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states that behaviours followed by positive outcomes are strengthened, whereas behaviours followed by negative outcomes are weakened.

The key question was how to correct stimulus. Response bound and dominates incorrect stimulus response. Thorndike also adds to law of exercise. A more often repeated response becomes established and a less often repeated response dies out. It is also called the 'Law of Use and Disuse', e.g. the part of the body which is more exercised becomes stronger part of the body that is less exercised. Thorndike's view is called S-R theory because the organism's behaviour is due to a connection between a stimulus and response.

3.3.4 Principle of Reinforcement: Reward and Punishment in the Control of Learning

Principle of reinforcement is also called Skinner's operant conditioning approach, which expanded Thorndike's basic ideas. Skinner (1938) strongly believed that the mechanisms of learning are the same for all species. Skinner conducted operant conditioning studies in his behavioural laboratory using rat in skinner boxes. A rat was placed in a box called skinner's box. The box presented a set of different stimuli to the rat, one of them was a lever. The rat was hungry and started responding to the stimuli present in the situation. Accidentally, it pressed the lever and a pellet (small ball) of food was dropped from a slot. The rat reached the pellet and consumed the food. Several trials were taken and rat finally avoided all other stimuli, it pressed the lever which produce the food pellet. It had learnt the connection between the pressing of the lever and food pellet. The dropping of the food pellet was conditioned to the pressing of the lever. It followed the response made by the rat. The conditioning was called operant, because the rat operated upon the stimuli present in the situation. It actively manipulated the situation. The condition was also called instrumental because the lever served as an instrument for obtaining the food objects. The food was reinforcing or reward stimulus.

Shaping

Shaping is the process of rewarding approximation of desired behaviour. It is extensively used in training animals. For example, shaping can be used to train a rat to press a bar and obtained food. It also used to train animals to perform tricks. It can use effectively be in educational classroom (J.W. Santrock, 2001). Shaping can be especially helpful for learning tasks that require time and persistence to complete.

Reinforcement/reward

Reinforcement is a term for the process of increasing the rate or probability of a behaviour (e.g. pulling a lever more frequently) by the delivery or emergence of a stimulus (e.g. a candy) immediately or shortly after the behaviour, called a 'response', is performed. Skinner defined reinforcement as anything that, when following a response, causes that response more likely to happen again. Behaviour psychologists have formulated a number of principles of reinforcement.

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Types of reinforcement

There are many types of reinforcement, they are as follows:

- **Positive and negative:** In positive reinforcement, the frequency of a behaviour increases because it followed a rewarding stimulus; whereas negative reinforcement prevents the response or leads to the avoidance of a punishing stimulus. For example, a rat placed in a maze. Let the maze have two alternative paths, one path has its floor covered with electrical wires and produces electrical shock to the rat passing through it. The other path has no wires and does not produce any shocks. After a number of trials, the rat learns to avoid the wired path, and hence the electric shocks, to reach in reaching the choice point. In this example, the shock producing electrical wire became a negative reinforced.
- **Primary and secondary:** Primary and secondary reinforcement are as follows:
  - o Primary reinforcement involves the use of reinforcers that are innately satisfying, i.e., they do not take any learning on the organism's part to make them pleasurable. Foods, water, sexual satisfactions are primary reinforcers.
  - o Secondary reinforcement involves the use of reinforces that acquire their positive value through experience. We have hundreds of secondary reinforces in our lives, such as getting a pat on the back, praise and eye contact. When an object can be exchanged for some other reinforcer, the object may have reinforcing value in itself, it is also called token reinforcers.

Schedules of reinforcement

Skinner (1956) found that reinforcing each and every response was not necessarily the best schedule of reinforcement for long lasting learning. There are a number of schedules; some of them are as follows:

- **Fixed-ratio schedule:** In fixed-ratio schedule, the number of responses required to receive each reinforcer will always be the same number. If someone receive a pay cheque once every two weeks (provided that they show up at work in those two weeks), they are being reinforced on this kind of schedule.
- **Variable-ratio schedule:** Variable interval is one in which the number of responses changes from one trial to the next. In other words, it occurs when a response is reinforced after an unpredictable number of responses. For example, the rat might be expected to push the bar an average of twenty times to get reinforcement. That means that sometimes the rat would push the lever only ten times before the reinforce comes, but at other times it might take thirty lever pushes or more. Buying lottery tickets is same as gambling.

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- **Fixed-interval schedule:** It is a schedule where the first response is rewarded only after a specified amount of time has elapsed. This schedule causes high amounts of responding near the end of the interval, but much slower responding immediately after the delivery of the reinforcer. For example, the rat pushes the bar and the food appears after every 5 minutes after the pushing of the bar. Initially, the rat will not be aware that the food will appear after some time. It will get agitated and run or hop everywhere, but as it gets to know of the pattern, it will wait for the food to appear every time it will push the bar.
- **Variable-interval schedule:** It is a schedule in which the interval of time, after which the organism must respond, in order to receive a reinforcer, changes every time. In other words, it occurs when a response is rewarded after an unpredictable amount of time has passed. This schedule produces a slow, steady rate of response. For example, on an average, the rat might receive a food pellet every 5 minutes. Sometimes, it might be two minutes, sometimes ten, but the rat must push the lever at least once after that interval to get the pellet. Dialling a busy phone number is also this kind of schedule; people do not know when the call will get through, and hence, they keep dialling the busy number.

