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Interrelationship between Physiology of Nervous System and Associative Learning Behaviour (Classical Conditioned Reflexes) of Animals

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Abstract **- Learning is the continuing process for human beings and other animals not only a situated at learning centres. The Learning processes are running in the environment and the societies and also the created circumstances. Learning is also creates the behaviour of animals. In this paper the associative learning behaviour in describing, the classical conditioning is the type of associative learning behaviour, which is described here with experiment of Pavlov. The learning is also controlled by nervous system. In the Pavlov's experiment the senses are involve (hearing and salivation). All senses are controlled by nervous system. The behavioural study and physiology of nervous system both are functioning with together, hence the interrelationship between physiology of nervous system and Associative Learning Behaviour has been established.**

Keywords: Learning, Behaviour, Neurons, Reflexes, Nerves.

Introduction

Animal behaviour is a very general have popular discipline or research study area, not just, with biologists but with the public - so much so that it has even come to occupy a lot of prime time on television, the surest measure of real our earliest origins, human beings popularity. Since always been fascinated by our fellow creatures. Apart from this intrinsic interest and the fact, which we hope to demonstrate, that the subject presents us with questions as challenging as any in science, the study of animal behaviour is also of great practical importance. The conservations of wild animals in their natural habitats and the welfare of those other species we have domesticated for our use bath topics which command a lot of public attention.

The science of animal behaviour was considered in its infancy, it has been studied extensively for last 50 years only. It still has a very long way to go because it is not so easy to observe the behaviour of various animals, they behave in a bewildering variety of ways, in fact, the range of animal behaviour patterns is a great as the variety of animals found on this earth with may many different shapes, size and colours which took generation of zoologists to describe and classify them. None of the species are identical nor do they behave like. Not only this, there can be many different types of behaviours in one individual of a species.

The nervous system is the highly complex part of an animal that coordinates its actions and sensory information by transmitting signals to and from different parts of its body. The nervous system detects environmental changes that impact the body, then works in tandem with the endocrine system to respond to such events. Nervous tissues first arose in wormlike organisms about 550 to 600 million years ago. In vertebrates, It consists of two main parts, the central. nervous system (CNS) and the peripheral nervous system (PNS). The CNS consists of brain and spinal cord. The PNS consists mainly of nerves, which are enclosed bundles of the long fibers, or arsons, that connect the CNS to every other parts the body. Nerves that transmit signals from the brain are called motor nerves (efferent), while those nerves that transmit information from the body to the CNS are called sensory nerves (afferent). The PNS is divided into two separate subsystems, the somatic and autonomic nervous systems. The autonomic of nervous system is further divided into the Sympathetic, parasympathetic and enteric nervous systems, The sympathetic nervous system is activated in cases of emergencies to mobilize energy, while the parasympathetic nervous system is activated when organisms are in relaxed state. The enteric nervous system functions to control the gastrointestinal system. Nerves that exit from the brain are called cranial nerves while those exiting from the spinal cord are called spinal nerves.

Physiology of Nervous System

One of the most important factor of survival value in natural selection is the capacity of animals to obtain and coordinate information from their environment. There are many types of information-visual, auditory, tactile and olfactory etc. All these are from external sources. Information as also received from the internal environment hunger, pain,

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thirst, orientation of body, temperature blood pressure etc. All this information from both external and internal sources is received simultaneously and sometimes these are conflicting. In course of evolution, animals have developed sense organs for collecting all this information. Simultaneously, the development of nervous system has evolved to conduct the coded Information to analysis centers and central nervous ganglia to decode and integrate the incoming information and distribute instruction to muscles, glands and other effectors.

The nervous system is involved in the behaviour of organisms from the unconscious regulation of an intracellular activity to coordination or movement of the whole organism, learning and memory. To study how sense organs and analyzing centres have become adopted to perform their special functions, it is necessary to consider the fundamental properties of all sensory and nervous elements. It is also necessary to study the fundamental properties of nervous system and the principles involved to receiving, transmitting and integrating Information.

