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Defns

- **Behaviour**; Is an outward expressive pattern of responses to stimuli in an organism.
OR
Is the sum total of responses of an organism to changes in its environment.
OR
Is a particular pattern of activity by which an organism makes a response to stimulus which is stereotype.
- **Stimuli**; changes in internal or external environment of an organism.
- **Ethology**; study of behaviour.

Approaches to behavioural studies

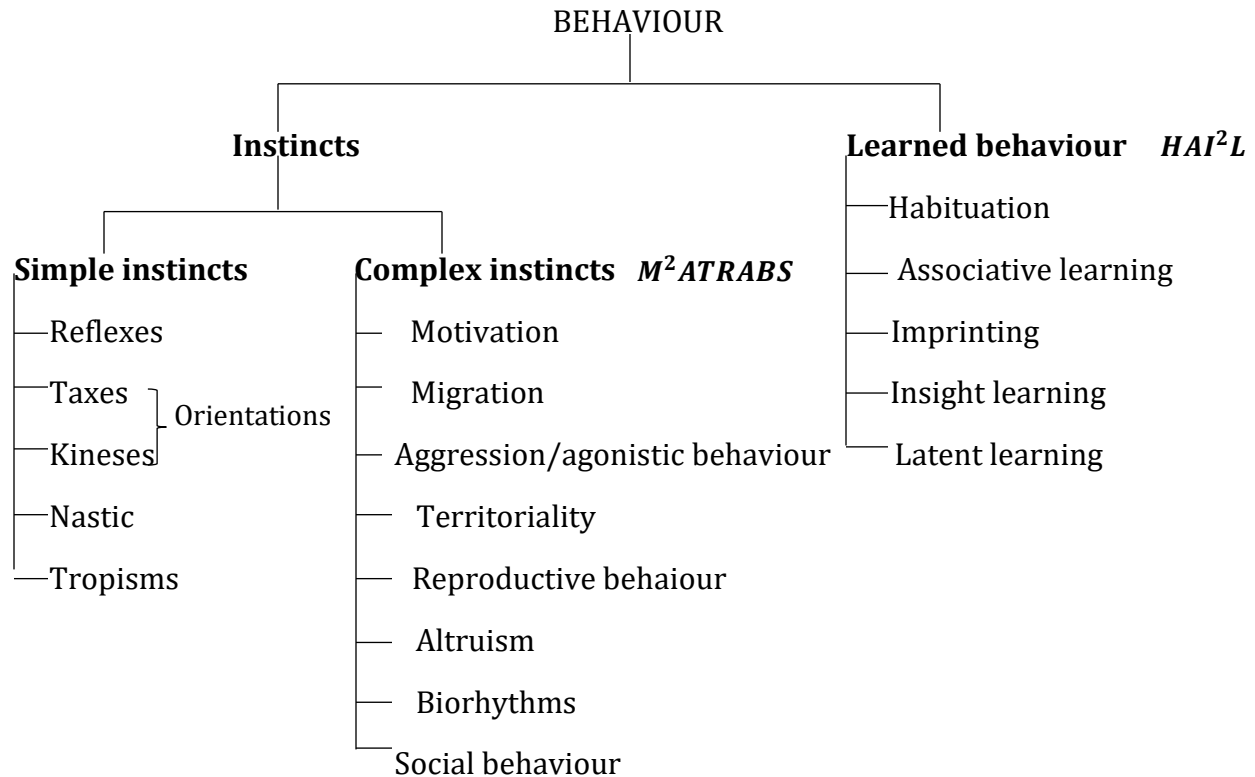
- Vitalistic approach**; behaviour activities explained in terms of what animals seen to do; relate them to changes in their natural environment.
- Mechanistic approach**; experimental; investigations; on behavioural aspects done under controlled conditions; laboratory; pioneered by Ivan Pavlov.
- Ethological approach**; contemporary; attempts explain behavioural responses observed in field; in terms of stimuli eliciting them. Pioneered by Lorenz Von Frisch & Tinbergen.

Techniques of behavioural studies

- **Video recordings**; for fierce animals
- **Kymographs**; for small animals
- **Slow-motion films**; for fast-moving animals like birds
- **Time-lapse photography**; for slow moving animals like sea anemones
- **Multiple-flash photography**; rapid movement; like in spiders

Types of behaviour

- 2 broad types of behaviour viz;
 1. Instinctive behaviour (instincts)/innate (inborn) behaviour
 2. Learned behaviour



INSTINCT BEHAVIOUR/INNATE BEHAVIOUR

Defn: Is a type of complex inborn stereotyped behaviour of immediate adaptive survival value exhibited by all organisms of the same species that doesn't require prior/previous experience.

- Elicited by specific and usually simple stimuli
- Stereotyped responses to one or more environmental stimuli.
- Species-specific behaviour

Characteristics

- Are unique
- Are inflexible; no alternative responses
- Are inherited from parents; controlled by genes
- Don't require prior experience
- Are automatic
- Often quick and exhibited by all organisms of the species

Significance of instinctive behaviour

- It's of much value in adapting the organism and the whole species to its environment and thus the stimuli.

Types of instinct behaviours

They range from simple like reflex action to complex behaviours like migration, nest building, mating behaviour etc.

SIMPLE INSTINCT BEHAVIOURS

(i) **Reflexes/reflex actions**

A reflex action is a simple form of behaviour in which a stimulus produces a specific short-lived response.

Reflexes are the simplest innate/inborn behaviour. The response to a stimulus follows a series of changes i.e. impulses beginning from receptors to central nervous system and then to the effectors i.e. the impulses flow through 3 types of neurones i.e. sensory, relay and motor neurones and this is referred to as reflex arc.

NOTE:

- Most reflexes are coordinated in the spinal cord and are known as spinal reflexes like knee jerk and ankle reflexes
- Those controlled through the brain are called cranial reflexes like blinking of the eyes.

An example of a reflex action in lower animals like earthworm and squid is the escape response.

(ii) **Tropisms**; growth responses of organism(plant) to directional external stimuli; growth responses affected by direction of stimulus; named depending on stimulus and its direction; e.g. roots exhibit negative phototropism; shoots; positive phototropism.

- Phototropism
 - Geotropism
 - Hydrotropism
- } In leaves; runners; grow at 90° to direction of light.
} Leaves are held out at 90° to direction of light.

(iii) **Taxes**; locomotory response of an organism to external directional stimulus.

Locomotory=movement of the whole organism

A taxis is a movement that is oriented in relation to the stimulus. Like in tropism, movement towards the stimulus is said to be positive and that away from the stimulus is said to be negative.

Are named depending on type of stimulus and its direction.

i.e.

Phototaxis; response to light.