Punishment

Although punishment can be effective in reducing or weakening behaviour, it is the opposite of reinforcement. Most of the times, punishment only serves to temporarily suppress or inhibit a behaviour until enough time has passed that the inhabitation itself weakens and disappears. Punishing a child's bad behaviour does not always eliminate the behaviour completely. After some times, the punishment is forgotten and the bad behaviour may occur.

Positive punishment

Negative or bad behaviour decreases when positive punishment is followed after an unpleasant stimulus. In an attempt to decrease the likelihood of a behaviour occurring in the future, an operant response is followed by the presentation of an aversive stimulus. This is positive punishment. Let us assume an example, if we stroke a cat's fur in a manner the cat finds unpleasant, the cat may attempt to bite us. Therefore, the presentation of the cat's bite will act as a positive punisher and decrease the likelihood that we will stroke the cat in that same manner in the future.

Negative punishment

In negative punishment, behaviour decreases when a positive stimulus is removed. In an attempt to decrease the likelihood of a behaviour occurring in the future, an operant response is followed by the removal of an appetitive stimulus. This is negative punishment. For example, when a child 'talks back' to his/her mother, the child may lose the privilege of watching his favourite television programme. Therefore, the loss of viewing privileges will act as a negative punisher and decrease

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the likelihood of the child talking back in the future. Let us consider another example of a time-out. It is a form of negative punishment in which a child is removed from a positive reinforcement. If a child is disturbing the classroom, the teacher might make the child stand in a corner of the room, or take the child to a time-out room.

Punishment by application

Punishment by application is one in which something unpleasant is added to the situation. Punishment by application can be quite severe, and does one thing well; it stops the immediate dangerous behaviour (B. Bucher and O.I. Lovaas, 1967, E.G. Carr and O. I. Lovass, 1983). Sever punishment may cause the child (or animal) to avoid the punishment instead of the behaviour being punished. It is due to the following reasons:

- Severe punishment creates fear and anxiety, and emotional responses that do not promote learning (D. Baumrind, 1997, Elizabeth Gershoff, 2000).
- Hitting provides a model for aggression (Elizabeth Gershoff, 2000; Milner, 1992).

Immediate and delayed reinforcement

Learning is more efficient in operant conditioning when the interval between a behaviour and its reinforcement is a few second.

Immediate and delayed punishment reinforcement and punishment

Immediate punishment is more effective than delayed punishment in decreasing the occurrence of behaviour.

Immediate punishment and delayed punishment

When the delayed negative consequences of behaviour are punishing and immediate consequences are reinforcing, the immediate consequences usually win, e.g., smoking and drinking follow the same patterns.

Punishment by removal

Bad behaviour is punished by the removal of something pleasurable or desired after the behaviour occurs. For example, putting a child in the time-out room (removing the attention of the others in the room), fining someone for disobeying the law (removing money), and punishing aggressive behaviour by taking away television privileges. This type of punishment is more acceptable for child development. It involves no physical aggression and avoids the problem caused by more aggressive punishment.

Problem with punishment

In using an aggressive type of punishment, such as spanking and yelling, the adult is indirectly modelling a particular behaviour (presenting behaviour to be imitated by the child). Some people turn too quickly to aversive stimuli, because they were harshly disciplined when they were growing up and they are just repeating how their parents dealt with them.

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Application of operant conditioning

The following are the applications of operant conditioning:

- **Useful in behaviour modification:** Operant conditioning procedures have helped people adapt more successfully and cope more effectively with their problems (Sussman, 2001).
- **Mental and physical health:** Behaviour modification can be used to help people improve their self-control in many aspects of mental and physical health (A.E. Kazdin, 2001, R.G. Miltenberger, 2001, D.L. Watson and R.G. Tharp, 2002).
- **Education:** Operant conditioning has also been applied in classrooms to improve the education of children (Charles, 2002, C.M. Evertson, E.T. Emmer, and M.E. Worsham, 2003).

CHECK YOUR PROGRESS

1. What are the two classifications of learning?
2. How is retraining made simpler?
3. What is operant conditioning?
4. State the Law of Effect.
5. What is punishment by application?

3.4 METHODS OF LEARNING

Learning is acquiring new or modifying existing knowledge, behaviours, skills, values, or preferences and may involve synthesizing different types of information. The ability to learn is possessed by humans, animals and some machines. Progress over time tends to follow learning curves.

Human learning may occur as part of education, personal development, or training. It may be goal-oriented and may be aided by motivation. The study of how learning occurs is part of neuropsychology, educational psychology, learning theory, and pedagogy.

Learning may occur as a result of habituation or classical conditioning, seen in many animal species, or as a result of more complex activities such as play, seen only in relatively intelligent animals. Learning may occur consciously or without conscious awareness. There is evidence for human behavioural learning prenatally, in which habituation has been observed as early as 32 weeks into gestation, indicating that the central nervous system is sufficiently developed and primed for learning and memory to occur very early on in development.

Play has been approached by several theorists as the first form of learning. Children play, experiment with the world, learn the rules, and learn to interact.

Vygotsky agrees that play is pivotal for children's development, since they understand their environment through play.

