** are coordinated movements (walking, flying, swimming, etc.) that occur in response to an external stimulus. These behaviors have adaptive value for survival by helping the insect locate (or avoid) the source of a stimulus.
- **3. Kinesis:** non-directional orientation behaviour where the rate of movement is directly proportional to the intensity of a stimulus.

Example: Woodlice move around rapidly and randomly when exposed to light until they find better conditions then they stop moving or move slowly.

4. Taxis: A directional locomotory response to a given stimulus.

Example:

Fly maggots move away from light sources (negative **phototaxis**)

5. Fixed Action Pattern (FAP): Inborn behavioural response triggered by a very specific stimulus, which once initiated, continues until completed. Each FAP is triggered by a unique stimulus known as a **sign stimulus** / **key stimulus**, or, if it is a signal from one individual to another, it is called a **releaser**.

Examples of FAPs:

(i) Toad capturing a grasshopper / prey (**releaser** is any movement by a small [prey-sized] nearby object).

Note: A toad can **starve** even though it is surrounded by dead insects because it cannot recognize non-moving animals as prey!

(ii) If, while the female graylag goose is rolling the egg back to the nest, the egg slides off to the side, she continues repeated movement to roll any objects like cans which are outside the nest, using her beak and neck, until they reach the nest. (Sign stimulus is the egg outside the nest).
(iii) Yawning in humans

Unlike simple reflexes, FAPs may involve a whole-body response and often require a threshold level of internal readiness (drive).

RELEASERS OF INSTINCTIVE BEHAVIOR

Releasers / sign stimuli / key stimuli: Signals that trigger instinctive acts.

Once the body is prepared for certain types of instinctive behavior, an external stimulus may be needed to initiate the response. However, the stimulus need not necessarily be appropriate to be effective.

Examples:

(i) Exposing the red breast of a male robin releases territorial behaviour in another male robin, but even a simple clump of red feathers instead of a stuffed robin will elicit similar response.

(ii) During the breeding season, the female three-spined stickleback normally guided by the redbellied male to the nest that he has prepared, after which he prods the base of her tail to cause her release the eggs. But even in the absence of the male, the female will follow any small red object to the nest, and any object that touches near the base of her tail causes her to release eggs.

LEARNED BEHAVIOR

Learning: adaptive change in behaviour that occurs as a result of experience / practice. *Learnt behaviour*: behaviour acquired through previous experience / practice.

COMPARISON OF INNATE BEHAVIOUR AND LEARNED BEHAVIOUR

| INNATE BEHAVIOUR | LEARNED BEHAVIOUR | |
|--|---|--|
| 1. <i>Heritable</i> - encoded in DNA and | <i>1. Non-heritable</i> - acquired only through | |
| passed from generation to generation | observation or experience | |
| 2. <i>Intrinsic</i> - present in animals raised in | 2. <i>Extrinsic</i> - absent in animals raised in | |
| isolation from others | isolation from others | |
| 3. <i>Stereotyped</i> - performed in the same | 3. <i>Permutable</i> - pattern or sequence may | |
| way each time by each individual | change over time | |
| 4. <i>Inflexible</i> - not modified by | 4. <i>Adaptable</i> - capable of modification to | |
| development or experience | suit changing conditions | |
| 5. <i>Consummate</i> - fully developed or | 5. <i>Progressive</i> - subject to improvement | |
| expressed at first performance | or refinement through practice | |
| 6. <i>Unintelligent</i> and automatic | 6. <i>Intelligent</i> and intellectual | |

Advantages of learned behaviour

- (i) Flexible
- (ii) Benefits animals with longer life spans and so there is time to learn
- (iii) Benefits animals with an element of parental care of the young; which involves learning from the parent (iv) Benefits animals that live with other members of the species for at least a time e.g. in herds & packs

Note: The responses of learnt behaviour are adapted to the environment.

TYPES OF LEARNED BEHAVIOUR

1. **Habituation:** is learning to "ignore" stimuli that are not important, irrelevant, or repetitive **e.g.** after sometime, birds learn to ignore a scare crow that is positioned in one position of the garden.

2. Associative learning: any learning process in which a new response becomes associated with a particular stimulus.

Two types of associative learning

(a) **Classical Conditioning:** A process in which an animal learns to associate a previously neutral stimulus with a behavior once triggered by a different stimulus

- (i) Honey bees learn to associate floral colors and fragrances with the presence of nectar.
- (ii) Pavlov's Dogs salivated on hearing the sound of a bell in expectation of food, yet initially it was the food smell that stimulated salivation.

