B.A. PART- II **PSYCHOLOGY**

(Semester-III) **(EXPERIMENTAL PSYCHOLOGY)**

Unit II

LESSON NO. :

2.1	**:**	**LEARNING : CONCEPT AND NATURE**
2.2	**:**	**CONDITIONING : CLASSICAL AND INSTRUMENTAL**
2.3	**:**	**NORMAL PROBABILITY DISTRIBUTION- PROPERTIES AND APPLICATIONS, AREAS UNDER NPC (NORMAL PROBABILITY CURVE)**
2.4	**:**	**HYPOTHESIS TESTING**
2.5	**:**	**CHI SQUARE AND ITS APPLICATIONS**

NOTE : **Students can download the syllabus from department's website www.pbidde.org**

LEARNING

CHAPTER PLAN

2.1.0 OBJECTIVE

In this lesson the students will get acquainted with the nature of learning, types of learning and the various laws of learning.

2.1.1 INTRODUCTION

"Learning is a discipline of psychology that attempts to explain how an organism learns. It consists of many different theories of learning, including instincts, social facilitation and observation. Learning is one key process that many people take for granted . They just assume it happens and happens basically the same way for most people. Definition of learning is comprised of several different components:

The 4 factors that form the definition of learning:

1) Learning is inferred from a change in behavior/performance*
2) Learning results in an inferred change in memory
3) Learning is the result of experience
4) Learning is relatively permanent

This means that behavior changes that are temporary or due to things like drugs, alcohol, etc., are not "learned. It is the combination of these 4 factors

that make definition of learning. “Learning is a relatively durable change in behavior, behavioural potential or knowledge that is due to experience” here Behavior Potential means that once something is learned, an organism can exhibit a behavior that indicates learning as occurred. Thus, once a behavior has been "learned", it can be exhibited by "performance" of a corresponding behavior.

2.1.2 NATURE OF LEARNING

As learning always involves some kind of experience , the behavioural changes occurring because of it are relatively permanent e.g. suppression of orienting reflexes resulting in habituation . Habituation is a decrease in response to a stimulus after repeated presentations. For example a new mobile ring tone, may initially draw your attention or even become distracting. After you become accustomed to this sound, you pay less attention to the noise and your response to the sound will diminish. This diminished response is habituation. But if it occurs due to fatigue or drugs it is not learning. Habituation is an example of non-associative learning.

Learning may be both vertical and horizontal. It is vertical in so far precision in increased or information is added to that already learned. It is horizontal in so far as what is learned is integrated and organized as a part of a functioning unit of expanding experience. Thus the former means qualitative and latter is quantitative in nature.

Learning is expected to bring about more or less permanent change in the learner's behavior. This change may range from the acquisition of a relatively simple skill. item of information to the mastery of complicated mechanical performance and application of difficult and abstract reading material, change in response or behavior is caused partly or wholly by experience. It includes behavior change in the emotional sphere, refers to the acquisition of symbolic knowledge or motor. skills. it however does not include physiological changes like fatigue, temporary sensory resistance and hunger.

Learning should enable us to make the least use of the things in the world around us. For example, one has to learn the art of living harmoniously with others by learning how to establish good relations with his fellows. Learning not limited

to the school alone, it being earlier and continues even after the school days.

1. **Learning is growth :**

   The individual grows as he lives. This growth implies both physical as well as mental development of the learner. The individual gains experiences through various activities. These are all sources of learning. The individual grows through living and learning. Thus growth and learning are inter-related and even synonymous.

2. Learning is adjustment :

Learning enables the individual to adjust himself properly, with the new situations. The individual faces new problems and new situations throughout his life and learning helps him to solve the problems encountered by him. That is why; many psychologists describe learning as "a process of progressive adjustment to the ever changing conditions which one encounters." The society in which we live is so complex and so dynamic that any one type of adjustment will not be suitable for all of many situations and problems. It is through learning that one could achieve the ability to adjust adequately to all situations of life.

3. Learning is purposeful :

All kinds of learning is goal-oriented. The individual acts with some purpose. He learns through activities. He gets himself interested when he is aware of his objectives to be realized through these activities. Therefore all learning is purposive in nature.

4. Learning is experience :

The individual learns through experiences. Human life is fall of experiences. All these experiences provide new knowledge, understanding, skills and attitudes. Learning is not mere acquisition of the knowledge, skills and attitudes. It is also the reorganization of experiences or the synthesis of the old experiences with the new.

5. Learning is intelligent :

Mere cramming without proper understanding does not make learning. Thus meaningless efforts do not produce permanent result. Any work done mechanically cannot yield satisfactory learning outcomes. Learning therefore must be intelligent.

6. Learning is active :

Learning is given more importance than teaching. it implies self-activity of the learning. Without adequate motivation he cannot work whole-heartedly and motivation is therefore at the root of self-activity. Learning by doing is thus and important principle of education, and the basis of all progressive methods of education like the project, the Dalton, the Montessori and basic system.

7. Learning is both individual and Social :

Although learning is an individual activity, it is social also. Individual mind is consciously or un-consciously affected by the group activities. Individual is influenced by his peers, friends, relatives' parents and classmates and learns their ideas, feelings and attitudes in some way or others. The social agencies like family, church, markets and clubs exert

immense, influence on the individual minds. As such, learning becomes both individual as well as social.

8. **Learning is-the product of the environment :**
   The individual lives in interaction of the society. Particularly, environment plays an important part in the growth and development of the individual. The physical, social, intellectual and emotional development of the child is molded and remolded by the objects and individuals in his environment. Therefore, emphasized that child's environment should be made free from unhealthy and vicious matters to make it more effective for learning.
9. **Learning affects the conduct of the learner :**
   Learning is called the modification of behavior. It affects the learner's behavior and conduct. Every learning experience brings about changes in the mental structure of the learner. therefore attempts are made to provide such learning experiences which can mould the desired conduct and habits in the learners.

The sequence of events and corresponding cognitive processes that are present in learning are:

(1) Gaining attention (reception)
(2) informing regarding objective (expectancy)
(3) recall of prior learning (retrieval)
(4) the stimulus (selective perception)
(5) learning guidance (semantic encoding)
(6) performance (responding)
(7) feedback (reinforcement)
(8) performance (retrieval)
(9) retention and transfer (generalization).

These events should satisfy or provide the necessary conditions for learning and as is clear from these that learning is an inferred process. Inference here means the act or process of deriving logical conclusions from premises known or assumed to be true. In other words it is the act of reasoning from factual knowledge or evidence.

2.1.3 TYPES OF LEARNING

Learning can take place in many ways depending upon simple or complex form of responses that needs to be learnt. The simplest form of learning is conditioning. Two types of conditioning has been identified

1. Classical conditioning
2. Instrumental / operant conditioning

The other form of learning include

3. Observational Learning
4. Verbal Learning
5. Concept Learning
6. Insight

2.1.4 CLASSICAL CONDITIONING

Ivan Pavlov, a Russian physiologist who was studying digestion in dogs, discovered classical conditioning accidentally. Pavlov noticed that a dog salivated at the sight of a food bowl. Pavlov recognized this as an important phenomenon. It represented the triggering of a biological reflex (salivation) by learning (in this case, by the sight of the bowl). Pavlov studied this phenomenon in the laboratory and called it signalization.

Classical conditioning always starts with a *reflex* : an unlearned stimulus-response circuit in the nervous system. In many situations, an organism benefits by making a reflex response to appropriate situations slightly *early*. Therefore animals are sensitive to cues that predict the activation of a reflex. Such signals allow the animal to make an anticipatory biological response. This is classical conditioning.

Learning or *acquisition* of a classically conditioned response occurs when a signal or cue is put before the activation of a reflex. Learning is fastest if the signal comes about a half second before the reflex, if the reflex involves skeletal muscle movement, such as a knee jerk or withdrawal of a fingertip. Learning typically occurs after only a few pairings of signal with reflex.

Extinction or unlearning of a classically conditioned response occurs when the predictive relationship between the signal and the reflex is destroyed. The signal is presented but the reflex is prevented or a competing reflex is activated. Soon the signal no longer has predictive power and the animal ceases to respond to it. After a time, or if the context is changed, an extinguished response may reappear. To completely eliminate a conditional response, the response must be extinguished several times.

Generalization is the name for responding the same way to different situations. The more similar the situations, the more generalization will occur. In naturalistic settings, a conditional response may occur or not depending upon how an organism *categorizes* stimuli.

Discrimination is the name for responding differently to distinct stimuli. It is the opposite of generalization. An animal discriminates between stimuli when it responds differently to them. An example is *release from habituation*. It occurs even in small babies and can be used to determine whether they distinguish between different categories of stimuli.

2.1.5 OPERANT CONDITIONING

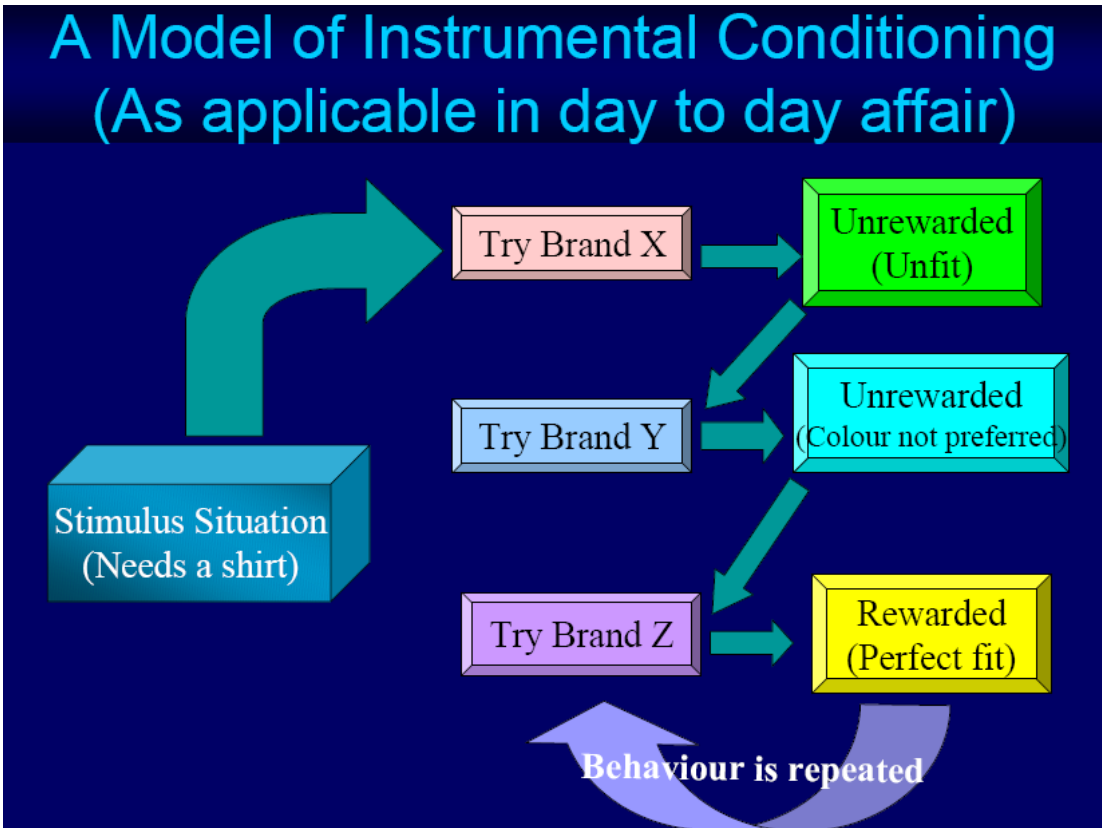
Classical conditioning forms an association between two stimuli. *Operant* conditioning forms an association between a behavior and a consequence. Operant conditioning is also called instrumental conditioning, because the subject uses its own behavior as an "instrument" to pursue some goal.

An operant is defined as a behavior producing a certain effect on the environment. Thus a bar-press operant is *any* behavior which results in a bar press, whether it is accomplished (for example) with the animal's paw or the animal's nose.

In a "rat lab" students start by teaching a rat to find food pellets in a small enclosure, the food magazine. Next the rat is reinforced (given food pellets) for any behavior that brings it close to the bar that sticks out of the cage wall. Then the rat is required to actually press the bar, to receive a pellet. This process of gradually reinforcing steps toward a desired behavior is called *shaping*.

A reinforcing stimulus is a stimulus that makes the behavior it follows more frequent. *Extinction* occurs when the reinforcer that maintains a behavior is stopped, and the behavior goes away. A punishing stimulus is one that makes the behavior it follows *less* frequent or probable. It is not the same thing as negative reinforcement. Negative reinforcement is a form of reinforcement (therefore it makes behavior more frequent). Negative reinforcement occurs when the reinforcing event is *removal* of a stimulus. "Negative punishment" or *response cost* occurs when the removal of a stimulus after a behavior makes the behavior *less* frequent.

Antecedents-stimuli that come before a behavior-are also used in operant conditioning. An S+ is a stimulus that indicates reinforcement *is available* if a behavior is performed. An S- is a stimulus that indicates reinforcement is *not* available. An S+ or an S- can be called a *discriminative stimulus*, because it helps the animal discriminate between situations when reinforcement is or is not available.



When animals learn to perform a behavior to escape from pain or other aversive stimulation, this is called *escape conditioning*. When animals receive a stimulus indicating something aversive is about to happen, they will try to escape ahead of time to avoid the unpleasant event. This is called *avoidance learning*. Avoidance conditioning is marked by its persistence. The relief produced by avoidance is reinforcing, so avoidance behavior tends to continue forever even when the original threat is no longer relevant.

2.1.6 OBSERVATIONAL LEARNING

Observational learning, also known as modeling or imitation, proposes that learning occurs as a result of observation and consequence. Behavior is learned through imitation; however behavior that is rewarded is more readily imitated than behavior that is punished. Termed vicarious conditioning, this type of learning is present when there is attention to the behavior, retention and the ability to reproduce the behavior, and motivation for the learning to occur. Observational learning is learning stimulated also by observing the behavior of another organism. *Modeling* is one form of observational learning. It occurs when one person performs a behavior, while others look on and learn from it.

Specialized nerve cells called mirror neurons may account for this ability. Mirror neurons are found in many different primate species. They fire the same patterns whether a creature is performing an action itself or watching another member of the same species performing the action. This provides a way for actions seen externally to be taken into the nervous system, through a sort of automatic motor empathy.

