Bureau's

Higher Secondary (+2)

PSYCHOLOGY

PART - I

Approved by the Council of Higher Secondary Education, Odisha, Bhubaneswar for the Higher Secondary Examination 2017 A.D. and onwards

BOARD OF WRITERS

Prof. Udaya Nath Dash
Ex-Professor of Psychology
Utkal University and University of Delhi

Sri Pramod Kumar Mohanty
Ex-Reader in Psychology
J.K.B.K. College, Cuttack

Sri Suresh Chandra Mohanty
Ex-Reader in Psychology
Banki College, Banki

Dr. Lalit Kumar Pattanaik
Ex-Reader in Psychology
Nayagarh College, Nayagarh

Dr. Gopal Krishna Nanda
Ex-Reader in Psychology
Kamala Nehru Womens' College,
Bhubaneswar

Dr. Girish Chandra Mishra
Ex-Principal
Mahila Mahavidyalaya,
Dehnkanal

Sri Chintamani Kar
Ex-Reader in Psychology
F.M. College, Balasore

REVIEWERS

Prof. Udaya Nath Dash
Ex-Professor of Psychology
Utkal University and University of Delhi

Sri Jugal Kishore Dash
Ex-Principal
Dhenkikote College, Keonjhar

Published By :
ODISHA STATE BUREAU OF TEXTBOOK PREPARATION AND PRODUCTION,
Pustak Bhavan, Bhubaneswar.

Bureau's
Higher Secondary (+2)

PSYCHOLOGY

Part - I

(Approved by the Council of Higher Secondary Education, Odisha)

Published by :

The Odisha State Bureau of Textbook Preparation and Production, Pustak Bhavan, Bhubaneswar, Odisha, India.

First Edition - 2004 / 2000 copies

Revised Edition - 2007-08/1000 copies

New Edition - 2016/2000 copies

Publication No. : 174

ISBN : 978-81-8005-347-4

Revised by :

Prof. Udaya Nath Dash
Ex-Professor of Psychology,
Utkal University and University of Delhi

Type Setting, Designing : Orissa Printing Works, Cuttack.

Printing : Orissa Printing Works, Cuttack.

Price : Rs. 150.00 (Rupees One hundred fifty only)

FOREWORD

It gives me immense pleasure in presenting the revised textbook entitled "Bureau's Higher Secondary (+2) Psychology", for the higher secondary students, published by the Odisha State Bureau of Textbook Preparation and Production. The authors have done a commendable job in the preparation of the book incorporating recent facts and figures.

I acknowledge with thanks the contribution of authors: Prof. U.N. Dash, Sri P.K. Mohanty, Sri S.C. Mohanty, Dr. L.K. Pattanaik, Dr. G.K. Nanda, Dr. G. C. Mishra and Sri C. Kar for writing the chapters as per the revised syllabus of CHSE, Odisha and I hope the labour put in by the authors will serve the purpose. My thanks are also due to Prof. U.N. Dash and Sri J.K. Dash for reviewing the book. My special thanks and gratitude to Prof. U.N. Dash, for complying with my request and doing the most arduous work of editing and proof reading. Only for his sincere efforts, this book could see the light of the day within the specified time limit.

I owe my gratitude to the Commissioner-cum-Secretary, Department of Higher Education, Odisha, and the Chairman, CHSE, Odisha, without whom we could not have ventured to undertake this work. The Bureau is indebted to the members of the Syllabus Committee in Psychology of CHSE for selecting the authors and recommending the book as the major prescribed textbook in Psychology for Higher Secondary students.

It is hoped that this book will fulfil the aspirations of both students and teachers. Constructive and valuable comments and suggestions on any aspect of the book for its

PREFACE TO THE REVISED EDITION

The book “Bureau’s Higher Secondary (+2) Psychology” has been prepared according to the syllabus of Council of Higher Secondary Education, Odisha. At this juncture, the formulation of a revised syllabus, incorporating the topics of contemporary developments in the field of Psychology for young learners is a welcome decision on the part of authorities and members of the board of studies of "Council of Higher Secondary Education, Odisha, Bhubaneswar". However, it would not have been possible without the encouraging acceptance of authorities in the Government of Odisha and Odisha State Bureau of Textbook Preparation and Production.

Writing a textbook of introductory nature like this is far from being easy. The authors of the present book have tried to bank upon the facts highlighting a few of the important experiments as per need and for better understanding. Relevant examples and appropriate illustrations have been incorporated as are common in any textbook on Psychology, so that the learners could grasp the concepts easily. Key words, summary and questions, both long and short, with answers at the end of each chapter would certainly reinforce the students' understanding of the subject. The authors sincerely believe that the book would positively cater to the needs of students of higher secondary classes of Odisha, and those of other states including the students of the CBSE and the ICSE. This would hopefully serve as a treasure for students wishing to make Psychology as a career.

The authors do not claim originality, except in the scheme of arrangement of facts, because a textbook in Psychology has to be factual and a number of reference books have to be consulted to put the right kind of materials to be useful to the learners. However, the authors have the satisfying pleasure and excitement in putting their experience as teachers in a fruitful way. The authors have taken all possible care in incorporating up-to-date information.

The book has been almost rewritten to its size, but keeping the original thought process intact, by incessant efforts of one of the authors, Dr. U.N. Dash, who has meticulously gone through the proof. It is largely his conscious handiwork that the book is not 'out of reading frame' for a junior level student or a general reader desirous of knowing the basics of Psychology.

Syllabus from 2016 Admission Batch (2017 Examination onwards)
FIRST YEAR
FOUNDATIONS OF PSYCHOLOGY

Total Marks: 100
Theory – 70 marks
Practical – 30 marks

Unit - I

1. **What is Psychology?** (Periods : 8)
(*seeks to help in understanding and appreciating psychology as a discipline, its application and relationship with other sciences*)
   a) Meaning and definition of Psychology
   b) Psychology as a science
   c) Brief idea about different approaches to the study of psychology
   i) Biological
   ii) Behaviouristic
   iii) Cognitive
   d) Psychology and other disciplines (Sociology and Anthropology)

2. **Methods used in Psychology** (Periods : 6)
(*familiarizes with the methods of studying and understanding behavior*)
   a) Experimental method
   b) Observational method
   i) Naturalistic observation
   ii) Subjective observation or introspection

Unit - II

3. **Physiological Bases of Behavior** (Periods : 9)
(*focuses on the role of biological factors in shaping of human behavior and experience*)
   a) Structure and functions of neuron
   b) Structure and functions of the Central Nervous System
   i) Spinal cord iii) Brain

c) Autonomic Nervous System
d) Endocrine System

4. Sensory and Perceptual Processes (Periods : 10)

(*aims at understanding how various sensory stimuli are received, attended to and given meaning*)

a) Attention: Determinants and types of attention
b) Perception: Meaning, operational definition, processes involved in perception (receptive, selective, symbolic, affective processes)
c) Principles of perceptual organization
d) Role of need, past experience and cultural factors in perception
e) Errors in perception: illusion and hallucination

Unit- III

5. Learning (Periods : 10)

(*focuses on how human beings acquire new behavior and how changes in behavior take place*)

a) Meaning and operational definition of learning; Learning distinguished from maturation and performance
b) Processes of learning
i) Trial and Error learning
ii) Classical conditioning
iii) Operant conditioning
iv) Cognitive learning: Insightful learning
v) Observational learning

6. Human Memory (Periods : 12)

(*deals with how information is received, stored, retrieved and lost and explains how memory can be improved*)

a) Memory process
i) Encoding ii) Storage iii) Retrieval
b) Systems (stages) of memory
i) sensory memory ii) short-term iii) long-term
c) Measurement of memory
i) recall ii) recognition iii) saving or relearning

d) Nature and causes of forgetting

e) Improving memory: mnemonics, methods of loci, number and letter peg system, chunking

Unit - IV

7. Motivation and Emotion (Periods : 8)

(*deals with why human beings behave as they do and also with how people experience positive and negative events and respond to those*)

a) Meaning and nature of motivation

b) Types of motives: Biological, Social and Psychological

c) Meaning and nature of emotion

d) Bodily changes during emotion

8. Processes of Thinking (Periods : 10)

(*deals with thinking related processes like reasoning, problem solving, decision making and creative thinking*)

a) Meaning and definition

b) Stages of cognitive development by Piaget

c) Problem solving and decision making

d) Creative thinking: Nature and stages of creative thinking

Unit - V

9. Intelligence (Periods : 7)

(studies how people differ with respect to intelligence)

a) Meaning and nature of intelligence

b) Approaches to understanding intelligence

i) Gardener ii) Sternberg iii) J.P. Das

c) Factors influencing intelligence

PRACTICALS

1. Span of Attention

2. Optical Illusion (Muller-Lyre Illusion)
3. Sensory-Motor Learning
4. Memory for Meaningful Words and Non-sense Syllables

Books recommended

1. Psychology Part-I, NCERT, New Delhi
2. Bureau's Higher Secondary +2 Psychology, Part-1
   Dash, Mohanty, Mohanty, Patnaik, Nanda, Mishra and Kar published by Odisha State Bureau of Textbook Preparation and Production, Bhubaneswar

SECOND YEAR

PSYCHOLOGY IN APPLICATION

Total Marks: 100
Theory – 70 marks
Practical – 30 marks

Unit - I

1. Life-span Development (Periods : 10)

(*deals with variations in development and the developmental tasks across the life span*)

a) Meaning of development – Life-span perspective
b) Principles of development
c) Stages of development : Prenatal stage, Infancy, Childhood, Adolescence, Adulthood, Old age

2. Self and Personality (Periods : 9)

(*focuses on the study of self and personality in the context of different approaches in an effort to appraise the person and includes assessment of personality*)

a) Concept of self and personality
b) Personality types and traits
c) Assessment of personality

Unit - II

3. Stress : Meeting Life Challenges (Periods : 6)

(*deals with the nature of stress and strategies to cope with stress*)

a) Meaning, nature and causes of stress
b) Coping strategies to deal with stress

4. **Physical Environment and Behavior** (Periods : 6)
(*focuses on the application of psychological understanding of human-environment relationship*)
a) Human impact on environment: Noise Pollution, Crowding, Natural disaster
b) Impact of environment on human behavior

Unit- III

5. **Group Processes and Leadership** (Periods : 7)
(*deals with the concept of group and the role of the leader in a group*)
a) Groups : Nature, types and formation
b) Leadership : Nature, functions and styles of leadership

6. **Counseling Processes** (Periods : 6)
(*focuses on helping the client live a meaningful and fulfilling life*)
a) Meaning and concept of counseling, Goals of counseling
b) Characteristics of an effective counselor

Unit - IV

7. **Psychological Disorder** (Periods : 10)
(*discusses the concept of normality and abnormality and the major psychological disorders*)
a) Concept of normality and abnormality, criteria for studying abnormal behavior
b) Causal factors associated with abnormal behavior
a) Major psychological disorders: Anxiety disorders, Somatoform disorder and Mood disorders

8. **Therapeutic Approaches** (Periods : 6)
(*discusses the purpose and processes to treat psychological disorders*)
a) Nature and processes of therapy
b) Types of therapy : Psychotherapy, Behavior therapy, Cognitive therapy, Biomedical therapy

Unit - V

9. **Statistics in Psychology** (Periods : 10)

deals with some basic statistical methods to be used in psychological studies)

a) Frequency distribution

b) Measures of central tendency : Computation and uses of mean, median and mode

PRACTICALS

1. RCPM Children / RPM Adults
2. Case History Method (Preparation of at least one case profile)
3. Personality Test (Type A / B)
4. Piagetian task (Conservation of Liquid Quantity)

Books recommended

1. Psychology Part-I and Part-II, NCERT, New Delhi
2. Published by Odisha State Bureau of Textbook Preparation and Production, Bhubaneswar

QUESTION PAPER PATTERN

Theory Paper

Group-A : Objective TYPE (Compulsory)

Q. No. 1 : Multiple choice (Fill up the blanks from all units)
1 mark each X 10 = 10 marks

Q. No. 2 : Statements "True" or "False"
1 mark each X 10 = 10 marks

Group-B: Short Type

Q. No. 3 : Short type answer (Answer within two/three sentences) and one has to answer 10 bits out of 12 bits.
2 marks each X 10 = 20 marks

Q. No. 4 : Short type answer (Answer within six sentences) and one has to answer 3 bits out of 5 bits
3 marks each X 3 = 09 marks

Group-C: Long Type

Q. No. 5 : Question No. 5 to Q. No. 10 (Questions will be from all the units and one has to answer any three questions)
7 marks each X 3 = 21 marks

PRACTICAL

There will be 4 questions and the examinee is to choose/draw 2 questions through lottery and is to conduct practical on any one question out of the two questions

Distribution of marks

Record	:	03
Vive-voce	:	07
Conduction & Report writing	:	20
Total marks	**:**	**30**

CONTENTS

Chapter 4
SENSORY AND PERCEPTUAL PROCESSES

Chapter 5
LEARNING

Chapter 6
HUMAN MEMORY

Chapter 7
MOTIVATION AND EMOTION

Chapter 8
PROCESSES OF THINKING

Chapter 9
INTELLIGENCE

1

WHAT IS PSYCHOLOGY ?

This chapter covers :

a) Brief Introduction to the Origin of Scientific Psychology

b) Meaning and Definition of Psychology

c) Psychology as a Science

d) Brief ideas about different Approaches to the Study of Psychology: (i) Biological, (ii) Behavioristic, (iii) Cognitive

e) Fields of Psychology

- **i)** Physiological and Comparative
- **ii)** Educational
- **iii)** Child and Developmental
- **iv)** Industrial and Organizational
- **v)** Abnormal
- **vi)** Social
- **vii)** Cognitive
- **viii)** Brief ideas on some emerging Fields of Psychology: Health Psychology, Environmental Psychology, Sports Psychology, and Counseling Psychology etc.

After you go through this chapter, you would be able to:

- *Understand the nature and scope of psychology as a social science discipline.*
- *Know the origin and development of scientific psychology.*
- *Appreciate the importance of studying psychology.*
- *Learn the approaches psychologists use in studying individuals and groups.*
- *Familiarize yourself with various branches of contemporary psychology.*

CONTENTS

Chapter 1

What is Psychology ?

Introduction

The opportunity for college education is only available to a few. The more fortunate ones who make a smooth transition from high schools to colleges make a big leap in their educational career. The adolescent in the High school, who was craving for independence from parental restriction and teacher's discipline now breathes a sigh of relief at the doorstep of college education. An adolescent student in a college is a relatively freer individual, experiencing freedom from parental restriction, teachers' control, and restrictive home environment. He is at a juncture in his life and educational career, where he can create more space for him, use time the way he likes, make friends at his own choice, and learn whatever he wishes to learn. He is relatively a freer individual, and the college environment opens up a wide range of avenues for him to choose from.

The wider spectrum of choices in the higher educational set up poses a challenge to the adolescent mind. For some students, college is an institution of higher learning with opportunities for academic pursuits and possibly a professional engagement later, while for others it is a platform to practice leadership roles. There are marked individual differences in the way students perceive and selectively respond to their institutional environment. Some prefer to make new friends for filling their leisure hours, some wish to create opportunities for interactions with the opposite sex, some enjoy the newly-discovered independence of an adolescent life, and for a few others, it is a wide-open confusion of what to do and what to choose from. Given the same environment, people respond differently, which lead to different outcomes. Why do they do so ? This is precisely the question that constitutes the subject matter of psychology.

Psychologists attempt to understand why and how individuals experience their environment differently. More formally, psychology is a discipline devoted to the scientific study of behaviors, experiences, and mental processes of the individual/organism in relation to its environment.

The phenomena in pure sciences are relatively easier to predict with a certain degree of accuracy. Given a particular treatment, a chemical behaves in a specific way. A ray of light passing through a prism shows seven colors of varying wavelength. The phenomena studied by psychologists are more variable, and therefore, more complex. A physicist studies the behavior of objects either static or in motion; a chemist studies the behavior of chemical reactions; a geologist studies the behavior of rocks; a botanist studies the behavior of plants, and a physician studies the behavior of the physiological system. As you may imagine, the behaviors of these people are far more complex and variable than the behaviors of the objects or systems they study. The psychologist studies the behavior of individuals like these professionals. The psychologists want to know how they perceive, learn, think, experiment, reason, judge, and take decisions? Thus, psychologists deal with more complex systems.