Pavlov on the control of salivation in dogs

- He noted that when presented with the sight and smell of food, the dogs began to salivate in preparation of eating.
- Pavlov began to ring a bell each time the dog was shown their food.
- After a while he found dogs salivated when the bell was rung, regardless of whether food was present.

(b) Operant conditioning (Instrumental learning / 'Trial-and-Error' learning):

A form of adaptive learning in which an animal learns to carry out a particular action in order to receive a reward or avoid an unpleasant experience.

(i) In Skinners box, rats learnt to press a lever in order to obtain food.

(ii) Cockroaches learning to run through a simple maze to find food.

Skinner's work on pigeons / rats

- > Trained rats and pigeons to press a lever in order to obtain food.
- > Certain motor-output responses generated e.g. running around, resting, pressing leaver.
- After training the subject will show the conditioned response (e.g. pressing the leaver) if the response to the unconditioned stimulus (a food reward) association has been memorized.

3. Latent Learning (Exploratory learning): Animals explore new surrounding and learn information that has no apparent value at the time, but may be remembered and used later when necessity arises.

- (i) Rabbits / rats / mice explore their burrows, which may save them in case of an emergency.
- (ii) A sand wasp remembers the pattern of surrounding landmarks to help her find the nest when she returns.
- (iii) Worker ants can remember a series of landmarks along a trail and follow them (in reverse order) back home to the nest site.
- (iv) A hen uses previous experience to regroup eggs in the nest using wings.

4. Insight learning: The highest form of learning in which an animal applies thinking and reasoning in order to solve problems or deal with complex situations with repeated trial and error.

- (i) A chimpanzee piles boxes to increase height for reaching hanging sweet bananas which are out of its reach.
- (ii) A child uses stones to hit at mango fruits which are high on the tree.

5. Imprinting: Within a specific period of time after birth an animal learns to recognize and bond to its parent. Imprinting occurs in the sensitive period called "**critical period**"- which is around 36 hours after hatching in goslings and helps survival during infancy *Example*: Goslings, ducklings and chicks become attached to the organism they interact with during the sensitive period.

COMPLEX BEHAVIOR

Most overt behavior is neither 100% innate nor 100% learned. Sometimes innate behaviors may be modified (or modulated) through practice and experience.

Example: In locusts the ability to fly is innate, but an older, experienced individual consumes less energy (per unit time) than a novice flier. This suggests that the older insect has "learned" to fly more efficiently.

TIMING OF BEHAVIOUR

Circaannual - occurs on a seasonal / annual basis

Examples: hibernation in bears, frogs, toads, salamanders bury themselves in mud during the winter.

Circadian - This is a 24-hour, light-regulated, sleep/wake cycle of behaviour.

Circadian rhythms are controlled by genes, yet are also influenced by factors such as jet lag and shift work.

TERRITORIAL BEHAVIOUR / TERRITORRIALITY

A territory: a physical space an animal defends against other members of its species.

The main reasons for territoriality

- **1.** Control food supply
- 2. Retreat; shelter; nest,
- 3. Access to females; space for sexual display; courtship

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|--|--|--|
| Advantages of territoriality | Disadvantages of territoriality | |
| 1. Males able to hold on to | 1. Cost of defending territory including risk of physical | |
| resources show their evolutionary | contact, and displays of strength. | |
| fitness and are attractive to females. | 2. Need to be vigilant for intruders. | |
| 2. Exclusive access to food, | 3. Defending territory is time that could be feeding or | |
| particularly at times of shortage. | mating. | |
| 3. Exclusive area for breeding | 4. Vocal or visual communication of territory ownership | |
| and raising young. | makes the individual vulnerable to predation. | |
| 4. Space for sexual display and | 5. Difficult for smaller animals to hold territory; i.e. more | |
| courtship. | likely to be attacked than larger animals | |
| 5. Spacing of animals avoids | 6. Difficult to move if resources exhausted. | |
| competition. | 7. Importance of territory size. If too large, then hard to | |
| 6. Reduces aggression / | maintain control. If too small, not enough resources for effort | |
| conflicts. | of defending. | |
| 7. Improves local knowledge of | 8. Higher risk of predation if territory within predator's | |
| predators and resources. | territory. | |
| 8. Exclusive place to retreat and | 9. Easy for predators to find. | |
| shelter. | 10. Ever present threat of take-over as surplus of animals | |
| 9. Dispersion of nests reduces | without territory, 11. Extra vigilance required at certain times | |
| predation. | of the year (e.g. breeding season) | |
| 10. Higher survival rates. | or the year (e.g. breeding beason). | |

Animals that have territories mark and defend their space by **singing** e.g. birds, **urinating** e.g. mammals, **constantly standing guard** e.g. carpenter bees, **releasing pheromones** e.g. some insects

MIGRATION

Migration: Inborn, seasonal, long-distance travel of animals to specific locations, usually with a return.