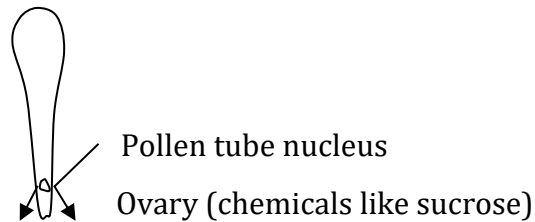
Chemotaxis; response to chemicals

Thermotaxis; response to heat/temperature

Hydrotaxis; response to water

E.g.

- Sperm cells; moving towards chemicals secreted by ova; positive chemotaxis.
- Liverworts, mosses, ferns, woodlice; away from light; negative phototaxis.
- Motile bacteria moving away from chemicals; negative chemotaxis.
- Green algae swim towards regions of optimum temperature; positive thermotaxis.
- Larvae & some small organisms moving away from extremes of temperature [cold/hot condition]; positive thermotaxis.



- Pollen tube nucleus; move towards chemicals secreted by ovary; positive chemotaxis.
- Euglena; move towards light; positive phototaxis
- Termites; placed on a dish half way in light and half way in darkness; all move to the dark side of the dish; negative phototaxis.

(iv) **Kineses**; locomotory responses of an organism/a cell to intensity of non-directional stimulus.

In other words, kinesis is a type of behaviour in which an animal responds to an alternation in intensity of stimulus by changing its activity level. Most kineses are locomotory /turning movements in nature.

- The speed of movement/turning depends on the strength of stimulus but the stimulus doesn't control the direction of movement of the organism i.e. the locomotion doesn't take a particular direction but speeds up and slows down according to the intensity of the stimulus.

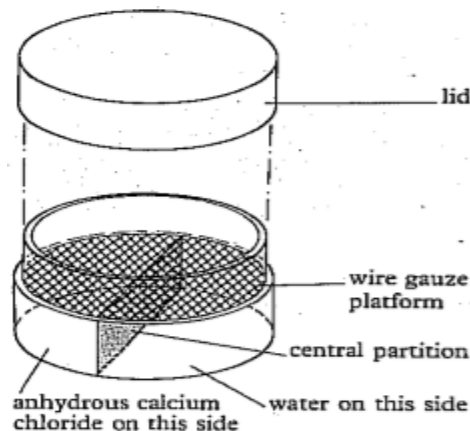
E.g.

- Woodlice in choice chamber which is half way moist and half way dry; if they cross into the dry area (their unfavourable environment), their rate of locomotion and turning increases.

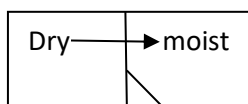
When turn back into the moist area (their favourable environment) their locomotion and turning cease altogether.

Generally, their rate of turning is increased as they try to get to favourable conditions; i.e. moving from dry to moist environment.

Illustration



Simply;



Organisms introduced here to spread out & show variations in rates of turning in moist & dry conditions.
"Orthokinesis"; intensity dependent.

- **Free living flatworms**; when these worms are placed in a dish which is half-way covered and the other lit, the worms eventually come to rest in the dark half. Because the rate of turning increases in illuminated area/half.

NOTE: Both kinesis and taxis are referred to as **orientation behaviour**.

- **Orientation**; Reflexes of complex behavioural responses where organism take a particular position in relation to stimuli.

(v) **Nastic responses**;

Nasty; non-directional movement of plant in response to intensity of a stimulus; magnitude of response; dependent on intensity of stimulus i.e. affected by; intensity of stimulus; structure.

Growth/turgor responses;

E.g.

- Opening & closing of stomata (stimulus is light).
- "Steep movements" / "nyctinasty"; opening & closing of petals in morning glory; folding of leaves in mimosa pudica on touch [pressure].

NB: Specify whether a response is a growth; locomotory; non-locomotory etc.

Response	Nature	Modification	Example
Tropism	Growth Non-locomotory	Direction	Roots exhibit -ve phototropism (light).
Taxis	Locomotory	Direction	Insect moving away from presence of pesticide.
Kinesis	Locomotory	Intensity	Woodlice moving towards moist region of a choice chamber.
Nasty	Movement Non-locomotory Non-growth	Intensity	Activity of mimosa pudica.

HINT:

- Stimulus**; change in internal /external environment of an organism; strong to cause a response.
- Response**; change in activity of organism/it's part in reaction to stimulus.

- c) **Effectors**; body structures/cells which respond to stimulus.

TYPES OF STIMULI

1. **Motivational stimuli**; determine stage/state of responsiveness of an organism; e.g. smell of food.
2. **Releasing stimuli/releasers (sign stimuli)**; elicit/evoke responses; e.g. sight of food; secretion of pheromones; red stripped abdomen(male); large abdomen (male) in stickleback fish; butch of red feathers in male ribbons; high frequency sound of female mosquito; male follow; red spotted beaks in gulls(birds); rolling of eggs into nests in ground nesting; escape. Shape; colour; particular making of opposite sex; etc. there're releasers like sex hormones that enhance gonads development.
3. **Terminating stimuli**; terminate/end behavioural responses; e.g. stretching of stomach walls on satisfaction; terminates desire to eat.

NB: Fixed action patterns; are instinctive behavioural sequences in species of organisms that are stereotyped and species-specific.

Characteristics

- Are stereotyped
- Are complex
- Are independent of experience
- Are triggered by stimulus
- Are species-specific

Types of releasers

- (i) Visual releaser; e.g. beautiful colours of peacock; change of tail structure
- (ii) Auditory releasers e.g. Singing of some birds
- (iii) Chemical releasers e.g. pheromones

COMPLEX INSTINCT BEHAVIOURS

1. **MOTIVATION**; a variety of factors that modify the number and nature of behavioural responses.
 - Complex innate behaviour; which drives an organism to respond to stimuli; self drives; intrinsic forces.
2. **MIGRATION**; more complex innate behaviour; that involves movement of a population/part of population; from one area to another and their return to original area/habitat after some time
Migration range from short distance migration like up and down a single mountain to long distances across continents or oceans.
E.g.
 - Salmon fish; spawn in fresh water streams in western Europe but return to the sea for normal life only seasonally to breed. The young ones after hatching and attaining some level of maturity, swim down and even locate their parents.

- Many species of birds live doves are known to migrate between the north pole in Europe and south pole in south Africa/southern America to escape unfavourable winter seasons. When winter ceases in their habitat, then they migrate back and area able to locate their actual habitats.
- Stickle back fish in the springs, the males migrate upstream to their breeding grounds.

Reasons

- To look for mates.
- To look for food.
- To look for water etc

Migration in animals is triggered off by some stimuli in the environment; such stimuli which trigger off innate behaviour are called **releasers**.

Defn: Releaser is any feature of the environment which is positively shown to evoke behavioural responses. E.g: change in day length, decreased temperature(winter), food scarcity etc.