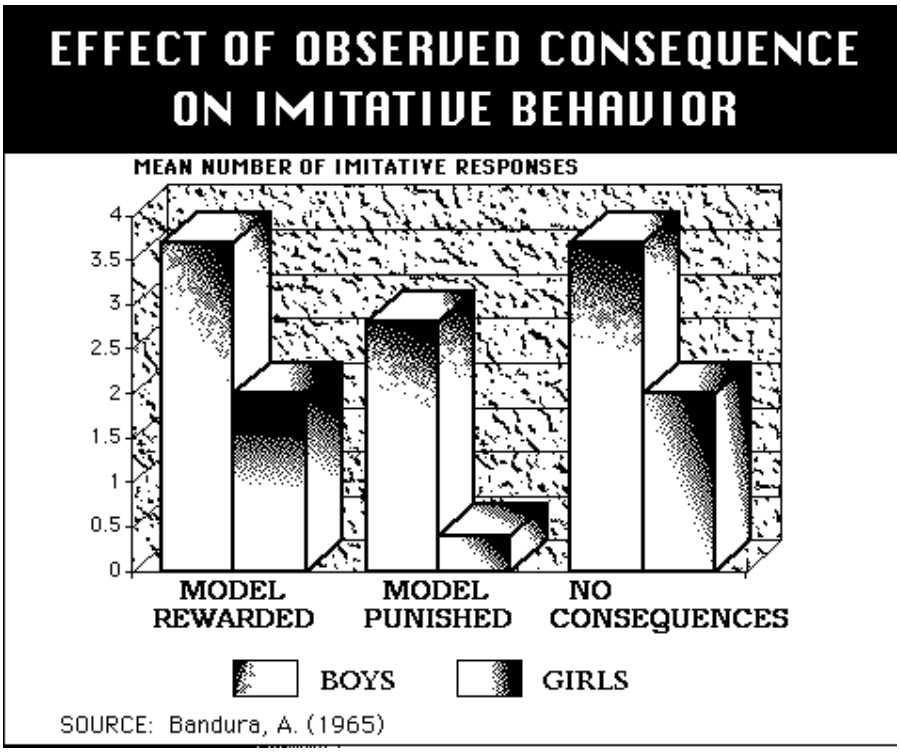
Observational or social learning is based primarily on the work of Albert Bandura. He and his colleagues were able to demonstrate through a variety of experiments that the application of consequences was not necessary for learning to take place. Rather learning could occur through the simple processes of observing someone else's activity. Bandura formulated his findings in a four-step pattern which combines a cognitive view and an operant view of learning.

1. Attention -- the individual notices something in the environment
2. Retention -- the individual remembers what was noticed
3. Reproduction -- the individual produces an action that is a copy of what was noticed
4. Motivation -- the environment delivers a consequence that changes the probability the behavior will be emitted again (reinforcement and punishment)

Bandura's work draws from both behavioral and cognitive views of learning. He believes that mind, behavior and the environment all play an important role in the learning process.

In a set of well known experiments, called the "Bobo doll" studies, Bandura showed that children (ages 3 to 6) would change their behavior by simply watching others.

Three groups of children watched a film in which a child in a playroom behaved aggressively (e.g., hit, kick, yell) towards a "bobo doll." The film had three different endings. One group of children saw the child praised for his behavior; a second group saw the child told to go sit down in a corner and was not allowed to play with the toys; a third group (the control) group saw a film with the child simply walking out of the room. Children were then allowed into the playroom and actions of aggression were noted. The results are shown below



2.1.7 GESTALT'S INSIGHT LEARNING

In contrast to classical and operant conditioning, which describe learning in terms of observable behavior, other theories focus on learning derived from motivation, memory, and cognition.

Wolfgang Köhler, a founder of the Gestalt school of psychology, observed the importance of cognition in the learning process when he studied the behavior of chimpanzees. In his experimentation, Köhler concluded that insight was key in the problem-solving conducted by chimpanzees. The animals did not just stumble upon solutions through trial and error, but rather they demonstrated a holistic understanding of problems that they solved through moments of revelation.

In the 1920s, Edward Tolman illustrated how learning can involve knowledge without observable performance. The performance of rats who negotiated the same maze on consecutive days without reward improved drastically after the introduction of a goal box with food, indicating that they had developed cognitive maps of the maze prior to the reward although it had not been observed in their behavior.

2.1.8 VERBAL LEARNING

A field of experimental psychology which studies the formation of certain verbal associations; deals with acquisition of the associations. Verbal learning is limited to human beings, as humans acquire knowledge largely in terms of words. the methods used in studying this kind of learning

1. Paired -Associates Learning: This method mimics S-S conditioning and S-R learning. It is used in learning some foreign language equivalents of mother-tongue words. First a list of paired associates is prepared. The first word of the pair is used is the stimulus and the second word as a response. Members of each pair may be from the same language or two different languages. A list of such words is given.

Ghar- home chhat- roof billi- cat etc.

The, first members of the pairs (stimulus term) are consonant-vowel-consonant (CVC) nonsense syllables and the second are English nouns (response term). The learner is first shown both the stimulus-response pairs together, and is instructed to remember and recall the response after the presentation of each stimulus term. after that a learning trial begins. One by one the stimulus words are presented and the participant tries to give the correct response term. In case of failure; he or she is shown the response word. In one trial all the stimulus terms are shown. Trials continue until the participant gives all the response words without any error. The total number of trials taken to reach the criterion becomes the measure of paired associate learning.

2. Serial Learning: This method of verbal, learning is used to find out how participant learn the lists of verbal items, and what processes are involved in it. First, lists of verbal items. i.e. nonsense syllables, most familiar or least familiar words, interrelated words. etc. are prepared. The participant is presented the entire list and is required to produce the items in the same serial order as the list. In the first trial, the first item of the list is shown and the participant has to produce the second item. If, he or she fails to do so within the prescribed time, the experimenter presents the second item. Now this item becomes the stimulus and the participant has to produce the third item that is the response word. If he or she fails the experimenter gives the correct item, which becomes the stimulus item for the fourth word. This procedure is called serial anticipation method. Learning trials continue until the participant correctly anticipates all the items in the given 'order.

3. Free Recall: In this method participants are presented a list of words, which they read and speak out. Each word is shown at a fixed rate of exposure duration. Immediately after the presentation of the list, the participants are required to recall the words in any order they can. Words in the list may be interrelated or unrelated. More than ten words are included in the list. The

presentation order of words varies from trial to trial. This method is used to study how participants organise words for storage in memory. Studies indicate that the items placed in the beginning or end of the lists are easier to recall than those placed in the middle which are more difficult to learn.

Verbal learning depends strongly on meaningfulness and category clustering. It has been found that verbal learning is both associative as well as organisational. Length of the list, meaningfulness, frequency, the usage of words and interrelatedness of the words in the list determine the learning difficulty. More the time spent in learning, stronger is the learning. Verbal learning is both intentional and incidental.

2.1.9 CONCEPT LEARNING

The world in which we live consists of innumerable objects, events and living beings. These objects and events are different in their structures and functions. One of the many things human beings have to do is to organise the objects, events, animals etc. into categories so that within the category objects are treated as equivalent even though they are different in their features. Such categorisations involve concept learning.

What is a concept?

A concept is a category that is used to refer to a number of objects and events. A concept is a name expressed in words, often only in one word. Cow, fruit, building and crowd are examples of concepts or categories. A concept may be used to refer to a number of instances. It may be noted that the terms concept and category are interchangeable. A concept is defined as 'a set of features or attributes connected by some rule.' Instances of a concept are those objects or events or behaviours , which have common features. A feature is any characteristic or aspect of an object or event or living organism that is observed in them and can be considered equivalent to some features observed or discriminated in other objects. Features are of innumerable kinds and their discriminability depends upon the degree of the observer's perceptual sensitivity. Properties like colour, size, number, shape, smoothness, roughness, softness, and hardness are called features.

Rules that are used to connect the features to form a concept may be very simple or complex. A rule is an instruction to do something. Keeping in view the rules that are used in defining concepts, psychologists have studied two types of concepts- artificial concepts and natural concepts or categories.

2.1.10 KEY LEARNING CONCEPTS

When learning takes place, whether it is CS-CR associations or stimulus response operant leading to reinforcement, it involves occurrence of certain processes. These include reinforcement, extinction, generalization and discrimination, spontaneous recovery and transfer of learning.

REINFORCEMENT

The term refers mostly to cases in which behavior has some consequences and, by virtue of these consequences, comes to occur more often. The term *reward*, sometimes used as a nontechnical synonym, is not equivalent. As a classical example of reinforcement, imagine a rat in a chamber with a lever and a cup into which food pellets can be delivered. If pressing the lever does nothing, the rat presses only occasionally. If each press produces a food pellet, however, the rat presses the lever more often. The food is called a reinforcer, and the rat's lever press is said to have been reinforced. The response that increases must be the one that produced the consequence.

There is difference between positive reinforcement and negative reinforcement. Negative reinforcement occurs when a behavior results in terminating an aversive stimulus. In the case of the rat, the negative stimulus might be a loud noise. A lever press turns off the stimulus. If the rat continues to press the lever, it would be said that loud noise functions as a negative reinforcer and the behavior is maintained by negative reinforcement. Thus, both positive and negative reinforcement refer to increases in behavior, but differ in whether a pleasant stimulus is presented as the result of some behavior (positive reinforcement). Negative reinforcement is also referred to as escape (if the response turns off the stimulus each time it appears) or avoidance (if the response can postpone presentation of the stimulus).

It is important to note that reinforcement is a concept that refers to the relationship between behavior and its consequences. Stimuli or events are not assumed to have inherent reinforcing effects. For example, although most people like money and will continue to exhibit behavior that results in obtaining money, it cannot be assumed that money functions as a reinforcer for everyone. For example, money might not serve as a reinforcer for a monk devoted to an ascetic lifestyle. The defining characteristic of reinforcement depends on how a behavior is changed and not on the types of things that serve as reinforcing events. Factors that help determine whether a given object or event is reinforcing or punishing for a given individual include that individual's previous experiences and other features of the environment that coexist and are associated with the object or event. The upshot is that different things may function as reinforcers for different people.

Generalization and Discrimination: Tendency of a similar but new stimulus to elicit a response that is similar to the conditioned response is called generalization while the process of learning to respond to certain stimuli and not to respond to others is called discrimination. The processes of generalisation and discrimination occur in all kinds of learning

However, they' have been extensively investigated in the context of conditioning Suppose an organism is conditioned to elicit a CR (saliva secretion or any other reflexive response) on presentation of a CS (light, bell sound). After conditioning is established, and another stimulus similar to the CS is presented, the organism makes the CR to it. This phenomenon of responding similarly to similar stimuli is known as generalization (When learned response occurs or is elicited by new stimulus, it is called generalization

Another process, which is complementary to generalisation, is called discrimination. Generalization is due to similarity while discrimination is a response to difference. 'For example, suppose a child conditioned to be afraid of a person wearing a black dress, sporting a bushy moustache Now when he meets another person dressed in black clothes with a beard, the child shows signs of fear. The child's fear is generalised. He meets another stranger who is wearing gray clothes and is clean shaven. The child shows no fear. This is example of discrimination

Extinction:

Extinction refers to weakening of the conditioned response in the absence of the unconditioned stimulus. Extinction means disappearance of a learned response due to removal of reinforcement from the situation in which the response used to occur. if the occurrence of CS-CR is not followed by the US, or lever pressing is no more followed by food pellets in the Skinner box, or the behavior learned through observation of some model or models by a child continuously fails to yield the expected result, the learned behavior will gradually be weakened and ultimately disappear Learning shows resistance to extinction. It means that even though the learned response is now not reinforced, it occurs for sometime to come. However, with increasing number of trials without reinforcement, the response strength gradually diminishes and ultimately it stops occurring. This is called resistance to extinction. How long a learned response shows resistance to extinction depends on a number of factors. It has been found that with increasing number of reinforced trials resistance to extinction increases and learned response reaches its asymptotic level. It is this level when performance gets stabilised. After that the numbers of trials do not make a difference in the response strength. Resistance to extinction increases with increasing number of reinforcement during acquisition, beyond that any increase in number of reinforcement reduces the resistance to extinction. Studies have also indicated that as the amount of ",reinforcement (number of food -pellets) increases during acquisition trails, resistance to extinction decreases If reinforcement is delayed during acquisition trials, the resistance to extinction increases. Reinforcement in every acquisition trial makes the learned response to be less resistant to extinction. To sum up a reduction or a loss in

the strength or rate of a conditioned response when the unconditioned stimulus or reinforcement is withheld.

Spontaneous Recovery: A conditioned response recurs after a time delay without further conditioning. It occurs after a learned response is extinguished. After a time lapse when CS stops receiving CR there happens a spontaneous recovery of CR when presented with CS.

Transfer of Learning

Transfer of learning refers to effect of prior learning on new learning. It can be subdivided into following

• Positive Transfer: When learning of one task facilitates acquisition of the other task.

• Negative Transfer: When the previously learnt task interferes with the learning of subsequent task.

• Zero Transfer: Learning of one task does not effect performance of another task.

LAWS OF LEARNING

Laws and principles of learning are attempts to define the fundamental conditions of the learning process. In general, we have five almost universally accepted laws of learning. Each of these laws has common sense applications based on lessons people have learned over the years. Your mastery of these applications will greatly enhance your ability to influence your students to learn and perform at a high level.

LAW OF READINESS

According to the law of readiness students learn best when they are physically, mentally, and emotionally ready to learn. Since learning is an active process, students must have adequate rest, health, and physical ability. Students who are exhausted or in ill health obviously cannot learn much. Although these areas are beyond your control, you must know how to address them in your classroom. For students to be mentally ready to learn, they must master certain knowledge and skills at one level before they can learn those required at the next higher level. For example, students who have not learned the basic application of a law have little chance of applying that law to more complex situations. Just as students must be ready to learn, you must be ready to teach. Always prepare your lesson plans, training materials, and classroom or laboratory before you begin to teach. Your readiness is an important step in gaining the confidence and attention of your students. Remember, you only get one chance to make a first impression.

LAW OF EFFECT

An individual learns best those things which result in satisfying consequences. Since the law of effect has a direct relationship to motivation, it has many practical applications for you in the training environment.

One of the most basic applications is in your relationship with adult students. Adults want immediate benefits from training, so begin your instruction by presenting the benefits of the lesson. Continue to remind students of these benefits throughout the training. Point out the value of the training in meeting the needs of your students: self-satisfaction, self-confidence, improved skills, and so forth. Begin each lesson with a statement of objectives to help students establish goals, and let them know you expect them to meet those goals. Motivate students by providing positive reinforcement as they proceed from success to success. That is the basis of the law of effect.

LAW OF PRIMACY

Based on the law of primacy, students retain information they learn for the first time longer than they retain information they must relearn. Unlearning incorrect procedures (or bad habits) is always more difficult than learning the correct procedures in the beginning. Therefore, the law of primacy plays an important role in Navy training. Navy training courses allow a limited amount of time for learning do not include time for students to relearn improperly taught information. Make sure you teach the correct information and procedures the first time; proceed from the simple to the complex, from the known to the unknown. Clarify misunderstandings and errors before moving on. Remember, your students must be ready to learn new material.

LAW OF EXERCISE

This law is based on the old maxim that practice makes perfect. It has been proven that students learn best and retain information longer when they have meaningful practice and repetition. The key here is that the practice must be meaningful. It is clear that practice leads to improvement only when it is followed by positive feedback. That means that as an instructor, you need to follow upon every homework assignment, every lab exercise, and any other student activities you assign. Students must have supervised practice in applying new skills to reach the required level of expertise to master course objectives. That is how the transfer method of learning takes place; from the information you teach, to the students' use of it.