Consider your own case as a student, and your experiences and behaviors in relation to the college environment. Ask yourself the questions that follow. Each question pertains to an area of study in psychology. What motivated you to prefer a course on psychology to other similar courses (*motivation*)? How do you plan to learn the topics in psychology (*learning*)? How would you remember what you learned and reproduce those in the final examination (*memory*)? No matter how hard you try, you still would forget the learnt material from time to time (*forgetting*)? Would you be able to keep cool, and deal with the feelings of stress arising from hard work just before the examination (*emotion*)? Do you perceive and feel that your college environment including the library, the teachers, and the instructional processes are supportive to your learning (*perception*)? Why is it that you could not keep yourself awake beyond the midnight just before the examination, no matter; how hard you tried (*physiological basis of behavior*) ? You may also ask, “What percentage of your seniors secured above 70% marks in psychology in the last examination?” to estimate your probability of securing marks above 70% (*statistics*). (If you were prompted by this reason to prefer this course to others, you are probably socially intelligent). If you are a serious student willing to think critically *(thinking)*, these and similar questions will cut across your mind from time to time. It is not that these questions apply only to you; these questions also come to the minds of your friends, which they either seek to answer or avoid. Furthermore, these questions are not only confined to college education; they form a part of our everyday encounters with the world around. Psychology, as a branch of social science would train you to obtain answers to these and similar questions so that you can help yourself and others.

Meaning and Definition of Psychology

During the formative period of scientific psychology, many attempts have been made to specify the meaning, scope, and definition of psychology. The term '**psychology**' has been derived from two Greek words, ***psyche*** (soul) and ***logus*** (science). The literal meaning of psychology is the *'science of **soul**'.* This was the earliest definition of psychology given by the ancient Greek philosophers. This definition stood on very soft grounds because soul is considered a philosophical and mystical construct, and cannot be directly observed. Hence, this early definition was rejected.

Some philosophers used the term 'mind' as a substitute for the word 'soul', and defined psychology as the *'science of **mind**'.* But the term 'mind' was as vague and as indistinct as the word 'soul'. Mind cannot be seen or observed, and therefore, cannot be studied scientifically. So this definition was not also acceptable.

Some thinkers thought that since psychology studies human beings, it could well be defined as the *'science of **man**'.* But problems arose again, because disciplines like physiology and anthropology also study different aspects of human functioning. Through this definition we cannot distinguish psychology from allied disciplines of anthropology and physiology. This definition was also not found to be satisfactory. Some other thinkers defined psychology as the *'science of **mental activity**'.* But by restricting the scope of psychology to mental activity only, the role of physiological functions that determine mental activity was ignored. Hence this definition was not complete and was, therefore, rejected.

In 1879, **Wilhelm Wundt** established the first psychological laboratory at Leipzig in Germany, and wanted to

give a formal status to psychology as a scientific discipline. Wundt defined psychology as the *'science of **conscious experience**' and* proposed **introspection** (self-observation) as the method for understanding conscious experience. In introspection, a trained person observes and analyzes his / her conscious experiences, and provides a verbal report to the experimenter. E.B. Titchner accepted Wundt's definition, and popularized Wundt's ideas in the United States. But this definition did not last for long; it was later criticized on several grounds. A detailed discussion of Wundt's ideas and the related criticisms are presented later in this chapter in the section on '*Origin and Development of Psychology*'.

J.B. Watson took a rigorous scientific approach, and wanted to make the study of psychology more objective and quantitative. Watson was dissatisfied with the philosophical and mentalistic constructs such as *'soul', 'mind',* and *'consciousness'.* He defined psychology as the *'science of **behaviour**'* and established **behaviorist school** of psychology. By '*behavior*' Watson meant all the outward and the observable activities of the individual. Watson used objective and experimental methods to study behavior. Watson's definition was more acceptable compared to others, but it did not provide a complete picture of what psychology is concerned about. Behaviours can be overt (external) activities or covert (internal) mental activities like perceiving, reasoning, thinking, imagining etc. The study of internal mental activities was ignored in the definition given by Watson. Furthermore, Watson undermined the role of the organism in any psychological process, and overemphasized the determining role of the environment. Hence Watson's definition could not be considered as a complete and comprehensive definition of psychology.

R.S. Woodworth, a member of the behaviorist school, defined psychology as *the scientific study of the **activities of the organism in relation to its environment**.* This definition was broader in scope compared to that given by Watson. By using the expression '*scientific study of activities*',

Woodworth emphasized the need to understand, predict, and control human behaviour. The term '**activities**' includes both external observable behaviors (e.g., walking, jumping, running, playing etc.) and internal mental processes (e.g., perceiving, memory, thinking, reasoning etc.). The term '**organism**' includes human beings as well as other animals. The expression '**in relation to the environment**' acknowledges the role of the organism and the environment in shaping the individual's activities or behaviors. Woodworth's definition was considered a more appropriate and acceptable definition of psychology; yet it was not comprehensive and exhaustive.

As psychology advanced, researchers became increasingly aware of the role of consciousness in shaping behavior. Wundt's ideas, which were rejected almost one hundred years ago, were recognized in different forms. The role of internal mental processes in the field of consciousness is now recognized as a valid subject matter of psychology. Most of the recent textbooks of psychology include behaviors, mental processes, and experiences in the definition of psychology. In the light of these viewpoints, **psychology may be defined as the scientific study of behaviours, experiences, and mental processes.** This is the most acceptable definition of psychology. The important features of this definition are discussed below:

1. ***Psychology is a scientific study*.** Psychology uses scientific methods for studying behaviours, experiences, and mental processes. Some people have difficulty in thinking of psychology as a science like physics, chemistry, or biology. Science is not defined by *'what'* it investigates but by *'how'* it investigates. The *'how'* part is covered by the methods. You will learn about the methods of psychology in Chapter 2.

Scientists are curious individuals willing to think critically about issues and ideas. They use a mixture of the methods of induction and deduction to investigate a phenomenon. **The purpose of science is to understand, predict, and control**. When psychologists use an intelligence test, they understand and assess the nature of intelligence in a student, predict his achievement in school, and intervene in promoting the intellectual capacity of the student.

Science produces a systematic and organized body of knowledge, which is relatively objective and verifiable. Psychologists develop laws and principles to understand various dimensions of behaviour. Another researcher can verify the knowledge gained by a psychologist. Since human behaviour is complex, psychologists differ among themselves in their analysis and interpretation. But all go through a systematic procedure of study: identifying a problem, stating hypotheses, designing a research strategy, collecting and analyzing data, interpretation and conclusion, and formulation or revision of theories.

People sometimes carry wrong notions about what psychologists do. Some believe that psychologists are fortunetellers, know about the future of a person, and can read one's mind by looking at him. In fact, psychologists do not carry out any of these exercises. Some confuse between psychology and psychiatry. A psychiatrist is a medical professional who has specialized in the medical treatment of mental disorders. A psychologist may not have a medical degree. Those who are clinical and counseling psychologists are trained in the use of counseling and therapy with their clients. Psychology, thus, conforms to the basic principles of the scientific tradition.

2. ***Psychology studies behaviors*****.** Behaviors consist of all external and internal activities of the organism. Psychologists study all forms of behaviours from simple reflexes (e.g., knee jerk, eye blinking etc.) to more complex patterns of human behaviour (e.g., reasoning, problem solving, decision-making etc.). Almost all forms of behaviour (simple or complex, verbal or non-verbal, external or internal) are studied by psychologists.

In order to be objective, psychologists use the term **'response*** to denote behaviours. A response is a measurable

activity generated by some sort of **'stimulus'.** A stimulus is defined by any change in the physical energy that is capable of evoking a response. 'Food' is a stimulus for the hungry man. His salivation at the sight of food is a response. For some psychologists like Thorndike, and Watson, psychology refers to the understanding of stimulus-response connections.

Behaviours can occur at different levels. Thus psychologists study the behaviours of individuals, groups, organizations, crowds, and communities. They study the behaviours of animals including rats, cats, dogs, and chimpanzees. They use the findings from studies on animals for making inferences about behaviours of human beings. They study all forms of abnormality to understand the causes of abnormal behaviour. Recently, psychologists are focusing on behaviours as they occur in natural settings, and the extent of cultural influences on patterns of behavior. A good understanding of the behaviors is possible only when they are interpreted in proper socio-cultural context. **Psychology finds a place in all those spheres, where behaviors of some sort are involved**. Accordingly, there are many applications of this discipline, giving rise to a large number of fields of psychology.

3. ***Psychology studies experiences of people*.** In recent years, psychologists have shown interest in both **conscious and unconscious experiences** of people. Some experiences are very personal, and thus are unique to an individual. Most recent textbooks on psychology include a chapter on consciousness or altered states of consciousness. Consciousness is altered when someone uses drugs, or performs meditation, or undergoes hypnosis, or dreams during sleep. Psychologists study these unique personal experiences of the individual.

4. ***Psychology studies mental processes*.** The study of observable behaviours does not provide a complete picture of what happens in the brain. The external world has a mental representation in the brain. These mental representations obviously have a physiological base in the form of neural activities in the brain and body. But these representations cannot be fully understood in objective physiological terms. The representations consist of mental processes, which have subjective as well as objective components. The mental processes consist of learning, perception, memory, problem solving, thinking, decision-making etc., which involve internal mental activities.

The mental processes cannot be directly observed, but they influence observable behaviors. **Hence, psychologists make inferences from observable behaviors regarding the processes that take place internally**. We cannot directly observe 'thinking' but can know whether or not a person is engaged in thinking by observing his behaviour while solving problems. Similarly, we ask a person to recall the earlier learnt materials to make inferences about his memory processes. Psychologists focus on how information is registered, processed, and evaluated by an individual. Even they study the information processing mechanisms in a computer to understand how human brain works. Hence the scientific study of the internal mental processes constitutes an important subject matter of psychology.

Psychology as a Science

It has been mentioned earlier in this chapter that psychology is defined as the scientific study of behaviors, experiences, and mental processes. This definition claims that

psychology contains the features of science. First of all, it is important to know what science is. Second, if psychology is a science, is it a natural science like physics, chemistry, or biology or a social science like sociology and economics? As you will read later, psychology has evolved out of the combined influences of natural science and philosophy. Hence, it contains some of the elements of natural science.

What is science? **Science refers to a systematic process of acquiring and organizing knowledge.** Science is defined not by its subject matter, but by the methods employed to acquire knowledge. The methods used in science are *systematic, objective*, and *verifiable*. The objective of science is to gain an understanding of the *cause-and-effect relationship* among variables under carefully controlled observations. The controlled observations, called experiments, usually take place in the laboratory with the help of scientific instruments. While using experimental procedures, certain variables or conditions are changed by the experimenter to observe their effects on another variable. The variables changed by the experimenter are called '*independent variables*'; the variables on which their effects are observed are called '*dependent variables*'.

The process of gaining knowledge follows certain defined stages in scientific enquiry: (a) identification and analysis of a problem, (b) formulation of a hypothesis which states the expected outcome of an investigation, (c) preparing a design or strategy, (d) collection and analysis of data, (e) interpretation of the findings, and (f) developing or revising a theory.

Since Wundt established the first psychology laboratory in 1879 at Leipzig, psychologists are claiming a scientific status for their discipline. In the early years, psychology imitated the methods of physics and biology. It was also

considered to be a life science as it was connected with biology. Recently, neuropsychology has emerged as a discipline, which studies the relationships between biological structure of the brain and its psychological functions. **Thus psychology contains a few elements of natural sciences**.

Let us take an example of how *method of learning* influences *retention of the learned material*. Here, the '*method of learning*' is the 'independent variable'; '*the amount of retention*' is the 'dependent variable'. The method of learning may be massed (no interval between learning trials) or distributed (a specific interval between learning trials). After the problem is identified, a hypothesis is formulated. In this case, the hypothesis may be, "*The amount of retention would be more for distributed than for massed method of learning."*. The design followed is an experimental design with two conditions. In one condition, the subjects are exposed to '*massed*' learning trials, and in the other, they are given '*distributed*' learning trials. Other variables such as laboratory setting, number of trials, nature of materials etc. are controlled, which means that they remain the same for the two groups. After learning, the subjects are asked to recall what they learned. Thus data are collected, analyzed, and interpreted. If the findings show that the distributed condition results in better retention compared to the massed condition, the hypothesis is supported; if it does not, the hypothesis is rejected. In this example, the procedures and steps of natural sciences are followed. The researcher has been objective and has collected information systematically. The findings can also be verified by another scientist, who would probably obtain the same results. These findings can be generalized to form scientific laws. Using these laws, scientists can understand and make predictions.

Can we then call psychology a science? Yes, we can, because it fulfils many conditions of science. It follows systematic and objective methods; its findings can be verified; it examines cause-and-effect relationships to produce universal laws governing human behaviour. The question arises, “Is psychology an exact science like physics, chemistry, and biology?” The answer perhaps is ‘No’. Unlike natural sciences, psychology deals with behaviors and mental processes. Behavior is very complex, dynamic, and ever changing. The mental processes are very abstract, and are in a state of dynamic interaction. **Hence, the laws in psychology are not as exact and precise as those in physics.**

We cannot expect that psychology would conform to the laws of natural sciences. Human beings not only live in their natural environment; they live in a community having its unique socio-cultural features. The cultural influences vary immensely from one setting to another. Hence it is difficult to come up with universal laws that would be applicable in all contexts. Furthermore, many issues of psychological interest cannot be studied in laboratory set up under artificially controlled conditions. Considering all these, **psychology can best be described as a social science, devoted to the scientific study of behaviors, experiences, and mental processes.**

Subject Matter of Psychology

You will read later regarding different branches of psychology, which provide a wide range of issues that psychologists are concerned with. The interests of psychologists are both theoretical and applied. Psychologists propose theories in the form of general laws. The knowledge so gained is applied for human comfort and welfare. The subject

matter covers all aspects that deal with behaviours, personal experiences, and internal mental processes of the individual. Psychology aims at understanding, explaining, predicting and controlling all aspects of behaviour and experiences. A brief idea about what psychology covers is given below.

The psychological and biological functions are interrelated. Both functions are shaped by environmental forces. In order to understand behavior, one has to understand its biological basis, because it is the biological organism that behaves. Hence, psychologists study the ***physiological bases of behavior,*** that is how biological structures and functions influence behaviors and experiences. The primary emphasis lies in the brain and the nervous system. At the same time, the influences of the society and the cultural forces cannot be ignored.

The biological organism is in continuous interaction with the environment. The environment directly affects our sense organs. We sense the external stimulus world, attend to its relevant features, and finally perceive i.e., attach meaning to our sensation. Psychologists study ***sensation, attention, and perception.*** These are very important topics of study as they provide our first steps of interaction with our environment. How do we attach meaning to the external world? We have to learn. Without learning, we would be static beings, and every time we would interpret our sensation the same way. As a result we would not be able to adapt to the changing demands of our environment, and would therefore perish. Our ability to learn helps us adjust to the world around us to make our living comfortable. Hence ***learning*** forms a core subject matter of psychology. Learning can be simple or complex. It may range from learning an alphabet to learning to be a cosmonaut. A wide range of skills and competencies are

acquired through learning. Psychologists carry out research in laboratories and field settings to discover principles underlying learning.

Both perception and learning would not help us, if we did not have the ability to remember. New information perceived and learnt are stored in our memory system for future use. The information will be used only when we are able to recall or recover it from our memory system. Without memory, the world would be a new place for us every day, every hour or even every second. Neither shall we be able to perceive nor be able to learn, if we had not a system for memory. Not all that we store in our memory last forever. Information tends to be lost in course of time. We forget the learnt material. Sometimes we purposefully forget to avoid unpleasant feelings in order to adapt to our environment more effectively. Psychologists study topics on ***memory and forgetting.*** How do we remember? Why do we forget? The studies provide us great insights into very complex mental processes such as thinking, reasoning, decision-making, problem solving, language learning etc. These higher-order, complex, and internal mental processes are all interrelated. All these internal mental processes are known as cognition or cognitive processes, because they help us in acquiring knowledge from our environment. They are continuously interacting with one another helping us to live a life of meaning and purpose.

Man is a cognitive, conative, and affective being. Cognition refers to our intellectual side. The conative aspect refers to motivation, while the affective side refers to emotion. No matter how intellectually efficient the person is, he cannot succeed if he is not properly motivated to perform and does not have the ability to balance his emotions. Psychologists study ***motivation and emotion.*** Motivation refers to the *"why"*

aspect of behavior. Without motivation, man would never be willing to engage in mental activities that he is capable of. Motivation energizes a person to work towards a goal. All the intellectual capacities of a student would not help him perform successfully, if he is not motivated to study and learn. Emotions add color to our lives. They can be constructive or interfering. Emotions, if not properly regulated, can interfere with the execution of our mental processes. Frustration, anxiety, fear, hate, shame, guilt, love etc. are some of the emotions that influence our mental processes and observable behaviors. The nature, the process, and the consequences of motivation and emotion form a part of the subject matter of psychology.