Reflexes: The basic unit of integrated reflex activity is the reflex arcs This are consists of a sense organ, an afferent neuron, one or more synapses in a central integrating station or sympathetic ganglion, an efferent neuron, and an effectors. In mammals, the connection between afferent and efferent somatic neurons is generally in the brain and spinal cord. The afferent neurons enter via the dorsal roots or cranial nerves and have their cell bodies in the dorsal root ganglia or in the homologous ganglia on the central nerves. The efferent fibers leave via the Ventral roots or corresponding motor cranial nerves. The principle that in the spinal cord the dorsal roots are sensory and the ventral roots are motor is known as the Bell Magnetic law.

The simplest reflex arc is one with a single synapse between the afferent and efferent neurons. Such arcs are monosynaptic, and reflexes occurring in them pre monosynaptic reflexes, Reflex arcs in more interneuron's are which are interposed between the afferent and efferent neurons are polysynaptic, the number of synapses in the arcs varying from two to many hundreds. In both types, but especially in polyseptic reflexes arcs, activity is modified by spatial and temporal facilitation, occlusion, Subliminal fringe effects, and other effects.

Monosynaptic Reflexes: When a skeletal muscle with an intact nerve supply is stretched, it contracts. This response is called the stretch reflex. The stimulus that initiates the reflex is stretch of the muscle, and the response is contraction of the muscle being stretched. The sense organ is the muscle spindle. The impulses originating in the spindle are conducted in the central Nervous System (CNS) by fast sensory fibers the pass directly to the motor neurons which supply the same muscle. The neurotransmitter at the central synapse is glutamate stretch reflexes are the best known and studiests monosynaptic reflexes in the body.

Poly synaptic Reflexes: This is the withdrawal reflexes The number of synapses in each of their branches as variable, Because of the synaptic delay incurred at each synapse, activity in the branches with fewer synapses reaches the meter neurons first, followed by activity in the longer pathways. This causes prolonged bombardment of the motor neurons from a single stimulus and consequently prolonged responses. Some of the branch pathways turn back on themselves, permitting activity to reverberate until propagated it becomes unable to cause a propagated trans synaptic response and dies out. Such reverberating circuits and spinal cord are common in the brain and spinal code.

Withdrawal Reflex

The withdrawal reflex is a typical polysynaptic reflex that occurs in response to a noxious and usually painful stimulation of the skin or subcutaneous tissues and muscle. The response is flexor muscle contraction and inhibition of extensor muscles, so that the part stimulated is flexed and withdrawn from the stimulus. When a strong stimulus is applied to a limb, the response includes not only flexion and withdrawal of that limb but also extension of the opposite limb. This crossed extensor response is properly part of the withdrawal reflex. Strong stimuli in experimental animals generate activity in the interneuron pool which spreads to all four extremities. This is difficult to demonstrate in normal animals but is easily demonstrated in an animal in which the modulating effects of impulses from the brain have been abolished by prior section of the spinal cord (spinal animal). For example, when the hind limb of a spinal cat is pinched, the stimulated limb is with-drawn, the opposite hind limb extended, the ipsi-lateral forelimb extended, and the contra-lateral forelimb flexed. This spread of excitatory impulses up and down the spinal cord to more and more motor neurons is called irradiation of the stimulus, and the increase in the number of active motor units is called recruitment of motor units.

Sensory Receptors:

Most activities of the nervous system are initiated by sensory experiences that excite receptors, whether visual receptors in the eyes, auditory receptors in the ears, tactile receptors on the surface of the body, of the body, or other kinds of receptors. Either of these sensory experiences can cause immediate reactions from the brain or memories of the experiences can be stored in the brain for minutes, weeks, or years and bodily reactions determined at some future date.

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The Somatic portion of the sensory System, which transmits sensory information from the receptors of the entire body surface, and seme deep structures. This information enters the central nervous system through peripheral nerves and is conducted immediately to multiple sensory areas in:

(i) The spinal cord at all levels
(ii) The reticular substance of the medulla, pons, and mesencephalon of the brain.
(iii) The cerebellum.
(iv) The thalamus.
(v) Areas of the cerebral cortex,

Learning: Learning is defined the ability, to alter behaviour or the basis of past experience, and memory is the ability recall the past experience. Learning is of two types namely,

(i) Non-Associative Learning.
(ii) Associative learning.