Advantages of migration(releasers)

- it's a means of finding better food suppliers
- provides better chances of finding good breeding places/sites thus animals that have migrated breed successfully
- enables animals to avoid adverse unfavourable environmental conditions.

Qn: How the organisms find their way back home?

- Follow prominent natural/Physical features e.g. Mountain ranges, waterbodies & waterfalls etc.
- Orientation towards the direction of sun's rays i.e. orient themselves in relation to the position of the sun
- Doves using their tails as a compass to find their way back home.
- Have inborn ability to sense direction like the homing ability of pigeons; internal biological clock.

3. TERRITORIALITY/TERRITORIAL BEHAVIOUR

- Is innate behaviour where organism or group of organisms acquire; demarcate; protect/guard an area out of intruders.

OR

Is the acquisition, demarcation and defense of a particular area by an organism or group of organisms against colonization/invasion by other organisms.

Amphibians don't display territoriality.

A **territory** is an area(avenue) of the habitat which is occupied by an individual/group of individuals and defended from other individuals of the same species.

- ❖ It occurs in all classes of invertebrates and some cats like cheaters, lions, true cats etc.
- ❖ The major purpose of keeping a territory is for breeding purposes; to defend the territory from predators/intruders.
- ❖ Animals don't keep the territory by physical fighting or other form of aggressive behaviour but they use passive methods like;

- (i) Defecating around the territory
- (ii) Urinating around it
- (iii) Making special sounds
- (iv) Making special signals like posture/facial expression.
- (v) Producing bad odour/smell.
- (vi) Rubbing glandular parts of the body against objects called scent posts.

However, if all these passive means fail, then physical combat(fighting) is used.

These postures or markings tend to intimate others/intruders/extruders from territory or make advances towards its mates. Such threat displays are common in fish and birds like the arched fish opens its mouth or gill region.

- ❖ The importance of these threat displays is often to prevent actual fighting from breaking out and the rival usually accepts defeat and departs as it is frightened by the threatening postures of the aggressor.

E.g.

- ✓ An aggressive dog threatens another rival by standing erect baring its teeth and the rival is threatened and departs.
- ✓ Open combat between human beings is avoided by facial expression.
- ✓ The stickle back fish, has a red berry; after migrating upstream to its breeding grounds, it starts building the nest; forming the eggs and protecting the young.
- ✓ In the mate robin, the red breast is the effective stimulus which elicits(starts) the threat in other mates. Similarly, in the mate stickle back, the red berry serves the same purposes.

Advantages

- Reduces losses of animals(organisms) to predation by defending the territory against predators;/intruders OR by making organisms more a familiar to a given area especially to young ones;
- Ensures/guarantees food supply, shelter and adequate space to offsprings, old and the mates; by keeping off all other animals that would feed on their food and reducing intraspecific competition;
- Reduces the amount of time devoted to aggression which is a destructive behaviour; and aggression is replaced by mere threats;
- Reduces/prevents spreading of diseases/epidemics; due to reduced contact with other organisms/ since combat between animals is reduced;
- Limits mating to biologically fit individuals only thus, increase the overall fitness of the population; by ensuring passing on of good genetic characters/traits from one generation to the next;(thus increased favourable features of the population)

- Enhances pair formation hence mating assured; which is a pre-requisite for reproduction of most animals;
- Permits improved defense of nest and young ones; due to protection of breeding area & offsprings;
- Reduces interference from other intending mates;(other organisms intending to mate)

Disadvantages

- Leads to genetic death since mating is only limited to fit individuals; and unfit/weak individuals are denied chance for mating thus don't propagate their genetics to their young ones/subsequent generation;
- Limits the population density that can be attained in an area;
- Reduces genetic variation; since it encourages inbreeding which results into reduced biological fitness;
- Puts animals at risk of predation in which case the entire territory likely to be consumed; since predators can always associate them with their territory; and some have to announce their presence by making sounds, bad odour etc;
- Encourages spreading of diseases amongst territory owners during the outbreak of epidemics; due to overcrowding;
- Encourages passing on of poor traits from fit individuals to offsprings; since mating is limited to fit individuals only;
- Weak organisms are incapable of making territories; since they can't secure and defend them;

4. **REPRODUCTIVE BEHAVIOUR** ; complex form of inborn behaviour involving both precopulatory/prenatal behaviour like courtship and post copulatory/postnatal behaviour like care for the young called parental care.

Categories of reproductive behaviour

- (i) Precopulatory e.g. courtship
- (ii) Post copulatory e.g. parental care

E.g.

- In birds, sexual behaviour in spring is brought on by increasing day length resulting in enlargement of the gonads. This activates the gonads to produce sex hormones thus produce reproductive behaviour.
- Similarly, courtship and mating of stickleback only occur in spring when the female is ripe and the sex urge reaches its height.

COURTSHIP; form of stereotyped(specific) behaviour between male and female organisms prior to mating which eventually lead them to mate.

- It ends in pair formation i.e. male-female pairs; occurs with focus of mating.

- The releasers/releasing stimuli for courtship can be a feature possessed by another individual like its colour, shape of a particular marking;

Examples of courtship

- (i) In the stickle back, the male after migrating upstream to its breeding ground in the spring, it acquires a territory, chases away any intruders of either sex, then he builds a nest when the female appears, he swims towards her while performing a zig-zag dance then the female responds by swimming towards the male. She enters the nest, discharge eggs and leaves. Then the male ejaculates over the eggs.
After mating is over, the male guards the nest and fans the eggs with his pectoral fins and this keeps them well supplied with oxygen.
When eggs hatch, the male keeps the young ones and defends them until they are capable of looking after themselves.
- (ii) Unmated female cockroach secretes a chemical substance which stimulates the male to court it.
- (iii) Making sounds in amphibians
- (iv) Change in colour of belly to red in male stickleback fish.
- (v) Wandering dance in fish; queen butterfly (albatross)
- (vi) Expanding in turkeys.

Courtship reduces aggressiveness in nature like in spider species [females].

Advantages

- Synchronizes development of gonads.
- Induces mating among accepted pair/leads to mating after pair formation
- Strengthen bond pair among mating pair.
- Reduces aggressiveness among mating pair.
- Synchronizes maturity towards to sexual activity[preparedness]
- Ensures pair formation and pair bond formation thus ensuring the responsibility of both male and female partners of the same species for the young.
- Suppresses some tendencies that exist in organisms like escaping behaviour, avoidance of body contact.
- Prevents mate cannibalism i.e. the tendency to eat members of the same species.

PARENTAL CARE; a series of activities a parent animal does to ensure the survival, development and well being of its young.

- The higher the animal is on the evolutionary scale, the smaller the number of young at birth and the more the parental care offered to the young. E.g. man at any particular time has smaller number of young compared to those of amphibians but offers maximum parental care.
- Parental care is mostly developed in mammals than in other animals.