LAW OF INTENSITY

The law of intensity states that a vivid experience is learned better and retained longer. Make your instruction powerful enough to have a strong, positive effect on your students by getting them actively involved in the lesson. Instruction that allows students to sit passively in the classroom doesn't have much

intensity. You can talk about the effects of tear gas all day. But talking will never have the same impact as putting students in a controlled environment and letting them experience tear gas without a gas mask. That is **Intensity.**

Use the best instructional media available, including the real thing. Use examples, analogies, and personal experiences to make learning come to life. Make learning interactive by initiating and controlling your students' involvement in the learning process.

2.1.11 FACTORS AFFECTING LEARNING

Many factors affect learning. Everyone does not learn in exactly the same way or at the same rate. Each is subject to a variety of negative and positive influences in the overall process. You need to be aware of as many factors that affect learning as you can. The more you know, the better chance you have of positively influencing the learning process.

MOTIVATION

Perhaps the single most important factor in learning is motivation. Unfortunately, it is one of the hardest to get a handle on or to channel effectively. Humans basically try to succeed and, conversely, try vigorously to avoid failure, and thus constant efforts towards new learning are made. Without a will to learn, a person would resist any efforts towards acquiring new skills, behaviors, or cognitive mechanisms or modifying the existing patterns of functioning. Similarly, a motivated person would learn even if he gets a small opportunity. Little doubt exists that motivation, either internally or externally stimulated, initiates learning; directs it; and, when derailed, can reduce or stop it.

THE LEARNING SENSES

Sensory learning is the first that occurs for any human being. Its influence is apparent in children as we watch them grow up. Each sense, either singularly or in various combinations, provides a pathway to learning. With that in mind, the learning process to be optimum it is essential that all the organs are functioning normally and any sensory deficit would be a factor hindering learning.

Sight is considered the most important sense, accounting for as much as 75 percent of our basic learning. Most early learning comes from seeing and imitating. Hearing is the second most important sense, accounting for a large percentage of the remaining sensory learning capacity. Experts differ on specific numbers, but the significance of sight and sound together is overwhelming. The sense of touch, while important in itself, becomes a major learning factor when combined with other senses. For eg. children do not associate/learn the word "hot" with anything in particular until they associate the word with their sense of touch. Through experience, we become sensitive to temperature, pressure,

and the overall feel of things. For instance, an experienced engineer doesn't need a temperature gauge to determine if a bearing is running hot, just as an experienced damage control investigator doesn't need one to decide that the temperature of a watertight door is above normal. The importance of taste is important to the training/learning of cooks and bakers. The sense of smell is part of our human warning system. For example, electricians immediately recognize the smell of burning insulation. Therefore, the sense of smell is a valuable learning tool in certain narrow applications.

Although it is not normally identified as one of the senses, the phenomenon of kinesthesia is an extension of sensory learning. Think of it as a sensory perception residing in one's muscles, joints, and tendons that gives people a special awareness of their spatial relationship with their surroundings. Kinesthesia is actually a blend of all senses with psychomotor and perceptual skills. It manifests itself in people's ability to balance or move with coordination and determines the learning of skills through practice

Retention It has been estimated that people retain only 10 percent of what they read, 20 percent of what they hear, and 30 percent of what they see. When those senses are combined, however, retention takes a dramatic leap forward. Those same estimates tell us that when someone hears and sees, retention jumps to 50 percent. Hence the role of senses in learning is undeniable.

INDIVIDUAL DIFFERENCES

There are marked individual differences among learners. The physical differences, besides those for sight and hearing impairments, are those dealing with physical prerequisites for training/learning of psychomotor skills. More subtle differences exist in aptitude and ability. Aptitude depends on the student's intelligence, inquisitiveness, ambition, reasoning ability, and other mental traits. Ability is somewhat similar to aptitude but deals more with skills in processing information to acquire concepts or to master physical skills.

Being slow learner or fast learner, prior knowledge and leadership qualities would also affect the type, pace and amount of learning of different individuals even when they are exposed to the same inputs. Emotional differences and personalities ranging from introverted to extroverted also play a major role in learning. Social stereotypes like gender bias and bias towards certain classes may be internalized ,and result in individuals efforts towards learning .For eg , a girl may feel that she can never be good in numbers and hence may not learn accounts keeping.

Such attitudes undoubtedly affect performance since they indicate how person feels about learning at a particular time. The motivation levels would be indicated by attitudes and will channel the efforts toward success.

LEARNING STYLES

Individuals have different styles of learning. One person's learning style may not be effective for another person. Concrete learners prefer an experience-based approach to learning. They rely heavily on their own feelings and personal judgments. They learn best by imitation after watching others take part in role playing and simulations. They very much like to be involved with the "real thing." For example, suppose you were trying to teach how to operate a fire pump. Concrete learners would prefer to watch you demonstrate the operation. They could then operate the pump by imitating your performance.

Active learners prefer to learn by becoming involved with the subject and taking an active step-by-step approach. They learn best from small group discussions, structured exercises, and problem-solving approaches. Active learners are experimenters who prefer to systematically try out new skills. A trial-and-error way of learning appeals to them. To operate the fire pump, active learners would systematically try out several different ways of operation.

Reflective learners like to observe and reflect (make comparisons and contrasts) before drawing conclusions. They learn best from lectures, films, and reading. Reflective learners prefer to play the role of the impartial observer while watching others. To operate the fire pump, reflective learners would watch others operate the pump and reflect (think) about the different ways of operation. They would then analyze their observations before attempting to operate the pump themselves.

Abstract learners refer a theory-based, analytical approach to learning. They learn best from lectures by experts, theoretical reading, case studies, and activities that require solitary thinking. Abstract learners like to find the "theory" behind the subject matter and analyze the approach to discover what concepts are involved. In operating the fire pump, they would prefer to read about its principles of operation and to analyze the concepts involved in its operation before attempting to operate it.

The input which matches with the persons style of learning would get best results.

CONTROL FORGETTING

One of the most common causes of forgetting is disuse. People tend to forget what they don't use. Planning the learning around conceptual bases avoids forgetting Concentrating on concept building by reviewing frequently, providing examples, and providing time for practice what has been learned forgetting can be minimized.

Another cause of forgetting is interference. Interference occurs when the memory of one event hinders the recall of another. This too is avoided when

current learning is complete and conceptual. Once there has been sufficient practice to learn the information as a concept, person will retrieve the information more easily.

MEANINGFULLNESS EFFECT

Highly meaningful materials are easier to learn and remember than less meaningful ones. This is true whether meaningful is measured by

1) the number of associations the learner has for the material,
2) by frequency of the association
3) or by familiarity with the sequential order of the concept,
4) or the tendency of the work to elicit clear images.

An implication is that retention will be improved to the extent the user can make meaning of the material to be learnt.

PRACTICE EFFECT

Active practice or rehearsal improves retention of learnt material, and distributed practice in learning is usually more effective than massed practice. The advantage to distributed practice is especially noticeable for lists, fast presentation rates or unfamiliar stimulus material. The advantage to distributed practice apparently occurs because massed practice allows the learner to associate a word with only a single context, but distributed practice allows association with many different contexts.

TRANSFER EFFECTS

Transfer effects are effects of prior learning on the leaning of new material. Positive transfer occurs when previous learning makes new learning easier. Negative transfer occurs when it makes the new learning more difficult. The more that two tasks have in common, the more likely that transfer effects occur.

ORGANIZATION EFFECTS

Organization effects occur when learners chunk or categorize the input. Free recall of learnt material is better when learners organize the items into categories rather than attempt to memorize the material in serial order..

ABSTRACTION EFFECTS

Abstraction is the tendency of learners to pay attention to and remember the gist of a passage rather than the specific words of a sentence. In general, to the extent that learners assume the goal is understanding rather than verbatim memory and the extent that the material can be analyzed into main ideas and supportive detail, learners will tend to concentrate on the main ideas and to retain these in semantic forms that are more abstract and generalized than the verbatim sentences included in the passage.

PRIOR KNOWLEDGE EFFECTS

Prior knowledge effects will occur to the extent that the learner can use existing knowledge to establish a context or construct a schema into which the new information can be assimilated.

MATHEMAGENIC EFFECTS

Mathemagenic effects, coined by *Rothkopf (1970)* , refer to various things that learners do to prepare and assist their own learning. These effects refer to the active information processing by learners. Mathemagenic activities include answering adjunct questions or taking notes and can enhance learning.

SOME OTHER FACTORS AFFECTING LEARNING INCLUDE

- Readiness
- Active involvement
- Feedback
- Simple to complex
- Cultural barriers

– Language, cultural values & practices

Self Check Exercise

a) Define learning. What are different types of learning?
b) Discuss the nature of learning. what different laws govern learning
c) Describe factors which affect learning
d) Evaluate verbal learning and concept formation.

2.1.12 SUMMARY

Of all the creatures in this world humans are the most capable in changing behaviour through learning. Learning is any relatively permanent change in behaviours or behavioural potential produced by experience or practice. It is an inferred process and differs from performance which is the observed behaviour / response / action. The temporary change in behaviour due to continuous exposure to stimuli is called habituation. The main types of learning are: classical and operant conditioning, observational Learning, concept learning, and skill learning.

Pavlov first investigated classical conditioning in the course on studies on digestion in dogs. In this kind of learning an organism comes to associate stimuli. A neutral stimulus (CS) that signals an unconditioned stimulus (US) begins to produce a response (CR) that anticipates and prepares the organism for US. Using time relation involved in pairing CS and US jour major variations are noted: I simultaneous, delayed, trace and backward. US may be appetitive

or aversive. The former elicits approach response while the later elicits avoidance responses.

Skinner first investigated operant or instrumental conditioning (OC). An operant is any response voluntarily emitted by an organism. OC is a type of learning in which, response is strengthened ,if followed by reinforcement. In observational learning, also known as imitation, modeling and social learning, one acquires knowledge by observing a model's behaviour. The performance depends on whether the model's behaviour is rewarded or punished. In verbal learning words get associated with one another on the basis of structural, phonetic, and semantic similarity and contrast. They are often organised in clusters.

2.1.13 Keywords

1. Learning or *acquisition:*

In classically conditioned response occurs when a signal or cue is put before the activation of a reflex. Learning is fastest if the signal comes about a half second before the reflex, if the reflex involves skeletal muscle movement, such as a knee jerk or withdrawal of a fingertip. Learning typically occurs after only a few pairings of signal with reflex.

2. Transfer effects:

Transfer effects are effects of prior learning on the leaning of new material. Positive transfer occurs when previous learning makes new learning easier. Negative transfer occurs when it makes the new learning more difficult. The more that two tasks have in common, the more likely that transfer effects occur.

3. Control forgetting:

One of the most common causes of forgetting is disuse. People tend to forget what they don't use. Planning the learning around conceptual bases avoids forgetting Concentrating on concept building by reviewing frequently, providing examples, and providing time for practice what has been learned forgetting can be minimized.

4. Law of exercise

This law is based on the old maxim that practice makes perfect. It has been proven that students learn best and retain information longer when they have meaningful practice and repetition. The key here is that the practice must be meaningful. It is clear that practice leads to improvement only when it is followed by positive feedback.

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CONDITIONING

LESSON STRUCTURE

2.2.0 OBJECTIVE

The student will learn the process and types of conditioning. The principles of conditioning and the difference between operant and classical conditioning will be clear after reading this lesson.

2.2.1 INTRODUCTION

The concept of conditioning can be better understood by explain some of its representative theories. The acquisition and modification of behaviour and their performance is dependent on learning. Learning is largely the outcome of an individuals experience with the environment. It has extensively been studied experimentally by Ivan Pavlov and BF Skinner as they proposed learning through conditioning.

Conditioning is a behavioural process whereby a response becomes more frequent or more predictable in a given environment as a result of reinforcement, with reinforcement typically being a stimulus or reward for a desired response. As sometimes change in the individual's behavior or mental state is in response to something in the environment and by controlling the environment, one's learning can be controlled.

In the present chapter we shall study two types of learning through conditioning..

(i) Classical Conditioning
(ii) Instrumental conditioning

2.2.2 CLASSICAL CONDITIONING

Classical Conditioning is one important type of learning Classical Conditioning, was actually discovered accidentally by Ivan Pavlov (1849-1936). Pavlov was a

Russian physiologist who discovered this phenomenon while doing research on digestion. Classical conditioning was the first type of learning to be discovered and studied within the behaviorist tradition (hence the name classical). Pavlov was studying the digestive system of dogs and became intrigued with his observation that dogs deprived of food began to salivate when one of his assistants walked into the room. He began to investigate this phenomena and established the laws of classical conditioning.

Classical conditioning is a very simple form of learning. Classical conditioning happens when a stimulus that one can identify (such as an aroma in the air) is followed by a biologically significant event (such as the appearance of food). After several such pairings, one *learns this connection so that* the next time that stimulus occurs; one acts like it *expects* the same event. That is, it makes an *anticipatory response*.

Creatures do not need much of a nervous system to notice that when stimulus *A* happens, event *B* happens next. The rule is, "Whenever you notice A, prepare for B." That is classical conditioning: an *anticipatory biological response.*

Major concepts

Classical conditioning is Stimulus (S) elicits >Response (R) conditioning .this is because the antecedent stimulus (singular) causes (elicits) the reflexive or involuntary response to occur. Classical conditioning starts with a reflex. Reflex is an innate, involuntary behavior elicited or caused by an antecedent environmental event. For example, if air is blown into the eye, one blinks. There is no voluntary or conscious control over whether the blink occurs or not. This reflex blinking becomes conditioned when it becomes associated with any antecedent stimulus

The specific model for classical conditioning is:

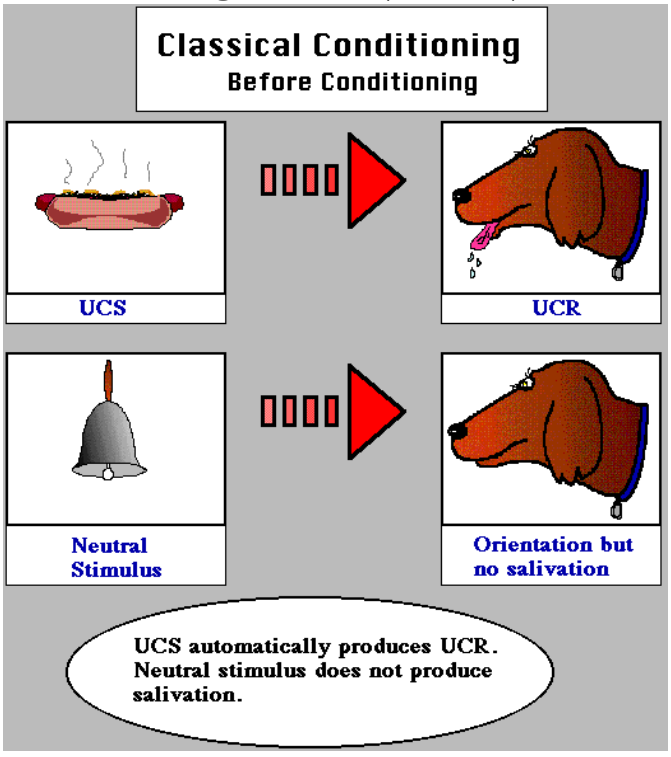
1. Unconditioned Stimulus (US) elicits Unconditioned Response (UR): a stimulus will naturally (without learning) elicit or bring about a reflexive response
2. Neutral Stimulus (NS) does not elicit the response of interest: this stimulus (sometimes called an orienting stimulus as it elicits an orienting response) is a neutral stimulus since it does not elicit the Unconditioned (or reflexive) Response.
3. The Neutral or Orienting Stimulus (NS) is repeatedly paired with the Unconditioned or Natural Stimulus (US).
4. The NS is transformed into a Conditioned Stimulus (CS): when the CS is presented by itself, it elicits or causes the conditioned response(CR) CR is the same involuntary response as the UR but the name changes because it is elicited by a different stimulus. This is written CS elicits > CR.