The different methods of learning are as follows:

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- **Part method:** For learning any written material, one may have to read it a number of times. One way of doing this is to learn the material in parts. One may read a sentence, or couple of sentences, a good number of times till they have been fully learned. He may then pass on to another sentence and read and re-read it. In this manner, one may complete the entire passage by reading and re-reading it bit by bit. The entire passage is thus divided into parts and each part is learned separately.
- **Whole method of learning:** The other method of learning is to read the entire passage repeatedly till it is fully learned. This is called the whole method of learning. The whole method is found to be generally better than the part method. It requires less time and less effort to learn the material.
- **Passive learning:** One may read a passage a number of times, understanding the content as he proceeds. After having given several repetitive readings, he may stop and find that he is able to reproduce what he read. This is called passive reading.
- **Active learning:** After every reading, one may turn his eyes from the passage and try to recite from memory what he has read. In doing so, he strains himself to recite or recapitulate as much as possible. He may then took at the passage and see how much he has been able to recite correctly and where he has made a mistake. He may then give a second reading and follow the same procedure. This is called active learning, or learning by the method of recitation. This active method is to be preferred to the passive method. The active method takes less time and less effort to learn. Within the same time, one can learn much more by active method than by the passive method; this method also betters the learning process.
- **Distributed learning or spaced learning**: If one has to learn something by practicing it a number of times, he must take a short rest after some practice. This method of taking short breaks is helpful in refreshing the brain. This method of learning is called distributed learning or spaced learning, as there is a space interval while studying.
- **Massed learning:** If one goes on practicing until he have learned the task, without taking any rest, or goes on reading for three or four hours without any break, the learning will be called massed learning.

The distributed learning method has proved to be better than the massed learning method. In some cases, the spaced learning may require less total time than the massed learning. Even when distributed learning takes as much time as massed learning, the rest pauses in distributed learning keep the learner fresh and

he is able to work for longer. While studying for long hours, it is useful to take some rest at intervals. One may have a fifteen-minute rest after studying for an hour and then start his studies again.

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3.5 OBSERVATIONAL LEARNING

Observational learning (also known as vicarious learning, imitation, social learning, or modelling) is a type of learning that occurs as a function of observing, retaining and replicating novel behaviour executed by others. Observational learning, also called social learning theory, occurs when an observer's behaviour changes after viewing the behaviour of a model. An observer's behaviour can be affected by the positive or negative consequences—called vicarious reinforcement or vicarious punishment—of a model's behaviour.

Although observational learning can take place at any stage in life, it is thought to be of greater importance during childhood, particularly as authority becomes important. The best role models are those a year or two older for observational learning. Because of this, social learning theory has influenced debates on the effect of television violence and parental role models.

As mentioned, learning a new behaviour by observing a model (watching someone else who is doing that behaviour) is called observational learning. Albert Bandura (1986, 2000) believes that if we learn only through trial and error fashion, learning would be exceedingly tedious and at times hazardous. He says many of our complex behaviours are the result of exposure to competent models that display appropriate behaviour in solving problem and coping (Streifel, 1998). By observing other people, we can acquire knowledge, skills rules, strategies, beliefs and attitude (Schunk, 2000).

Bandura's classic study in observational learning involved preschool children in a room, Bo-Bo doll and an experimenter, in which the experimenter and a model interacted with toys in the room in front of the children (Bandura, et al., 1961). In the first condition, the model interacted with the toys in a very calm manner, without any aggression. The model completely ignored the presence of the Bo-Bo doll (a punch-bag doll that looks like a clown). In the second condition, the model became very aggressive with the doll, kicking it and yelling at it, throwing it in the air and hitting it with a hammer. When each child was left alone in the room and he had the opportunity to play with the toys, a camera filming through a one-way mirror caught the children who were exposed to the aggressive model, as they were beating up the Bo-Bo doll exactly like the model. Children who saw the model ignore the doll, did not act aggressively toward the toy. Obviously, the aggressive children learned their aggressive actions by merely watching the model—with no reinforcement necessary.

The fact that learning can take place without actual performance (a kind of latent learning) is called the learning/performance distinction. Four important element of observational learning described by Bandura (1986) are as follows:

(i) **Attention:** Attention is the most important aspect in learning anything through observation. Attention represents that condition within a person which enables him to be clearly aware of a certain object or activity. Attention to the model is influenced by a host of characteristics; for example, warm and powerful people command more attention than to cold and weak people.

(ii) **Retention:** The learner must be able to retain the memory of the sensory registered in order to retrieve it.

(iii) **Imitation:** People might see a model and retain in their memory what they have seen. However, limitations in motor development might make it difficult for them to reproduce the model's action. A two-year old child might be able to watch someone tie shoelaces and might even remember most of the steps, but any two-year old will not have the dexterity for tying the laces.

(iv) **Motivation/reinforcement:** The learner must have a desire to perform the action. If a person expects a reward because one has been given in the past or if the reward has been promised (like the children in the second group of Bandura study), or has witnessed a model getting a reward (like the children in the first group), that person will be much more likely to initiate the observed behaviour. Successful models are powerful figures for imitations, but surely would be motivated to imitate someone who fails or is punished.

Application of observational learning

Positive role models and mentors play an important role in developing potential and help the people to achieve their goals. Role model and mentors can be parents, teachers, and older peer. A mentor can be very beneficial for the students.

3.6 COGNITIVE LEARNING

Cognitive learning is a powerful mechanism that provides the means of knowledge and goes well beyond simple imitation of others. Conditioning can never explain what we are learning at any given time. This learning illustrates the importance of cognitive learning. Cognitive learning is defined as the acquisition of knowledge and skill by mental or cognitive processes—the procedures we have for manipulating information 'in our heads'. Cognitive processes include creating mental representations of physical objects and events, and other forms of information processing.

3.6.1 Purposive Theory

Edward Tolman (1932) emphasized on the purposiveness of behaviour, in other words, much behaviour is goal directed. Tolman (1948) believed that an organism's expectations about which actions are needed to attain a goal, take the form of

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cognitive maps. A cognitive map is an organism's mental representation of the structure of physical space. His experiments with rats in maze led him to conclude that rat developed mental awareness of physical space and the elements in it and then used these cognitive maps to find the food at the end of the maze, which is their goal.