Every person experiences the basic psychological processes, yet each person is different from the other. Not only people differ in their physical characteristics such as height, weight, and color, they also differ widely in their psychological characteristics such as personality, temperament, intelligence, creativity, interests, and values. Understanding how individuals differ is extremely important. If we know the strengths and weaknesses of each individual, we would be able to help him develop personally through guidance and counseling. We can learn the unique features of persons with different forms of disability, and help them face challenges of life. Hence, the area of individual difference, particularly relating to ***intelligence*** and information processing has received considerable attention. Psychologists working in this area have developed tests and instruments for measuring intelligence, and personality dimensions of individuals. They have shown interest in understanding and controlling abnormal behaviors and in applying psychology in different individual and institutional spheres. The expanding scope of psychology has made it an interesting topic of study

for even non-psychology personnel. Its applications are innumerable. In the last two decades, psychological knowledge and principles are being increasingly applied in the fields of health promotion, sports, defense, neuroscience, information management, space and aviation research, hospital management, business organizations, and forensic sciences, to name only a few. You will come to know more about the different branches of psychology and different fields of psychology later. Psychology is crucial to promoting the interests and welfare of mankind.

Origin and Development of Psychology

Wilhelm Wundt

"*Psychology has a long past, yet its real history is short*" was the statement made by **Hermann Ebbinghaus** (1908). Psychology is as old as the human civilization. Man in his eternal quest for knowledge has been curious about himself, his thought processes, his reflections, and his experiences. Psychology grew out of man's interest in studying and understanding himself. The psychology we study today began in western philosophy. The roots of psychology can be traced back to the ancient Greeks and Romans. Yet the contribution of the Indian philosophers cannot be ignored. While tracing the roots of psychology, the western textbooks hardly mention the contributions of ancient Indian thinkers. But the most recent researchers in psychology are turning their attention to the Indian vision of human consciousness. The ancient Indian views are lately being respected by the western psychologists.

The Indian sages have dealt with and spoken extensively on the functioning of consciousness. In order to understand

the experience of man, and the problems of mankind, the Indian sages used experience and observation *(pratyaksha)* and reason *(anumana),* which were supplemented by intuition and testimony *(pramana).* All Indian philosophical discourses including Vedanta, Yoga, Nyaya, Mimansa, Budhism, Jainism, Sufi and Charvak provide rich information regarding important psychological themes such as mind, body, art of living, values, ethics, perception, emotion, motivation etc.

The modern discipline of psychology has its roots in ancient Greek philosophical thoughts propounded by Plato and Aristotle. The development of psychology can be divided into two periods: (i) *Pre-scientific period,* and (ii) S*cientific period.* In 1879, Wundt founded the first formal laboratory of experimental psychology at Leipzig, and was the first person to refer to him as a psychologist. **The year 1879 marked the boundary between the pre-scientific period and the scientific period**.

Pre-scientific Period


E. B. Titchener

Prior to the 19th century, psychology was considered a branch of speculative philosophy. It was not recognized as an independent science with its specific subject matter, and methods of study. The earliest Greek philosophers were of the opinion that psychology was not different from philosophy. The development of psychology as a distinct branch of knowledge was very much influenced by Greek philosophical thought. The early Greek philosophers described psychology as the science of soul. They tried to explain how the soul functions, where it exists, whether soul can be seen, and what happens to the soul after death. The ancient people believed that soul exists even after the death of the man; soul is invisible, but immortal.

The Greek philosophers like **Plato** and **Aristotle** (384 BC - 322 BC) tried to explain the nature of soul, but they never tried to make it a subject matter of science, and hence, never tried to establish psychology as a science. Plato explained the concept of psychology as the “science of soul”, which is unscientific. Plato believed that soul has no physical existence. As the soul can neither be seen nor touched, nor its existence scientifically demonstrated, his concept of psychology was not accepted. However, his ideas distinguished ‘soul’ from the ‘body’. Aristotle was of the opinion that mind is the function of the body. He believed that heart is very much related to the activities of human beings. The objects in the environment stimulate the sense organs and the results of such stimulation are transmitted to the heart. His view was to some extent correct as he said that the mental functions are the products of physical entity.

The contribution of **Rene Descartes** (1596-1650) was important for the development of psychology. **He distinguished between mind and body, but recognized that each influences the other**. He believed that the animals do not have soul, and therefore, behave like machines. The animals are “automata” as their activities are mechanical. But man has a soul, which controls his activities. The soul, as he believed, exists in the pineal gland, which is located at the base of the brain. So his concept of soul was different from that of Aristotle. His “dualism” explains that the mind and body are different; yet there is interaction between both. The interaction takes place in the pineal gland. But his concept could not explain how this interaction takes place. The physiologists questioned his idea of interaction between the

William James

Sigmund Freud

agreement among the early founders with respect to what this new science should be.

The philosophical thoughts during the eighteenth and nineteenth centuries provided the basic ground rules for the development of modern psychology. At the same time, the proponents of natural science argued that the systematic methods of formal sciences could be applied to study many aspects of human behaviour. **Charles Darwin**, a British scientist, published a book *"The Origin of Species"* in 1859, which revolutionalized thinking in the fields of biology and genetics. He placed human beings and animals on a continuum. Human beings, like other organisms, change as they adapt to their natural environment. As such, they share some common characteristics, and much can be learned about human behaviour by observing the behaviors of other organisms. The methods of science applied to the study of other organisms can also be applied with human beings. As you will know later, the modern psychologists have shown interest in studying the behaviors of rats, cats, dogs, chimpanzees, and other animals, and have made inferences about human behavior.

J.B. Watson

Figure 1.1 The dual roots of Psychology.

In summary, **psychology emerged from philosophy and natural science**. The philosophers dealt with the relationship between mind and body, and with ideas regarding how knowledge is acquired. The scientists in the fields of biology and genetics used formal methods of science to understand the dimensions of physiological behavior. This, in essence, speaks of the dual roots of psychology (see Figure 1.1).

Scientific Period

Ideas from philosophy and natural sciences were combined to give rise to the development of the new field of psychology. In the last quarter of the nineteenth century, psychology established itself as an independent discipline. The formal start of modern psychology can be traced back to 1879 when **Wilhelm Wundt** (1832-1920) established the **first psychological laboratory at the University of Leipzig in Germany**. He was the first person to refer to him as a psychologist. He did not believe in the philosophical approach to the study of mind. He applied experimental methods for analyzing human consciousness. He published a book entitled *'Fundamentals of Physiological Psychology',* which was considered to be the draft of the constitution of psychology as an independent science. He opened his laboratory to students from all over the world. As he took the first step in establishing psychology as an independent science, **Wundt is rightly regarded as the father of modern psychology**.

B.F. Skinner

Jean Piaget

Wundt defined psychology as the study of conscious experience, and

developed a model that came to be later known as structuralism. His aim was to study the building blocks of mind. Thus he and his colleagues started analyzing human consciousness to identify its basis elements. He believed that the mental state, in order to be understood, has to be broken down into its fundamental components. In order to achieve this, he and other structuralists used a method called ***introspection,*** whereby a trained person (often called subject) carefully observes and analyzes his own mental experiences (thoughts and feelings). The person turns inward or looks within to search for what happens in his mind. Wundt was a master of introspection training. He trained some of his students with minimum of 10,000 practice observations before they were allowed to introspect themselves. **Wundt's views**

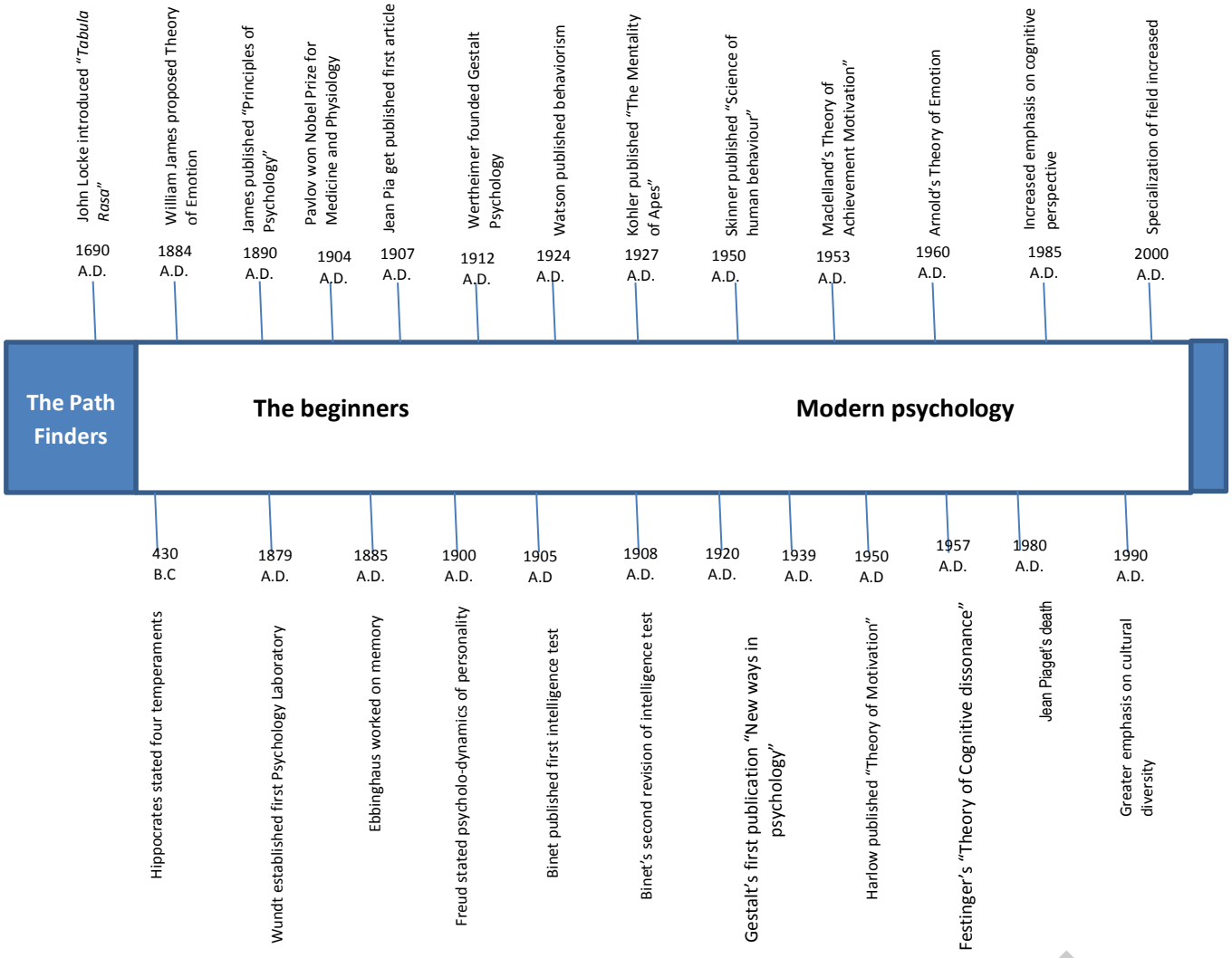


Figure 1. 2 : Important historical turning points in the development of psychology through ages

and assumptions spread far and wide, but they did not stand the test of time.

Structuralism. **E. B. Titchener** (1867-1927), who was a student of Wundt, strengthened his teacher's thinking about mind and popularized his ideas in the United States. Titchner advocated that psychology should focus on the study of conscious experience using the method of introspection. Titchener, like his teacher, departed from earlier philosophical approach, and emphasized the *'What'* of mental activity, rather than the *'Why'* and *'How'.* He believed that all conscious experiences consist of ***sensations, images,*** **and** ***affective states.*** Titchener's approach came to be known as **structuralism,** as he was interested in studying the basic elements that combine to form the structure of mind, and behaviors. **Structuralism represents a tradition in psychology, which suggests that the structure of mind can be understood as the combination of simple events and elements**. The method for understanding mind's structure is introspection, which means asking the experiencing person to present a verbal report of his mental activity.

You can understand the basic features of structuralism, if you have ever asked a cook regarding the ingredients of a dish that you have liked. The dish contains so many different ingredients. In order to understand the nature of a dish, you need to familiarize yourself with its basic ingredients as reported by the cook. Similarly, the structuralists attempt to discover the basic elements of experience by asking the person to analyze his thoughts and provide a verbal description of what the contents of thought were like. Hence the method of introspection was considered as a vehicle for exploring the mental experiences of an individual.

Both Wundt and Titchner contributed immensely to the

development of modern psychology. But structuralism hardly stood the test of time. All the structuralists' ideas were criticized vehemently. First of all, reducing complex mental experiences to basic sensations was considered far too simple to describe human behaviour. Second, introspection was not truly a scientific method because (i) the person cannot experience his feelings and analyze his experiences at the same time; and (ii) there is no way of verifying whether the person's introspective report was truly genuine. Third, animals and mentally retarded persons cannot provide an introspective report of their conscious experiences. Finally, the introspection is a subjective experience and its truth-value cannot be ascertained by an independent observer. On all these grounds, structuralism fell into pieces. The fall of structuralism gave way to other emerging schools of thought. But the residues of structuralism even last till date. Psychologists in the modern era have once again turned their attention to the study and description of human consciousness. Structuralism that perished about 100 years ego has now reflections in the minds of modern psychological thinkers, though in a different form.

Functionalism. The model that largely replaced structuralism was known as functionalism. **William James** (1842-1910) agreed with Titchener that the study of consciousness must be the central theme of psychology. But James disagreed with structuralists' search for basic elements of mind. Rather **James emphasized that psychologists should study how the mind functions**. William James published a book titled *'Principles of Psychology'* in 1890, which promoted functionalism. James agreed that consciousness is an ongoing stream, a property of the mind that continually interacts with the environment. Through this interaction,

human beings learn to adapt to their environment. For James, the functions of mind were more important than the structures of mind. Thus, his system was rightly called as **'functionalism'.**

Functionalism was later developed by the American philosopher **John Dewey.** He applied the assumptions of functionalism in developing the field of school psychology and educational practices. As the functionalists studied the functions of consciousness, gradually their attention shifted to the learning process itself. They paid less attention to the study of consciousness, and more to the environmental conditions that facilitate mental functions.

Gestalt School. Gestalt psychology emerged in Germany as a revolt against structuralism. Later the gestalt psychologists criticized the reductionist approach of behaviorists like Watson. This school was founded by **Max Wertheimer** (1880-1943), and his colleagues **Kurt Koffka** (1886-1941), and **Wolfgang Kohler** (1887-1967). They disliked the '***brick and mortar***' psychology of the structuralists. The German word '***gestalt***' means '*form*' or '*configuration*'. This school believed that structuralists' analysis of mind into its component parts was wrong. On the other hand, mind functions as a 'whole' as it combines different units into a meaningful whole or pattern. Their slogan was ***'The whole is different from the sum of its parts'***.

The gestalt school focused on the study of how perception is organized. If we would analyze our perceptual experience into its component parts, we would miss the uniqueness or wholeness of our experience. The basic components that are combined to form perception produce something greater and more meaningful than the individual elements alone. **Gestalt psychologists provided the laws of perceptual organization and theories on insightful learning and productive thinking**.

Psychoanalysis. While psychologists elsewhere were busy with the study of conscious experience and observable behaviour, **Sigmund Freud** (1856-1939) in Vienna, Austria emphasized the role of unconscious motives and urges in shaping human behaviour. His school is regarded as *psychoanalysis.* Freud was a psychiatrist and saw his patients suffering immensely because of mental conflicts. The mental conflicts were manifested in the form of physical problems and abnormal behaviour.

Freud believed that **outward behaviour is motivated by inner forces and conflicts over which the person has little awareness and control**. Abnormal behaviours can be understood if we explore the contents of the unconscious. The methods used for studying the unconscious are *hypnosis, free-association,* and *dream analysis*. He used all these methods with his patients. When the patients were hypnotized and allowed to talk freely, they experienced some sense of relief. Dream analysis revealed the hidden wishes of the patients that lied in their unconscious. Freud understood the mind in terms of *conscious, sub-conscious,* and *unconscious* processes, and emphasized that the **'unconscious' primarily influences the 'conscious experience'**. He proposed concepts of *id, ego* and *super-ego* to understand and analyze the personality structures of individuals. **Alfred Adler, Carl Jung, and Erik Erikson** worked with Freud in the early years, but later, they developed their independent schools of thought. Freud's thinking was revolutionary. Even those who have never taken a course in psychology are aware of Freud's contribution.