In classical conditioning no new behaviors are learned. Instead, an association is developed (through pairing) between the NS and the US so that the animal or person responds to both events or stimuli in the same way In other words, after conditioning, both the US and the CS will elicit the same involuntary or reflexive response ie the person or animal learns to respond reflexively to a new stimulus.

The following is a restatement of these basic principles using figures of Pavlov's original experiments as an example.

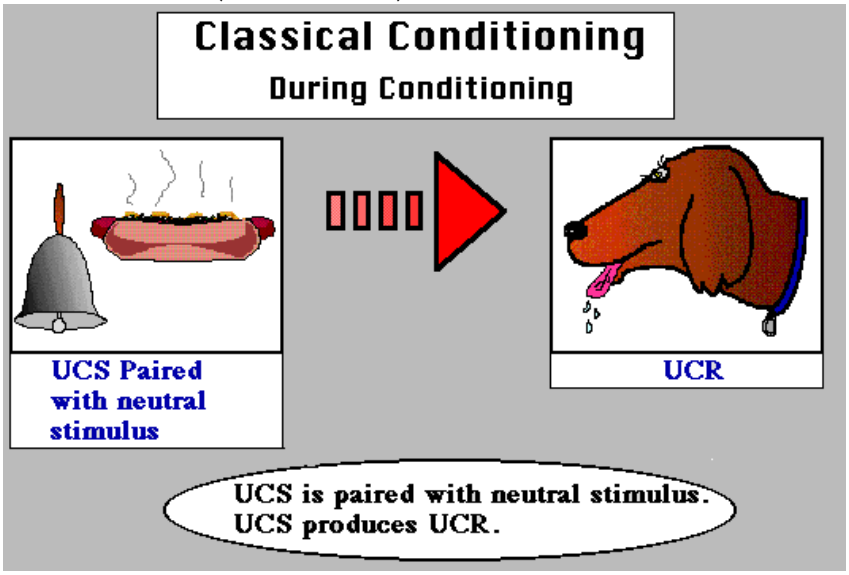
Before conditioning

In order to have classical or respondent conditioning, there must exist a stimulus(food) that will automatically or reflexively elicit a specific response(salivation in dog). This stimulus is called the **Unconditioned Stimulus** or UCS because there is no learning involved in connecting this stimulus and response. There must also be a stimulus that will not elicit this specific response, but will elicit an orienting response. This stimulus is called a **Neutral Stimulus** or an **Orienting Stimulus(the bell)**.



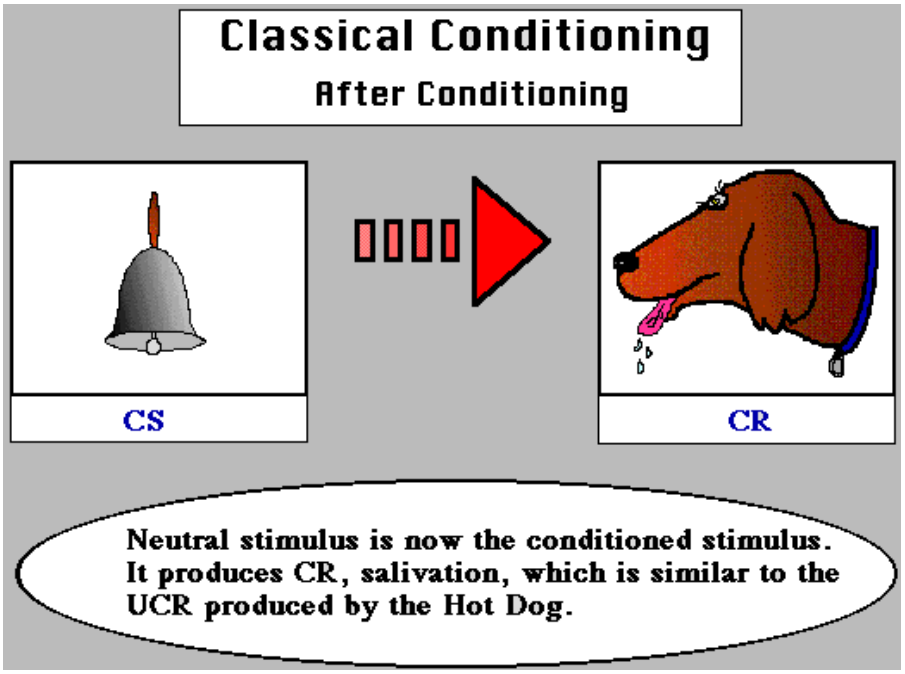
During conditioning

During conditioning, the neutral stimulus(bell) will first be presented, followed by the unconditioned stimulus(food). Over time, the learner(dog) will develop an association between these two stimuli i.e., will learn to make a connection between the two stimuli (bell and food)



After conditioning

After conditioning, the previously neutral or orienting stimulus (bell) will elicit the response (salivation) previously only elicited by the unconditioned stimulus (food). The stimulus (bell) is now called a **conditioned stimulus** because it will now elicit a different response as a result of conditioning or learning. The response (salivation) is now called a **conditioned response** because it is elicited by a stimulus (bell) as a result of learning. The two responses, unconditioned and conditioned, look the same, but they are elicited by different stimuli and are therefore given different labels.



Basically, Pavlov's findings support the idea that we develop responses to certain stimuli that are not naturally occurring. When a child touches a hot glass of milk, his reflex pulls his hand back. It he does this instinctually, no learning is involved. It is merely a survival instinct. But why kids, after getting burned, pull their hands back even when the milk glass is cold? Pavlov discovered that we make associations which cause us to generalize our response to one stimulus onto a neutral stimulus it is paired with. In other words, hot milk = ouch, glass = hot milk, therefore, glass = ouch. This will be learning through classical conditioning

Many of our behaviors today are shaped by the pairing of stimuli. Have you ever noticed that certain stimuli, such as a certain song, or smell of cooked rice results in fairly intense emotions? It's not that the smell or the song that are the cause of the emotion, but rather what that smell or song has been paired with... the death of a loved one, or maybe the day you met your husband or wife or just mothers cooking. We make these associations all the time and often don't realize the power that these connections or pairings have on us. But, in fact, we have been classically conditioned.

Additional Terminology

There are several terms associated with this behavioral approach that deserve further explanation.

Extinction refers to the breaking of the stimulus-stimulus or stimulus-response connection. When CS-US pairings are followed by presentations of the CS alone or by unpaired CS and US presentations, the CR decreases. In other words if the conditioned stimulus (CS)(eg: bell) is repeatedly presented by itself ,without pairing with the unconditioned stimulus [US](eg:food) the conditioning process is reversed, and the CS will become a NS again.

Spontaneous recovery: Sometimes, after extinction in classical conditioning, if the conditioned stimulus (CS) is again presented, it will "spontaneously" ie without any new learning,will elicit the conditioned response (CR). Presentation of the CS after some time after the subject stopped responding might yield renewed responding.

Higher (or second) order conditioning: Classical conditioning does not have to involve pairing a neutral stimulus (NS) with an unconditioned stimulus (US). If a NS is paired with an existing conditioned stimulus (CS), the NS will also become a CS.

Stimulus generalization and discrimination

- generalization -- behaviors learned in one context or situation are transferred to other similar context or situation (e.g., child may fear all white liquids in glass from earlier example) A CS2 elicits a CR when it shares some characteristics with a CS1 that has been paired with the US.
- discrimination – behaviors learned in one context or situation have a different response in another(eg:child does not fear orange juice in the same glass from the earlier example)

2.2.3 INSTRUMENTAL (operant) CONDITIONING

The classic study of instrumental Conditioning involved a cat who was placed in a box with only one way out; a specific area of the box()latch) had to be pressed in order for the door to open. The cat initially tries to get out of the box because freedom is reinforcing. In its attempt to escape, the area of the box is triggered and the door opens. The cat is now free. Once placed in the box again, the cat will naturally try to remember what it did to escape the previous time and will once again find the area to press. The more the cat is placed back in the box, the quicker it will press that area for its freedom. It has learned, through natural consequences, how to gain the reinforcing freedom.

We learn this way every day in our lives. Imagine the last time you made a mistake; you most likely remember that mistake and do things differently when the situation comes up again. In that sense, you've learned to act differently based on the natural consequences of your previous actions. The same holds true for positive

actions. If something you did results in a positive outcome, you are likely to do that same activity again.

The major theorists for the development of operant conditioning are B. F. Skinner and Edward Thorndike. This approach to behaviorism played a major role in the development of the science of psychology, especially in the United States. They proposed that learning is the result of the application of consequences; that is, learners begin to connect certain responses with certain stimuli. This connection causes the probability of the response to change (i.e., learning occurs.)

Thorndike labeled this type of learning instrumental. Using consequences, he taught kittens to manipulate a latch (e.g., an instrument). Skinner renamed instrumental as operant because it is more descriptive (i.e., in this learning, one is "operating" on, and is influenced by, the environment). Where classical conditioning illustrates **S-->R** learning, operant conditioning is often viewed as **R-->S** learning since it is the consequence that follows the response that influences whether the response is likely or unlikely to occur again. It is through operant conditioning that voluntary responses are learned.

The 3-term model of operant conditioning (**S--> R -->S**) incorporates the concept that responses cannot occur without an environmental event (e.g., an antecedent stimulus) preceding it. The antecedent stimulus in operant conditioning does not elicit or cause the response (as it does in classical), but it can influence it. When the antecedent does influence the likelihood of a response occurring, it is technically called a discriminative stimulus. It can be thought of as learning due to the natural consequences of our actions.

It is the stimulus that follows a voluntary response (i.e., the response's consequence) that changes the probability of whether the response is likely or unlikely to occur again. There are two types of consequences: positive (sometimes called pleasant) and negative (sometimes called aversive). These can be added to or taken away from the environment in order to change the probability of a given response occurring again.

General Principles

There are 4 major methods used in instrumental conditioning. They result from a) combining the two major purposes of instrumental conditioning (increasing or decreasing the probability that a specific behavior will occur in the future), b) the types of stimuli used (positive/pleasant or negative/aversive), and c) the action taken (adding or removing the stimulus).

	Outcome of Conditioning	
	Increase Behavior	**Decrease Behavior**
Positive Stimulus	**Positive Reinforcement (add stimulus)**	**Response Cost (remove stimulus)**
Negative Stimulus	**Negative Reinforcement (remove stimulus)**	**Punishment (add stimulus)**

Schedules of consequences

Consequences are thus the base of instrumental conditioning It has been experimentally studied that these consequences or reinforcers have different impact depending on how and when they are presented These are called the schedules of reinforcement Stimuli are presented in the environment according to a schedule of which there are two basic categories: continuous and intermittent. Continuous reinforcement simply means that the behavior is followed by a consequence each time it occurs. Intermittent schedules are based either on the passage of time (interval schedules) or the number of correct responses emitted (ratio schedules). The consequence can be delivered based on the same amount of passage of time or the same number of correct responses (fixed) or it could be based on a slightly different amount of time or different number of correct responses that vary around a particular number (variable). This results in four classes of intermittent schedules.

1. Fixed interval -- the first correct response after a set amount of time has passed is reinforced (i.e., a consequence is delivered). The time period required to receive the consequences is always the same.

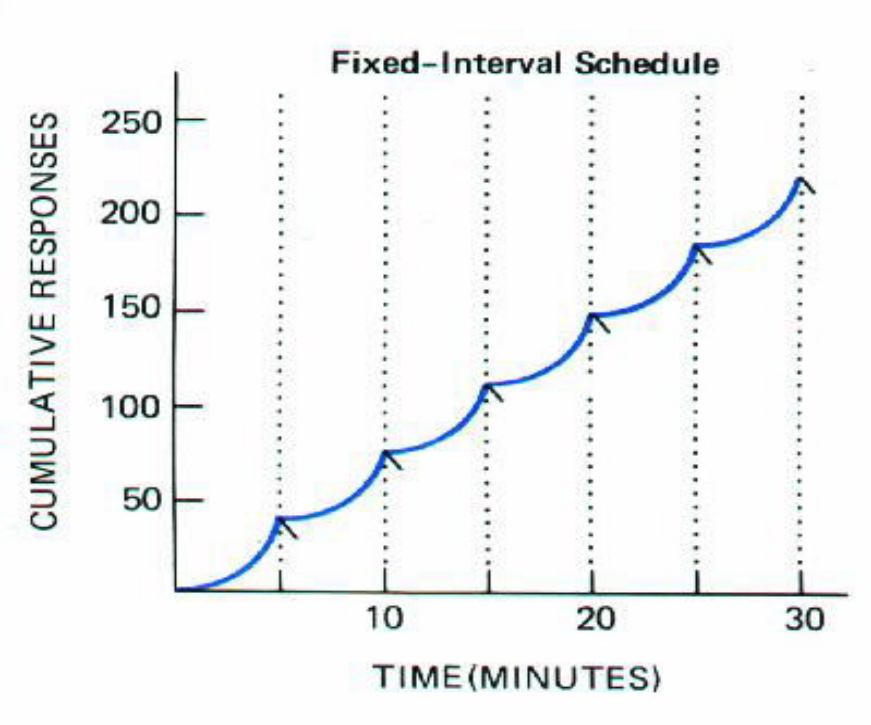


Figure a

As evident in figure a (where the dotted lines indicate the point of reinforcement) in the context of positive reinforcement, this schedule produces a scalloping effect during learning (a dramatic decrease in responding immediately after reinforcement.) Also notice the number of behaviors observed in a 30 minute time period ie approximately 220 when when the consequence has been received every 10 mins

2. Variable interval -- the first correct response after a set amount of time has passed is reinforced. After the reinforcement, a new time period (shorter or longer) is set for the reinforcerer. As shown in figure b the time varies for every reinforcement. (the dotted line)

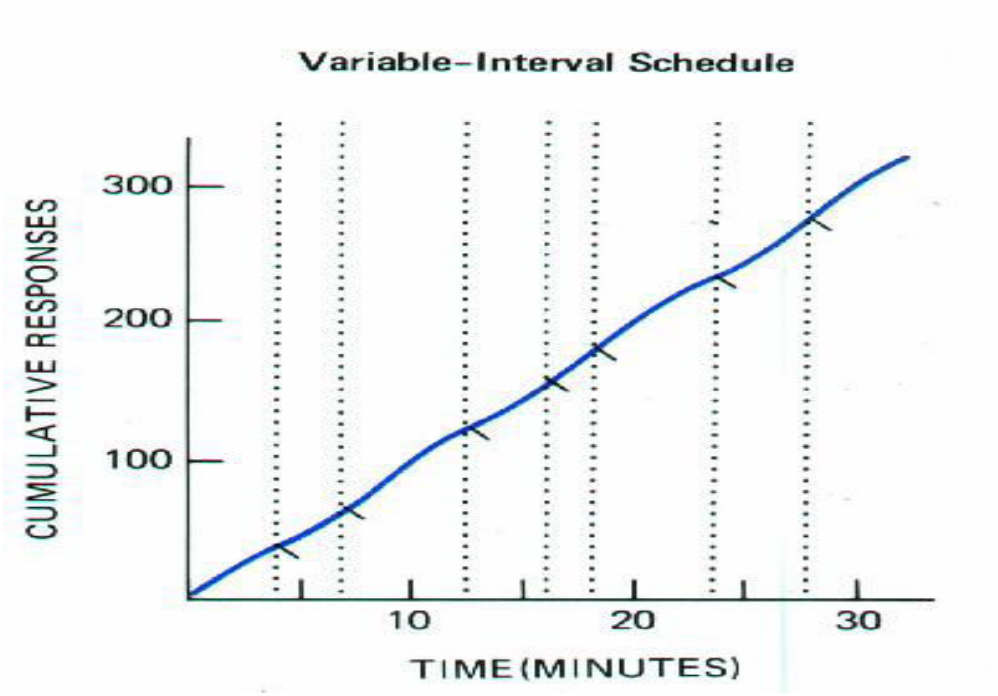


Figure b

Notice that this schedule reduces the scalloping effect and the number of behaviors observed in the 30-minute time period is slightly increased.ie approximately 300

3. Fixed ratio -- a reinforcer is given after a specified number of correct responses. This schedule is best for learning a new behavior

Notice that behavior is relatively stable between reinforcements, with a slight delay after a reinforcement is given. Also notice the number of behaviors observed during the 30 minute time period is larger than that seen under either of the interval schedules.