Orientation: organism is capable of detecting compass direction (N, S, E, W) using cues from the environment

Navigation: organism is capable of detecting its position as well as orientation, (N, S, E, W) of something – river, ocean, mountain range, etc)

Examples of migration:

- (i) Some species of Gallinaceous and raptorial birds migrate from valley to mountain peaks.
- (ii) Salmon return to native streams to breed after several years at sea.
- (iii) Deer and Caribou, African ungulates mammals engaged in overland migrations.
- (iv) Some sharks, whales (northern oceans for calving, southern areas for breeding) and other marine mammals engaged in long distance oceanic migrations

Migration is triggered by seasonal changes in weather, air temperature or day length, or changing food supply. *Examples*: wildebeest move towards rain in the dry season, some animals move from one food source to another, while others migrate to particular breeding areas.

CUES THAT ANIMALS USE TO NAVIGATE

- (i) *Endogenous* hormonal
- (ii) *Exogenous* external cues from the environment

Examples:

- 1. Sun compass movement of sun; angle of sun; polarised light (pattern of light based on sun's position and reflection on water)
- 2. Geomagnetic compass sensitivity to magnetic North and the earth's magnetic field
- 3. Star compass or position of moon
- 4. Other visual cues patterns of waves; cloud patterns; landmarks
- 5. Smell
- 6. Sound
- 7. Electric
- 8. Young animals may learn when and where to migrate by following their parents

| Advantages of migration | Disadvantages of migration | |
|---|---|--|
| 1. Return to specialist site for breeding that does | 1. Large amount of energy required to | |
| not need all year round food supply, and often no (or | travel long distances. | |
| few) predators. | 2. Problems and risks of navigation. | |
| 2. Move to where food/prey available when not | 3. Risk of forgetting sites or not being | |
| breeding, particularly with young (i.e. maximise | able to find again. | |
| feeding opportunity). | 4. Leave home territory empty | |
| 3. Stationary can mean increased predator risk. | allowing for invaders, and then fights on | |
| 4. Constant temperature conditions: escape bad | returning. | |
| weather and lower temperatures (and greater risk of | 5. Risk at temporary stopovers from | |
| death), especially to give birth. | lack of local knowledge about predators. | |
| 5. Able to have specialist breeding site (e.g. no | 6 Vulnerable to weather changes or | |
| Flavible strategy some members of the | poor conditions in one year. | |
| o. Flexible strategy - some members of the | 7 Many decisions required including | |
| where live | optimal fuel load and optimal time of | |
| 7 Stationary animals risk exhausting food | departure. | |
| supply using it all year round particularly if | 8 Other risks like the change from | |
| competition from other species. | salt to freshwater or vice versa for some | |
| 8. Opportunity for different members of the | fish. | |
| species to meet, and greater breeding variety | 9. Evolutionary maladaptive | |
| 9. Ideal when specialist food required because | behaviour in some cases: e.g. green turtles | |
| the earth's resources are not evenly distributed. | feed on eastern coast of South America but | |
| 10. Birds migrating at night usually safe from | breed on Ascension Island (south | |
| predators as few day-time birds of prey adapt to | Atlantic). | |
| night-time hunting. | 10. Risks of night-time migration if | |
| | animals normally active in day-time (e.g. | |
| | bat predation of birds). | |

AGONISTIC BEHAVIOURS

Ritualised behaviours that substitute for physical contact and fighting e.g. yawn of baboons, dogs and baring their teeth, cats and raising their fur, birds raising their feathers, fighting and physical contact in wolves, coyotes, seals, etc.

Aggressive behaviour is used to intimidate another animal of the same species.

Animals fight or threaten one another in order to defend their young, their territory, or a resource such as food.

Animals of the same species rarely fight to the death; fights are symbolic / highly ritualised.

The fight is over when the defeated individual shows submission to the victor.

In animals, usually the oldest or strongest wins the argument.

DOMINANCE HIERACHY

A *dominance hierarchy:* a form of social ranking within a group in which some individuals are more subordinate than others.

The ability to form a dominance hierarchy is innate, but the position each animal assumes may be learned.

The term *pecking order* comes from a dominance hierarchy that is formed by chickens. The topranking chicken can peck any other chicken. The chicken lowest in the hierarchy is pecked at by all the other chickens in the group.