Behaviorism. A revolution was made against the views on psychology held by both structuralists and functionalists, and a school was established in America by **J.B. Watson** (1878-1958). He argued that if psychology is to become a science, it

must completely reject all the philosophical ideas and concepts like soul, consciousness, or mind. He emphasized that **the subject matter of psychology should be observable behavior, and the methods to be used in psychology should be exactly like the methods used in pure sciences like physics and chemistry**. He rejected the method of *introspection* as too subjective and unverifiable. He defined psychology as the "**science of behavior**". By "behavior", he meant the activities of the organism as a whole in response to the environmental stimuli. He promoted ***stimulus-response (S-R) approach*** to the study of psychology. Watson was an extreme environmentalist, as he believed that environment solely determines behavior. He neglected the role of heredity in the growth and development of human personality. He emphasized the role of environment and said,

> "*Give me a dozen healthy infants, well-formed, ... and my own specified world to bring them up, and I will guarantee to take any one at random, and train him to become any type of specialist I might select..... doctor, lawyer, artist, merchant-chief, and yes, even beggar man and thief, regardless of his talents*."

The view of Watson marked a turning point in establishing psychology as a science. Later **Skinner** and **Hull** developed behaviorist ideas, and applied those in the field of learning. Watson's views were one-sided as he completely neglected the role of the organism in the process of development. He overemphasized the role of environment, and restricted the role of psychology to the study of observable behaviors. The man as the experiencing person was ignored by Watson. In spite of criticisms, Watson's contribution marks a significant period in the evolution of psychology.

Cognitive Revolution. An outline of the history of the development of psychology would remain incomplete without mentioning the contributions of Swiss scientist, **Jean Piaget**. His monumental theory of cognitive development, based on the observations mainly of his own children, has profound influence on contemporary developmental psychology. As a prolific writer, he published his first article in 1907, when he was only 10 years old, and since then, he has published more than 30 books and 200 articles. His theory of cognitive development has provoked hundreds of psychologists to carry out research on intellectual development of children.

He considered that human beings actively interpret information with the help of cognitive structures. Human beings, as behaviorists claimed, are not passive recipients of environmental stimulation. ***According to Piaget, human beings actively construct and organize knowledge, which helps them to adapt to their environment. His emphasis was on how children understand the world, and represent information in their minds****. To cater to the interest of the readers, the development of psychology in a broad historical timeframe is given in Figure 1.2.*

Present Status

The psychology today rests on stronger theoretical and applied grounds. The expansion is phenomenal. The current approach has inherited the ideas of earlier schools of thought. The different schools and perspectives are no more considered as presenting opposing views. Each school has its own strengths and contributions, and supplements the other. Many recent approaches and theories combine the strengths of several schools or perspectives.

The modern psychology places a great emphasis on cultural determinants of behaviour. As cultures vary, the

models used for understanding behaviour need a different orientation. Psychological theories are being developed, revised, and reconstructed to understand human behaviour across varied socio-cultural contexts. **The discipline of psychology has now been extended to cover almost every sphere of human activities**. With increasing technology and information, psychologists are facing new challenges to address the issues of global concerns as well as local realities.

Approaches to the Study of Psychology

Psychologists use a variety of approaches to study the behaviours and experiences. Each approach has its own points of view and assumptions. **Each approach defines a different area that is important for scientific analysis**. Our understanding of the roots of behaviors, experiences, and mental processes depends on our approach to the study of reality. While some believe that our behaviours depend largely on what happens in our body, others view that our behaviours are largely the result of inner urges that lie in the unconscious. For some, the observable behaviours are outcomes of our learning and constitute the primary subject matter of psychology. Still others believe that our thought processes primarily determine our way of interaction with the external world. Some contemporary psychologists focus on the unique personal experiences of the individual. The current emphasis is on the predominant role of culture in shaping human behaviour. Accordingly, there have been several approaches or perspectives to the study of behaviors and experiences.

Why are there so many approaches to psychology? Is one of them right, and others wrong? In a sense, all approaches are correct. We cannot fully accept one at the cost of the other. **Each one provides a valid, but different understanding**

of reality. The photographs of a person taken from different views are different, yet all of them represent the same person. By taking different views of the same person, we can develop a better understanding of the complete physical features of the person. Similarly, **all the different psychological approaches represent a portion of the reality with its unique emphasis on a particular dimension of behaviour**. Approaches are judged on the basis of whether they generate useful information. The different approaches discussed next are: (a) *biological*, (b) *behavioristic*, (c) *cognitive*, (d) *psychoanalytic*, (e) *humanistic*, and (f) *socio-cultural*.

Biological Approach

This approach attempts to understand behaviors and experiences in terms of biological structures and functions. In fact, the basis of behavior lies in the biological system of the organism. The behaviors not only emanate from the biological system, but they also influence the system. This approach analyzes behaviour at the molecular level in physical terms. In this approach, environmental influences are recognized, but the biological processes are considered more important. The biological approach studies brain processes, nervous system, functions of glands, genetic basis of behavior, biochemical and neural processes, role of instincts, and the influence of heredity. Simple and even complex forms of behaviors are considered to have critical biological components. The researchers use a variety of methods to study brain functions and the causes of abnormal behavior.

The biological approach, because of its precise and objective methods of investigation, has broad appeal. The methods adopted closely resemble those in natural sciences. This approach has made major contributions in treating people

with severe mental disorders.

Behavioristic Approach

This approach focuses only on those aspects of behavior, which can be directly observed, and the overwhelming influence of the environment in shaping those behaviors. This approach stands in sharp contrast to the biological, psychoanalytic, and cognitive approaches, which look inside the organism to determine the causes of behavior. On the other hand, behaviorists minimize the role of the organism, and look for the environmental factors that control behavior. **John B. Watson** was the first American psychologist to advocate the behavioristic approach. Other proponents have promoted similar kinds of views. Those who favor this approach are known as behaviorists. They optimistically believe that by controlling a person's environment, it is possible to train him to show any kind of desirable behavior. Behaviors which get rewards from the environment are strengthened and shown. Thus, by changing the reward system, we can change the behaviors of persons. There is no need to look within the organism to study his internal mental processes, because whatever these mental processes are, they would at one time manifest in the form of observable behaviors. Hence, behavior should be the primary focus of study for the psychologists. Behaviorists adopt experimental and observation methods for determining the environmental causes of behavior.

This approach has a lot of followers in modern psychology, because emphasis on observable behaviors continues till date. Behaviorists have made significant contributions in the field of learning, school educational practices, treatment of mental disorders, controlling aggression, and treating

causes of drug-addiction.

Cognitive Approach

This approach focuses on how people know, understand, and think about their world, and how their thoughts influence their behaviors. The proponents of this approach believe that people do not respond to the external events, but to their interpretation of those events. They propose that humans are active processors of information. They receive external information, process it stage by stage until they produce an output in the form of behavior. The cognitivists emphasize the study of mental processes, which people use in learning, perceiving, thinking, remembering, deciding, problem solving etc. These mental processes help us understand and react to our environment. Many forms of abnormal behaviors are the results of maladaptive thought processes. Those who think positively show successful adaptation to their environment. To help a person get rid of his abnormal behavior is to train him to change his thought processes. Only then he can improve his personality. In this approach, there is no emphasis on unconscious urges.

The cognitive psychologists use experimental method, sometimes with the help of sophisticated instruments, to make inferences about the internal mental processes. Cognitive approach has substantial influence in all aspects of psychology, particularly in social, developmental, and educational areas.

Psychoanalytic Approach

This approach is based on the belief that behavior is motivated by inner forces over which the individual has little control. It tries to understand the inner person. **Sigmund Freud** is called the father of the psychoanalytic

school, which advocates that the inner energies that help us act lie in the unconscious. It is these unconscious urges and motives that drive us to action. Each and every behavior has an unconscious basis. As such, the unconscious forces are to be uncovered so as to understand different forms of behavior. This approach emphasizes the understanding and the treatment of abnormal behaviors. We often notice people engaging in irrational behaviors of which they later feel guilty and ashamed. These behaviors are the primary focus of study for the psychoanalysts. Freud argued that the early childhood experiences and hereditary instincts fully determine the adult personality. Abnormal behaviors can be treated by resolving the early childhood conflicts. The psychoanalysts use *free association, dream analysis*, and *hypnosis* to understand and resolve unconscious conflicts.

The psychoanalytic model takes a negative view of human nature. Yet the approach has a very powerful appeal even for the non-psychology students. The psychoanalysts have contributed significantly to the understanding and treatment of mental disorders.

Humanistic Approach

This approach suggests that people are basically good and potential enough to make decisions about their lives and control their behaviors. Humanists reject the view that behavior is determined largely by biological functioning, or by unconscious processes, or by the environmental factors. Each person has his unique world of experience. In order to understand his world, one needs to respect his feelings and interpretations. Every behavior and experience is as good as the other. A behavior considered abnormal by us may be very normal for the experiencing person.

To help him move towards maturity is to accept his feelings with genuine regard. Thus, every one has the power to reach higher levels of maturity, if given the right opportunity. **Carl Rogers** feels that a person is disturbed if there is a big gap between what he is, and what he thinks he should be. The psychologists' job is to provide opportunities to the person so that he can make his own life choices, and use his free will for self-improvement.

More than any approach, this perspective stresses the role of psychology in enriching people's lives and helping them to achieve self-fulfillment. It deals with the whole person. It takes psychology beyond the boundaries of science to include valuable lessons from literature, history, art, and music.

Socio-Cultural Approach

This approach views that individuals' behaviors and mental processes are strongly influenced by the social and cultural system in which they live. As cultures differ, so also their behaviors and interpretations. An appreciable behavior in one culture may be considered abnormal in another. In order to understand behaviors completely, one needs to understand the socio-cultural factors that shape behavior. The Western psychology is predominantly unicultural in its focus. Recently, psychologists are advocating for multicultural perspectives so as to understand the behaviors of people who belong to different cultures. Only then we can understand their behaviors and help them adapt to their environment. The cross-cultural psychologists advocate the understanding of the unique influences of different cultures. Many national level policy and administrative considerations take into account a multicultural perspective while addressing the needs of people.

Psychology in Relation to Other Sciences

Psychology is a social science which studies behaviors and cognitive processes as determined by various biological, anthropological, sociological, and psychological factors. So psychology has close relationship with biological and social sciences. It draws from biology, physiology, anthropology, sociology, and medical sciences, to name only a few.

Psychology and Biology

Psychology is a science of behaviour, including both overt and covert activities. Biology studies the activities of all living beings, and its aim is to study how they grow, reproduce, and continue the life processes. Behaviour of man is the result of his interaction with the environment. So, the behaviour cannot be systematically studied without the knowledge of biological principles.

Biological sciences are related to physiology, which studies the functions of living organisms and biochemical basis of behavior. They are also related to neurology, which studies the brain processes, and the nervous system. There are new branches called ‘physiological psychology’ and ‘neuropsychology’. Physiologists study the functions of internal bodily organs, activities of glands, and the nature of respiration, blood circulation, and digestion. **All these activities are related to behaviors, as biological and psychological systems are interdependent**. Further, the biological sciences have relations with ‘Genetics’ that studies the hereditary processes, and ‘Embryology’ which studies the

growth and development of the organism before birth.

Though psychology has close relationship with biology, yet both differ in terms of their emphasis. The primary focus of a biologist is to study the structures and functions of the bodily organs. Psychology emphasizes the study of mental processes and behaviors as they are shaped by the biological structures and functions. In spite of some overlapping concern, each discipline maintains its unique emphasis.

Psychology and Anthropology

Psychology has relationship with anthropology or the "*science of man*". Anthropology studies the history of human race, the physical evolution of mankind, and the development of human civilization. It is concerned with the social problems of primitive man and their culture, tradition, customs, and manners. Psychology studies how these cultural factors influence the human behaviour. **Particularly, the cross-cultural psychologists draw from the knowledge base of the anthropologists to understand the unique features and influences of a culture**. They use the methods of the anthropologists. So the study of anthropology facilitates the study of psychology. Similarly, the knowledge of abnormal and social psychology helps the anthropologists in explaining the man, his religion, and culture. Moreover, psychological techniques are applied for the comparative study of culture. Thus, there is a close relationship between anthropology and psychology. The relationships among anthropology, sociology and psychology are so close that they are classified under the discipline of "Behavioral Sciences".

Psychology and Sociology

Psychology is related to sociology and both the branches of knowledge belong to one discipline called social science.

Sociology studies the laws that govern the development and functioning of different kinds of groups like political, social, economic, and religious. It emphasizes the observable characteristics of group structure and group functions. Psychology studies the activities of the individual and a group is formed by several individuals. **Sociology studies the group behaviour, and its influence on individual behaviour**. Knowledge of individual behaviour helps to understand the group behaviour and the knowledge of group behaviour helps to analyze and interpret the individual behaviour. Psychology studies the behaviour of the individual and sociology studies the role of individual in group activities, and group structure. So sociology and psychology are closely related.

Psychology and Medical Science

Psychology has close relationship with medical science. Knowledge of psychology helps the physicians in the treatment of certain diseases like peptic ulcer, asthma, migraine headache etc., which are called psycho-physiological disorders. **In this modern age, physicians admit that most physical diseases emanate from psychological disturbances, and are therefore, psycho-physiological in nature**. We cannot understand and treat a disease without recognizing the emotional conflicts that patients go through. Certain degree

of psychological help and counseling are necessary for helping patients face their physical problems and recover from their illness. Similarly the knowledge of certain physical diseases and the functioning of bodily organs help the psychologists to understand human behaviors. A psychiatrist, who treats the psychological disorders, examines the physical health conditions of the patients. So psychology and medical science are closely related.

Fields of Psychology

Psychology has expanded its scope in modern times. Within the discipline, several sub-fields have emerged. Each sub-field has its assumptions, theories, methods of inquiry, and applications. In many academic institutions, psychology constitutes one department, but psychologists differ in their interests, choice of the subjects, and the degree to which they are involved in the application of psychology in solving life's problems. In order to know the wide range of interests of the psychologists, one needs to acquaint oneself with varied branches of psychology. Some of the contemporary fields of psychology are discussed below.

Physiological and Comparative Psychology

Physiological and Comparative Psychology share a great deal in common. As such, it is offered as a field of specialization in many educational institutions. Experiments conducted in physiology influenced the development of scientific psychology. By now, you know that mental activities are influenced by physiological structures and functions. ***Physiological psychology primarily emphasizes the study of biological structures and functions, and their role in shaping behaviors***. The physiological psychologists study how the brain, the nervous system, the glands, and the

sense organs influence mental activities.

The comparative psychology deals with the similarities and differences in the behaviors of animals belonging to different species. The major issues in these two areas include neural basis of behavior, heredity and instincts, behavior genetics, evolution of behavior, sleeping, eating, and drinking behaviors, states of consciousness, the functions of nervous and glandular systems, neuropsychology, and the effects of drugs. Experimental and observational methods are used to gain knowledge about different physiological subsystems and the behaviors of different species.

Educational Psychology

It is concerned with applying the general principles of psychology in educational settings with a purpose to improve the quality of the educational process and learner's achievement. The educational psychologists are concerned more with the learning, memory, and motivational processes of the learner. There is a felt need to attend to the needs of the students with different disabilities. Educational psychologists provide them special educational practices. They study teacher and learner characteristics, the instructional climate in the school, issues of classroom management, effectiveness of different evaluation systems, and the individual differences among students. The focus is on training teachers to address the educational needs of the students, creating a conducive educational climate, and counseling and guiding students for scholastic and career advancement. Evaluation of student performance is one of the major interests of educational psychologists. In the present system, education of children with special needs has become a prime concern of the educational and school psychologists.

Child and Developmental Psychology

Developmental psychologists study the physical and mental development of human beings from the time of conception till old age. Child psychology is a part of the developmental psychology as it studies the growth and development of the child from conception till adolescence. Studying the child is helpful for understanding adult behaviors, as most of the adult personality and behaviors are the results of childhood experiences. Moreover, the development is much faster in the early years than later years of life. Both the developmental and child psychologists have similar interests except that child psychologists confine themselves to in-depth study of the behaviors during the early part of human life.

The developmental psychologists study the cognitive, emotional, and motivational development during the entire life span of the individual. It covers all the life-span stages such as infancy, childhood, adolescence, adulthood, and old age. This field focuses on the developmental changes in perception, learning, thinking, emotion, language skills, personality, and social relationships. For each stage of development, it identifies the needs and the challenges faced by the individual. It also studies the developmental pattern of special groups of people. Child psychology studies the same basic psychological processes in children emphasizing the role of heredity and environment in shaping behaviors in the early years of life. Child psychologists help parents and teachers in providing guidance for children's development and education.

Industrial and Organizational Psychology

Psychology has enormous application potentials in industry and organizational sectors. In modern times, most people earn their living by working in industries and business

organizations. The output in the business sector largely depends upon the efficiency and motivation of the employees. If the human resources in the organizational sectors are not properly cultivated, the productivity will decrease in spite of modern technology, and sophisticated equipments. ***This branch applies the principles of psychology in the workplace to improve employee and organizational effectiveness***. Hence, it is one of the very popular branches of psychology. The industrial psychologists study the employer-employee relationship, the causes and prevention of accidents, the morale of the employees, problems of absenteeism and labor strikes, the effectiveness of financial and non-financial incentives, and the factors influencing the work efficiency of the employees.