By conducting experiment in latent learning, cognitive map in learning was obtained. Latent learning is unreinforced learning that is not immediately reflected in behaviour. In one study, three groups of rats in the same maze—one at a time—were studies. In the first group, each rat was placed in the maze and rewarded with food for making its way out the other side. The rat was then placed back in the maze, rewarded every time the maze was solved, until the rat could successfully solve the maze with no errors. The second group of rats was treated exactly like the first, except that they never received any reinforcement upon exiting the maze. They were simply put back in repeatedly, until the tenth day of the experiment. On the tenth day, the rats in the second group began to receive reinforcement for getting out of the maze. The third group of rats, serving as a control group, was also not reinforced and was not given reinforcement for the entire duration of the experiment. A strict Skinnerian behaviourist would predict that only the first group of rats would learn the maze successfully because learning depends on reinforcing consequences. At first, this seemed to be the case. The first group of rats did indeed solve the maze after a certain number of trials, whereas the second and third groups seemed to wander aimlessly around the maze until accidentally finding their way out.

On the tenth day, however, something happened that would be difficult to explain using only Skinner's basic principles. The second group of rats, upon receiving the reinforcement for the first time, should have then taken as long as the first group to solve the maze. Instead, they began to solve the maze almost immediately. Tolman concluded that the rats in the second group, while wandering around in the first nine days of the experiment, had indeed learned where all the blind alleys, wrong turns, and correct paths were in the maze. They had simply not demonstrated this learning because there was no reason to do so. The learning had remained hidden, or latent, until the rats had a reason to demonstrate their learning by getting to the food. Tolman called this latent learning.

3.6.2 Seligman's Learned Helplessness

In the mid- to late-1960s, M.E.P. Seligman and his colleagues accidentally discovered an unexpected phenomenon while experimenting on dogs using classical conditioning (M.E.P. Seligman, 1975). Their original intention was to study escape and avoidance learning. Seligman and colleagues presented a tone followed by a harmless but painful electric shock to one group of dogs. The dogs in this group were harnessed so that they could not escape the shock. The researchers assumed that the dogs would learn to fear the sound of the tone and later try to escape from the tone before being shocked. These dogs, along with another group of dogs that had not been conditioned to fear the tone, were placed into a special box with a low fence that divided the box into two compartments. The dogs, which were

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now unharnessed, could easily see over the fence and jump over. In fact, these dogs showed distress but did not try to jump over the fence even when the shock began.

Why would the conditioned dogs refuse to move when shocked? The dogs that had been harnessed and then provided the shocks were conditioned and had apparently learned—in the original tone/shock situation—that there was nothing they could do to escape the shock. So when placed in a situation where an escape was possible, the dogs still did nothing because they had learned to be 'helpless'. They believed they could not escape, so they did not even try. Seligman extended this theory of learned helplessness, the tendency to fail to escape from a situation because of a history of repeated failure in the past, to explain depression. Depressed people seem to lack normal emotions and become somewhat apathetic, often staying in unpleasant work environments or bad marriages or relationships rather than trying to escape or better their situation. Seligman proposed that this depressive behaviour is a form of learned helplessness. Depressed people may have learned in the past that they seem to have no control over what happens to them (L.B. Alloy and C.M. Clements, 1998). A sense of powerlessness and hopelessness is common to depressed people, and certainly this would seem to apply to Seligman's dogs as well.

3.6.3 Insight Theory of Learning

Wolfgang Kohler (1887–1967) was a Gestalt psychologist. In one of his more famous studies (Kohler, 1925), he set up a problem for one of the chimpanzees. Sultan, the chimp was faced with the problem of how to get to a banana that was placed just out of his reach outside his cage. Sultan solved this problem relatively easily, first trying to reach through the bars with his arm, then using a stick that was lying in the cage to rake the banana into the cage. As chimpanzees are natural tool users, this behaviour is not surprising and is still nothing more than simple trial-and-error learning.

Then, the problem was made more difficult. The banana was placed just out of reach of Sultan's extended arm with the stick in his hand. At this point there were two sticks lying around in the cage, which could be fitted together to make a single pole that would be long enough to reach the banana. Sultan first tried one stick, then the other (simple trial-and-error). After about an hour of trying, Sultan seemed to have a sudden flash of inspiration. He pushed one stick out of the cage as far as it would go toward the banana and then pushed the other stick behind the first one. Of course, when he tried to draw the sticks back, only the one in his hand came. He jumped up and down and was very excited. When Kohler gave him the second stick, he sat on the floor of the cage and looked at them carefully. He then fitted one stick into the other and retrieved his banana. Kohler called this Sultan's rapid 'perception of relationships' insight and determined that insight could not be gained through trial-and-error learning alone (Kohler, 1925). Although Thorndike and other early learning theories believed that animals could not demonstrate insight, Kohler's work seems to demonstrate that insight requires a

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sudden 'coming together' of all elements of a problem in a kind of 'aha' moment that is not predicted by traditional animal learning studies. More recent research has also found support for the concept of animal insight (B. Heinrich, 2000; C. Heyes, 1998; T.R. Zentall, 2000), but there is still controversy over how to interpret the results of those studies (Wynne, 1999).