4. Variable ratio -- a reinforcer is given after a set number of correct responses. After reinforcement the number of correct responses necessary for reinforcement changes. This schedule is best for maintaining behavior, that has already been learnt i.e. it controls or prevents forgetting or the nonuse of learnt behaviour.

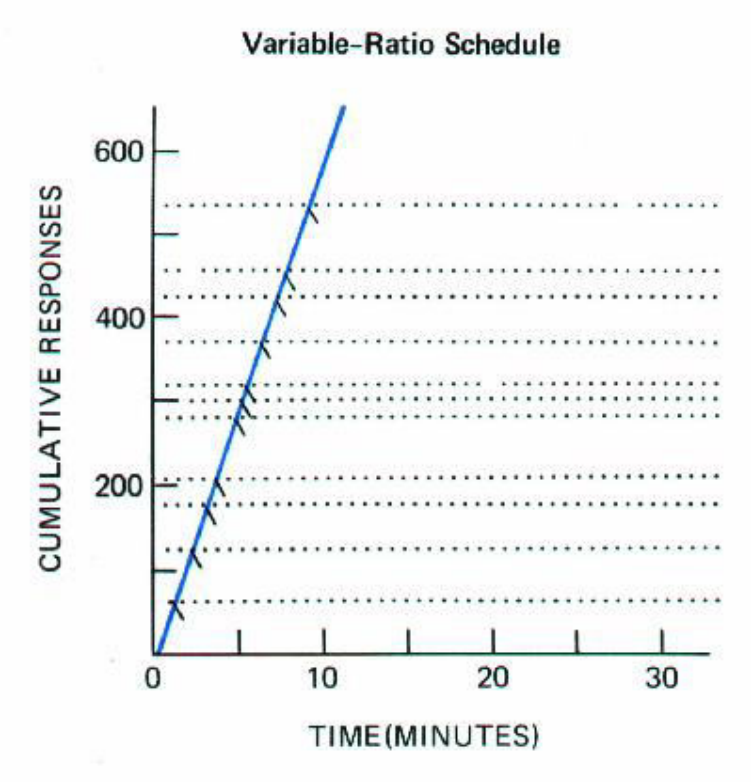
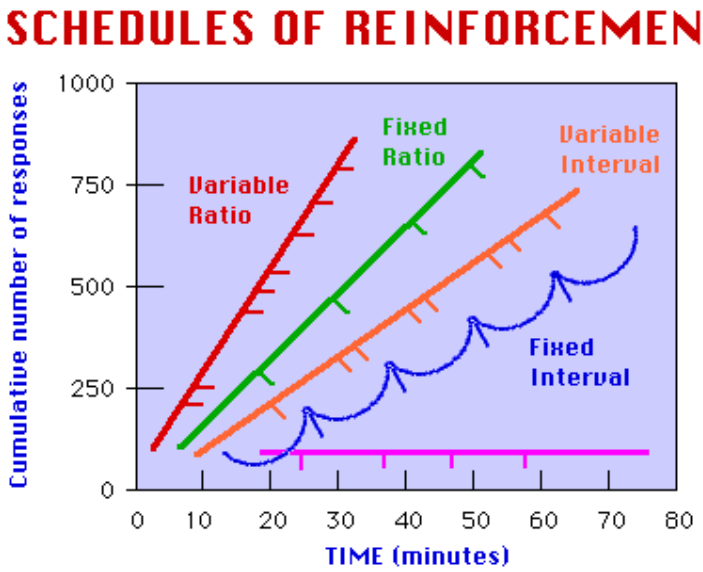


Figure c

As evident from figure c , within a small time large no. of responses have occurred. Notice that the number of responses per time period increases as the schedule of reinforcement is changed from fixed interval to variable interval and from fixed ratio to variable ratio.



In summary, the schedules of consequences are often called schedules of reinforcements because there is only one schedule that is appropriate for administering response cost and punishment: continuous or fixed ratio of one. In fact, certainty of the application of a consequence is the most important aspect of using response cost and punishment. Learners must know, without a doubt, that an undesired or inappropriate target behavior will be followed by removal of a positive/pleasant stimulus or the addition of a negative/aversive stimulus. Using an intermittent schedule when one is attempting to reduce a behavior may actually lead to a strengthening of the behavior, certainly an unwanted end result.

Premack Principle

The Premack Principle states that a high frequency activity can be used to reinforce low frequency behavior. Access to the preferred activity is contingent on completing the low-frequency behavior e.g. mother telling “You have to finish your VEGETABLES (Low Frequency) before you can eat any ICECREAM (High Frequency)"

Reinforcement

The term reinforce means to strengthen, and is used in psychology to refer to anything stimulus which strengthens or increases the probability of a specific response. For example, if you want your dog to sit on command, you may give him a biscuit every time he sits for you. The dog will eventually come to understand

that sitting when told to will result in a biscuit. This biscuit is reinforcing because he likes it and will result in him sitting when instructed to do so.

This is a simple description of a reinforcer (Skinner, 1938), the biscuit, which increases the response, sitting. We all apply reinforcers everyday, most of the time without even realizing we are doing it. You may tell your child "good job" after he or she cleans their room; perhaps you tell your partner how good he or she look when they dress up; or maybe you got a pay raise at work after doing a great job on a project. All of these things increase the probability that the same response will be repeated.

There are five basic processes in operant conditioning: positive and negative reinforcement strengthen behavior; punishment, response cost, and extinction weaken behavior.

1. **Postive Reinforcement**--Think of it as adding something in order to increase a response. For example, adding a biscuit will increase the response of sitting in dog; adding praise will increase the chances of your child cleaning his or her room. The most common types of positive reinforcement or praise and rewards, and most of us have experienced this as both the giver and receiver.
2. **Negative Reinforcement**-- Think of negative reinforcement as taking something negative away in order to increase a response. Imagine a teenager who is nagged by his mother to help lay the table week after week. After complaining to his friends about the nagging, he finally one day performs the task and to his amazement, the nagging stops. The elimination of this negative stimulus is reinforcing and will likely increase the chances that he will help next week.
3. **Response Cost**--if positive reinforcement strengthens a response by adding a positive stimulus, then response cost has to weaken a behavior by subtracting a positive stimulus. After the unwanted response a positive reinforcer is removed which weakens the frequency of the response. Eg if the dog messes with the carpet then he does not gets usual biscuit or if wife takes too long to dress she is not appreciated for her attire.
4. **Punishment**-- Punishment refers to adding something aversive in order to decrease a behavior. The most common example of this is disciplining (e.g. spanking) a child for misbehaving. The reason we do this is because the child begins to associate being punished with the negative behavior. The punishment is not liked and therefore to avoid it, he or she will stop behaving in that manner.

5. **Extinction**--. When you remove something in order to decrease a behavior, this is called extinction. You are taking something away so that a response is decreased.

Examples. The following examples are provided to assist you in analyzing examples of operant conditioning.

a. Fateh likes to do gardening in the backyard. He worked on every Friday during the month of June. The last time he was working, some older kids snuck up while he was working and threw a bucket of cold water on him. Fateh has not done gardening for three weeks.

l. What behavior was changed? *gardening*
2. Was the behavior strengthened or weakened? *weakened* (eliminate positive and negative reinforcement)
3. What was the consequence? *having water thrown on him*
4. Was the consequence added or subtracted? *added*

Since a consequence was added and the behavior was weakened, the process was punishment.

b. Every time Noor raises her hand in class she is called on. She raised her hand 3 time during the first class, 3 times in the second and 4 times during the last class.

l. What behavior was changed? *handraising*
2. Was the behavior strengthened or weakened? *strengthened* (eliminates response cost, punishment, and extinction)
3. What was the consequence? *being called on*
4. Was the consequence added or subtracted? *added*

Since the consequence was added and the behavior was strengthened, the process is positive reinforcement.

c. Harry is being reinforced using a token economy. When he follows a direction / command he earns a point. At the end of each day, he can "buy" playtime, t.v. privileges, etc. with his points. When he misbehaves or doesn't follow a command, he loses points. Harry used to fight with his mom . Since he has been on the point system, his fighting has been reduced to almost zero.

l. What behavior was changed? *fighting*
2. Was the behavior strengthened or weakened? *weakened* (eliminate positive and negative reinforcement)
3. What was the consequence? *losing points*
4. Was the consequence added or subtracted? *subtracted*

Since the consequence was subtracted and the behavior was weakened, the process is response cost.

d. Teg used to avoid going to the dentist every 6-months for a checkup. Instead, he waited until a tooth really hurts, then go to the dentist. After two emergency trips to the dentist, teg now goes every 6-months.

1. What behavior was changed? *going to the dentist*
2. Was the behavior strengthened or weakened? *strengthened* (eliminate response cost and punishment)
3. What was the consequence? *tooth no longer hurting*
4. Was the consequence added or subtracted? *subtracted*

Since the consequence was subtracted and the behavior was strengthened, the process is negative reinforcement**.**

Comparison between classical and operant conditioning

	Classical Conditioning	Operant Conditioning
Response	Involuntary, automatic	"Voluntary," operates on environment
Acquisition	Associating events; CS announces UCS.	Associating response with a consequence (reinforcer or punisher).
Extinction	CR decreases when CS is repeatedly presented alone.	Responding decreases when reinforcement stops.
Cognitive processes	Subjects develop expectation that CS signals the arrival of UCS.	Subjects develop expectation that a response will be reinforced or punished; they also exhibit latent learning, without reinforcement.
Biological predispositions	Natural predispositions constrain what stimuli and responses can easily be associated.	Organisms best learn behaviors similar to their natural behaviors; unnatural behaviors instinctively drift back toward natural ones.

2.2.4 LET US SUM UP:

In Classical Conditioning organism comes to associate two stimuli i.e. a neutral stimulus that signals an unconditioned stimulus begins to produce a response that anticipates and prepares for the unconditioned stimulus. Conditioned Stimulus (CS) is originally irrelevant stimulus that, after association with an unconditioned stimulus, comes to trigger a conditioned response. It is learned response to a previously neutral conditioned stimulus. Generalization is tendency for stimuli similar to CS to elicit similar responses. Shaping is an operant conditioning procedure in which reinforcers guide behavior toward closer approximations of a desired goal.

Discrimination in classical conditioning is the learned ability to distinguish between a CS and other stimuli that do not signal a UCS. There are five basic processes in operant conditioning: positive and negative reinforcement strengthen behavior; punishment, response cost, and extinction weaken behavior.

EVALUATE SELF

a) Describe contribution of Pavlov to psychology.
b) Compare classical and instrumental conditioning.
c) Describe the schedules of reinforcement.
d) How is extinction different in classical and instrumental conditioning?

2.2.5 Keywords

1. Response Cost--if positive reinforcement strengthens a response by adding a positive stimulus, then response cost has to weaken a behavior by subtracting a positive stimulus. After the unwanted response a positive reinforcer is removed which weakens the frequency of the response.

2. Punishment-- Punishment refers to adding something aversive in order to decrease a behavior. The most common example of this is disciplining (e.g. spanking) a child for misbehaving. The reason we do this is because the child begins to associate being punished with the negative behavior. The punishment is not liked and therefore to avoid it, he or she will stop behaving in that manner.

3. Extinction refers to the breaking of the stimulus-stimulus or stimulus-response connection. When CS-US pairings are followed by presentations of the CS alone or by unpaired CS and US presentations, the CR decreases. In other words if the conditioned stimulus (CS)(eg: bell) is repeatedly presented by itself ,without pairing with the unconditioned stimulus [US](eg:food) the conditioning process is reversed, and the CS will become a NS again.

4. Fixed interval- the first correct response after a set amount of time has passed is reinforced (i.e., a consequence is delivered). The time period required to receive the consequences is always the same.

5. Conditioning- is a behavioural process whereby a response becomes more frequent or more predictable in a given environment as a result of reinforcement, with reinforcement typically being a stimulus or reward for a desired response. As sometimes change in the individual's behavior or mental state is in response to something in the environment and by controlling the environment, one's learning can be controlled.

2.2.6 REFERENCES:

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Munn, N.L. Fernald, (1967) introduction to psychology, oxford & IBH Publishing, New Delhi

Lesson No. : 2.3 **Writer: DR. DAMANJIT SANDHU**

Normal Probability Distribution- Properties and Applications, Areas under NPC (Normal Probability Curve)

Structure

2.3.0 Objective

The objective of this chapter is to understand the concept of Normal Probability Curve (NPC) and its applications. We shall be covering a brief introduction to what is meant by a NPC, characteristics of a NPC, divergence of NPC. Also, we shall focus on the application of NPC, while dealing with statistical problems encountered in Psychological research.

2.3.1 Introduction & History

The word probability or "chance" is very commonly used word in day to day conversation and generally people have a vague idea about it.

For example:

We come across statement like "Probably it may rain tomorrow." "It is likely that Mr. X may not come for taking his class today." All these – possibly probably, likely etc. convey the same sense i.e. the event is not certain to take place or in other words, there is uncertainty about happening of the event in question. In layman's terminology the word "probability" thus connotes that there are uncertainties about the happening of event. However, in mathematics and statistics we try to present conditions under which we can make sensible numerical statement about uncertainty and apply certain methods of calculating numerical values of probability and expectations. In statistical sense

the term probability is thus established by definition and is not connected with beliefs or any form of wishful thinking.