Organizational psychologists apply psychological principles in selection of employees, training and counseling employees, improving their work motivation, managing conflicts, and improving the total organizational culture. The human aspects and its mobilization for improving organizational effectiveness constitute the major aim of the organizational psychologists.

Abnormal Psychology

Understanding maladaptive behaviour in human beings has a long history. However, formal introduction of abnormal psychology as a new branch of psychological inquiry dates back to Sigmund Freud's discovery of the unconscious. As one of the most sophisticated and specialized branch of psychology, ***abnormal psychology seeks to describe, explain, predict, and control behaviours that are considered strange, maladaptive, or unusual***. Its subject matter consists of studying a range of behaviours that depart from some norm,

and harm the affected individual and others. These behaviour anomalies range from simple adjustment problems, neurotic behaviour, anxiety problems, and socio-emotional disorientation to severe psychotic disorders of schizophrenia and manic-depressive psychosis. The purpose of abnormal psychology lies in the classification of various mental disorders, locating and explaining their etiology, preparing tests and instruments for their assessment, and finally, making provisions for treatment. Mental health problems are widespread in the contemporary societies. Therefore, abnormal psychology takes up a new assignment of prevention of mental disorder by planning out mental health programmes and counseling services.

Now-a-days, psycho-physiological disorders are a major concern of the abnormal psychologists. Hypertension, asthma, peptic ulcer, migraine etc. are happening to people in a very large scale. Medical practitioners also try to find out a psychological root in almost every physical disease.

Social Psychology

This branch focuses on the nature and causes of individual behavior in social settings. ***The principles of general psychology are applied in social situations to understand how society, social groups, and the behavior of others affect the individual's behavior***. Social psychologists study how we perceive other people, and how our social perceptions influence our behavior. They study group formation and functions, formation and change of attitudes, spread of rumors, nature of social prejudice, interpersonal attraction, leadership functions, propaganda and public opinion, social motivation, and inter-group relations. Their interest overlaps considerably with that of the sociologists. While the focus of the social psychologists is on the

individual, sociologists are primarily concerned with studying societal institutions.

Cognitive Psychology

Cognition refers to all the psychological processes used for acquiring knowledge about the environment. ***Cognitive psychology studies how individuals acquire, store, transform, evaluate, and use information***. The study of cognitive processes is included in the basic definition of psychology. The major cognitive processes include attention, perception, learning, memory, reasoning, thinking, decision-making, problem solving, and language learning. As you may see, all these processes are used in our everyday life situations. Cognitive psychologists rely heavily on experimental methods in laboratory settings. They work in collaboration with neuroscientists and computer scientists. Research in cognitive psychology generates laws and principles that are meaningfully applied to understand individuals' behaviors in other settings.

Health Psychology

Health psychologists explore the relationships between psychological factors and physical ailments or diseases. There is a growing awareness among doctors that almost all physical ailments have a psychological base. Health psychologists study how psychological factors (e.g., stress, tension, anxiety, unsupportive home conditions etc.) lead to physical illness. They deal with methods and strategies to promote awareness among people regarding their health. They create community awareness for avoiding unhealthy practices such as smoking and drinking, and promote behaviors related to good health. Health psychologists contribute immensely to modern health care and disease prevention.

Environmental Psychology

It deals with human behaviour as influenced by the physical characteristics of the environment they live in. ***The environmental psychologists study how the physical environment and the living conditions affect our emotions, inter-personal interactions and the behavioral dispositions***. They examine the influence of the environmental stressors like noise, pollution, crowding, heat, and humidity. In modern times, they focus on the effects of population explosion, disposal of waste matters, nuclear radiation, climatic changes, and the physical resources of the community. This discipline is assuming increasing significance in modern times.

Sports Psychology

This branch investigates the application of psychology in sports and athletic activities in order to understand how sports performance is influenced by psychological factors, and what can be done to promote sports performance. It studies the role of motivation, the social aspects of sports, the influence of training on athletic activities, and the effect of different forms of physical exercises on muscle development. In recent years, quite a good member of sports psychologists are involved in training sports persons for the Olympic and other international competitions.

Counseling Psychology

The counseling psychologists are trained professionals whose primary focus is to help and guide persons experiencing mild personal, emotional, and social problems. This branch has many overlapping concerns with the field of clinical psychology. A large number of clinical and counseling psychologists are employed in hospitals, clinics, and educational and vocational institutions. In many cases,

they work in close association with the psychiatrists in treating people with severe emotional disturbances. While psychiatrists treat patients with drugs, counseling psychologists use a variety of cognitive and behavioral management techniques to help clients for achieving personal effectiveness.

Cross-Cultural Psychology

The cross-cultural psychologists study how social and cultural contexts influence human behavior. As cultures differ, so also the nature and interpretations of human behavior. Behaviors judged normal in one culture may be judged as undesirable in another culture. This branch of psychology examines all aspects of cultural determinants of behavior. The cross-cultural psychologists rely heavily on observational and ethnographic methods to understand culture's unique ways of child rearing and socialization practices. They attempt to understand those aspects of human behaviors that help people adapt to their cultural environment.

Community Psychology

This branch is concerned with the application of psychological principles for solving social problems arising in community life. Unhealthy relationships among the different groups in a community, and frustrations resulting from unemployment etc. are some of the problems of community life, which are dealt by community psychologists. They also work for educating the public to adjust with other members of the community, and develop a sense of oneness for a healthy community life.

Other fields

Besides the fields of specializations mentioned above, many other new branches of psychology have emerged in recent times in response to the needs of the people and the institutions. These new trends include rural psychology, cultural psychology, political psychology, work psychology, neuropsychology, forensic psychology, rehabilitation psychology, engineering psychology, peace psychology, managerial psychology, personnel psychology, behavioral psychology, legal psychology, space psychology, aviation psychology, and medical psychology. The interests of the psychologists have been so varied that they offer special courses, and Masters and Ph.D. level courses in different areas of specialization.

KEY TERMS

Psychology	*Response*
Structuralism	*Functionalism*
Psychoanalysis	*Stimulus*
Cognition	Introspection
Gestalt	*Behaviorism*

SUMMARY

1. *Psychology may be defined as the scientific study of behaviors, experiences and mental processes with reference to the socio-cultural environment*. This recent most definition departs from its earlier definitions as ‘science of soul’, ‘science of mind’, ‘science of man’, ‘science of

Chapter 2

METHODS USED IN PSYCHOLOGY

This chapter covers :

a) Experimental Method

b) Observational Methods

- **i)** Participant
- **ii)** Non-participant
- **iii)** Naturalistic
- **iv)** Subjective

After you go through this chapter, you would be able to :

- *Appreciate the scientific temper of the methods used in psychology.*
- *Describe the important features of the experimental method.*
- *Know various types of observational methods.*
- *Understand the importance of correlational and case-study methods.*
- *Appreciate the strengths and limitations of different methods of enquiry.*

CONTENTS

Chapter 2

Methods Used in Psychology

Introduction

Psychology, as a science, uses methods that are systematic and objective, and produce verifiable findings. Whether a branch of knowledge can be called a science or not depends on the methods it uses to study its specific subject matter. So every science has its methods of study to suit its subject matter. Like all other sciences, psychology has also developed its own methods. A study of historical development of psychology shows that scientific methods were not used when it was treated as a branch of philosophy. But psychology began to claim the status of a science with the establishment of first psychological laboratory at Leipzig by Wilhelm Wundt in 1879. **Some of the important methods used in psychology are observation, experimental method, correlational method, and case-history method**, which are discussed next.

Observational Methods

Every science is based on observation of facts, and hence, observational methods are most common to every discipline of science. Like all other sciences, psychology also uses observational methods to study its subject matter. **Observation can be objective or subjective**. In objective observation, a single observer or a number of observers can observe, whose findings can be cross-checked, and verified. It is possible for a common man to observe the external or overt activities, and this type of observation is *objective observation*. But when a person feels pain, hunger, or fatigue, it is not possible for others to observe these experiences that are internal to him. Only the person himself can be aware of these experiences and can observe himself. Such type of observation is called *subjective observation*, which is otherwise known as *introspection*. Psychology studies both overt and covert activities using objective and subjective observations, respectively. Observation can be made either in the laboratory by creating an artificial situation, or can be made in natural settings, where the events take place. Observing occurrence of events in the natural settings is called *naturalistic observation*.

The literal meaning of observation is clear perception of some objects or events. Observation forms the basis of any scientific enquiry. Scientific observation cannot be regarded as just a simple perception of a layman. When some objects or events are observed in a scientific manner, these objects or events are examined systematically. Objective observation is concerned with the events of the external world. Psychologists use objective observation to study the overt activities of the organism. The subjective observation, called introspection, asks a person to look within, and report his mental experiences. Both the methods have considerable utility in psychology. Recently, many psychological instruments are used to record the inner experiences. Yet the observational methods have their own advantages.

The observation may take place in the artificial setting of a laboratory *(**laboratory observation**),* or in the natural field settings *(**naturalistic observation**).* The observer may be a part of the situation to be observed *(**participant observation**),* or may observe from a distance without being a part of the event *(**non-participant observation**).* The observer may study the outward activities of other persons in a systematic manner *(**objective observation**), or* may observe himself by looking within to analyze his thought processes *(**subjective observation**).* Depending on how and where the observation takes place and for what purpose, there are different kinds of observational methods. A few observational methods are discussed below.

Naturalistic Observation

A systematic study of behaviour in the natural settings is called naturalistic observation. It is very critical to the development of scientific knowledge. Behaviours which otherwise cannot be observed in experimental settings can be studied through naturalistic observation. The researcher takes a passive role and simply records what occurs. For example, a bird-watcher may observe the behaviours of birds in a forest. A social psychologist may observe how a crowd is formed, and how people behave in a crowd. Psychologists interested in studying animals may observe the social behaviour of monkeys. In each case, the researcher does not intervene in the phenomenon.

The advantage of naturalistic observation is obvious. We get a real picture of what people do in their natural habitat. The major limitation of this method is that the researcher cannot control any of the factors of interest. Too many extraneous factors influence the

phenomenon. In order to observe an event, the researcher will have to wait until the appropriate event takes place. If people know that they are watched, they may also alter their behaviour, which may not be truly representative of their natural set of behaviours. Therefore, many researchers take recourse to laboratory observation, in which the investigator observes the behaviors of interest under controlled laboratory conditions.

Participant Observation

While conducting observations, the investigator may take the role of either a participant or non-participant observer. ***In participant observation, the investigator actively participates in the group activities, and thereby, becomes a part of the situation that is observed***. Anthropologists make extensive use of participant observation in studying the behaviors of and cultural practices of tribal groups. They believe that a phenomenon can be best understood only when the researcher experiences the situation by himself. Even in a laboratory set up, when a researcher administers a test to a subject, his observation of the subject's behaviour can best be described as participant observation. Teacher's observation of students' behaviour in the classroom and observation of your friend's behaviour in a social get-together are examples of participant observation.

The participant observation can be ***overt*** in which the subjects know that they are being observed or ***covert*** in which the researcher disguises his identity and acts like any other participant. Covert participant observation yields more meaningful data, but can be criticized on ethical grounds. The overt participant observation has a major drawback of not assessing the true picture of activities, as the subjects would change their activities in the presence of the observer.

Non-participant Observation

In non-participant observation, researcher observes the phenomenon from a distance without participating in the activities. Naturalistic observation is a form of non-participant observation. **The researcher takes care to see that he exerts minimal impact on the situation being observed**. There are occasions when non-participant observation is not possible. In order to observe the marriage customs and marital life in a tribal society, it is not possible to stand back and observe the process. The subtle and sensitive aspects of a situation would only be available to a participant observer. The nature of observation would depend on the interest and requirement of the researcher.

Subjective Observation (Introspection)

In subjective observation, which is also called introspection,* a *person observes his own mental activities. Introspection literally means, "**looking within**". It means getting insight into one's own mental activities. In introspection, a person perceives, analyses, and gives a report of his own feelings and experiences. **Although introspection is self-observation, all self-observations are not introspection**. A person may keep his hand on his forehead and report that he his having temperature, and is suffering from fever. This is not introspection, but self-examination. Introspection is a type of self-observation in which a person perceives his mental activities.

Introspection method was introduced by **Wundt** and was popularized by E.B. Titchener, the founder of structuralism. Wundt viewed that psychology is a science of mental contents and Titchener defined psychology as the "science of consciousness or mind." So, both psychologists accepted mental activities as the subject matter of psychology, and accordingly, they used introspection as the method of study. For this reason, Titchener's system is sometimes called as "*Introspectionism*". He said that observation is a method common to all sciences and introspection is a form of observation. But introspection requires two tasks to be done simultaneously, i.e., to engage in a mental activity, and also to look within to analyze the contents of this mental activity. The person has to be trained to introspect. Wundt trained his subjects with a minimum of 10,000 practice trials to be able to introspect. Thus introspection requires hard work and considerable effort on the part of the person who would introspect himself.

The **introspection method** has merits as well as limitations. First, let us consider the ***advantages***.

a) It is an easy and simple method and provides direct observation of mental processes. By other scientific methods, the mental processes cannot be directly observed since those are purely private and personal experiences. ***Introspection is the only method by which the person can be directly aware of his own experiences***.

b) While using experimental method to study the mental activities, laboratory and scientific instruments are required. But for the use of introspection method, no laboratory or test materials are required. ***So introspection method can be used at any time and at any place***.

c) ***The subjective observation method provides an opportunity to check the results obtained through other methods***. For example, the general finding is that the pleasant materials are better remembered than the unpleasant ones. Suppose, in an experiment the results suggested that the unpleasant materials were better remembered than the pleasant materials. The reason for this unexpected finding can be found from the introspective report given by the subject. The subject might have reported that he was inattentive or mentally disturbed or feeling unwell when the pleasant materials were presented to him. Here the introspective report would be helpful in explaining the results.

In spite of some advantages, the method of introspection or subjective observation has some ***limitations.***

a) The observer is expected to perform two mental activities simultaneously. He experiences his mental processes, and at the same time analyzes what these experiences were like. ***At the same time, he acts as the 'observed', and the 'observer'***. Obviously, his mental experiences would be distorted, and not reflect the true nature of mental activities.

b) ***The subjective observational report lacks objectivity, as the verbal report of the subject cannot be verified by other scientists***. Furthermore, the experiences of one person cannot be generalized to understand the mental activity of another person. A universal principle concerning the mental processes cannot be stated, as mental processes would differ from person to person. Thus, the method lacks scientific validity.

c) ***Most persons would not like to reveal their private experiences such as the feelings of guilt and shame***. The report in such cases would be distorted

d) The method of subjective observation cannot be applied to the study of the mental activities of the animals, children, insane, and persons having language disabilities. The behaviors of these subjects are of interest to the psychologists. ***Thus, introspection has only a limited applicability***.

e) ***The unconscious experiences cannot be accessed through introspection***. The psychoanalytic school founded by Freud argues that most of human behaviors are influenced by the unconscious motives and urges. A person cannot observe

his unconscious mental processes, which means that the method of subjective observation leaves out a large chunk of relevant mental experiences.

Some psychologists have suggested that the inherent difficulties with the method of subjective observation can be overcome by observing the mental process after it ends. This is known as "**retrospection**", or backward introspection. In retrospection, one is asked to give a report about his mental process after the mental activity ends. In case of anger or fear, he will give a report about his experiences after the anger or fear responses end. He will be asked to recall the experiences immediately after the anger or fear responses and will give a report. But Titchener and others did not give importance to this type of post-mortem examination. It was viewed that retrospection is not actual observation of the mental process, but simply the recall of experiences and analysis of memory. Such reports cannot be taken as accurate.

In spite of the above-mentioned limitations, introspection method is still used as a method in psychology, because it is the only method that provides direct observation of mental processes.

Advantages of Observational Methods

a) ***Observation forms the basis of any scientific enquiry***. It is the primary mode of acquiring knowledge about the environment. Through systematic observation, and a process of induction, the investigator forms hypotheses, which are tested later by using experimental methods.

b) ***The results obtained through any other scientific method need to be in conformity with the outcomes of skilled observation***. In case of any departure, the processes adopted in the 'other' methods have to be carefully scrutinized and evaluated.

c) The experimental and other laboratory-based methods study behaviors under artificially controlled conditions. But through observational method, the investigator gets a real picture of the behaviors and the events as they manifest in natural settings. ***Systematic and unbiased observation can yield a true picture of individual's natural set of behaviors***.

d) ***Certain phenomena can be accessed and properly understood only through observation***. Crowd behavior, social behaviors of the animals, and mother-child

interaction at home are some exemplary situations, which can be meaningfully assessed and understood only through observation.