3.7 OPTIMIZING LEARNING

Learning is based on experience and leads to long-term changes in behaviour potential. Behaviour potential designates the possible behaviour of an individual, not actual behaviour. As already studied, the main assumption behind all learning psychology is that the effects of the environment, conditioning, reinforcement, etc., provide psychologists with the best information from which to understand human behaviour.

3.7.1 Programmed Learning and Automated Instruction

Programmed learning is a teaching technique in which a learner is presented with a small chunk of information, and is asked to answer a question after understanding it. If the answer is correct, the learner may proceed to the next chunk, otherwise go back to a previous piece of information and proceed from there. Programmed learning was introduced in the mid-1950s by B.F. Skinner, a behaviourist. It is a system whereby the learner uses specially prepared books or equipments to learn without a teacher. It is based on the principle of operant conditioning, which theorized that learning takes place when a reinforcing stimulus is presented to reward a correct response. In early programmed instruction, students punched answers to simple math problems into a type of keyboard. If the answer was correct, the machine would advance to another problem. Incorrect answers would not advance. Skinner believed such learning could, in fact, be superior to traditional teacher-based instruction because children were rewarded immediately and individually for correct answers rather than waiting for a teacher to correct written answers or respond verbally. Programmed instruction quickly became popular and spawned much educational research and commercial enterprise in the production of programmed instructional materials. It is considered the antecedent of modern computer-assisted learning.

Two types of programmed learning can be compared. Linear programming involves a simple step-by-step procedure. There is a single set of materials and students work from one problem to the next until the end of the programme. Branching programming is more complex. Students choose from multiple-choice answers and then are prompted to proceed to another page of the book depending on their answer. If correct answer is given, students move on to another page with more information to learn and more questions to answer. An incorrect answer leads to comments on why the answer is incorrect and a direction to return to the original question to make another selection.

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Programmed-learning books differ from traditional workbooks because they actually teach new information through this step-by-step stimulus-response method rather than simply offering practice material for already-learned skills.

Research has shown that programmed learning often is as successful, and sometimes more successful, than traditional teacher-based learning because it recognizes the different abilities and needs of individual children. Students who have mastered the material can move ahead more quickly, while those who need more practice are repeatedly exposed to the problems. Programmed learning also allows teachers more time to concentrate on more complex tasks. One criticism of programmed learning is that it lacks student-teacher interaction. It has been shown that some students thrive more fully with the human motivation inherent in more traditional learning situations.

Although there has been considerable controversy regarding the merits of programmed instruction as the sole method of teaching, many educators agree that it can contribute to more efficient classroom procedure and supplement conventional teaching methods. Teaching machines enable students to work individually, calling for active participation of the learner. Programmed instruction is often used to train personnel in industry and the armed services.

Automated instruction

Automated instruction is useful to researchers as well as practitioners looking for guidance on designing automated instruction systems In so doing, the following two critical problem are focussed upon:

(i) Diagnosis of the student's current level of understanding or performance.

(ii) Selection of the appropriate intervention that provide specific, detailed guidance on how to develop these systems.

CHECK YOUR PROGRESS

6. Define learning/performance distinction.
7. What is a cognitive map?
8. What is programmed learning?
9. How do programmed-learning books differ from traditional workbooks?

3.8 TRANSFER OF LEARNING

Transfer of learning is the process of applying or carrying over knowledge, skills, habits, attitudes or other responses from one learning situation, in which they were initially acquired, to a different learning situation. For example, a person who has learnt to ride a bicycle finds it easy to ride a scooter. It means that experience or performance on one task influences performance on subsequent learning tasks. A

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person's ability to recognize objects, perceive relationships and conceptualize the experiences of daily life is facilitated by transfer of learning. The influence of transfer is found, not only in the domain of intellectual tasks and in complex motor skills, but also in emotional reactions and individuals' attitudes. If transfer of learning does not take place, each task would have to be learnt afresh and it would make life difficult.

Types of transfer of learning

Transfer of training affects learning of a new task in three ways, viz., positive, negative and zero. They are discussed as follows:

(i) **Positive transfer:** When learning of one task makes the second task easier to learn, positive transfer effect is seen. What one has learnt in one subject or a task may facilitate learning in another subject or task. In positive transfer, the carry-over of knowledge or skill is beneficial to future learning. For example, after learning to spell the word 'house' a child may be able to apply the appropriate phonetic rule and spell the word 'mouse' correctly, even without being taught the word 'mouse'. Similarly, skill in riding a bicycle facilitates learning to ride a motor cycle. Learning the rules of addition and subtraction makes it easier to count one's change and check the balance when one makes purchases from the market. Learning to drive a car makes it easier to learn to drive a truck or a bus. In all these cases, the previous learning experience facilitates subsequent learning. It occurs when the responses expected from two tasks or learning situations are similar. However, the maximum amount or positive transfer is obtained, when the stimulus and the response elements in the previous and the new learning situations are similar.

(ii) **Negative transfer:** Sometimes, carrying over the knowledge or experience in one task interferes with further learning. As a result of negative transfer, performance on one task may block performance on the subsequent task. For example, a child's experience in learning the plural of house may inhibit his/her learning the plural of a word 'mouse'. The child may spell the plural of the world mouse as 'mouses' instead of 'mice'. Negative transfer usually occurs when the stimuli in the previously learnt task and the new task are the same or comparable, but the responses are dissimilar.

(iii) **Zero transfer:** When the learning of one task, does not have any effect on the ability of a person to perform another task, zero transfer is seen. It happens when the tasks are dissimilar in stimuli as well as responses. In zero transfer, the performance in the new situation is neither aided nor hindered by the past learning. Learning history may contribute to the understanding of one's own culture, but it has hardly any effect on learning mathematics. Similarly, improving one's skill in playing football will have no effect on the improvement of one's skill in writing an essay. Learning to typewrite, will not affect the learning of painting.