The theory of probability has its origin in the games of chance related to gambling such as throwing a dice, tossing a coin, drawing cards form a pack of cards etc. **Terame Cardon (1501-76),** an Italian mathematician, was the first man to write a book on the subject entitled "Book on games of chance" which was published after his death in 1663.

Galileo (1564-1642), an Italian mathematician, was the first man to attempt quantitative measures of probability while dealing with some problems related to the theory of dice in gambling.

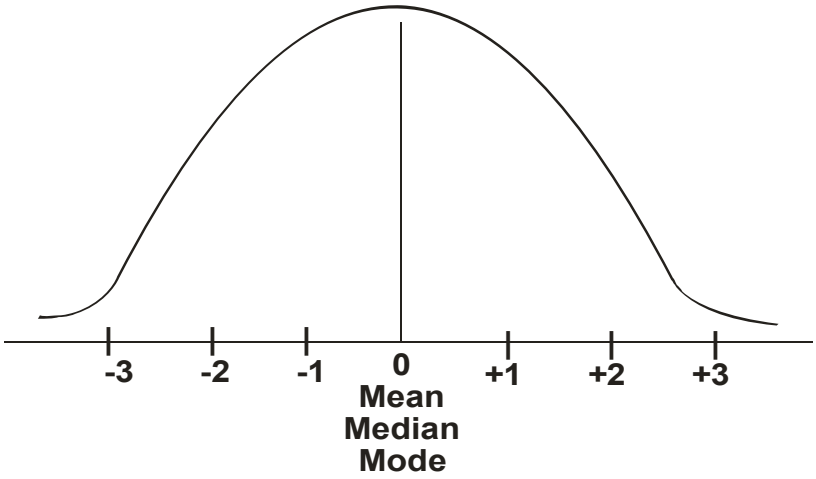
De Moivre (1773) was the first mathematician who developed a mathematical equation of the NPC. He was approached by gamblers to find out the chance of beating an opponent at different gambling games.

Gauss and Laplace (in 19th century) rediscovered the normal curve independent of De Moivre's work in the later half of 19th century and undertook the study of individual difference and during this systematic study, he found that most of the physical and psychological traits of human beings confirmed responsibly to the normal curve.

Today Normal curve is known by various names such as Gaussian curve, De Moivre's curve or bell-shaped curve.

2.3.2 Characteristic or Properties of Normal Probability Curve

Normal Probability curve is a graph representing a distribution of score. It is the ideal symmetrical frequency curve. In it the measures are concentrated closely around the centre and taper off from its central point or top to the left and right. There are few measures at the low score end of the scale; an increasing number up to a maximum at the middle position and a symmetrical falling off towards the high score end of the scale. The curve exhibits almost perfect bilateral symmetry. It is symmetrical about central altitude. This altitude divides it into two parts which will be similar in shape and equal area. The curve which is also called normal curve is a bell shaped figure. It is very useful in psychological and educational measurements. It is shown in figure.



The normal probability curves possess many important properties which are as follow;

1. All the three central tendencies - arithmetic average, median & mode coincide in it. They all lie at the same point.
2. It is symmetrical around its highest point.
3. It is equally divided into two parts by the perpendicular drawn from the highest point. The figure exhibits perfect bilateral symmetry.
4. The first and third quartiles are equidistant from median.
5. The ordinate at the mean is the highest ordinate. The heights of other ordinates at various sigma distances from the mean are also in a fixed relationship with the height of mean ordinate.
6. The curve is asymptotic to the base line. It means that it continues to approach but never reaches the base line. For practical purpose the curve may be taken to the end at points -3σ and +3σ distant from the mean.
7. The most important relationship in the normal curve is the area relationship. If we divide the range into six equal parts the cases between the two extremes are 99.73% and the cases between ± 2σ are 95.44% and the cases between ± 1σ are 68.26%.
8. On an NPC raw score can be converted into Z-scores. Z-score are raw scores expressed in terms of standard deviation units from the means. A z-score tells you how many deviations the corresponding raw- score lie about or below the mean.

$$Z = \frac{\text{Score} - \text{Mean}}{\text{S.D. } (\sigma)}$$

(i) e.g. If raw score is 66, mean = 50, σ = 8

$$z = \frac{66-50}{8} = \frac{16}{8} = 2$$

(ii) If raw score = 34, mean = 50, σ = 8

$$z = \frac{34-50}{8} = \frac{-16}{8} = -2$$

Also, the percent of cases between

0 to +1σ = 34.13%
0 to -1σ = 34.13%
0 to +2σ = 47.72%
0 to -2σ = 47.72%
0 to +3σ = 49.87%
0 to -3σ = 49.87%
+1σ to +2σ = 13.59%
+1σ to +3σ = 15.74%
+2σ to +3σ = 2.15%
-1σ to +1σ = 68.26%
-1σ to +2σ = 81.85%
-1σ to +3σ= 84.00%

In terms of probability it can be said that in any normally distributed sample, chances are that 2/3 cases will fall within the area of –1 to +1. There are 68 chances in 100 that a case will lie with in ± 1 σ from the mean in a normal distribution.

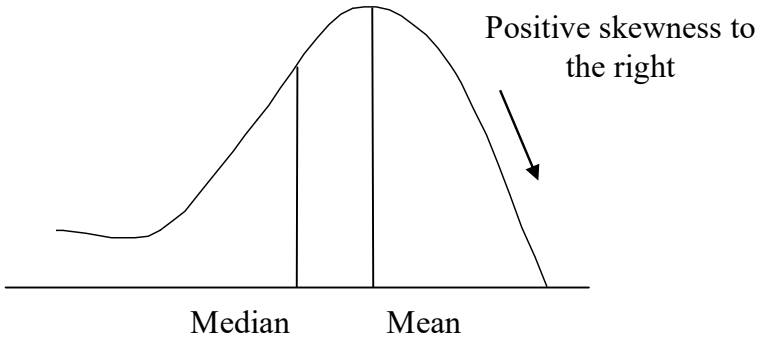
2.3.3 Divergence from Normality

(i) Skewness
(ii) Kurtosis

(i) Skewness

In a normal curve model, the mean, median and mode all coincide and there is a perfect balance between the right and left halves of the figure. A distribution is said to be "skewed" when the mean and the median fall at different places between the distribution and the balance is shifted to one side or the other – to left or to right. Distribution is said to be skewed negatively or to the left when scores are massed at high end of the scale (the right end) and are spread out more gradually towards the low end (or left).

Distribution are skewed positively on the right when **scores** are massed at the low (or left) end of the scale and are spread out gradually toward the high or right. Moreover, when skewness is negative the mean lie to the left of the median and when skewness is positive, the mean lies to the right of the median.



The simple measure of skewness is

$$S_k = 3\left(\frac{\text{mean} - \text{median}}{\sigma}\right) = P_{50}$$

$$S_k = \frac{(P_{90} + P_{10})}{2} = P_{50}$$

P_{50} = 50th percentile
P_{90} = 90th percentile
P_{10} = 10th percentile

(ii) Kurtosis

The term "kurtosis" refers to the "peakedness" or flatness of a frequency distribution as compared with the normal. A frequency distribution more peaked than the normal is said to be letokurtic; one flatter than the normal, platykurtic. A normal curve is called mesokurtic.

$$Ku = \frac{Q}{(P_{90} - P_{10})}$$

Where Q = Quartile, P = Percentile

2.3.4 Application /Areas Under NPC.

(I) To find the limits in any normal distribution which include a given percentage of the cases. (Mean & S.D (σ) is given)

For example:-

(1) In a normal distribution of scores, with a mean of 50 and S.D of 10, what limit of scores will include the middle 50% of cases.

Solution

Middle 50% cases means 25% cases on the left side and 25% cases on the right side of the mean. 25% cases can be converted into number which is $\frac{25}{100} x 10000$ = 2500 (10000 is taken because total number of cases on a NPC is

assumed to be 10000). Now we know that 2500 cases lie on the left side and 2500 cases lie on the right side of the mean in this particular case. Now see Table A (Garett and Woodworth, 1981). Roughly, it is clear that 2500 cases correspond to 0.675 value of z. For the positive side (right side), the sign would be + and for the left side the sign would be –.

(Positive) $Z = \frac{\text{Score} - \text{Mean}}{\sigma}$

0.675 x 10 = Score – 50
6.75 = Score – 50
6.75 + 50 = Score
56.75 = Score

(Negative) $Z = Z = \frac{S - M}{\sigma}$

$-0.675 = \frac{\text{Score} - 50}{10}$

- 0.675 x 10 = Score – 50
- 6.75 + 50 = Score
43.25 = Score

Middle 50% of cases lie in the range of 43.25 to 56.75 score.

(2) If Mean = 15, S.D. = 3, find the range of scores where middle 60% cases lie

Solution

Middle 60% cases means 30% on left and 30% on right. Table A shows that the z value for 3000 cases $\left(\frac{30}{100} x 10000 = 3000\right)$ is 0.845. For positive side the sign is + for the negative side the sign is – .

(Positive) $Z = \frac{\text{Score} - \text{Mean}}{\sigma}$

$0.845 = \frac{\text{Score} - 15}{3}$

Score = 0.845 x 3 + 15
Score = 2.535 + 15
Score = 17.53

(Negative) $= \frac{\text{Score} - \text{Mean}}{\sigma}$

$-0.845 = \frac{\text{Score} - 15}{3}$

Score = - 0.845 x 3 + 15
Score = - 2.535 + 15
Score = 12.46

Middle 60% of cases lie in the range of 12.46 to 17.53

(II) To determine the percentage of cases in the normal distribution within given limits.

For example;-

(1) Given a normal distribution with a mean of 100 and standard deviation of 20, find what percentage of cases lie between scores of 85 and 120

$$Z = \frac{\text{Score} - \text{Mean}}{\sigma}$$

(i) $Z_{120} = \frac{120-100}{20}$

$Z_{120} = 20/20 = +1$

(ii) $Z_{85} = \frac{85-100}{20}$

$Z_{85} = -0.75$

From Table A we see that 3413 cases lie till 1. So converting the number of cases into percentage we get 34.13 per cent cases till +1. From 0 to .75 we see that 2734 cases lie, which amount to 27.34 per cent cases.

Thus 0 to +1 = 34.13 percent

0 to -0.75 = 27.34 percent

Thus percentage of cases from -0.75 to +1 = 34.13 + 27.34 = 61.47

So, 61.47 percent cases lie between the raw scores of 85 and 120.

(ii) If the above scores were found on 3000 students, how many students score between 85 to 120

$\frac{61.47}{100} \times 3000 = 1844.1$

So, there are 1844 students who have got scores ranging from 85 to 120.

Q.2 If mean = 100, S.D. = 20 find out percentage of cases which lie above score of 120.

$$Z = \frac{\text{Score} - \text{Mean}}{\sigma}$$

$Z_{120} = \frac{120-100}{20} = 20/20 = +1$

Percentage of cases between 0 to +1 = 34.13.

Percentage of cases between 0 to +3 = 49.17% cases.

34.13 percent cases lie till +1.

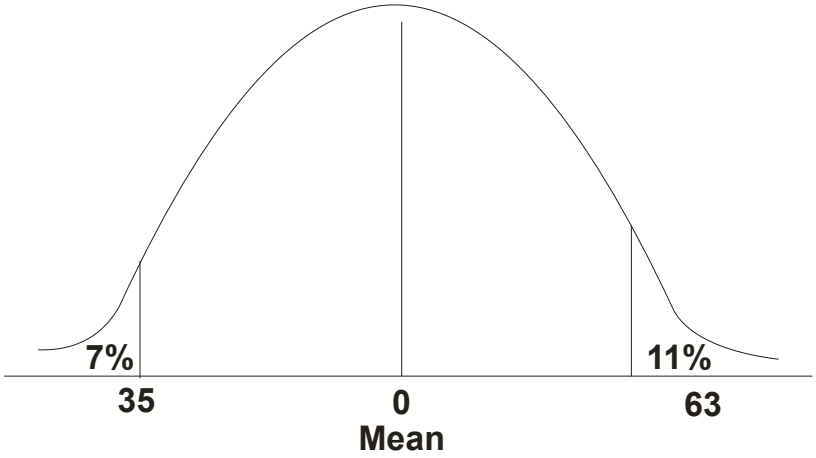
Thus percentage of cases above z score = +1

(i.e. between +1 and +3) = 49.17 – 34.13 = 15.04

So, 15.04% cases lie above raw score of 120.

(III) Calculating mean and S.D., when percentage of cases and limits are known.

Q.1. In a normal distribution 7% lie below a raw score of 35 and 11% are above a score of 63. What is the mean and S.D. of the distribution.



Solution

We know that 49.17 per cent cases lie from 0 to +3 and also from 0 to -3. We take this value to be roughly as 50%. As below 35 score, only 7% cases lie this score falls to the left side of the mean so from mean till point of 35 score,

50% – 7% = 43% cases lie.

43% cases means 4300 cases, and the z score for this is 1.48. Because this value is for left side we give – sign to 1.48.

$$Z = \frac{\text{Score} - \text{Mean}}{\sigma}$$

$$-1.48 = \frac{35 - \overline{X}}{\sigma} \qquad \text{-------- (1)}$$

If 11% cases lie above 63 this score should be on the positive side. Similarly we also know that if 11% cases lie above this point so percentage of cases from mean to this point 50% – 11% = 39% cases.

39% cases means 3900 cases and the z value for 3900 is 1.23. Because this z value is on positive side, we give + sign to this value.

$$z_{63} = \frac{\text{Score} - \text{Mean}}{\sigma}$$

$$1.23 = \frac{63 - \overline{X}}{\sigma} \qquad \text{----- (2)}$$

$$-1.48 = \frac{35 - \overline{X}}{\sigma} \qquad\qquad + 1.23 = \frac{63 - \overline{X}}{\sigma}$$

Cross-multiplying — Cross-multiplying

$$-1.48\,\sigma = 35 - \overline{X} \qquad\qquad + 1.23\,\sigma = 63 - \overline{X}$$

$$-1.48\,\sigma = 35 - \overline{X} \qquad \text{---- (1)}$$

$+1.23\ \sigma = 63 - \overline{X}$ --- (2)

\- - +

---------- (simultaneous equations)

$-2.71\ \sigma = -28$

$\sigma = \frac{28}{2.71} = 10.33$

Putting the values of σ in equation (1)

$-1.48\ \sigma = 35. \overline{X}$ ---- (1)

$-1.48 \times 10.33 = 35 - \overline{X}$

$35 - \overline{X} = -1.48 \times 10.33$

$35 - \overline{X} = -15.28$

$-\overline{X} = -15.28 - 35$

$-\overline{X} = -50.28$

$\overline{X} = 50.28$

So, mean is 50.28 and σ is 10.33

(IV) To separate students given graph into sub-group, according to capacity, when the trait is normally distributed.