Limitations of Observational Methods

a) The major problem with the observational methods is that ***the investigator has little control over the situation he is interested to observe***. In the natural setting, too many extraneous factors influence the phenomenon. As a result, it is difficult to assess what causes or determines the behaviors of researcher's interest. It is extremely difficult, and sometimes impossible to establish cause-and-effect relationships in our understanding of the behaviors. The observational report in most cases turns out to be descriptions of events rather than explanations for the event that can be used for prediction and control.

b) In many cases the observer has to wait until the appropriate event takes place. To study crowd behavior, the investigator would have to wait until a crowd is formed in a natural setting. ***Therefore, some types of observations are time-consuming, and labor-intensive***.

c) ***Observer-bias is one of the important problems in observational research***. The personal philosophy, attitudes, beliefs, convictions, and sometimes the personal interests of the observer are most likely to color his perceptions of the event. His observational report may in part reflect his biases in describing and interpreting the event. Thus, the description may not reflect the true features of an event.

d) ***The observer himself may be affected during the process of observation.*** His initial neutral disposition may be affected and distorted. The outcome would be a description of the event as personally experienced by the observer. These descriptions would be subjective, and cannot be generalized to other similar situations.

e) ***Finally, the presence of the observer may influence the phenomenon itself***. In other words, those subjects who are observed may change their activities in the presence of the observer. As a result, the observer would fail to obtain a true picture of subject's behaviors, i.e., those behaviors that would have taken place, if the observer would not have been present. It is always better to supplement the observational record with the findings obtained through other methods.

Experimental Method

Establishment of the first psychological laboratory at the Leipzig University in the year 1879 certified the use of experimental method in psychology. Physiological psychologists already prepared the ground work for the experimental method in their efforts to analyze and understand psychological processes involved in sensation, attention, perception, feelings, images, and so on. Further impetus to the use of experimental method was provided by the psychophysical experiments, which recognized that the relationship between stimulus and the corresponding sensory experience could be studied in a laboratory setting. Hermann Ebbinghaus's discovery of nonsense syllables and his series of experiments on memory opened a new era in the history of experimental psychology. The classic experiments of E.L. Thorndike, I.P. Pavlov, B.F. Skinner, and W.G. Kohler ensured that the experimental method could be meaningfully applied to the study of behaviors. By the turn of the 21st century, the use of the experimental method was diversified, and was considered as the predominant method of understanding, explaining, and predicting the psychological processes.

Experimental method is a method in which the investigator systematically manipulates one or more variables to study their effects on other variables in a carefully controlled laboratory setting. Manipulation of variables is made according to a schedule, which is called the design of the experiment. A number of such experimental designs are developed to deal with the queries of psychology. The experimental method is used either to collect data, or to explore a relationship, or to test a hypothesis. If the experimenter wants to explore or find out what would happen by introducing a variable, it is called an "exploratory experiment". If he wants to test a hypothesis or supposition made on the basis of findings of experiments conducted earlier, it is called a "confirmatory experiment". A hypothesis is formed on the basis of knowledge available from previous experiments. Usually, hypotheses are not formed relating to exploratory experiments because no provisional answer to the problem under investigation is available in the past studies. But in a confirmatory experiment, there is a definite hypothesis.

Variables

Experimental method uses variables. ***A variable is a fact or a phenomenon within or outside the organism that evokes a response in the organism and can***

take on different values. The response evoked through the process is also a variable. In the context of an experiment, variables are defined as *independent variables, dependent variables,* and *controlled variables*.

Independent Variable

The purpose of an experiment is to find out whether changes in one variable (say, X) cause changes in another variable (say, Y). Here 'X' is referred to as the *independent variable*, and 'Y' as *the dependent variable*. Thus, independent variable is the variable that is systematically altered in an experiment. While designing an experiment, attempt is made to control the situations in such a manner that a meaningful relationship can be explored between the *antecedents* and *consequences*. Antecedents are the conditions that are present in the environment or in the organism. Those are referred to as the independent variables, when the experimenter manipulates them in an experimental setting. In the words of Ghorpade, ***"An independent variable is one that can be introduced, varied, or removed by the experimenter in order to study its effect on the phenomena he studies."*** When the experimenter introduces the independent variable, the response of the subject begins. When he changes the independent variable, the subject's response changes and as he removes the independent variable, the response no longer occurs. So independent variable is the cause for the response to occur. In an ideal psychological experiment, there is usually one independent variable. If there are more independent variables in an experiment, complex experimental designs are used to study them.

Dependent Variable

The dependent variable in an experiment is the performance or response of the subject. It is the aspect of behaviour that is measured in an experiment. This is so called, because it depends on the independent variable. For example, an experiment is designed to study the effect of alcohol on memory. Here, alcohol intake is the independent variable, and the score on a memory test is the dependent variable. Precisely, dependent variable is the result of an experiment. Changes in the dependent variable occur due to manipulation of the independent variable. The dependent variable is also called the "**response variable**". In a graphical presentation of the result, the independent variable is plotted along the OX axis or abscissa and dependent variable is plotted along the OY axis or ordinate.

Controlled Variable

In the context of an experiment, there may be variables other than the independent variable, which are likely to influence the response of the subject. The experimenter does not allow those variables to influence the result. He, therefore, keeps those variables same throughout the experiment either by keeping them constant or by neutralizing them through counter-balanced designs. For example, in studying the effect of alcohol on memory, alcohol intake is the independent variable. But the amount of materials, nature of materials, method of learning etc. are the other variables, which are likely to influence the result. These variables are called "*controlled variables*". ***Thus, controlled variables are the relevant variables in an experiment whose effects on the dependent variable are neutralized***

Control-Group Design

Control-group design is a simple form of experimental design. In such an experiment, two similar groups of subjects are used, one as the **Experimental Group** and other as the **Control Group** (see Figure 2.1). Independent variable is administered to the subjects of the Experimental Group, and it is not administered to the subjects of Control Group. Finally, the performances of the subjects in the Experimental Group and the Control Group are compared. Suppose an experiment is conducted to study the effect of alcohol on memory. The experimenter may take two groups of subjects, consisting of equal number of people, belonging to the same sex, and age group and having roughly the same learning ability. The subjects in Group-A (Control Group) are not be given alcohol, i.e., the independent variable and the subjects in Group-B (Experimental Group) are given alcohol. Then a test of memory is administered to both the groups and their performance on the memory task may be compared. The differences in their performance may be attributed to the intake of alcohol.

But sometimes it is difficult to match the subjects of Control and Experimental groups. The experimenter will match the subjects on a number of factors, which are considered relevant and then randomly select them into either the Control Group or the Experimental Group.

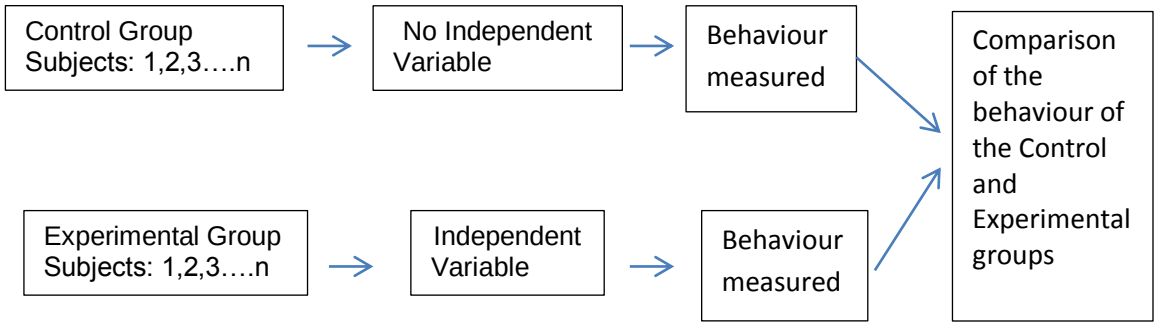


Figure 2.1 : *The design of a control-group experiment*

Controlling Extraneous Variables

The goal of the experimenter is to obtain precise answers to research questions. The dependent measure is susceptible to the influences of many variables other than the independent variable. These other variables are called **extraneous variables**. In order to determine the influence of the independent variable on the dependent variable, all other variables likely to exercise a potential influence need to be controlled. These relevant but extraneous variables may be organismic, situational, or sequential in nature. The subject related variables such as sex, personality, intelligence etc. are organismic variables. The situational variables include the environmental factors operating in the experimental setting such as temperature, physical arrangement in the laboratory, humidity, noise etc. The sequential variables relate to the sequence of different conditions the subject experiences. Exposure of the subject to one treatment condition may influence his response in later conditions. Moreover, the exposure to multiple treatment conditions may result in practice or fatigue that would unduly distort the dependent variable. There is a felt need for controlling the influence of the extraneous variables. The experimenter can achieve this by following one or some of the important techniques discussed below.

1. **Holding variables constant**: One way of controlling for the effects of the extraneous variables is ***to hold them constant for all subjects and all treatment conditions***. Through this, the experimenter ensures that their effects remain the same for all the experimental conditions, so that differences, if any, in the dependent variable can be attributed to variations in the independent variable.

2. Eliminating: The experimenter may eliminate those variables from the experimental settings, possible. But in some cases, elimination is not

possible. In such situations, the experimenter may attempt to hold them constant for all conditions.

3. **Matching**: Particularly for the organismic variables, the experimenter may ***select subjects who are matched on relevant variables of interest***. This procedure is known as *matching.*

4. **Random assignment**: The experimenter is best placed by ***randomly assigning subjects to different groups***. Through this, the experimenter eliminates the possibility of any systematic differences between groups.

5. **Counterbalancing**: If there are two or more experimental conditions, ***the order in which the subject is given the conditions can be counterbalanced***. These designs are called counter-balanced designs. Suppose thirty subjects are to go through two experimental conditions, half of the subjects may receive the first condition followed by the second, where as the other half would receive the second condition followed by the first. Counter-balanced design eliminates the effect of the order of the conditions on the dependent variable.

Steps in Experimental Method

The investigator goes through a series of steps systematically in using the experimental method, which are discussed below.

1. ***Stating the research question.*** The initial step is to identify the problem to be investigated, and state the problem in the form of a question. The research question gives direction to the study. In fact, a question well stated makes the rest of the tasks easier for the researcher. It is said that a question well asked is half answered.

2. ***Formulating hypothesis.*** The hypothesis is a tentative statement of the expected relationship between two or more variables. Variables refer to any measurable attribute of an object or organism that varies. First of all, the variables may be clearly defined and their relationships be stated in the form of hypotheses. In a learning experiment, the hypothesis may be, "*Those who are given feedback on their performance would require lesser number of trials to learn compared to those who are not given any feedback."* The hypothesis gives direction to the research.

They are derived from the findings of earlier research, existing theories, and researcher's observation, and personal experiences.

3. ***Designing the experiment.*** This is a very critical step in experimental research, where the researcher will have to decide how exactly he is going to perform the experiment. The important questions to be addressed at this step are: (a) How would the independent variable be manipulated? (b) What would be the different conditions of the experiment? (c) How would these conditions be ordered? and (d) How would the extraneous variables be controlled? These general questions and any others relating to a specific experiment is to be addressed.

4. ***Data Collection.*** Once the experiment is designed, the actual empirical part begins. The experimenter collects information on the variables of interest, mostly in a quantitative form. The focus is on obtaining information on the dependent variable and in some cases on the independent variables. The subjects are given clear instructions to run through the experiment and necessary empirical data are collected by using scientific instruments or tools prepared by the experimenter. Subject's overt activities considered relevant for the experimental purpose are recorded. Introspective reports, if considered necessary, are taken to facilitate interpretation of unexpected results later.

5. ***Data Analysis and Interpretation.*** The researcher has to make meaning of the data he has collected. In the raw score form, the data would not be easy to comprehend. The data need to be compiled into a proper form, and then analyzed statistically or qualitatively to throw light on the problem and hypotheses of the study. After data analysis, the researcher would be able to know if the hypothesis was confirmed.

6. ***Preparing Report and Publication.*** The findings of the research should be shared with the scientific community. A very well conducted research would be of little help for the advancement of knowledge, if its findings were not shared with colleagues with similar scientific interests. Hence the researcher prepares a report according to the guidelines specific to a discipline and publishes it on personal initiative or submits it to a scientific journal. Through this, knowledge gained from a single research is shared with a wider audience.

Advantages

1. The experimental method, in many respects, ***is the best way of gathering scientific information*** that is the information, which is *empirical, reliable, systematic*, and *verifiable*. It is possible because the experimenter plans his research carefully and makes observations under controlled conditions so as to eliminate the influence of extraneous variables.

2. Among all the methods, ***the experimental method exercises greater control over the independent variable***. The researcher can manipulate the independent variable as he wishes in order to examine its effect on the dependent variable. In doing so, the experimenter attempts to determine the cause and effect relationships among the variables.

3. Since, the method is clearly laid out, one can replicate the experiment elsewhere to examine whether similar results are obtained. It is not wise to draw conclusions from a single experiment. In fact, several experiments by different investigators should be conducted to arrive at a universal principle. ***The steps in experimental method are so clearly laid out that many experimenters can repeat the same procedures with a high degree of exactness***.

4. ***The method is so objective that there is a very little scope for the experimenter's bias and personal opinions to affect the results***. Use of modern equipments and technological devices to record the behavior of the subjects eliminates, in a large measure, the role of experimenter's personal opinion and competence in influencing the outcome of the study.

Limitations

1. The major drawback of the experimental method is that ***the behavior is often studied in an artificial environment under controlled conditions***. The more the conditions are controlled, the more the artificiality. Thus the behavior observed in a laboratory set up is a distortion of what would naturally occur. Because of this artificiality, it is difficult to generalize the experimental findings to the natural world settings.

2. ***Certain events and phenomena cannot be accessed through experimental methods***. This method cannot be applied in situations that may be considered

dangerous, painful, or unethical for the subjects. Obviously, children cannot be given severe punishment in order to determine how severe punishment influences conformity behaviors in children. Such practices are unethical and punishable under law.

3. The research subjects know that they are in an experiment, and are being tested and measured. They react to this awareness by trying to please (or displease) the researcher, guess the purpose of research, and behave in a way that is different from their natural behaviors. They identify the demand characteristics of the research, and engage in purposeful behaviors that might influence the outcome of the experiment. This is known as ***subject's reactivity***.

4. The experimenter states his research expectations in the form of hypotheses. The researcher's expectancy may lead him to behave in a way so as to elicit an expected kind of behavior from the subjects. The subjects' behaviors would be distorted and conform to the expectation of the experimenter. This is called ***self-fulfilling prophecy***.

5. ***Some critics challenge experimental research on ethical grounds***. Certain types of experiments are unethical, as they invade the private world of the subjects. Some experimental procedures may interfere with the physical and psychological well being of the subjects. In some experiments, the subjects are deceived, that is they are not told about the true purpose of the experiment. Such experimental designs are criticized on grounds of being unethical.

Correlational Method

The basic feature of the experimental method is that the experimenter manipulates variables to observe their effects on subjects' behaviors. It is, however, not always possible to directly manipulate variables. Intelligence as a variable is not under the control of the investigator. He cannot create persons with high or low levels of intelligence. In other words, he cannot manipulate intelligence. There are innumerable variables of greater psychological interest on which the researcher has no control, and, therefore, he cannot alter those variables to see their effects on subjects' behaviors. These variables are called attributes. All that a researcher can do is to examine how these variables are related to variables of his interest. In such

situations, correlational method would help the researcher determine how one variable is related to another.

Psychologists use correlational method, when they want to determine how changes in one variable are associated with changes in another variable. The stronger the relationship, the more successfully one variable can be predicted from the other. Since, prediction is an important goal of science, correlational method assumes greater importance. In fact, many research investigations in psychology are correlational in nature. However, correlational studies cannot determine the causes of relationships; they can only suggest them. These suggestions often provide the impetus for experimental research.

The researcher uses correlational methods to determine the strength and the direction of the relationships. He uses a statistical formula to compute *coefficient of correlation*, which indicates how the variables are related. If changes in one variable are associated to a large extent with changes in another variable, the coefficient of correlation would be high. A positive correlation suggests that the increment in one variable is associated with increment in another variable. A negative correlation suggests that increment in one variable is associated with decrement in another variable. As intelligence increases, so also academic achievement; so, intelligence and academic achievement are positively correlated. On the other hand, the common observation is that if the level of anxiety increases, the level of achievement decreases; hence, anxiety and achievement are negatively correlated.

Correlation should, however, be not taken to indicate cause-and-effect relationships. If social status is related to the amount of monthly expenditure, it does not mean that social status is the cause and the amount of monthly expenditure is the effect. Correlational research does not carry the rigor of experimental research. Correlational research is preferred over other methods, when (a) it is impossible to manipulate the variables, (b) the investigation is exploratory in nature in that the researcher has limited knowledge about the relevant variables, and (c) it is unethical to manipulate variables.