3.8.1 Learner and Learning Styles

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Leaning styles are the various approaches or ways of learning. They involve educating methods, particular to an individual that are presumed to allow that individual to learn best. Most people prefer an identifiable method of interacting with, taking in, and processing stimuli or information. Different types of learners have different styles of learning, they are as follows:

- **Active and reflective learners:** Active learners tend to retain and understand information best by doing something active—by discussing or applying it—like group; whereas, reflective learners prefer to think about it quietly first. They tend to work alone.
- **Sensing and intuitive learners:** Sensing learners tend to learn facts, solve problems, resent being tested on material, use well-established methods, are more practical and careful; whereas, intuitive learners often prefer discovering possibilities and relationships, like innovation and dislike repetition, they may be better at grasping new concepts and are often more comfortable than sensors with abstractions and mathematical formulations.
- **Visual and verbal learners:** Visual learners remember best what they see—pictures, diagrams, flow charts, time lines, films, and demonstrations. Verbal learners get more out of words, written and spoken explanations. Everyone learns more when information is presented both visually and verbally.

  In most college classes, very little visual information is presented. Students mainly listen to lectures and read material written on chalkboards and in textbooks and handouts. Unfortunately, most people are visual learners and that means that most students do not get nearly as much as they would if more visual presentation were used in class. Good learners are capable of processing information presented either visually or verbally.
- **Sequential and global learners:** Sequential learners tend to gain understanding in linear steps, with each step following logically from the previous one. Global learners tend to learn in large jumps, absorbing material almost randomly without seeing connections, and then suddenly getting it.
- **Auditory earners:** They learn through listening and learn best through verbal lectures, discussions, talking things through and listening to what others have to say. Auditory learners interpret the underlying meanings of speech through listening to tone of voice, pitch, speed and other nuances. Written information may have little meaning until it is heard. These learners often benefit from reading text aloud and using a tape recorder.
- **Tactile/kinesthetic learners:** Such learners learn through moving, doing and touching. Tactile/kinesthetic persons learn best through a hands-on approach, actively exploring the physical world around them. They may find it hard to sit still for long periods and may become distracted by their need for activity and exploration.

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3.9 LEARNING DISABILITIES

The central concept of specific learning disabilities (SLD) involves disorders of learning and cognition that are intrinsic to the individual SLD. They are specific in the sense that each of these disorders significantly affects a relatively narrow range of academic and performance outcomes. SLD may occur in combination with other disabling conditions, but they are not due to other conditions, such as mental retardation, behavioural disturbance, lack of opportunities to learn, or primary sensory deficits, etc. (D.E. Bradley et. al., 2002).

Learning disabilities fall into broad categories based on the four stages of information processing used in learning—input, integration, storage, and output (NIHY, 2004). These stages are discussed in detail as follows:

- **Input:** This is the information perceived through the senses, such as visual and auditory perception. Difficulties with visual perception can cause problems with recognizing the shape, position and size of items seen. There can be problems with sequencing, which can relate to deficits with processing time intervals or temporal perception. Difficulties with auditory perception can make it difficult to screen out competing sounds in order to focus on one of them, such as the sound of the teacher's voice. Some children appear to be unable to process tactile input; for example, they may seem insensitive to pain or dislike being touched.
- **Integration:** This is the stage during which perceived input is interpreted, categorized, placed in a sequence, or related to previous learning. Students with problems in these areas may be unable to tell a story in the correct sequence, unable to memorize sequences of information such as the days of the week, able to understand a new concept but be unable to generalize it to other areas of learning, or able to learn facts but be unable to put the facts together to see the 'big picture'. A poor vocabulary may contribute to problems with comprehension.
- **Storage:** Problems with memory can occur with short-term or working memory, or with long-term memory. Most memory difficulties occur in the area of short-term memory, which can make it difficult to learn new material without many more repetitions than is usual. Difficulties with visual memory can impede learning to spell.
- **Output:** Information comes out of the brain either through words, that is, language output, or through muscle activity, such as gesturing, writing or drawing. Difficulties with language output can create problems with spoken language; for example, answering a question on demand, in which we must retrieve information from storage, organize our thoughts, and put the thoughts into words before we speak. It can also cause trouble with written language for the same reasons. Difficulties with motor abilities can cause problems with gross and fine motor skills. People with gross motor difficulties may be clumsy, that is, they may be prone to stumbling,

falling, or bumping into things. They may also have trouble running, climbing, or learning to ride a bicycle. People with fine motor difficulties may have trouble buttoning shirts, tying shoelaces, or with handwriting.

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Impaired functions

Deficits in any area of information processing can manifest in a variety of specific learning disabilities. It is possible for an individual to have more than one of these difficulties. This is referred to as comorbidity or co-occurrence of learning disabilities.

Reading disorder (ICD-10 and DSM-IV codes: F81.0/315.00)

Reading disorder is the most common learning disability. Of all students with specific learning disabilities, 70–80 per cent has problems in reading. The term, developmental dyslexia is often used as a synonym for reading disability; however, many researchers assert that there are different types of reading disabilities, of which dyslexia is one. A reading disability can affect any part of the reading process, including difficulty with accurate or fluent word recognition, or both, word decoding, reading rate, prosody (oral reading with expression), and reading comprehension. Before the term 'dyslexia' came to prominence, this learning disability used to be known as 'word blindness'.