- In most animals where parental care occurs, stimulation for parental care is often by the young themselves like the fragile and pleasant baby look.

E.g.

- In man, where there's highest form of parental care, this care goes as far as ensuring language and cultural transmission from one generation to another.
Generally, in mammals, the care goes further to training the young on how to escape from any form of danger.
- In birds, the care involves activities like nesting, feeding the young and warning them.

Evolutionary significance of parental care

- ✓ It ensures survival of species from one generation to another.

DISPLACEMENT ACTIVITIES

Defn: irrelevant activities done to relieve stress.

OR

Is a form of behaviour performed by an organism under stress which is out of context.

- When the incompatible forms of behaviour of an animal are simultaneously stimulated like approach & flight, fighting & escape, the animal performs an apparently unconnected and irrelevant actions.

E.g.

- Human beings when in stress perform displacement activities like biting of nails; stroking of forehead; smoking; moving up & down after quarrel; drinking alcohol; scratching the head & ear and quarrelling.
 - Two birds fighting suddenly peck at the ground or get into resting positions/preen themselves.
 - A male stickleback suddenly adopt a vertical position with it's head pointing downwards and start digging the sand.
 - A bird going through the process of nest building even when there are no building materials.
- ✓ All these are as a result of 2 opposing forces i.e. fighting and escape.

NB: Vacuum activity; right responses directed toward a wrong stimulus; right response not correlating with the impulse e.g. beating up innocent people due to something that annoyed you; A cock deprived of a mate displays to inanimate object like bucket.

Advantages of displacement activities to animals

- Sometimes they serve the useful purpose of preventing/diminishing open conflict.

- Some are the basis of many normal behaviour patterns like courtship behaviour evolved from displacement activities arising from frustration.
- They perform a great role as releasers eliciting appropriate responses in other individuals. e.g. In the context, the male's sexual motivation builds up but can't be released until the appropriate signal is given by the female.

PHEROMONES

A pheromone is a chemical substance produced by one animal which influences the behaviour of another.

- It does so either by acting as a releaser or by building up motivation towards a particular type of behaviour.
- Most common pheromones are secretions of mammals which are used for marking out a territory or attracting a mate.
- Similarly, there are chemical attractants responsible for bringing the sexes together in insects, marine worms and many other pheromone examples e.g. unmated female cockroaches secrete a chemical substance which stimulates the male to court them.

In this case, the males are aroused even if they touch a piece of paper which has been in contact with the female, thus contain some of these pheromones.

- In social animals like bees, pheromones play an important role in directing the development and behaviour of different castes in the colony e.g. pheromones produced by the queen bee affects the workers; dead ant produces the pheromones that cause other ants to throw it out of the nest.

BIOLOGICAL FITNESS

5. **ALTRUISM [ALTRUISTIC BEHAVIOUR]**; social behaviour where an individual puts itself at a risk/personal disadvantage in trying to ensure survival of organisms of the same species.

OR

is an activity where an organism puts itself at an increased risk/disadvantage for the sake of other organisms

- Organisms waste time & energy in trying to protect organisms of the same species.
- There must be a link between the organisms in most cases organisms share alleles; or close relatives [kin] thus **kin selection**; brothers, sisters, cousins (siblings).

E.g. Mating & parental care. Birds feeding their young ones until they reach an age of feeding themselves;

significance of altruism

- Ensures defense for members of a group
- Ensures protection and care for the young ones
- Leads to increased allele frequency

- Leads to increased population size
 - Ensures continuous food supply for the young ones and also other members of the group.
 - Ensures continuity of the species of organisms thus survival.
6. **BIORHYTHMS [BIOLOGICAL RHYTHMS]**; biological activities occurring at regular intervals.

Affected by **Endogenous rhythms**/physiological factors [internal biological clock mechanism].

Exogenous rhythms/external factors; photoperiod e.g. courtship displays; nesting, migration (birds), diapause in insects; birds; mammals; preparation to hibernation in the mammals.

External factors;

- Photoperiods.
- Tidal variations.
- Seasonal changes.

How organisms get to know the changes?

- ✓ The internal biological clock.

Significance; work as basis of migration.

- ❖ **Social hierarchy**; social behaviour dependent on size; strength; fitness & aggressiveness e.g. Waggle & round dance (pecking order); mating; food like in bees [eusocial insect].

Bees; they,

- Queen; only fertile female.
- Workers; females; infertile.
- Drones; males.

The round dance [90/100m]



- Food within less than 90m; from the hive; real location & direction not known; but distance known.

The waggle dance



- Food within greater than 90m; from the hive; real the sun; information on distance, direction of food source; position of sun relative to hive. *over 100m; the direction of the waggle corresponds to the direction where the food is.

On cloudy day, they dance due to plane-polarised light.

How the bees detect its day/night?

They use internal biological clocks.

$\text{Speed of dance} \propto \frac{1}{\text{distance from food}}$

NB: Social behaviour; is exhibited by animals which live in societies.

7. **AGGRESSIVE/AGONISTIC BEHAVIOUR/AGGRESSION;** a group of behavioural activities including threat postures, rituals & occasionally physical attacks [protection] onto other organisms, often to members of same sex and species; other than those associated with predation

- Ritual contests of strength;
- Hierarchy is developed & organisms no longer aim at hurting each other e.g. giraffes using their shorthorns to fight fellow giraffes and kicking strangers.
- Threat displays; posture that may be scare away other organisms e.g. dogs standing erect.
- Appeasement displays; e.g. dogs lying on the back as a way of giving into stronger ones.

Significance of aggression

- Enhances food capturing.
- Leads to Creation of hierarchy.
- Ensures defense for the young ones and mates.
- Leads to increased genetic fitness over generations
- Leads to displacement of weaker ones
- Ensures mating for only fit individuals
- Leads to increased allele frequency for valued traits.
- Enhances establishment of territories.
- Minimizes risks of physical combat within the population.
- Leads to display of weaker ones.

Qns:

- (a) What is a dominance hierarchy? (01mark)
 (b) State any two features of a dominance hierarchy. (02 marks)

Solution

- (a) Is a form of social ranking within a group, where some members are subordinate to others.
 (b)
- The position of the member in hierarchy is determined by the level of agonistic behaviour.
 - Each member carries out specific roles in the group
 - Levels of testosterone and oestrogen determines the order in the hierarchy.

LEARNING AND LEARNED BEHAVIOUR

LEARNING; is the **adaptive** change in behaviour of an organism due to previous /past experience.

OR

Is an adaptive change in behaviour developed by experience and practice from past behaviour leading to into a change of the organism's behaviour.