The correlational method offers several advantages. It can be used to study behaviors in real life settings. It is highly efficient in yielding a large amount of interesting information within a short period of time, as it can accommodate many variables of interest

in a single research. Unfortunately, the findings from correlational research are not conclusive with respect to cause-and-effect relationships. The very fact that two variables tend to rise or fall together simply reflects that both may be caused by a third variable. In spite of some limitations, correlational method is a powerful method for scientific investigation.

Case-Study Method

It is one of the *qualitative research methods* used mostly by the clinical psychologists. It is an in-depth look at the individual in the context of his environment. Sometimes much can be learned from studying just one individual and his unique experiences and behaviors for helping him improve some aspects of his behavior. Even if the focus is on the individual's behavior, yet the case-study method carries implications for understanding human mind and behavior in general.

Usually, ***case-study examines behaviors in the real life context, collecting information about the individual from multiple sources, such as parents, family members, peers, teachers, and other relevant persons in the life of the individual***. The background variables that have contributed to the present status of the individual are assessed. His medical, family, and social histories are taken into consideration to understand his unique experiences. The assessment of individual's current level of psychological functioning is done within the context of all the background variables. Such an exercise helps the investigator in understanding the fears, aspirations, and fantasies of the individual, and provides guidelines regarding what can be done to deal with the problems faced by him. Usually, case studies have a clinical orientation with a focus on helping the individual for self-improvement. In special cases, case studies of the lives of great persons can be an illuminating experience for those willing to learn from the life experiences of such people. A researcher while using the case-study method may use psychological tests and questionnaires, and may interview relevant persons to collect information regarding the life experiences of the individual.

The two most important figures in psychology, Sigmund Freud and Jean Piaget, used case-study approach. Freud observed his patients, and his insights led to the development of psychoanalytic school of thought. Jean Piaget observed his children to understand how development takes place, and his insights led to the development of the

most powerful theory in developmental psychology. A good deal of insight is required to make generalizations from the experiences of a single person.

Case studies closely resemble naturalistic observations, as they focus on understanding behaviors in a natural context. But a great deal of caution needs to be exercised when we try to generalize information from case studies. This method has some limitations. First of all, case studies suffer from problems of *reliability* and *validity*, because people interviewed may overemphasize certain selected aspects of behavior while ignoring others. The unique experiences that are prone to arouse feelings of shame and guilt may not be easily accessed. It is, therefore, extremely important that researchers use multiple sources of information, objective measurements, and repeated assessments of the relevant variables.

KEY TERMS

Naturalistic observation

Participant observation

Non-participant observation

Subjective observation

Introspection

Experimental method

Independent variable

Dependent variable

Controlled variable

Extraneous variable

Control-group design

Hypothesis

Observer-bias

Demand characteristics

Self-fulfilling prophecy

Random assignment

Correlational method

Case study

SUMMARY

1. Psychology, as a science, uses methods that are *systematic, empirical and objective,* and *produce verifiable findings*. The two of the most important methods in psychology are *observation* and *experimentation*.

2. Observation forms the basis of any scientific enquiry and provides the ground rules for developing scientific knowledge.

3. A systematic study of the behavior in natural settings is called *naturalistic observation*. It helps researchers assess how people behave in their natural habitat. The major limitations of this method are: (a) too many extraneous variables influence the phenomenon, (b) the researcher has little control over the situation, and (c) the researcher will have to wait until the event occurs.

4. The investigator may take the role of either a participant or a non-participant observer. *Participant observation* may be either *overt* (the subjects know that they are being observed), or *covert* (the subjects do not know that they are being observed as the researcher disguises his identity). In overt participant observation, the subjects may change their behaviors in the presence of an observer. The covert participant observation is criticized on ethical grounds.

5. The subjective observation, which is also called *introspection*, refers to the observation, and analysis by a trained person of his internal mental experiences. The introspection method lacks *objectivity* and *reliability*. It may be difficult for a person to act as the 'observer' and the 'observed' simultaneously. Furthermore, unconscious experiences cannot be accessed through introspection. Thus, the results of introspection should be supplemented with findings obtained through other methods of enquiry.

6. The major limitations of all the observational methods are (a) researcher's inability to control the variable, (b) observer-bias, and (c) the unwanted influence of the observer's presence.

7. *Experimental method* is considered to be the most scientific of all methods as it allows the experimenter to manipulate certain selected variables to observe their effects on other variables in a controlled condition. The variable manipulated by the experimenter is called the *independent variable*, while the variable on which the effect of such manipulation is observed is called the *dependent variable*. The

variables, which are held constant for all experimental conditions, are *controlled variables*.

8. The *control-group design* consists of taking a control group and an experimental group. The subjects in both groups should be equivalent in every way except for the independent variable. This design helps the researcher in determining whether or not the independent variable influences the dependent variable.

9. The variables other than the independent variable, which can have potential influence on the dependent measure, are the *extraneous variables*. The experimenter can control the extraneous variables by holding them constant, eliminating them, matching the groups on those variables, randomly assigning subjects into different conditions, and counterbalancing the order of the experimental conditions.

10. The steps in the experimental methods are (a) stating a research question, (b) formulating hypothesis, (c) designing experiments, (d) data collection, (e) data analysis and interpretation, and (f) preparing report and publication.

11. The experimental method yields empirical, systematic, reliable, and verifiable data, with the researcher having greater control over the independent variable. It helps in determining the cause-and-effect relationships among variables in an experimental setting.

12. The major drawbacks of the experimental method are (a) observation of behavior in artificially controlled situation, (b) experimenter bias, (c) subjects' awareness of the demand characteristics of an experiment, (d) inaccessibility of certain phenomena for experimentation.

13. *Correlational method* helps researchers determine how changes in one variable are associated with changes in another variable. It, however, does not determine the cause-and-effect relationships among variables. Though it does not have the rigor of experimental research, it is a useful technique in situations where it is not possible to manipulate variables experimentally or on ethical grounds.

14. *Case-study* is a qualitative research method that takes an in-depth look at the individual in the context of his environment. It throws light on the unique experiences of the individual as shaped by his personal, medical, family, and social histories. As the case-study reports may suffer from problems of reliability and validity, it should be supplemented with multiple sources of information, objective measurements, and frequent assessment of relevant variables.

QUESTIONS

A. True - False Questions

(State whether each of the following statements is 'True' (T) or 'False' (F))

1. Scientific method uses objective approach.

2. Introspection is otherwise known as subjective observation.

3. Bird-watchers use naturalistic observation.

4. Introspection is a technique to observe the behaviors of others.

5. Self-observation method can be applied to children.

6. The researcher does not intervene with the phenomena in naturalistic observation.

7. All variables are manipulated in an experiment.

8. Introspection method is objective.

9. Observation can be objective or subjective

10. In experimental method, the facts relating to life are collected.

11. Dependent variable is the cause of the behaviour.

12. Subjects behave naturally in the presence of the participant observers.

13. All self-observations are not introspection.

14. Introspection helps to look at unconscious experiences.

15. Watson accepted introspection as a method in psychology.

16. Experimental method is subjective.

17. Subjective observation can uncover unconscious experiences.

18. Independent variable refers to the result of an experiment.

19. Titchener popularized introspection method.

20. Correlational method establishes cause-and-effect relationships.

21. The experimenter manipulates the dependent variable.

22. In experimental method, we study the relationship between independent and dependent variables.

23. Behaviour of the animals cannot be observed.

24. Naturalistic observation is a form of participant observation.

25. Psychologists in general prefer introspection to experimental method.

26. Usually hypotheses form a part of the experimental method.

27. The variable, which is manipulated in the experimental method, is called the independent variable.

28. The experimenter can control the variables in naturalistic observation.

29. Case studies are retrospective.

30. Participant observation can be either overt or covert.

31. In case-history method, information is collected about the individuals having behavioral problems.

32. Case study is a qualitative research method.

33. Observation method cannot be applied to study children.

34. Matching can control the effects of extraneous variables.

35. Naturalistic observation is artificial in nature.

36. Behaviours of monkeys can be best studied through participant observation.

37. Hypothesis is stated after designing the experiment.

38. Outcome of an experiment may be distorted because of self-fulfilling prophecy.

39. The coefficient of correlation indicates the relationship between variables.

40. Experiments on deception are criticized on ethical grounds.

B. Multiple-Choice Questions

(Choose the correct alternative from the bracket to fill up the blank or answer the question)

1. The best method to analyze personal experiences is …….. (objective observation, introspection, experimentation).

2. ……..method is most suitable to study the migration of birds. (naturalistic observation, experimental, case-study).

3. The data collected through ……..method is most likely to suffer from researcher's bias (experimental, observational, correlational).

4. Introspection is also called……. (subjective observation, objective observation, subjective experimentation).

5. In the experimental method, psychologist manipulates ……..variable (independent, dependent, extraneous)

6. All of the following are involved in the experimental method except…….(independent variable, controlled variable, introspection)

7. ……. is a statement of the expected result, (hypothesis, design, dependent variable).

8. The covert activities can be studied through ……..observation (objective, subjective, naturalistic).

9. In …….. a person provides a verbal report after the mental activity ceases (introspection, retrospection, observation)

10. ……..method helps in establishing cause-and effect relationship (experimental, correlational, case-study).

11. ……..experiences cannot be accessed through introspection (conscious, personal, unconscious).

12. An experimental situation always requires ……. (a laboratory, controlled conditions, statistical analysis).

13. .....method is most scientific method in psychology, (case-history, observational, experimental)

14. In the experimental method, the psychologist keeps, ...variables constant (independent, dependent, controlled).

15. Crowd behaviour can be observed through the method of ..... (case-history, experimentation, naturalistic observation)

16. By..... method, the overt activities are observed, (introspection, objective observation, statistical)

17. While using .....method in psychology, one has to divide his attention between two mental activities, (experimental, subjective observation, case-study).

18. Teacher's observation of students' behaviour in the classroom is an example of ……. observation (covert participant, overt participant, naturalistic).

19. By randomly assigning subjects into different groups, the experimenter controls the effects of ……. variables (independent, dependent, extraneous).

20. Hypothesis is stated before deciding the ……. (problem, research design, independent variable).

C. Short-Type Questions

(Write the answer to each question in five sentences)

1. What are the limitations of the experimental method?

2. Write a note on subjective observation.

3. What is naturalistic observation?

4. What are the advantages of observational methods?

5. What is independent variable?

6. Examine the concept of dependent variable

7. Write a note on observation method.

8. Give an example of dependent variable.

9. What are the limitations of observational methods?

10. What is the purpose of correlational method?

11. Explain the concept of controlled variable

12. What are the merits of the experimental method?

13. Point out the limitations of the introspective method.

14. What are the limitations of the case-history method?

15. How is participant observation different from non-participant observation?

16. How can extraneous variables be controlled?

17. Briefly state the steps in the experimental method?

18. What is a control-group design?

D. Essay-Type Questions

(Write long answers)

1. What is observational method? Discuss the merits and limitations of different types of observations.

2. Discuss the important features of the experimental method. What are the merits and limitations of this method?

3. What is subjective observation? Discuss its merits and demerits.

4. What is experimental method? Discuss how extraneous variables can be controlled?

5. Discuss the utility of and steps involved in the experimental method.

6. Explain the case-study method using a suitable example, and point out its merits and limitations.

7. Explain the utility of the correlational method with the help of an example.

ANSWERS

A. True-False Questions

1.	T	**2.**	T	**3.**	T	**4.**	F	**5.**	F	**6.**	T	**7.**	F	**8.**	F	**9.**	T	**10.**	F	**11.**	
	F	**12.**	F	**13.**	T	**14.**	F	**15.**	F	**16.**	F	**17.**	F	**18.**	F	**19.**	T	**20.**	F	**21.**	
	F	**22.**	T	**23.**	F	**24.**	F	**25.**	F	**26.**	T	**27.**	T	**28.**	F	**29.**	T	**30.**	T	**31.**	
	T	**32.**	T	**33.**	F	**34.**	T	**35.**	F	**36.**	F	**37.**	F	**38.**	T	**39.**	T	**40.**	T		

B. Multiple-Choice Questions

1.	introspection	2.	naturalistic observation	3.	observational	4.	subjective observation
5.	independent	6.	introspection	7.	hypothesis	8.	subjective
9.	retrospection	10.	experimental	11.	unconscious	12.	controlled conditions
13.	experimental	14.	controlled	15.	naturalistic observation	16.	Objective observation
17.	subjective observation	18.	overt participant	19.	extraneous	20.	research design

Chapter 3

PHYSIOLOGICAL BASES OF BEHAVIOUR

This chapter covers :

a) Structure and Functions of Neuron

b) Neural Impulse Transmission

c) Brief Ideas about Methods of Studying Brain Functions:

- **i)** Ablation
- **ii)** Stimulational
- **iii)** Electrical recording
- **iv)** Scanning methods

d) Structure and Functions of the Central Nervous System:

- **i)** Spinal cord
- **ii)** Brain

e) Structure and Functions of the Peripheral Nervous System:

- **i)** Somatic
- **ii)** Autonomic

After you go through this chapter, you would be able to:

- *Understand the role of biological processes in determining individual's behaviour and experiences.*
- *Understand the structure and functions of neuron as the basic building block of the nervous system.*
- *Describe the structure and functions of the Central Nervous System and the Peripheral Nervous System.*
- *Gain an understanding of the methods used for studying brain functions.*

CONTENTS

Chapter 3

Physiological Bases of Behaviour

Introduction

Psychology is the scientific study of behaviours and conscious experiences of the organism in relation to its environment. What is behavior ? Behaviour is what the organism does externally or internally – covertly or overtly from the very conception till death. Organism means any living being. Animals or organisms continue to behave whether they are awake or asleep, and all their behaviours take place in the context of an environment.

The study of behaviour involves three different but closely related physiological processes such as *receptor process, effector process,* and *process of nervous system*. Physiological psychologists study these processes to understand biological bases of behaviour. The three kinds of physiological processes work with three kinds of structures. In fact, there are receptor structures, effector structures, and structures of the nervous system.

Receptors

Receptors are the gateways to information. ***Our body has eight kinds of receptors***, such as **visual** receptors (eyes), **auditory** receptors (ears), **olfactory** receptors (nose), **gustatory** receptors (tongue), **tactual** receptors (skin), **labyrinthine** receptors (cochlea in inner ear giving us sensation about our position of the body in space), **kinesthetic** receptors (deep joints and muscles) and **visceral** receptors (about internal organic sensation). Thus receptors are divided into eight types according to sense modalities.

Any event, which causes the sense organs to be active, is termed as stimulus. Receptors are those sense organs of the body by which we receive the stimulation of various kinds from the environment. These receptors are sensitive to stimulation. What is stimulation? Stimulation is physical energy. Our eyes, ears, tongue etc. are sensitive enough to notice stimulation through our receptors. Without these receptors

we would sense nothing, feel nothing, would see nothing and would have no information about the world.

Specific stimulations are received by specific receptors. For example, visual stimuli (color, people, light, books etc.) are received by only visual receptors i.e., eyes only. Similarly, auditory stimulations (music, sound, noise, chirping etc.) are received by pair of ears only. We also receive combined stimulations from the environment and these are integrated in the brain. Thus, receptors being the sensitive parts of our body detect any changes in stimuli present in the environment. The cells in our sense organs are built to receive information in special ways. All receptors are able to produce impulses as a result of changes in some form of energy. There are mainly 3 categories of receptors, such as: (a) *exteroceptors,* (b) *interoceptors,* and *(c) proprioceptors.*

The **exteroceptors** receive stimulus information ***from external sources*** but only when the source of information comes in direct physical contact with the receptors. Such receptors are found in the sense organs like eyes, ears, nose, skin and tongue. The **interoceptors** receive stimulus information ***form internal sources***. Such receptors are found in organism's sense organs such as lining of the stomach, bladder, viscera etc. These receptor cells may be called as *organic receptor cells*. When our stomach is empty for example, the organic receptor cells, which are present in the stomach boundary wall, receive this information. The **proprioceptors** do not require either an external or internal stimulus to be stimulated. These receptor cells are ***stimulated by themselves.*** These are found in the kinesthetic sense organs, which constitute muscles, tendons, joints etc., and the static or vestibular sense organ (semi-circular canal of the inner ear). These receptor cells are also called kinesthetic or vestibular receptor cells, respectively. Kinesthetic receptor cells receive information form our muscles and joints as they move. Vestibular receptor cells receive such information when our body is lifted, or is moving, falling down or speeding up.

Effectors

Effectors are the muscles and glands, which are the exercising organs for doing action. Effectors are the organs, which bring "effects" in the environment. Effect leads to changes; we execute our actions by our hands, legs, and muscles. Secretions

from glands within the body at appropriate times supply energies to such activities. The “effects” or changes, which are brought by our bodily effectors, are called “responses” or “performances”. Salivary glands, digestive glands, and sweat glands are a few examples of glands.