Importance of dominance hierarchy

- (i) Reduces aggression, established order and stability
- (ii) Influences resources among population (food, water, etc.)
- (iii) First choice of mating
- (iv) Subordinate remains to obtain food, avoid predators, chance to mate

HIBERNATION

Hibernation: a state in which the body temperature drops substantially, oxygen consumption decreases, and breathing rates decline to a few breaths per minute to avoid cold temperatures. Its conserves energy

AESTIVATION

Estivation: is a state of reduced metabolism that occurs in animals living in conditions of intense heat. Could be due also to lack of food or periods of drought.

REPRODUCTIVE BEHAVIOUR

Courtship Behaviour: is a set of display behaviours in which an animal attempts to attract a mate and exhibit their desire to copulate.

Examples:

- (i) Singing in male birds
- (ii) Peacocks display flamboyant plumage colors and prominent tail feathers
- (iii) Preening (sit with their bodies touching one another to show that they are not intending to harm their partner) (iv) Dancing in birds
- (v) Building nests in birds

Importance of courtship behaviour

(i)It synchronizes the time of producing with the availability of food.

(ii) Allows pair bonding which leads to successful mating/tightens pair bond mating pairs.

(iii) It synchronizes gonad development so that gametes mature at the same time to ensure that fertilization occurs when mating takes place.

(iv) It minimizes breeding between members of different species i.e. ensures that pairing occurs between partners of the same species most likely to produce fertile offspring.

(v) Suppresses negative tendencies like avoidance of body contact, escape behavior and cannibalism (spider) i.e. from predating to sexual. However, after copulation her behavior reverses to aggressive and she eats her mate.

(vi) Courtship has the initial function of attracting a partner who may be at a distance. Animals use sound e.g. singing in birds, coloration e.g. in stickleback, pheromones, elaborate movements, light (glow warm) and body displays (peacock).

- (vii) Provides protection to courting individuals.
- (viii) Stimulates mating of individuals i.e. to sexual activity.
- **NB.** Synchronizations are achieved by secretions of the pituitary gland.
- (ix) Courtship behavior is developed in sexually mature individuals and therefore mating between immature individuals which can't produce offspring is avoided/ induces mating.

ANTI-PREDATORY BEHAVIOUR

(a) Mimicry

Superficial resemblance of two or more organisms that are not closely related taxonomically. e.g. the non-poisonous viceroy butterfly mimics the poisonous monarch butterfly.

(i) **Batesian mimicry**: the palatable species mimics other distasteful species e.g. viceroy butterfly mimics the poisonous monarch butterfly, the harmless hoverfly mimics the painful stinging wasp

(ii) Mullerian mimicry: both the mimic and mimicked are unpalatable or dangerous e.g. the five spot Burnet moth and related moths.

GUIDING QUESTION

Viceroy butterflies avoid predators by mimicking monarch butterflies' coloration, but viceroys are not poisonous and monarchs are. When might this mimicry stop deterring predators?

This type of mimicry depends on predators learning to avoid the butterflies. To do that, they have to taste a few to learn that they taste bad. If there are a lot more viceroys than monarchs, the predators will usually have a satisfying meal without getting sick, and will not associate getting sick (when they eat an occasional monarch) with eating the butterflies. The whole mimicry depends on predators making the association between color and poison.

(b) Camouflage

The use of any combination of materials, coloration, or illumination for concealment, either by making animals difficult to see, or by disguising them as something else.

| Advantage of camouflage | Disadvantages of overcamouflage |
|---|---|
| Reduces predation chances, enabling the | (i) Increases risks of being trampled upon while in |
| organism to reproduce and pass on | the habitat. |
| advantages genes to offspring. | (ii) Makes it difficult to be noticed by potential |
| | reproductive mates. |

(c) Warning colouration

Conspicuous colouring that warns a predator that an animal is unpalatable or poisonous e.g. the poisonous frogs, some snakes, monarch butterflies and some grasshoppers.

(d) Disruptive colouration (Disruptive camouflage or disruptive patterning)

A form of camouflage that works by breaking up the outlines of an animal with a strongly contrasting pattern, thus decreasing detectability.

Predators who look at them may not be able to recognize them without their distinct shape being obvious.

(e) Cryptic coloration

Coloration that allows an organism to match its background and hence become less vulnerable to predation or recognition by prey

CHEMICAL SIGNALS (e.g. PHEROMONES)

These serve as releasers in many animals.

Examples:

(i) Social insects (ants, bees, and termites) release pheromones that elicit alarming, mating, and foraging in other members of their species.