- Learned behaviour is thus acquired during the life time of an individual as a result of constant experience.
- It's a relative **permanent** change in behaviour which doesn't include change in behaviour due to;
 - ✓ Maturation
 - ✓ Illness or physiological development or use of drugs.
- Learning is not directly observed but manifest itself in the activities of an individual.
- Learned behaviour depends on practice and experience of the past situations
- It's adaptable in the form that the information learnt in one situation can be used to solve problems in new situation.
- What's learnt vary from one individual to another thus learned behaviour is also referred to as **individual characteristic behaviour**.
- It can be modified if environment changes.
- In humans, acquiring or learning facts like for exams can be short-lived but the ability to carry out coordinated motor activities like toilet training, riding a bicycle or swimming; lasts throughout life.
- Memory is very important
MEMORY; Ability to store and retrieve information.
- First stored to primary short-term memory then stored in long-term memory.

NB: Learned behaviour can't be inherited (it's not instinct) though the ability to learn is inherited.

TYPES OF LEARNED BEHAVIOUR

- (i) **Habituation**; is the type of learned behaviour where an organism gradually stops to respond to repeated stimuli subjected it.
 - Is a form of learned behaviour in which repeated exposure of an organism to a stimulus results in decreased responsiveness.
 - A given organism stops responding to a given stimulus because there's no association with reward/punishment.
 - In this case, the stimulus is useless/harmless.

E.g.

 - a) If the snail is touched with a leaf, it rapidly foldback into its shell but later the snail gradually stops folding back when its body makes contact with leaves as it moves.

- b) Fan worms withdraw(jerk) back into their tubes when touched OR if its tentacle is repeatedly stimulated by touching it, the worm quickly stops reacting and its movement cease altogether.
- c) The snail getting used to tolerate prodding (hitting a board); if ends up just continuing not to drawback in its shell.
- d) Birds stop to respond to scare crow (ignore) which used to prevent them from landing.

Significance of habituation

- It avoids wasting time and energy on harmless stimuli.
- Time and energy is used for important activities like feeding; courtship, mating, parenting, protection, acquiring territory.
- It prevents over stimulation and damaging of receptors and effectors.
- The first response to the stimulus is vital as a precaution in case of danger.
- Avoid responding to trivial stimuli and respond only when appropriate to stimuli with survival value.
- The animal stops responding to a stimulus that is not associated with a reward or punishment.
- Prevents the animal to perform escape responses so frequently that it has no opportunity to do important work

E.g.

- a) A goat tied near the road will learn not to run away from the by-passing people and as such, it will concentrate on grazing.
- b) On learns to sleep when there's a familiar noise like music on radio but an unfamiliar one like an alarm/falling chair etc wakes him up.

NB: Once fully habituated, the animal will not respond to the stimulus even though weeks or months have elapsed since that stimulus was last presented.

(ii) **ASSOCIATIVE LEARNING/ASSOCIATION/CONDITIONING**

is a type of learning where animals learn to associate their response with either a reward or punishment or to associate one stimulus with the other.

OR

Is a type of learned behaviour whereby an animal learns to associate a particular response with a reward or punishment.

- The reward can be finding food or a mate and the punishment can be being attacked by a predator.
- The animal remembers its past experience and modifies its behaviour accordingly.

- The animal's response builds up in its system of association by repeated use of the same response to a particular stimulus which when the animal sees or hears anything related to it, it responds appropriately and automatically.

Types of associative learning

1. Conditioned reflex(learning)/classical conditioning
2. Trial & error learning/operant conditioning/instrumental conditioning

1. **Conditioned reflex(learning)/classical conditioning**

Is form of associative learning where a stimulus which doesn't normally elicit a particular response elicits it due to organism learning to associate the stimulus with one that normally elicits it.

E.g. Pavlov's condition of his dog to the metronome (bell's sound) and food

Before conditioning

Dog+ Food ———→ Salivation
(UCS) (UCR)

Dog + bell ———→ No salivation

During conditioning

Dog+ Bell+ Food ———→ Salivation
(CS) (UCS) (UCR)

After conditioning

Dog + Bell ———→ Salivation
(CS) (CR)

Later;

Dog + bell ———→ No salivation

Thus the dog associated the sound of the bell with food.

Characteristics of conditioned reflex

- Evoked after many trials.
- A delay in conditioned response occurs.
- The response involves association of stimuli.
- It is enhanced/reinforced by repetitions.
- It's involuntary.
- It decays with time after removal of the unconditioned stimuli.
- Removal of the cerebral cortex affects the response; loss of memory. i.e. response loss on removal of cerebral cortex.

Significance of conditioned reflex

- a) Allows the animals to modify their behaviour in such a way that maximum rewards are obtained and punishments are avoided e.g. animals get to learn about their predators (punishment avoided).
- b) Predators their prey(reward) maximized.

- c) Is important in wild animals e.g. predators learn to associate unpalatable animals with certain marking or colouration and thus avoid eating them.
- d) In human beings, we get conditioned ourselves to take cover at the sound of powerful gunfire.

2. **Operant learning /trial and error learning/instrumental learning**

Is a type of associative learning whereby an organism learns to solve problems by making a number of trials and hence rewarded and learns to minimize errors in which it is punished.

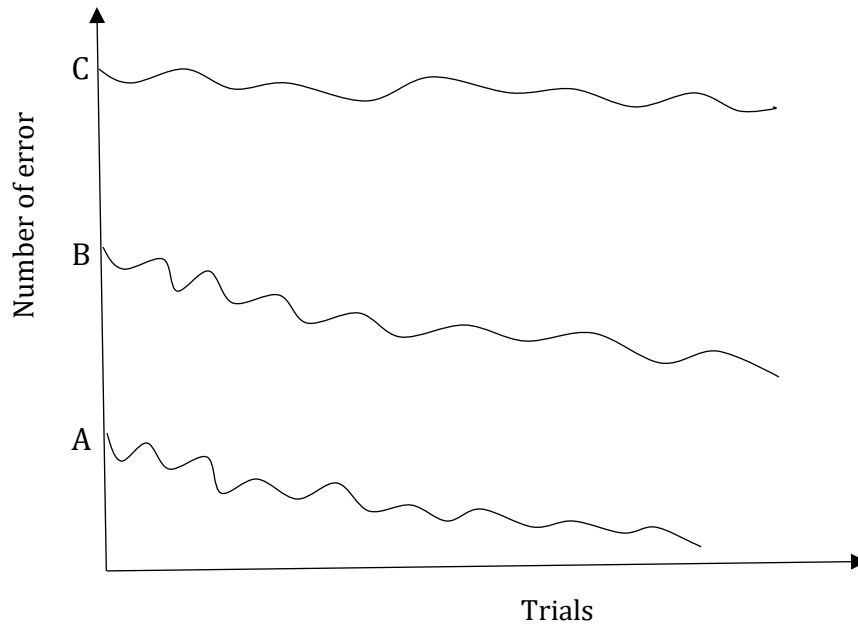
- The organism learns to associate its own behaviour with either a reward or punishment.
- The organism learns to avoid certain responses and executes particular rewarding responses.
- It's wide spread amongst animals from flatworms to man
- The animals learn that if it makes a "**wrong**" choice, it is punished and if it makes the "**right**" choice, it's rewarded. Thus, an animal learns to make less errors until it finally becomes perfect in taking a **correct response**.