For example:-

(1) In a college, 10 grades are assigned to students, first is A+, A, A-, B+, B, B-, C+, C, C-, and D. If the ability in mathematics is normally distributed, how many students in a group of 500, receive each group to find the percentage of cases in A+, from mean to +3 these are 49.87 cases

0 to 2.4 → 49.18

(i) A = 49.87 – 49.18

= 0.69%

Converting into numbers

$\frac{0.69}{100} \times 500 = 3.4 = 3$ Approximately

So 3 students have score A+

(ii) A = 49.18 – 46.41 = 2.77

$= \frac{2.77}{100} \times 500 = 13.85 = 14$

So, 14 students who scored A

(1.8 – 1.2)

(iii) A^{-} = 46.41 – 38.49 = 7.92

$\frac{7.92}{100} \times 500$ = 39.6

40 students who score A^-

(iv) B^+ = 38.49 – 22.57 = 15.92

= $\frac{15.92}{100} \times 500$ = 79.6

= 80 students who scored B^+

(v) B = Mean → 0.6

= 0.6 = 22.57

= $\frac{22.57}{100} \times 500$ = 112.85

so 113 students who scored B.

(vi) B^- = (Mean to -0.6)

= -0.6 = 22.57

= $\frac{22.57}{100} \times 500$ = 112.85

so 113 students who scored B^-.

(vii) C^+ = 38.49 – 22.57 = 15.92

= $\frac{15.92}{100} \times 500$ = 79.6

= 80 students who scored C^+

(viii) C = 46.41 – 38.49 = 7.92

= $\frac{7.92}{100} \times 500$ = 39.6

so 40 students who scored C

(ix) C^- = 49.18 – 46.41 = $\frac{2.77}{100} \times 500$ = 13.85

So, 14 students who scored C^-

(x) D = 49.87 – 49.18 = 0.69

$\frac{0.69}{100} \times 500$ = 3.4

so 3, students who scored D

then all the students who scored A^+, A, A^-, B^+, B, B^-, C^+, C, C^-, D

(A^+) + (A) +(A^-) + (B^+) + (B) + (B^-) + (C^+) + (C) + (C^-) + (D)

3 + 14 + 40 + 80 + 113 + 113 + 80 + 40 + 14 + 3

= 500 students.

2.3.5 Summary

The chapter covered the introduction to Normal Probability Curve and its application in Psychology. The students were familiarized with the concept of normality and the various properties of a Normal Probability Curve. We touched some very significant issues like skewness and kurtosis. Also, emphasis was laid upon the applications of NPC in Psychological research.

Check your progress

1. Given a normal distribution with a mean of 120 and SD of 15, and what percent of cases lie between the score of (i) 110 to 130 (ii) 100-125.
2. In a normal distribution, 8% lie below a raw score of 80, and 10% above a raw score of 100. What is the mean and SD of the distribution.
3. What is skewness?
4. What is a leptokurtic curve?

2.3.6 Keywords

1. Skewness

In a normal curve model, the mean, median and mode all coincide and there is a perfect balance between the right and left halves of the figure. A distribution is said to be "skewed" when the mean and the median fall at different places between the distribution and the balance is shifted to one side or the other – to left or to right.

2. Kurtosis

The term "kurtosis" refers to the "peakedness" or flatness of a frequency distribution as compared with the normal. A frequency distribution more peaked than the normal is said to be letokurtic; one flatter than the normal, platykurtic. A normal curve is called mesokurtic.

3. Normal Probability Curve-

The normal distribution is a continuous probability distribution that is symmetrical on both sides of the mean, so the right side of the center is a mirror image of the left side. The area under the normal distribution curve represents probability and the total area under the curve sums to one.

4. Median-

The median is the middle number in a sorted, ascending or descending, list of numbers and can be more descriptive of that data set than the average. It is sometimes used as opposed to the mean when there are outliers in the sequence that might skew the average of the values.

5. Mode-

The mode is the value that appears most often in a set of data values. Like the statistical mean and median, it is a way of expressing, in a (usually) single number, important information about a random variable or a population.

2.3.7 References :

1. Garrett : Statistics in Psychology and Education.
2. Guilford and Fruchter : Fundamental Statistics in Psychology and Education

LESSON NO. : 2.4 **AUTHOR : DR. DAMANJIT SANDHU**

Hypothesis Testing, One Tailed And Two Tailed Tests, Levels Of Significance, Degrees Of Freedom.

Lesson Structure

2.4.0 Objective

The objective of this chapter is to familiarize the students of Psychology with some key issues in Statistics and Research. Here we shall be covering topics like hypothesis – its types, characteristics, sources, difficulties in formulating a hypothesis etc. Also, we shall try to have a look on topics like one-tailed and two-tailed tests of significance, levels of significance, and degrees of freedom.

2.4.1 INTRODUCTION

The need for research arises when one finds a gap in knowledge, that is when the occurrence of an event fails to be explained by the existing body of knowledge, when the issue between conflicting findings is sought to be settled, or when some new facts have to be assimilated to the existing body of laws and theories. The awareness of a problem thus becomes the starting point of a research in any area of knowledge. **Mc Guigan** suggests that a scientific problem should be such that its answer is presently testable.

2.4.2 CONCEPT AND DEFINITIONS

The problem is the starting point of a research because every research activity is directed towards answering a problem. The next step is formulating a hypothesis. A conjectural statement about a relationship among two or more variables has been called a hypothesis. For example – How is A related to B? A hypothesis declares A is related to B.

Hypothesis simply means a mere assumption or some supposition to be tested. It is a guess or hunch, not haphazard guessing but based on facts.

According to G.A. Lundberg "An hypothesis is a tentative generalization, the validity of which remains to be tested. In its most elementary stage, the hypothesis may be any hunch, guess, imaginative idea, which becomes the basis for action or investigation."

According to Townsend, "Hypothesis is a suggested answer to a problem or it is a tentative solution to a problem."

Arthur S. Weber (1985) in his dictionary of Psychology quotes hypothesis as, 'In scientific work, any statement, proposition or assumption that serves as a tentative explanation of certain facts. A hypothesis is always presented so as to be amenable to empirical test and then either supported or rejected by the evidence'.

Clarke and Clarke remark, "Hypothesis is a statement tentatively accepted in the light of what is known about as the basis for action in the search for new truth".

According to Kerlinger, "A hypothesis is a conjectural statement of the relationship between two or more variables".

Kelleth D. Bailey, "Hypothesis is a tentative explanation for which the evidence necessary for testing is at least potentially available".

Hypothesis are always in declarative sentence form and they relate either generally or specifically, variables to variables. There is no hypothesis without facts- tentative or established, traditional or scientific. In essence, a hypothesis may be a preliminary tentative organization of facts in a meaningful way to be tested, accepted or discarded on the basis of critical observation or experimentation. Verified and repeatedly tested hypothesis give birth to theory and loss.

Prior to commencing experimentation or observation, the researcher states hypothesis so that with collection of data and subsequently its analysis, tenability of the hypothesis would be tested. Hypothesis serves a sort of guiding light in research study precisely; it is not a haphazard guessing but an outcome of highly intellectual exercise; it is based on known facts or beliefs; it is to be tested or verified and accepted or rejected; it is a binding link between the unknown and yet to be known; it is a basis for action and it gives birth to theories and principles. There would be no science in any complete sense without hypothesis.

2.4.3 CHARACTERISTICS OF A GOOD HYPOTHESIS

Now the question arises, "what are the characteristics of a usable hypothesis?" The answer may be – a 'good" usable hypothesis is the one which satisfies many of the following criteria.

1) A hypothesis should be empirically testable. It should be so stable that it is possible to reduce logically certain inferences from it which in turn can be tested by observation in the field.
2) A good hypothesis is in agreement with the observed facts. A single unexplained conflict between fact and hypothesis is disastrous to the latter.
3) A hypothesis is entirely plausible and conceivable. It is based directly on existing data.
4) A good hypothesis does not conflict with any law of nature which is known to be true.
5) A good hypothesis is expert. It is stated in a scientific and research like language and is not an ordinary statement.
6) A hypothesis should be so designed that its test will provide an answer to the original problem which forms the primary purpose of the investigation. It should be related to available knowledge.
7) A hypothesis must be stated in final form early in the experiment before any attempt at verification is made.
8) The hypothesis must be conceptually clear. The concepts embodied in the hypothesis be defined in a manner commonly accepted and communicable.
9) The hypothesis must be specific. A hypothesis would include a clear statement of indexes which are to be used. For example, the concept of social class needs to be explicated in terms of indexes such, as income, occupation, education etc.
10) Hypothesis should be related to a body of theory or some theoretical orientation.
11) A hypothesis should be related to available techniques.
12) Hypothesis must actually explain what it claims to explain.
13) A hypothesis is never absolutely true or false but is probably true or probably false. They have a determinable degree of probability.

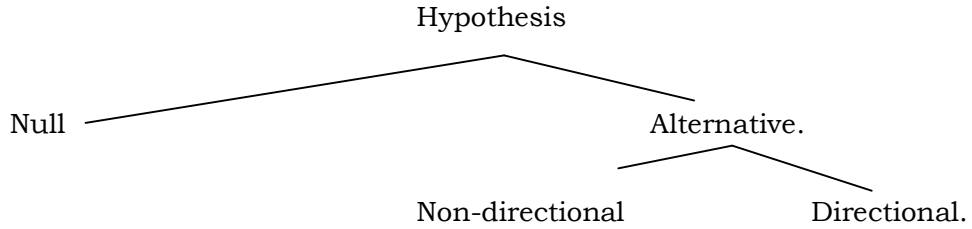
2.4.4 SOURCES OF HYPOTHESIS;

There are various sources of hypothesis. Some of them are as under:-

1. Reduction from theory.
2. Induced from direct observation.
3. Intuition.
4. Finding from previous experiments.

5. Serendipity (accidental discovery of relationship between two variables.)
6. Consultation with specialists.

2.4.5. TYPES OF HYPOTHESIS:-



Null hypothesis(H_O):-

This hypothesis proposed by Ronald Fisher. It is a statement of no relationship among the variables being tested, and that any relationship found may be attributed to sampling error. It is the simplest form of hypothesis and asserts that there is no actual difference between the sample and the population which is under consideration, or no difference between two groups on any variable. Null is a German word which means zero. It is also termed statistical hypothesis or zero hypothesis because it denies the existence of any difference or relationship. It is also known as chance hypothesis.

H_O: $\mu_1-\mu_2 = 0$

$\therefore \mu_1=\mu_2$

According to **Kerlinger**, the null hypothesis is a statistical proposition which states essentially that there is no relation between the variables of that problem.

e.g- Drugs have no effect on memory.

Alternate hypothesis(Ha)

It is opposite to null hypothesis or an alternate to null hypothesis. In statistics, a hypothesis that functions as an alternative to the null hypothesis and typically asserts that the independent variable has an effect upon the dependent variable, or there are differences between two groups that cannot be explained by chance alone is called on alternative or experimental hypothesis.

Ha: $\mu_1 \neq \mu_2$

$\mu_1 - \mu_2 \neq 0$

Alternative hypothesis further has two types.

(i) Non- directional:-

In this the researcher simply predicts that the two groups which have been compared will differ but does not predict the direction of that difference. The researcher does not predict

which group will score higher or lower. Thus, a hypothesis that does not predict the direction of the difference is called the non-directional hypothesis.

(ii) Directional hypothesis:-

If the researcher predicts the direction of the difference, then it is a directional hypothesis. It gives an expected direction in relationship or difference between variables.

2.4.6 DIFFICULTIES IN FORMULATION OF HYPOTHESIS

There are a number of difficulties from which a beginner may suffer at the stage of formulating a good hypothesis:-

- Lack of knowledge and clarity of the theoretical framework of the area in which the investigator chooses to work.
- Lack of ability to make use of the theoretical framework logically.
- Lack of acquaintance with available research technique resulting in failure to be able to phrase the hypothesis properly.
- Vagueness of the statement: For example, a course of ethics will make a student a more ethical adult.

2.4.7 FUNCTIONS & IMPORTANCE OF HYPOTHESIS

Theories are relatively elaborate tools used to explain and predict events. The social scientist develops a theory to account for some social phenomenon and then he devices a means where the theory can be tested or subjected to verification or refutation. Seldom does the researcher test the theory directly. Most of the time he conduct tests of hypothesis that have been generated and derived from that theory.

All statements of theory in testable form are called hypothesis. Main functions of hypothesis are:-

(a) to test theories.
(b) to suggest theories.
(c) to describe social phenomenon.

Hypothesis has a very important place in research although it occupies a very small place in the body of thesis. The aimless collection of data is not likely to lead the investigator anywhere. The importance of hypothesis can be more specifically stated as under:-

1) By formulating hypothesis the researcher puts himself on the right track.
2) Hypothesis keeps the study within bounds or boundary.
3) Hypothesis delimits the problem to its specific objectives and goals to the choice of subjects to review of literature and to persue data collection techniques.
4) Hypothesis is the binding link between the known and yet to be known or unknown. In other words, an important bridge between theory and empirical inquiry.

5) Hypothesis based on others experiences and ones own to serve as a guiding light in the world of darkness.
6) Hypothesis provided infrastructure of facts on which the researcher builds up further.
7) Hypothesis provides a sort of framework on the basis of which the researcher draws conclusion from the result of his study.
8) Hypothesis are powerful tools for the advancement of knowledge because they enable scientists to get outside themselves.
9) It focuses research. Without it research would be like a random and aimless wondering.
10) Hypothesis is a prediction. It says if 'X' occurs 'Y' will also occur. 'Y' is predicted from 'X'.
11) It is a device which provokes the researcher to think and interpret his results in a meaningful way.

So these are some basic points of importance of hypothesis. These points are very important in the research process.

2.4.8 TWO- TAILED AND ONE- TAILED TEST OF HYPOTHESIS

TWO-TAILED TEST

A two tailed test of hypothesis is so called because in a two-tailed test the rejection region is located in both the tails of a Normal Probability Curve.

1) At 0.05 level of significance

If we are testing a hypothesis at 0.05 level of significance, the size of the acceptance region of the each side of the mean would be 0.475 (one-half of 0.95).

(a) If the sample mean fall into this area the hypothesis is accepted.
(b) If the sample mean fall into the area beyond 1.96 the hypothesis is rejected because it falls into the rejection region.

2) At 0.01 level of significance

The size of acceptance region on each side of the mean would be 0.495 (one-half of 0.99) the size of rejection region is 0.005 from table of NPC, an area of 0,495 corresponds to 2.58 standard error from μ_H mean. At 0.01 level of significance of the probability of rejection a hypothesis is 1%.

ONE-TAILED TEST

One tail test is so called because the rejection region is located in only one tail which may be either left or right depending upon the alternative hypothesis formulated.

2.4.9 LEVELS OF SIGNIFICANCE

Whether a difference is to be taken as statistically significant or not depends upon the probability that the given difference would have arisen "by chance". It also depends upon the purpose of the experiment. Usually a difference is

marked "significant" when the gap between two sample mean point signifies a real difference between the parameters of the populations from which our samples are drawn.