1. Non-Associative Learning

This involves response of a person to only one type of stimulus. It depends upon two factors namely:

(i) Habituation and
(ii) Sensitization.

i) Habituation

Habituation means getting used to. When a person is exposed to a stimulus repeatedly, the person starts ignoring the stimulus slowly. During the first experience, the event (stimulus) is novel and evokes a response.

However, it evokes less response when it is repeated. Finally, the person is habituated to the event (stimulus) and ignores it.

ii) Sensitization

When a stimulus is applied repeatedly, there is habituation. But if the same stimulus is combined with another type of stimulus, which may be pleasant or unpleasant, the person becomes more sensitive to the original stimulus. This is called the sensitization. For example, a lady gets habituated to different sounds around her and sleeps. But, she promptly wakes up when her baby cries.

2. Associative Learning

This is a complex process. And, it involves learning about relations between two or more stimuli at a time. The classic example of associative learning is the conditioned reflex.

Conditioned Reflexes

Conditioned reflex is a reflex response acquired or learnt by experience. Conditioned reflex is the basis of learning. The unconditioned reflex is the inborn reflex. There is no need of previous experience for this reflex. The example is the salivary secretion by placing the food in the mouth. But, the conditioned reflex is acquired after birth and it requires previous experience.

Classical Conditioned Reflexes

Classical conditioned reflexes are those reflexes, which can be established by a conditioned stimulus followed by an unconditioned stimulus.

The various types of classical conditioned reflexes and their properties are demonstrated by the classical salivary secretion experiments done by Ivan Pavlov and his associates.

In dogs, the duct of parotid gland or submandibular gland was taken outside through cheek or chin respectively and the saliva was collected by some special apparatus. Apparatus consisted of a funnel, which is sealed over the opening of the duct. The salivary secretion was measured in drops by means of an electrical recorder.

The great Russian physiologist I.P. Pavlov's Influence on behavioural studies and neurophysiology in Russia is still considerable but perhaps because the reflex theory he developed attracted little favour here, his influence in the west has been less.

The classical conditioning Pavlov's training a dog to salivate at the ringing of a bell, it is stimulus substitution. He was basically interested in studying the process of gastric secretion in dog. The physiological secretion was the basis of classical conditioning. He classified reflexes into two categories, physiological and psychic reflex. The prychic reflexes occur only as a result of its particular experience. Physiological reflexes are the innate process. The dog began to salivate by ring a bell.

According to the M.W. Bernard the conditioning is the automatization of behaviour by repetition of stimuli which follows in given response and which ultimately become cause for the behaviour which formally they merely be accompanied.

In the view of J.P. Gilford, the most simple interpretation of this phenomenon is that when two stimuli are presented repeatedly together, the new one first then the original, effective one, the new one also become effective

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Similarly Ladell said that in a conditioned reflex the natural stimulus to action has been replaced by an otherwise in effective stimulus which has become effective through association.

1. Unconditioned Stimulus (US) Food	→	Unconditioned Response (Natural) (UR) Saliva
2. Unconditioned Stimulus (US) + Unconditioned Response (UR) Food + Bell	→	Unconditioned Response (UR) Experiment saliva
3. Conditioned stimulus (CS)	→	Conditioned Response (CR) (Conditioning)

Classical conditioning may be defined as "a process in which a natural stimulus, by pairing with a unnatural stimulus acquired all the qualities of natural stimulus.

US + CS ⟶ UR (Experiment)

CS ⟶ CR (conditioning)

Pavlov conducted an experiment on a dog which was kept hungry and put it in controlled situation The eyes of the dog was covered so that dog could hear not to see, simultaneously the food was placed in his mouth along ringing a bell. This procedure was repeated several times. The dog began to salivate only ringing the bell. His famous concepts of conditioning was derived mainly from his interpretation of how dog he have when placed in such situation. The Phenomenon of conditioning is attributed as psychic reflexes.