E.g.

- a) Suppose a hungry dog is allowed to move around a room and soon as it jumps on a chair, it is rewarded with food, quickly the dog learns to associate the chair with a reward and consequently goes straight to it as soon as it enters the room.
- b) When an octopus was presented with a crab (prey) with a white square, it attacked the crab and was given a brief electric shock(punishment) on several occasions. But when it was given a crab only and not shocked after 10 trials, the octopus no longer attacked with crab with the white square but attacked the crab without a white square. Thus, by trial and error learning, octopus associated the punishment (electric shock).
- c) When the earthworm is placed in a T-shaped tube(Y-maze/puzzle) and if it turns on the left it turns on the left it is given a brief electric shock(punishment) and on turning right, it is not shocked(rewarded), later the earthworm associates turning left with the punishment and eventually always turns right when there's no electric shock(rewarded).
- d) When a rat is put in a skinner box, learning that tapping on a lever results in food release from dispenser. But tapping wires it gets electric shock.

In operant learning, the animals come to the solution first as they reduce the number of errors.

This is illustrated by the graph below



The graph shows that animal A learns quickly; B moderately quick and C fails to learn at all.

In trial & error learning, the ability of animal to learn is reflected by 3 factors;

- (i) The speed with which it ceases to make errors.
- (ii) The length of time between trials that can keep remembering the content without the repeated trials.
- (iii) The complexity of the situation to which it will respond/cate.

The graph above is neither a smooth curve nor a straight line because the animal is bound to forget some aspects of the choice of environmental situations where there are many alternations.

CHARACTERISTICS OF OPERANT LEARNING

- It's involuntary.
- Removal of the cerebral cortex doesn't affect the response.
- Enhanced by repetitions.
- Associative stimulus follows the action and doesn't need to be presented with the action.
- The response improves with to stimulus.

Significance of trial and error learning

- In higher animals like primates, it enhances quick learning of complex situations and retaining of the relevant information for a relatively longer time.

- In lower animals like worms and insects, enhances learning of simple problems although at a slow rate.

NOTE: Animals with larger brains like mammals learn faster and retain information for longer periods than those with small brains like most invertebrates.

- (iii) **LATENT LEARNING /EXPLORATORY LEARNING;** is the type of learning which involves solving problems by the use of previous learning experiences related to the problem.

OR

Is form of learning in which an organism explores environment and learn some useful information in the environment to be used later in life.

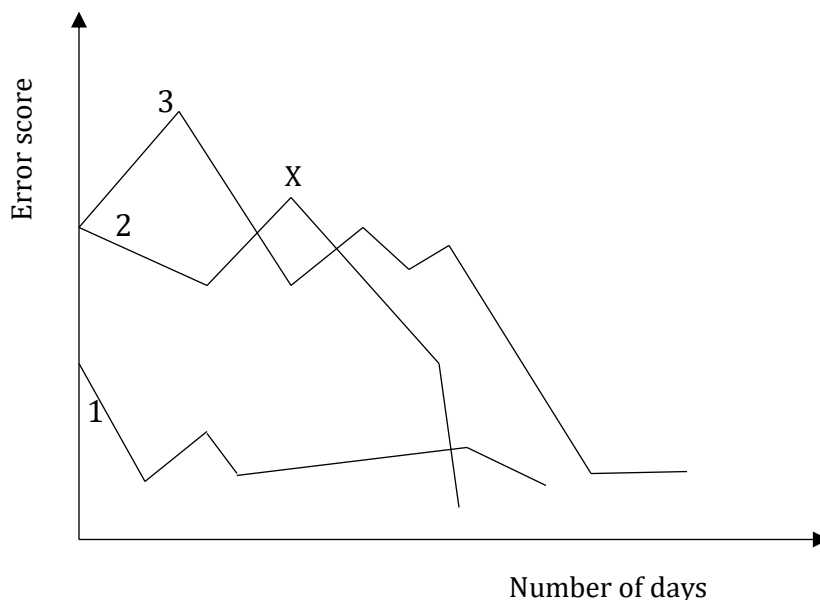
E.g.

- (a) A rat recognizing a hole in its habitat to be used when in trouble escape.
- (b) If a hungry rat is placed in a maze, it will master the maze after about 12 trials. Assuming that it is rewarded with food or water at the end. However if a hungry/thirsty rat is allowed to stay for some time in the maze before the trials begin, it is found that it subsequently requires fewer trials to gain mastery of the maze.

Significance of latent learning

- Enables rapid escape and finding refuge.
- Enables animals to find their way about their environment.
- Enables animals to learn all the characteristics and remember their landmarks of its habitat.

Graph illustrating exploratory learning



- Graph 1, rats were given rewards (food) at the end of each run.
- Graph 2 and 3, rats were given no rewards until the 3rd and 7th day respectively i.e. points marked; after which they were rewarded each time. Therefore, there was slow learning prior to X and very rapid reduction in errors (fast learning) immediately after X. This is contributed to the previous exploratory learning.

IMPRINTING

Is a simple and specialized form of learning occurring during critical periods/receptive periods in an animal's life and involves formation of associations with other organism/some large object which they first interact with.

- Is type of learning whereby young animals (newly born) tend to recognize objects/animals they first see.
- Many young animals tend to follow or imprint on their parents
- Imprinting is best developed in vertebrates especially in mammals.

E.g.

- ✓ F.Lorenz found that goslings and ducklings deprived of their parents would follow him and use him as a substitute parent.
- ✓ In human beings, children are known to imprint on their parents and other people in the like of baby sitters
- ✓ If the young muller is reared by foster parents of another species, it subsequently pairs with a member of that species rather than its own.

Significance of imprinting

- Enables offsprings to acquire essential skills possessed by the parents e.g. learning to fly in birds.
- Improves survival chances of the organism which becomes imprinted to the parent.
- Influences behaviour of an organism later in life e.g. in humans since children are known to be imprinted to their parents.
- Determines future behavioural pattern of the young ones.
- Creates strong bond between the offspring and parents thus protection from predators and parental care.
- Young ones develop a sense of belonging.
- The parent provides food;
- The parent offers warmth; and shelter;
- The parent teaches the young the important features of the environment; like the stream in which salmon spawn.

- In humans, children imprint to the parents and relatives thus learn not to mate with them in future this saves embarrassment and limits chances of inbreeding.