A significance level is a statement of the probability that an observed difference is a chance difference. Significance level is usually determined in advance before testing the hypothesis. The most commonly used significance levels are 0.05 and 0.01. If 0.05 level of significance is to be used, this means we accept real difference so large that it could have occurred by chance only 5 times in 100. If 0.01 level, the difference can be expected to occur only one time in 100 by chance.

In simple words, there must be some guideline that determines how large a difference must be, to be considered real.

Only rarely can we be absolutely sure that the obtained difference between group means is not due to chance. Even very large differences would occur by chance except in rare cases with a restricted and finite population

The confidence with which an experimenter rejects or retains a null hypothesis depends upon the level of significance.

The 0.01 level of significance is more exacting than 0.05 level.

2.4.10 DEGREES OF FREEDOM

The concept of degrees of freedom is highly important in small sample statistics. It is crucial, too, in analysis of variance and in other procedures. When a statistic is used to estimate a parameter, the number of degrees of freedom (df) available depends upon the restriction placed upon the observations. One df is lost for each restriction imposed. If we have 5 score, 5, 6, 7, 8, 9. The mean is 7, and the deviations of individual scores (5,6,7,8,9) from 7 are –2,-1,0, 1, 2. Sum of these deviation, is zero. Of the 5 deviations, only 4 (N-1) can be selected freely.(i.e. one independent) as the condition that the sum equals zero restricts the value of 5^{th} deviation. One df is lost in calculating mean.

The formula for calculating df is

$$df = N-1$$

The degree of freedom are not always (N-1) however, but will vary with the problem and restrictions imposed.

2.4.11 Summary

The present chapter dealt with some very important and basic issues in statistics and research like hypothesis, its types, sources etc, difficulties in formulating a hypothesis. Also we covered areas like levels of significance, one-tailed and two-tailed test and degrees of freedom.

Check Your progress :

Q. What is a hypothesis?

Q. Define degrees of freedom.

Q. What are the commonly used levels of significance?

2.4.12 Keywords

1. Level of significance

A significance level is a statement of the probability that an observed difference is a chance difference. Significance level is usually determined in advance before testing the hypothesis. The most commonly used significance levels are 0.05 and 0.01. If 0.05 level of significance is to be used, this means we accept real difference so large that it could have occurred by chance only 5 times in 100.

2. Degrees of freedom

In statistics the number of degrees of freedom (df) available depends upon the restriction placed upon the observations. One df is lost for each restriction imposed. If we have 5 score, 5, 6, 7, 8, 9. The mean is 7, and the deviations of individual scores (5,6,7,8,9) from 7 are –2,-1,0, 1, 2. Sum of these deviation, is zero. Of the 5 deviations, only 4 (N-1) can be selected freely.(i.e. one independent) as the condition that the sum equals zero restricts the value of 5^{th} deviation. The degree of freedom are not always (N-1) however, but will vary with the problem and restrictions imposed.

3. Alternate hypothesis(Ha)

It is opposite to null hypothesis or an alternate to null hypothesis. In statistics, a hypothesis that functions as an alternative to the null hypothesis and typically asserts that the independent variable has an effect upon the dependent variable, or there are differences between two groups that cannot be explained by chance alone is called on alternative or experimental hypothesis.

4. ONE-TAILED TEST

One tail test is so called because the rejection region is located in only one tail which may be either left or right depending upon the alternative hypothesis formulated.

5. Null hypothesis(H_O):-

This hypothesis proposed by Ronald Fisher. It is a statement of no relationship among the variables being tested, and that any relationship found may be attributed to sampling error. It is the simplest form of hypothesis and asserts that there is no actual difference between the sample and the population which is under consideration, or no difference between two groups on any variable.

Reference:

Garrett: Statistics in Psychology and Education

Lesson No. : 2.5 **Writer: Ms. Ruby Gupta**

Chi Square and its Applications

Lesson Structure :

2.5.0 Objectives

The objectives of this lesson is to understand the concept of Chi Square and its applications. By end of this lesson you should be able to :

- Explain the meaning of Chi Square
- Focus on the application of Chi Square

2.5.1 Introduction : Chi Square

X^2 is one of the most important non-parametric statistics. It is used for a number of statistics.

It involves no assumptions regarding the normality of distribution or HOMOGENEITY OF VARIANCE. It is a non-parametric inferential procedure, which is used when the data is expressed in terms of frequencies. It applies to discrete data.

The scores indicate the category that the subjects fall in and total number of subjects in each category.

2.5.2 Uses of Chi Square ($x^{2)}$:-

2.5.2.1 When there is one sample or single variable case :- Here, it is referred to as a goodness of fit test. It permits us to determine whether there's a significant difference between the observed number of cases in each category and live expected number of cases based on the H_0. It is a way to answer to question that how well does an observed distribution corresponds to the theoretical distribution. Why it is called a good fit? because it indicates whether the observed frequencies are a good fit to expected frequency or not. The fit is good when the observed frequencies

are within random functions of the expected frequencies and the computed X^2 value is small (i.e. it'll be insignificant when expected of observed frequencies will be close. When there's a lot of discrepancy between the two it'll get reflected in a significant X^2)

The larger the value of X^2 , the more the discrepancy between the observed and expected frequencies.

e.g. There are 100 subjects, who've been randomly selected and we want to see whether there's a significant difference in the proportion of individuals who prefer the taste of each of the 4 brands of a cold drink.

So. N = 100

	A	B	C	D
Observed Frequency	20	31	28	21
Expected Frequency	25	25	25	25

Expected frequency $\frac{N}{k} = \frac{100}{4} = 25$

K-number of categories

An exp. freq. is the mean of the observed frequencies that would occur on infinite repetitions of an expected when sampling is random and the H_0 is true.

Here H_0 - There's no difference in preferences amongst the subjects for the 4 brands of cold -drinks.

To study the discrepancy between O & E frequencies, we use X^2 statistic. The use of X^2 tells whether the relative frequencies observed in the several categories of our sample frequencies distribution, are in accordance with the set of frequencies hypothesized to be characteristic of a population distribution.

df = k-1 where k - number of categories

= 4-1

= 3

Level of sig. at which we check our results = .01

$$\hat{X}^2 = \sum_{i=1}^{r} - \sum_{j=1}^{k} - \frac{(fo - fe)^2}{fe}$$

where

i=1 to r means starting from the first row to the last row

j=k to r means starting from the first column to the last column

$$\therefore X^2 = \frac{(20-25)^2}{25} + \frac{(31-25)^2}{25} + \frac{(28-25)^2}{25} + \frac{(21-25)^2}{25}$$

$$= \frac{-5^2}{25} + \frac{6^2}{25} + \frac{3^2}{25} + \frac{4^2}{25}$$

$$= \frac{25}{25} + \frac{36}{25} + \frac{9}{25} + \frac{16}{25}$$

= 1 + 1.44 + 0.36 + 0.64

= 3.44

df = 3

$\alpha = .01$

The critical value at df = 3 and at α .01 is 11.34. The calculated value is 3.44, which is lesser than the critical value. So we fail to reject H_0 because the value is insignificant.

The discrepancy between the E & O frequencies are of a magnitude small enough to be reasonably expected if the H_0 is true therefore we fail to reject H_0.

A sig. X^2 (obt. X^2 is longer then labeled X^2) indicates that across all categories of the frequencies are described in. It is a non directional test. If on X^2 value had been significant, we would have rejected H_0 and conclusion would have been that there's a significant difference between the cold drinks but we can't say, which over one preferred.

X^2 can't be negative because all the frequencies are squared.

X^2=0 when each fo =fe .longer the discrepancy between fo & fe, longer the X^2 value.

It is the size of the discrepancy relative to magnitude of fe that account for the contribution to the value of X^2.

2.5.2 When we've 2 samples - Here, the use of the X^2 test is referred to as the testing the significance of the independence hypothesis. By independence hypothesis is meant that one variable is not related to or affected by another variable and so the 2 variables are independent. X^2 is not a measure of the degree of relationship. It just provides an estimate of some other factors other than chance, which account for the apparent relationship when we deal with data related to the individual hypothesis, we arrange the data in a contingency table. When observations are classified in a two way table then the data is called continous data and the table is referred to as contingency table.

e.g. 2 : You've data on 200 subjects, who are classified into 3 categories. On the basis of there educational qualifications : Masters, Bachelors, Intermediates their educational achievement in the cause of study is measured and they are classified into 3 -superior, Average & inferior.

	Superior	**Average**	**Inferior**	
Masters	30 (25)	15 (15)	5 (10)	50
Bachelors	25(25)	10 (15)	15(10)	50
Intermediate	45(50)	35 (30)	20(20)	100
	100	60	40	200

You've to see whether educational achievement is related to educational qualification.

H_0 : There is no relationship between the 2 variables.

H_A : The 2 variables are slightly related

$\alpha - 0.05$

First calculate row & columns Totals. Then calculate fe. If H_0 is true under the assumption of independence, the fo in each cell should be proportional to the distribution of row & column totals. fe is estimated and the product of the marginal totals (row & columns total) common to that cell and divided by N.

$$\frac{100x50}{200} \quad \frac{100x50}{200} \quad \frac{100x100}{200}$$

$$= 25$$

$$\frac{60x50}{200} \quad \frac{60x500}{200} \quad \frac{60x100}{200}$$

$$\frac{40x50}{200} \quad \frac{40x50}{200} \quad \frac{40x100}{200}$$

fo	**fe**	**fo-fe**	**$(fo-fe)^2$**	**$x^2=(fo-fe)^2/fe$**	
30	25	5	25	1	
25	25	0	0	0	
45	50	-5	25	0.5	
15	15	0	0	0	
10	15	-5	25	1.67	
35	30	5	25	0.83	
5	10	-5	25	2.5	
15	10	5	25	2.5	
20	20	0	0	0	$\therefore X^2 = 9$

df = (r-1) (c-1)

(3-1) (3-1)

2x2

= 4

For df = 4 at 0.5 level, the labeled value of X^2 is 9.48. Our obtained X^2 value is 9 ,m which is less so we fail to reject the H_0 so there is no significant relationship between 2 variables so they are independent.

When data is arranged in a 2x2 contingency table, there is another method. We needn't calculate fe.

A	B
C	D

The X^2 is calculated directly using the formula.

$$X^2 = \frac{N(AD - BC/)^2}{(A+B)(A+C)(B+D)(C+D)} - \text{Product of row f column totals}$$

Where A, B,C,D are the symbols for the frequency in the cells and N is the total no. indicate that when we subtract BC from AD, the sign is ignored.

e.g. 3 : Suppose we want to know whether 2 items in a test are independent or related, both the items are answered in yes or No. The total number of subjects are 400. Frequencies in each cell are:-

A B

180	120
90	10

C D

Substitute the values in 4 w

$X^2 = \frac{400(/180x10\text{-}120x90/)^2}{(300)(270)(130)(100)}$

$= \frac{400(/1800-10800)^2}{1053000000}$

$= \frac{400(-9000)^2}{1053000000} = \frac{4w(81000000)^2}{1083000000}$

$= \frac{3.24x10^{10}}{1053000000}$

= 30.77

df = (r-1) (c-1)

= (2-1) (2-1)

= 1x1

= 1

α = .05

The tabelled/critical value is 3.84 at df = 1 at .05. Our obtained X^2 value is 30.77, which greatly exceeds the critical value. So we reject the H_2. So our conclusion is that item no. 5 & item no. 10 are related.

e.g. 4 : We have 60 students - 50 boys & 10 girls, who have been administered an attitude scale and the answers are in yes & no. You're given the frequencies towards item no. 10. We've to see whether there's a significant difference between the opinions of the boys & the girls.

	Yes	No	
Boys	20	30	50
Girls	$\frac{3(3.83)}{23}$	$\frac{7}{37}$	$\frac{10}{60}$

fe = $\frac{23x10}{60} = 3.83$

X^2 = $\frac{N(/AD-BC/-\frac{N}{2})^2}{(A+B)}$

= $\frac{60(/20x7-30x3/-\frac{60}{2})^2}{50\,x\,10\,x\,23\,x\,37}$

= $\frac{60(/140-90/-30)^2}{425500}$

= $\frac{60(/50/-30)^2}{425500}$

= $\frac{60(20)^2}{425500} = \frac{60\,x\,400}{425500} = \frac{24000}{425500}$

= .056

df = (r-1) (c-1)

= (2-1) (2-1)

= 1x1

= 1

α = .05

The tabelled value is 3.84 at df = 1 and at α .05. Our obtained value of X^2 is .56 which is not significant so we reject the H_0.

Fortune to use this correction results in the probability of the given result to be underestimated and the chances of its being called signification considerably increased.

Another use of X^2 - It has been used in checking the significance for other statistics e.g. contingency coefficient, Phi coefficient and coefficient of concordance.

2.5.3 Summary :

The lesson covers the introduction to Chi Square and its application in Psychology. The students are familiarized with the application of Chi Square in case of one and two samples.

Check Your Progress

Q: When do we apply Chi Square test?

Q: Explain the steps in applying Chi Square test for independent samples.

Q: Write the characteristics of Normal Probability curve in detail.

Q: If mean=150, S.D.=20, find out percentage of cases which lie above score of 180.

Q: In a normal distribution 7% lie below a raw score of 45 and 15% are above a raw score of 63. What is the mean and SD of the distribution.

Q: Write short notes on the following ;

(a) Skewness

(b) Kurtosis

(c) Leptokurtic Curve

(d) Write any four characteristics of NPC.

2.5.4 Keywords

1. Chi Square

X^2 is one of the most important non-parametric statistics. It is used for a number of statistics. It involves no assumptions regarding the normality of distribution or HOMOGENEITY OF VARIANCE. It is a non-parametric inferential procedure, which is used when the data is expressed in terms of frequencies. It applies to discrete data.

2. Homogeneity of variance

It is an assumption of the independent samples t-test and ANOVA stating that all comparison groups have the same variance. The independent samples t-test and ANOVA utilize the *t* and *F* statistics respectively, which are generally robust to violations of the assumption as long as group sizes are equal. Equal group sizes may be defined by the ratio of the largest to smallest group being less than 1.5. If group sizes are vastly unequal and homogeneity of variance is violated,

then the *F* statistic will be biased when large sample variances are associated with small group sizes.

3. Parametric test

Parametric tests assume a normal distribution of values, or a "bell-shaped curve." For example, height is roughly a normal distribution in that if you were to graph height from a group of people, one would see a typical bell-shaped curve. This distribution is also called a Gaussian distribution. Parametric tests are in general more powerful (require a smaller sample size)than nonparametric tests.

4. Critical Value

In hypothesis testing, a critical value is a point on the test distribution that is compared to the test statistic to determine whether to reject the null hypothesis. If the absolute value of your test statistic is greater than the critical value, you can declare statistical significance and reject the null hypothesis.

5.Sample

A sample refers to a smaller, manageable version of a larger group. It is a subset containing the characteristics of a larger population. Samples are used in statistical testing when population sizes are too large for the test to include all possible members or observations.

References :

1 Garrelt : Statistics in Psychology and Education
2 Guilford and Fruchter : Fundamental Statistics in Psychology and Education.

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