Common indicators of reading disability include difficulty with phonemic awareness (the ability to break-up words into their component sounds), and difficulty with matching letter combinations to specific sounds (sound-symbol correspondence).

Writing disorder (ICD-10 and DSM-IV codes F81.1/315.2)

Speech and language disorders can also be called dysphasia/aphasia (coded F80.0-F80.2/315.31 in ICD-10 and DSM-IV).

Impaired written language ability may include impairments in handwriting, spelling, organization of ideas, and composition. The term 'dysgraphia' is often used as an overarching term for all disorders of written expression. Others, such as the International Dyslexia Association, use the term 'dysgraphia' exclusively to refer to difficulties with handwriting.

Math disability (ICD-10 and DSM-IV codes F81.2-3/315.1)

Sometimes called dyscalculia, a math disability can cause such difficulties as learning math concepts (such as quantity, place value, and time), difficulty memorizing math facts, difficulty organizing numbers, and understanding how problems are organized on the page. Dyscalculics are often referred to as having poor 'number sense' (Jane Emerson, 2009).

Non ICD-10/DSM

- ***Nonverbal learning disability:*** Nonverbal learning disabilities often manifest in motor clumsiness, poor visual-spatial skills, problematic social relationships, difficulty with math, and poor organizational skills. These

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individuals often have specific strengths in the verbal domains, including early speech, large vocabulary, early reading and spelling skills, excellent rote-memory and auditory retention, and eloquent self-expression.

- ***Disorders of speaking and listening:*** Difficulties that often co-occur with learning disabilities include difficulty with memory, social skills and executive functions (such as, organizational skills and time management).
- ***Auditory processing disorder:*** Difficulties processing auditory information include difficulty comprehending more than one task at a time and a relatively stronger ability to learn visually.

Assessment

Many normed assessments can be used in evaluating skills in the primary academic domains, reading, not including word recognition, fluency, and comprehension; mathematics, including computation and problem solving; and written expression, including handwriting, spelling and composition.

The most commonly used comprehensive achievement tests include the Woodcock-Johnson III (WJ III), Weschler Individual Achievement Test II (WIAT II) and the Wide Range Achievement Test III (WRAT III), amongst others. These tests include measures of many academic domains that are reliable in identifying areas of difficulty (Marcia et al, 2007).

3.10 MEMORY AND FORGETTING

Memory is the retention of information over time through three different stages—encoding, storage and retrieval (refer Figure 3.1). They are discussed as follows:

- **Encoding:** The first step in the memory system is to get sensory information (sight, sound, etc.) into a form that the brain can use, a process called encoding. Encoding is the set of mental operations that people perform on sensory information to convert the information into a form that is usable in the brain storage system. Encoding is not limited to turning sensory information into signals for the brain, but instead it can take a different form in each of three different storage systems or stages of memory. In one stage of memory storage, encoding can take the form of revising the information over and over to keep it in memory, whereas in another stage encoding involves elaborating on the meaning of information.
- **Storage:** The next step in memory is to hold on to the information for some period of time, a process called storage. The period of time will vary depending on the stage of memory.
- **Retrieval:** Retrieval takes place when information is taken out of storage. Our memories are affected by a number of things, including the pattern of facts we remember, the situations we associate with memories and the personal and emotional content.

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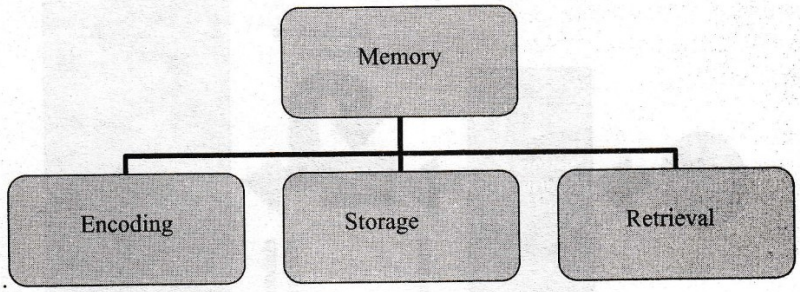

Fig. 3.1 Different Stages of Memory

Forgetting

We cannot talk about remembering without mentioning its counterpart. It seems that as much as we do remember, we forget even more. Forgetting is actually a natural phenomenon. Imagine if we remembered every minute detail or every hour, of every day detail of our entire life, no matter how good, bad, or insignificant. Now, imagine trying to sift through it all for the important things like remembering where we left our keys.

There are many reasons we forget things and often these reasons overlap. Like in the example mentioned, some information never makes it to long-term memory (LTM). Other times, the information gets there, but is lost before it can attach itself to our LTM. Other reasons include decay, which means that information that is not used for an extended period of time decays or fades away over time. It is possible that we are physiologically preprogrammed to eventually erase data that no longer appears pertinent to us.

Failing to remember something does not mean the information is gone forever though. Sometimes the information is there, but for various reasons we cannot access it. This could be caused by distractions going on around us or possibly due to an error of association (e.g., believing something about the data which is not correct causing us to attempt to retrieve information that is not there). There is also the phenomenon of repression, which means that we purposefully (albeit subconsciously) push a memory out of reach because we do not want to remember the associated feelings. This is often seen in cases where adults 'forget' incidences of sexual abuse when they were children. Another reason is amnesia, which can be psychological or physiological in origin.