INSIGHT LEARNING

Is the highest form of learning involving immediate comprehension and response to a new situation without trial and error; based on advanced perceptual abilities.

- It's most difficult to interpret.
- It involves internal mental process (mental reasoning) or intelligence.
- It involves putting familiar things together in new ways i.e. reasoning or thinking and it obviously requires high intelligence which is the ability to carry out abstract thinking,
- Animals intelligence is assessed by the speed with which it solves a problem it has not encountered before
- It is more developed in mammals especially high primates like man.
- Like trial and error learning, it results in discovery.

E.g. When a chimpanzee was placed in a room with a ripe banana at a height it couldn't reach, the chimpanzee tried all the strategies to reach the banana i.e. putting boxes on top of each other and standing on them, piling sticks together with a rope which it later used and arrived at the solution of getting bananas(food).

Significance of insight learning

- Ensures survival of an organism by avoiding adverse, dangerous conditions through solving problems at first sight/immediately;
- Leads to discovery;

NB: An animal has a good insight and intelligence if it is good at solving problems it has not encountered before

IMITATION

Is a form of social learning that involves rapid spreading of certain types of animal behaviour from one area to another.

- It involves copying behaviour of another animal by a member of usually the same species.
- It not limited to critical period.

E.g. Hunting skills in dogs.

Questions

1.
 - (a) What is meant by the following;
 - (i) Insight
 - (ii) Instinct
 - (iii) Learning
 - (b) Explain the significance of the following behavioural types
 - (i) Altruism
 - (ii) Aggression
 - (iii) Territoriality
 - (c) Using relevant examples, state and explain the various types of learned behaviour
2.
 - (a) Write differences between instinct and insight? (04 marks)
 - (b) What is the significance of the following types of behaviour?
 - i. Habituation (03 marks)
 - ii. Imprinting (03 marks)
 - (c) Describe the dances performed by the worker bee to communicate a distant food source.

Solutions

1.
 - (a)
 - (i) Insight; Is the highest form of learning involving immediate comprehension and response to a new situation without trial and error; based on advanced perceptual abilities.
E.g. Kohler's work on chimpanzees suggested "insight learning" when presented with many boxes and bananas too high to reach, the chimpanzees stacked up the boxes beneath the bananas and climbed up to get them.
 - (ii) Instincts; are complex inborn stereotyped behavioural patterns of immediate adaptive survival value to the organism and are produced in response to sudden changes in the environment.
Are unique, inflexible, automatic, inherited from parents, don't require prior experience, often quick and exhibited by all organisms of the species.
 - (iii) Learning; Is an adaptive change in behaviour developed by experience and practice from past behaviour leading to into a change of the organism's behaviour.
In humans, acquiring or learning facts like for exams can be short-lived but the ability to carry out coordinated motor activities like toilet training, riding a bicycle or swimming; lasts throughout life.

(b)

(i)

Ensures defense for members of a group
Ensures protection and care for the young ones
Leads to increased allele frequency
Leads to increased population size
Ensures continuous food supply for the young ones and also other members of the group.
Ensures continuity of the species of organisms thus survival.

(ii)

- Enhances food capturing.
- Leads to Creation of hierarchy.
- Ensures defense for the young ones and mates.
- Leads to increased genetic fitness over generations
- Leads to displacement of weaker ones
- Ensures mating for only fit individuals
- Leads to increased allele frequency for valued traits.
- Enhances establishment of territories.
- Minimizes risks of physical combat within the population.
- Leads to display of weaker ones.

(iii)

- Reduces losses of animals to predation by defending the territory against predators;
- Ensures food supply, shelter and adequate space to offsprings, old and the mates; by keeping off all other animals that would feed on their food and reducing intraspecific competition;
- Reduces the amount of time devoted to aggression which is a destructive behaviour; and aggression is replaced by mere threats;
- Reduces spreading of diseases/epidemics; due to reduced contact with other organisms/ since combat between animals is reduced;
- Limits mating to biologically fit individuals only thus, increase the overall fitness of the population; by ensuring passing on of good genetic traits from one generation to the next;
- Enhances pair formation hence mating assured; which is a pre-requisite for reproduction of most animals;
- Permits improved defense of nest and young ones; due to protection of breeding area & offsprings;
- Reduces interference from other intending mates;

(c)

- **Habituation**; is the type of learned behaviour where an organism gradually stops to respond to repeated stimuli subjected it.

E.g. Birds stop to respond to scare crow (ignore) which used to prevent them from landing.

- **Classical conditioning;** Is form of associative learning where a stimulus which doesn't normally elicit a particular response elicits it due to organism learning to associate the stimulus with one that normally elicits it. E.g. The dog associated the sound of the bell with food in Pavlov's experiment.
- **Operant learning;** is a type of associative learning whereby an organism learns to solve problems by making a number of trials and hence rewarded and learns to minimize errors in which it is punished. E.g. Suppose a hungry dog is allowed to move around a room and soon as it jumps on a chair, it is rewarded with food, quickly the dog learns to associate the chair with a reward and consequently goes straight to it as soon as it enters the room.
- **Latent learning;** Is form of learning in which an organism explores environment and learn some useful information in the environment to be used later in life. E.g. A rat recognizing a hole in its habitat to be used when in trouble escape.
- **Imprinting;** Is a simple and specialized form of learning occurring during critical periods/receptive periods in an animal's life and involves formation of associations with other organism/some large object which they first interact with. E.g. F.Lorenz found that goslings and ducklings deprived of their parents would follow him and use him as a substitute parent.
- **Insight learning;** Is the highest form of learning involving immediate comprehension and response to a new situation without trial and error; based on advanced perceptual abilities. E.g. Kohler's work on chimpanzees suggested "insight learning" when presented with many boxes and bananas too high to reach, the chimpanzees stacked up the boxes beneath the bananas and climbed up to get them.

2.