(ii) The pheromone from the mammary glands of domestic rabbit releases immediate nursing behavior by their babies (pups).

USES OF PHEROMONES

- Secretion of mammals is used for marking out territory and or attraction of mates.
- Responsible for bringing for out distant sexes together in insects like cockroaches, dogs.
- In bees it plays a part in directing the development and behavior of different castes in the colony. A dead ant produces a pheromone which causes other ants to throw it out of the nest.
- Used increasingly as a method of biological control in insect species. The pheromones attract males where they are captured and killed.

ALTRUISM

Altruistic behavior is one in which an individual (the donor) performs an action that helps another animal (the recipient) with no apparent advantage to itself.

Examples: alarm calling in squirrels, helpers at the nest in scrub jays, sterile worker castes in honey bees etc.)

KIN SELECTION

Is the evolutionary mechanism that selects for those behaviours that increase the inclusive fitness of the donor.

GUIDING QUESTIONS

1. Alarm calls put the caller at increased risk of predation by drawing attention to its location. Why might this behavior be favoured by evolution?

Animals that use alarm calls put themselves at risk but increase the chances of their relatives' survival. Animals that live in colonies with alarm calls usually live in large family groups, so their genes benefit by allowing others in the group to survive. Alarm calls may be favored by kin selection.

2. What are some benefits to living in a group? What are some negative consequences of group living?

Group members can cooperate in finding food.

Group hunters can catch larger prey than individual animals can, and animals foraging might find spots where food is plentiful and all members of the group benefit rather than wasting time fighting over it.

Groups can defend territories more efficiently than individuals can, and living in a group also provides better access to mates.

- □ There are also drawbacks to living in a group.
- Groups may attract predators or attacks by other animals because of scents or noises.

□Animals living in groups also spread disease more easily than animals living on their own.

DISPLACEMENT ACTIVITY

An irrelevant activity produced by an excess of one or more conflicting drives in an organism. Displacement activities occur when an animal experiences high motivation for two or more conflicting behaviours, the resulting displacement activity is usually unrelated to the competing motivations. *Examples*

- (i) Birds may peck at grass when uncertain whether to attack or flee from an opponent.
- (ii) A human may scratch his or her head when they do not know which of two options to choose.
- (iii) A bird may pick up nesting material from the ground and throw it away on being disturbed from the nest.
- (iv) Sticklebacks suddenly dig in the vertical position during a boundary clash.

VACUUM ACTIVITY

Animal behaviour pattern performed without apparent need or stimuli. Or *a form of behavior which provides a means of reducing frustration where the normal response is produced but not directed towards the normal object*

Examples

(i) Even if there are no insects, a bird snaps at imaginary insects in the air, no reason to do so but just exercising instinctive action pattern.

(ii) Domestic squirrel raised in a metal cage will go through the entire sequence of nut-burying activities as if it were in the bush.

(iii) Showing irritation towards someone who is not the cause of irritation but acts as a substitute.

REDIRECTED ACTIVITY

Behavior that is redirected from a threatening or inaccessible target to another target that is more convenient or less threatening **e.g.** middle level managers when disciplined by their superiors may fail to respond in kind, so they take it out on their subordinates.

HONEYBEE DANCE LANGUAGE

Honey bee dancing is performed by a worker bee that has returned to the honey comb with pollen or nectar, informing other workers about both the distance and direction where the food is.

1. **Round dance:** Communicates only distance from the food source (less than 50 meters from the hive). It involves running around in narrow circles, suddenly reversing direction to her original course.

2. Sickle dance: Communicates only distance from the food source (between 50 and 150 meters from the hive). This dance is crescent-shaped and represents a transitional dance between the round dance and a waggle dance.

3. Waggle dance (wag-tail dance): Communicates both distance and direction. Is performed by bees foraging at food sources that are more than 150 meters from the hive.

| Round dance | Sickle dance | Waggle dance |
|-------------|--------------|---------------|
| | | Sun Flower |

How waggle dance is performed

A bee that performs a waggle dance runs straight ahead for a short distance, returns in a semicircle to the starting point, runs again through the straight course, then makes a semicircle in the opposite direction to complete a full figure-eight circuit.

While running the straight-line course of the dance, the bee's body, especially the abdomen, wags vigorously from side to side.

The duration of the waggle phase is proportional to the distance from the food source (1 second = 1 Km).

The orientation of the dancing bee during the straight portion of her waggle dance indicates the location of the food source relative to the sun.

The angle that the bee adopts, relative to vertical, represents the angle to the flowers relative to the direction of the sun outside the hive.