3.10.1 Two-Process Theory (Memory Information Processing Theory)

The two-process theory of memory can also be referred to as the memory information processing theory, which was first proposed by R.C. Atkinson and R.M. Shiffrin (1968). Memory processes differ between situations that requires us to store material like less than a second, for a matter of seconds and for longer intervals ranging from minutes to years. Thus, the two processes are short-terms memory and long-term memory processes (refer Figure 3.2). These two processes will be discussed a bit late in the unit, first it is important to understand sensory memory.

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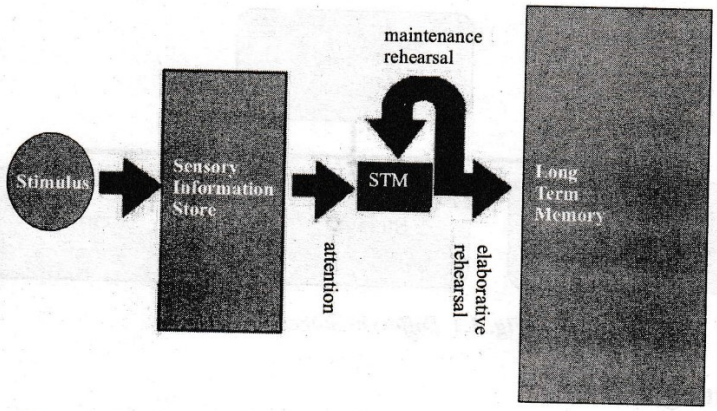

Fig. 3.2 Atkinson and Shiffrin (1968) Process Model of Memory

Figure 3.3 illustrates a detailed memory structure.

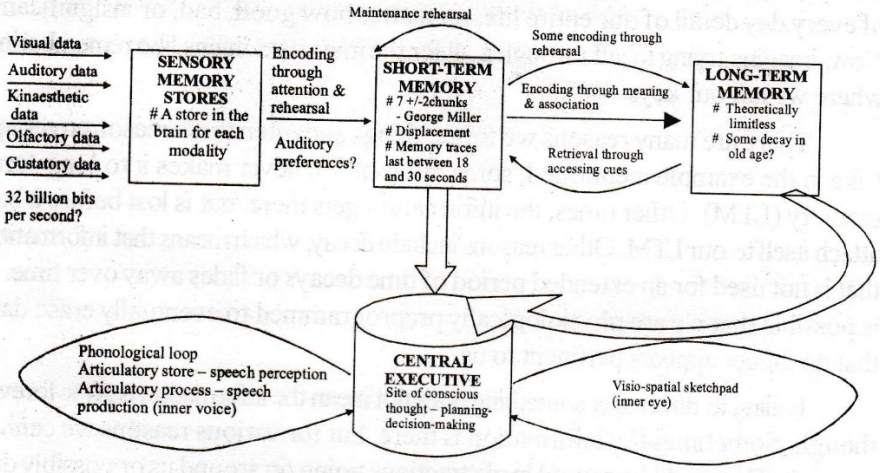

Fig. 3.3 Memory Structure

Sensory memory

Sensory memory is the first stage of memory, here the information enters through different sensory systems like visual and auditory and other senses (G. Rainer and E.K. Miller, 2002).

Information is encoded into sensory memory as neural messages in the nervous system. As long those neural messages are travelling through the system, people have a memory for that information that can be accessed if needed. During morning walk, thousands of stimuli come across our fields of vision and hearing—chirping birds, a noisy motor cycle, the blue sky, etc., but we do not process all there stimuli. We process many more stimuli at the sensory level that we noticed consciously. Sensory memory retains this information from our senses, including the ignored portion also. There are two kinds of sensory memory, viz., iconic (visual) and echoic (hearing) memories.

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(i) **Iconic sensory memory:** Iconic memory is visual sensory memory, lasting only a fraction of a second. G.A. G.A. Sperling (1960), studied sensory memory and presented their subjects with a pattern of stimuli. He flashed the letter on the screen for about 1/20th of a second. These subjects could only recall only five or four letters. With such short exposure, reporting all nine letters was impossible

Duration of iconic memory: Research suggests that only after a quarter of second, old information is replaced by new information.

Functions of iconic memory: The following are the functions of iconic memory:

- Iconic memory helps the visual system to view surrounding as continuous and stable in spite of the saccadic movement.
- It also allows enough time for the brain to decide if the information is important enough to be brought into consciousness.

(ii) **Echoic sensory memory:** It refers to the phenomenon in which there is a brief mental echo that continues to sound after an auditory stimulus has been heard. We hear something, but the brain did not interpret it immediately. Instead, it took several seconds to realize the sound. Then we think it might have been important and then try to remember what it was. If we realize all this within 4 second (the duration of the echoic memory) we would be able to hear an echo of the statement in our head as a kind of instant reply.

Duration of echoic memory: Capacity is limited to what can be heard at any moment and is smaller then the capacity of iconic memory, although it lasts longer—about 2 to 4 second (R. Schweickert, 1993).

Functions of echoic memory: The following are the functions of echoic memory:

- It is very useful in meaningful conversations with others. It allows the person to remember what someone said.
- It allows people to hold on to incoming auditory information long enough for lower brain centre to decide if the information is important enough to become conscious.
- Echoic memory allows the musician to learn a musical instrument.

Now we will discuss the two memory processes, viz., short-term and long-term memory processes in detail.

Short-term/working memory

The second stage of memory process is the short-term memory (STM). It takes place through the process of selective attention or the ability to focus only one stimulus from among all sensory input (D.E. Broadbent, 1958).

In short-term memory, the information is held for a brief period of time while being used. It is a limited capacity memory system in which information is usually retained for only for 30 seconds. Short-term memory tends to be encoded