(a)

Instinct	Insight
<ul style="list-style-type: none"> • Inborn/innate/inherited. • A complex pattern of behaviour. • The behaviour pattern cannot be adjusted/is a fixed pattern/stereotyped. • Triggered by simple stimuli. • Same response in organisms of the same species in most cases 	<ul style="list-style-type: none"> • Acquired as a result of experience; • A relatively simple pattern of behaviour; • The behaviour pattern can be adjusted/is not fixed /not stereotyped; • Triggered by complex stimuli in some cases; • Response varies among organisms of the same species in most cases;

(b)

(i)

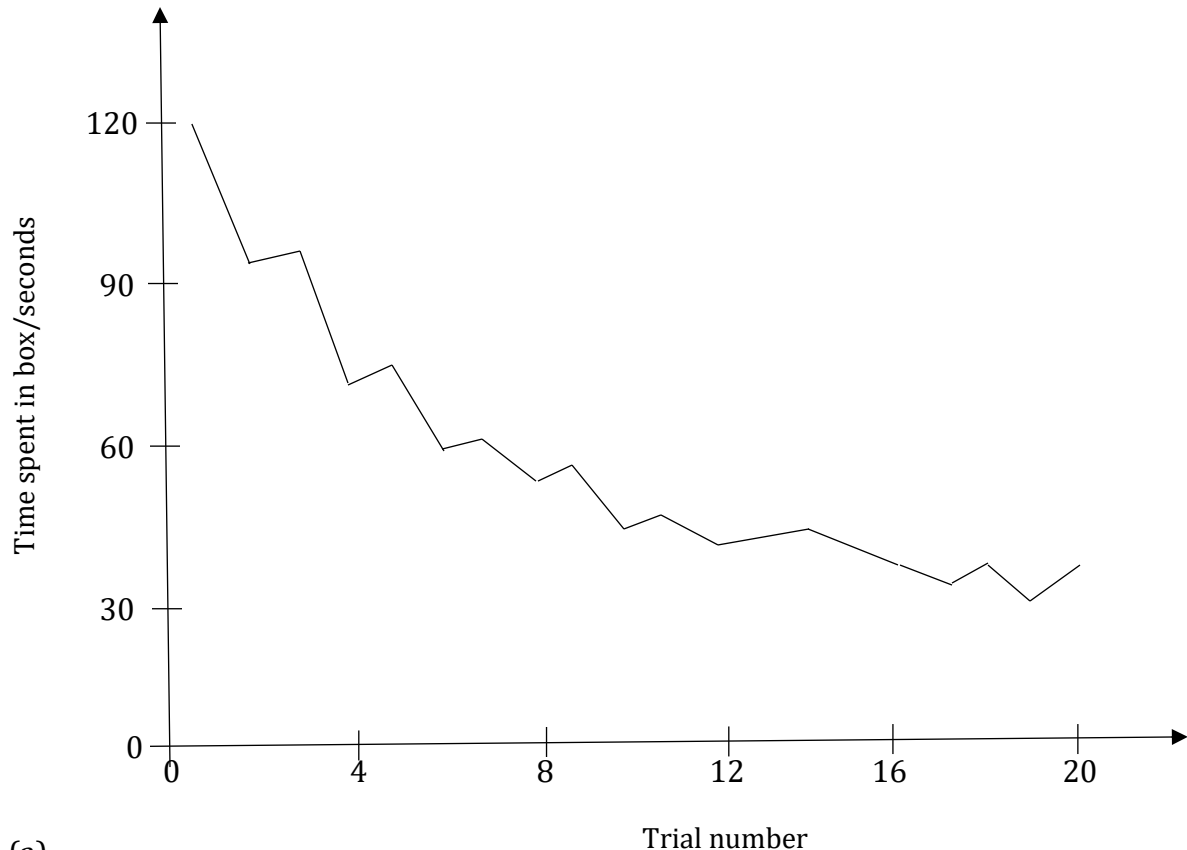
- It avoids wasting time and energy on harmless stimuli;
- Time and energy is used for important activities like feeding; courtship, mating, parenting, protection, acquiring territory.
- It prevents over stimulation and damaging of receptors and effectors;
- The first response to the stimulus is vital as a precaution in case of danger;
- Avoid responding to trivial stimuli and respond only when appropriate to stimuli with survival value;
- The animal stops responding to a stimulus that is not associated with a reward or punishment;

(ii)

- The parent imparts essential skills for survival like flying;
- The parent provides food;
- The parent offers protection from predators;
- The parent offers warmth; and shelter;
- The parent teaches the young the important features of the environment; like the stream in which salmon spawn.

(c) Waggle dance; the bee moves in a figure of eight; wagging the abdomen; to communicate the distance; and direction; of a food source; from the hive. The food source is at a distance more than 90m; the speed of abdomen wagging; is inversely proportional to the distance of the food source from the hive; the direction of the food source can be determined; the angle between the vertical line and a line made between the 2 loops of the figure 8; is equal to the angle subtended at the hive by the sun and food source;

3. During an experimental trial, a cat was placed inside the puzzle box. if the cat pulled the loop with its mouth or a paw, the door opened and it could escape. The time taken for the cat to escape was recorded. The experiment was then repeated several times with the same cat. The figure below shows a graph of the time taken for the cat to escape from the puzzle box during repeated trials.



- (a)
- Account for the changes in time spent by cat in box at different trial numbers.
 - What evidence shown by the figure show that learning took place?
 - State three factors that could affect the learning of a new situation like a puzzle in animals.
- (b) How could the time needed by the cat to escape out of the puzzle box be reduced?

Solution

- (a)
- Time spent by cat is highest at first trial; cat spent a lot of time at first in cage hence it had not learned how to escape/environment was new; and still so complex; cat investigated puzzle box by exploration, pulled loop accidentally/by chance/by trial and error; a reward e.g. food led it to escape. Rapid decrease in time spent by cat in first 6 trials; time spent in box

decreased, the number of trials increased due to learning; greatest change in response occurred; cat was highly motivated; food/reward appears; thus, positive reinforcement improving performance; though error rate still high. From 6 to 20 trials there was gradual decrease in response time; time spent in puzzle box very low; learned rapidly to associate escape with the reward; pulls the loop sooner due to learning/ease to remember; sufficient acclimatization period/repetition enabled learning to occur.

Time spent by cat in box fluctuates; rise in time is due to forgetting, fall in time is due to learning; need to make a choice; as learning is by choice

- (ii) Errors reduced with time as time spent in box reduced with increase in number of trials; time spent in box fluctuated.

(iii)

- The size of reward or punishments
- The state of development of the brain
- The state of development of sense organs
- The complexity of the mazes/puzzle box.

(b)

- Rewarding it at the end of right attempt reduces time required for it to leave the cage e.g. giving to food, rat meat.
- Punishing the cat when it makes the wrong choice.
- Increasing number of trials per day to enable learning
- Reducing the complexity/number of turns of the puzzle box.

QUICK CHECK

1.

- (a) What is instinctive behaviour? (01 mark)
 (b) State two factors that influence instinctive behaviour. (02 marks)
 (c) Territorial behaviour is common among many animal species. State
 (i) Four advantages of this behaviour. (04 marks)
 (ii) Three disadvantages of this behaviour. (03 marks)

2.

- (a) What is displacement activity? (01mark)
 (b) State the ecological importance of each of the following forms of behaviour.
 (i) Territorial behaviour (03 marks)
 (ii) Courtship behaviour (03 marks)
 (c) Give two ways in which animals avoid predation. (03 marks)

3.

- (a) With relevant examples, what is meant by the following terms;
 (i) Displacement activity
 (ii) Vacuum activity
 (iii) Motivation
 (iv) Releasers
 (b) State the functions of releasers in behaviour.

END

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