S (food) ⟶ R (Saliva) Natural

S1 (bell) ⟶ R1 (hearing) Natural

US + CS1 ⟶ UR (Saliva) Experiment

(food) + (bell) ⟶ Saliva

US (food) was removed only the sound of the bell. The dog began to salivate after repeating this situation.

CS ⟶ CR Conditioned

(bell) (saliva) Stimulus.

Pavlov found that almost any stimulus could act as a es provided that it did not produce too strong a response of its own. With very hand hungry dogs even painful stimuli, which initially caused flinching and distress, quite evoked salivation if paired with food. The CR is formed by the association of stimulus with a reward and in the same way a CR for withdrawal can be formed by associating the CS with punishment. An electric shock to the foot causes a dog to lift its pace, if a metronome is paired with the dog soon raises its paw to the sound alone.

Properties of conditioning

(i) The stimulus for a particular conditioned. Learning is more of less specific. If a CR be established with a particular sound then a different sound will be ineffective. If one sound be associated with the giving of food and another with 'no food' then the animals get conditioned to discriminate between the two sounds.

(ii) If a CR be not practiced for several months ut undergoes decay due to disuse or if the CS (bell ringing) be repeated several times without UCS (meat) then also the learning goes extinct

(iii) The Stimulation that follows with a reward is called positive reinforcement and when at is associated with punishment - it is termed as negative reinforcement, Pavlov had used positive reinforcement.

Discussion, Conclusion and Recommendations:

In the higher animals, a set of cells is set aside, whose only function is to gather information from the environment through organs called receptors', and to transfer them to various other tissues and organs are called effectors' which react in response to a change. This set of cells Constitutes the nervous tissue and the system is builds up is the nervous system. It controls and regulates the whole animal. It may be recalled that the nervous tissue is made up of nerve- cells or neurons. The human brain itself as is composed one hundred thousand (10^{11}) neurons.

In the Pavlov's experiment on dog, there were the two main receptors active.

(i) Auditory Receptor - hearing the Sound of Bell.

(ii) Receptor of Taoist - Eating of food and Salivation after listening the sound of Bell.

The Nervous system of these above receptors was activated. The basis of functional organization of nervous system is known as the Reflex ars, with a definite polarity in the nerve cells, it is cleared that the receptor surfaces in organs are supplied with the dendrites of nerve cells, lection is to pick up the information of change or stimulus in the environment and pass it on to their azonic fibers (axons) in the form of signals or impulses. These neurons are called sensory neurons, and their azonic fibers are called afferent nerve-fibers. The terminal branches of the afferent fibers reach within the central nervous system (brain and spinal cord) to initiate activity in the dendrites of a number of motor neurons with which they form synapses directly or after passing through internuncial (intermediate) neurons. The motor neurons discharge impulses that travel down their azonic fibers constituting the efferent fibers, which terminate in the efferent organ.

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In the Pavlov's experiment on dog the all activities are controlled by the central nervous system. The all above activities of nervous system and receptors are involved in the responding of dog after taking the stimulus.

It is concluded that the learning and involved activities of learning are controlled by the nervous system.

The rapid advances in science and technology have put the scientists and technologists on their heels to cope up with the simultaneous changes that have occurred during the past decades. Various types of revisions, rectifications as well as modifications and sometimes even all together innovated ideas that developed in numerous fields of specializations have required to be incorporated with the advanced level concepts in order to keep pace with the recent researches advanced in the concerning fields of the study. The innovative techniques have put the researches on consistent 'think' and 'rethink' level to entertain higher concepts related to the biology.

Based on the study, the following recommendation can be advanced since the incorporation of units of Physiology of Nervous System and Classical conditioning Reflexes of Animals.

To sum up, it may be stated firm determination that the with standard of the courses of study related to life Science and animal Psychology as well as the introduction of advance concepts of learning along with well-defined practical work is significant for the successful living maintenance of the present-day society as well as for the advancement of the standard of the biology education and animal psychology, Hence the findings of the present study with prove highly useful in order to put forth ideas for improvements and up-dating curricula at different strate and grade levels In order to keep pace with the recent researches. taking it the fields of life sciences and animal psychology.

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