Nervous System connects all receptors with all effectors. It spreads over the entire body through nerves. A single nerve consists of a bundle of many individual neurons. Neurons in a nerve differ both in sizes of axon and diameter of axon. There are chains of neural structures, which connect each receptor with each effector. These connections are made by nerves and neurons inside. The neurons, which conduct impulses from different sense organs to the brain, are called sensory neurons. For example a neuron, which carries impulses from the ears to the brain, is an example of sensory neuron. Sensory neurons are called afferent neurons. Most sensory neurons extend from each sense organ to the central nervous system, which is composed of the brain and the spinal cord. The neurons that transmit nerve impulses from the brain to the motor organs (or effectors) are called motor or efferent neurons. The nerve impulses are carried by efferent neurons to the muscles or glands in order to contract, relax or to expand according to the responses made by the organism.

Neurons : Building Blocks of the Nervous System

To understand how the nervous system controls behaviour, it is essential to understand the structure and functions of its basic building blocks, i.e., the neurons or the nerve cells. How many neurons are there in the nervous system? No one has actually counted the number. But we can see estimates of neurons in the nervous system in different books to be between 100 and 1000 billions.

Basic Structure of a Neuron

The neuron is the basic element of the nervous system. ***The neuron or the nerve cell is the information transmitting and information-processing element of the nervous system.*** Neurons come in many different shapes, sizes and varieties according to the specialized jobs they perform. Some of them are very small in size. They are so small that we will require an electronic microscope to detect them. Some of the neurons are very long in structure. Their length in some cases may be more than one meter. **Whatever may be their sizes and shapes, neurons usually have a**

common form. We shall consider the structure and functions of neurons having a common form. Neurons in general have the following structures: (i) *cell body or soma*, (ii) *dendrites*, (iii) *axon*, *and* (iv) *terminal buttons or axon terminals* (see Figure 3.1).

Cell Body or Soma. **The enlarged "head" of the neuron is called "cell body" or soma.** The soma or the cell body is enclosed by the cell membrane and contains the nucleus of the cell. Soma is the head side of the neuron. It uses oxygen and nutrients to generate energy to carry out the work of the cell. Its shape varies considerably in different kinds of neurons.

Dendrites. Dendron is the Greek word for tree and the dendrites of a neuron look very much like trees. Dendrites are extended from the cell body. There are several extensions from the cell body of the neuron. **Dendrites receive the neural impulses from the receptors or from several adjoining neurons**. In no case, other parts of a neuron excepting dendrites receive the impulse.

Axon. There are two types of extensions from the cell body. The many shorter extensions from the cell body are called dendrites. **The longer single-branched extension is called the axon**.

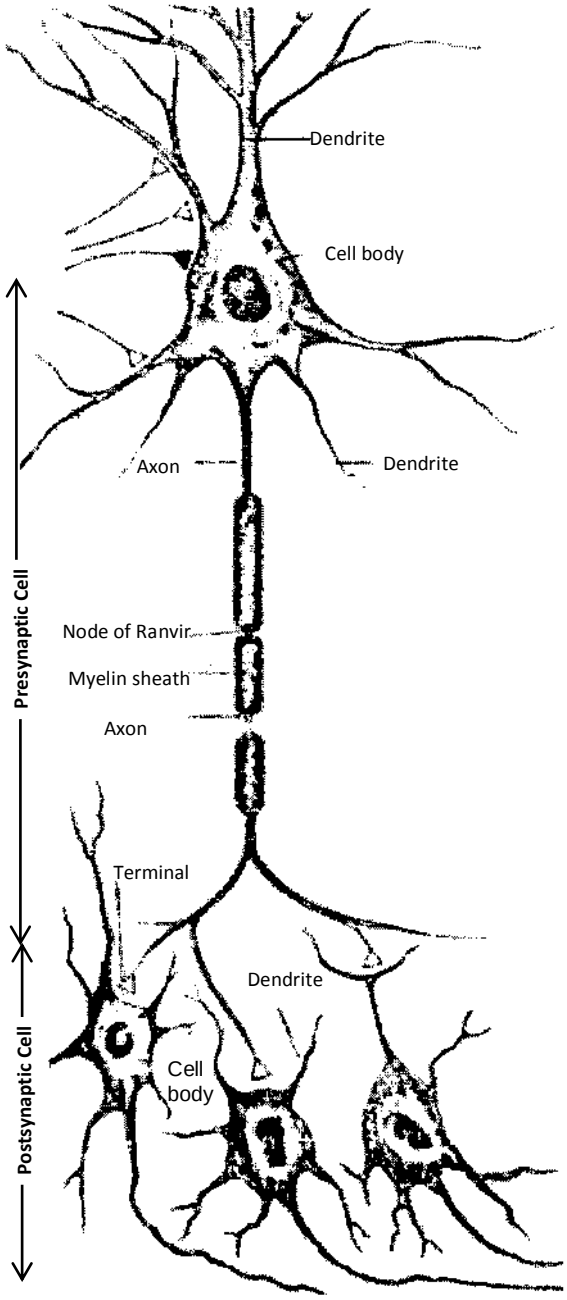


Figure 3.1 The major structures of a neuron, the basic element of the nervous system.

Each neuron has one axon that extends trunk-like from the cell body. The point in the axon nearest the cell body is called the axon hillock. Axons are very thin and long. Like tree trunks, axons may have some branches also. These branches are called axon collaterals.

Axon has two coverings, which of course may not be found in the axons of all neurons. The outer boundary of the neuron is called membrane. The membrane serves as a barrier for the neuron. In the axons of some of the neurons, there is a fatty white sheath called **myelin sheath**. Axons, which have myelin sheath, are called as *myelinated axons* and which do not have it are called *unmyelinated axons.* Myelin sheath is found only around the axon, and not around any other parts of the neuron. Myelin sheath is made up of a series of specialized cells of fat and protein. It is not of equal thickness around the axon. Its function is to insulate the message while traveling along the axon. It also serves to increase the velocity with which the electrical impulses travel through the axons.

Neurilemma is another covering found in axons of neurons exclusively outside the brain and the spinal cord. It is a very thin covering, which takes part in regeneration. Therefore, if a neuron outside the brain and the spinal cord is damaged, it can be regenerated. **But the neurons of the brain and spinal cord cannot be regenerated, as they do not have neurilemma in their axons**. They are highly specialized cells and if damaged, they are damaged forever.

Terminal Buttons. Axons end in smaller branching structures called axon terminals or terminal buttons. **These are swollen bulb-like structures located at the end of the axon through which stimulations pass to near by glands, muscles, and other neurons**. There are some bag-like structures called as synaptic vesicles at the tips of axon terminals. These have the capability of transmitting information to another neuron. Thus, the axon terminal end of the neuron is the delivering side of the neuron. Dendrites receive and axon terminals deliver. Neurons transmit information in only one direction: from the dendrites through the cell body to the axon to the terminal buttons. This is known as the **law of forward induction**. We shall discuss the process of neural transmission in detail later.

Types of Neurons

In general, there are three major classes of neurons: *sensory neurons, motor neurons,* and *inter-neurons*. **Sensory neurons,** which are also called **afferent neurons**, carry messages from the sensory receptors toward the central nervous system to be finally interpreted by the brain. The receptor cells are specialized sensory neurons that are sensitive to the external stimuli such as light and sound.

The **motor neurons,** also called **efferent neurons** carry the messages away from the central nervous system toward the muscles and glands. They are responsible for all our actions, movements, and responses. Usually the motor neurons are long.

The sensory neurons rarely come in contact with the motor neurons. They rely on the network of *inter-neurons,* which are mainly located in the central nervous system with 85 per cent being in the brain. They receive messages from the sensory neurons, and relay the same to other inter-neurons or to motor neurons. It is estimated that for every motor neuron, there are as many as 5000 inter-neurons, which do the intermediate task.

Supporting Cells. Neurons constitute only about half the volumes of the central nervous system. The rest consists of a variety of supporting cells. Because neurons have a high rate of metabolism but have no means of storing nutrients, they must constantly be supplied with nutrients and oxygen or they will quickly die. Thus, the cells that support and protect neurons are very important.

The most important supporting cells of the central nervous system are the **glia cells**. These cells surround neurons and hold them in place. They also supply some chemicals to the neurons, which they need, to exchange messages with other neurons. They also insulate neurons from one another, so that neural messages do not get scrambled.

Two of the most important glia cells are *astrocytes* and *oligodendroglia. Astrocytes* produce chemicals that neurons need to fulfill their functions. In addition, astrocytes help control the chemical composition of the fluid surrounding neurons. It is very important to note that the chemical composition around the neuron must be kept within a critical level for smooth transmission of neural impulses. On the other

hand, the principal function of *oligodendroglia* is to provide support to axons to produce *myelin sheath*.

Functions of the Neurons

Conduction of Nerve Impulse. The important function of the neuron is to communicate "*messages of stimulation*" in the form of nerve impulses. Sensory (*afferent*) neurons come from receptors and go to the brain and motor (*efferent*) neurons go to muscles and glands. The inter-neurons are the linking neurons. All our behaviours involve the flow of nerve impulses. There are about 10 billions or more neurons firing in our brain, i.e., sending and receiving various nerve impulses. This is the communicative action of a neuron. Neurons also send nerve impulses when we are asleep. The communicative mechanism is conduction of nerve impulse. When a neuron is adequately stimulated an electrochemical reaction occurs inside. Like a gun, neurons fire or do not fire; there is no in between stage. **The neurons follow an all-or-none law, i.e., they are either on or off**.

How do the neurons serve their communicative function? Let us see how nerve impulses or nerve energies are formed. The cell membrane of a neuron is *semi-permeable*. The neuron contains fluid, which is known as *intracellular fluid*. The fluid on the outside of the neuron is called the *extra-cellular fluid*. The cell membrane is in between the intracellular fluid and extra-cellular fluid.

The fluid contains many dissolved substances. Many chemical substances are broken to pieces when they dissolve in water or any fluid. **Ions** are particles formed when a substance is dissolved in fluid. Ions are electrically charged particles when dissolved. The electrical charges carried by ions are of two types, *negative* and *positive*. Positive electrical charges repel each other, so also the negative electrical charges. On the other hand positive and negative electrical charges attract each other. The same thing happens in a neuron. Ions are found in extra cellular fluid and in intracellular fluid as well.

When a neuron is in a resting state, there is a negative electrical charge of about -70 millivolts (a millivolt is one-thousandth of a volt) within the neuron. This is called the **resting potential** of the neuron, which does not come automatically; the neuron works to maintain its resting potential. It pumps out the positively charged

ions (electrically charged particles) to its outside, and only keeps the negatively charged ions. The neuron can be compared with a battery with the inside of the neuron representing the negative pole and outside of the neuron representing the positive pole (Koester, 1991). When a message arrives and the neuron is stimulated (by external stimuli such as light, heat, and sound etc. or by messages from other neurons), the positively charged ions outside the neuron rush inside the neuron at rates as high as 100 million ions per second. The sudden arrival of the positive ions inside the neuron causes the charge to change from negative to positive. When the charge

(a) The neuron in a resting state has slight negative charge of - 70 millivolts across the cell membrane

(b) The positively charged particles enter into the neuron eliminating the negative charge, when the neuron is stimulated. Neural impulse is conducted.

(c) After a brief period, positively charged particles are pumped out.

(d) Neuron returns to the resting state with a negative charge of - 70 millivolts.

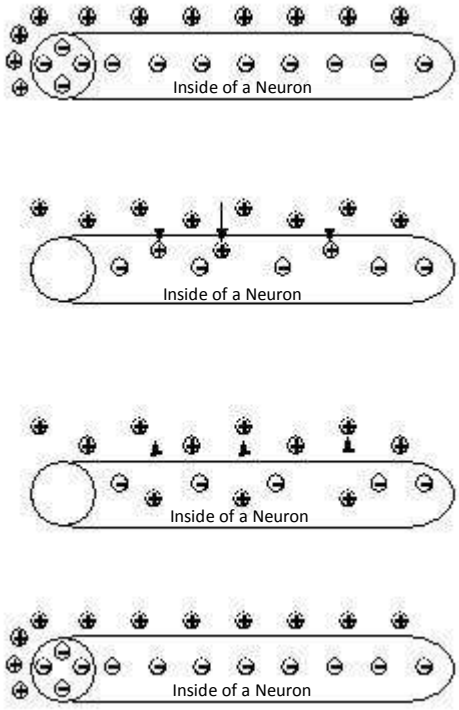


Figure 3.2 : Conduction of nerve impulse in a neuron.

reaches a critical level, an electrical nerve impulse known as **action potential** travels down the axon of the neuron (see Figure 3.2).

The **action potential** moves from one end of the axon to the other. After the nerve impulse has traveled, the positive ions are pumped out of the axon, and the charge returns to negative. As a result, the neuron returns to its resting state, and becomes ready once more to fire again. The flow of the nerve impulse is 10 to 250 miles per hour depending upon the diameter of the particular neuron. A larger diameter carries nerve impulse speedily. A smaller-diameter axon carries the nerve impulse slowly.

Absolute Refractory Period. Just after an action potential has passed, the neuron cannot be fired again immediately, no matter how much stimulation it receives. It is almost similar to the act of reloading the gun after each shot. As soon as the action potential is transmitted by the neuron, it takes rest for a brief period of time. This brief period just after carrying action potential during which the neuron is inactive is called the *"***absolute refractory period***."* During this period, the neuron is in "**resting potential**". This period of resting time is usually less than 1/1000th of a second. ***An action potential cannot be produced during the absolute refractory period***. When this short refractory period (i.e., no action) is over the neuron can carry a nerve impulse. The absolute refractory period is followed by a **relative refractory period** during which a strong stimulus can make the neuron active, i.e., carry a nerve impulse

Threshold point. The point at which a stimulus triggers an action potential is called the **threshold of a neuron**. Stimuli especially too weak cannot produce an action potential in a neuron. A weak stimulus, which is too small to produce an action potential, does not open the membrane-gate and does not produce nerve impulse. A stimulus of certain strength is needed to produce action potential. ***Different neurons have different thresholds of excitation***. Some require greater stimulation than others to make them fire. Thus weak stimuli evoke few impulses in only a few neurons. Strong stimuli evoke high rates of impulses in many neurons. Generally threshold point of each neuron is fairly constant.

The rule usually for determining the threshold of a neuron is that if a stimulus causes a nerve impulse 50 percent of the time, that stimulus is said to be at the threshold of that neuron. ***In other words, the threshold of a neuron is the point at which a stimulus causes a nerve impulse 50% of the time***. During the absolute

refractory period, the threshold of a neuron becomes very high as a result of which the neuron does not carry action potential.

All or None Law. In conducting action potential, the neuron obeys a law called “all-or-none law.” ***This law states that neurons fire or do not fire; there is no in between stage***. It is similar to the action of a gun. If you pull the trigger, the gun fires. Pulling the trigger harder is not going to make the bullet travel faster. Your finger pressure on the trigger must be of certain intensity for the gun to fire. A pressure less than what is required will not result in gun fire and more pressure would not result in a better fire. Similarly, **the neurons follow the all-or-none law**.

The stimulation must reach a threshold to generate enough of an action potential to be conducted through the axon. Below the threshold, the stimulus cannot excite the nerve. Once the threshold is reached, the stimulus intensity does not have any effect on the amount of the nerve impulse conducted. **The nerve impulse is an electrochemical stimulation, which does not decrease in its intensity as it travels through the axon**. If an axon carries any nerve impulse at all, the impulse continues to maintain the same strength throughout its travel in the axon until it reaches the terminal buttons.

What happens when the stimulus intensity increases beyond the threshold point? As the stimulus intensity increases, the sensory neurons increase the rate of their impulse generation to as many as 200 to 1000 impulses per second. Furthermore, a stronger stimulus generates impulses in more neurons. On the other hand, weak stimuli evoke low rates of responses and a few impulses in only a few neurons. The axons of the neurons are not of the same size. The speed of a nerve impulse depends on the diameter of the axons. The larger the diameter, the greater is the speed. The strength of the nerve impulse depends on the nature of the axons. **The dendrite and the cell body do not obey the all-or-none law**. Only the function of the axon is governed by this law.

Neural transmission

All our behaviors have a neural base. The neural activity is the biological medium in which all our psychological processes occur. Changes in neural and nervous system activities lead to changes in how people think, perceive, learn, memorize, and behave. All the mental functions stem from biological functions, and in

turn also influence the biological activities. It is, therefore, important to understand how neural impulses travel from one part of the biological system to another.

It is not only that the neural impulse travels within a neuron, but also from one neuron to the other. The two major parts of the neural transmission are: (i) communication within a neuron (**action potential**), and (ii) communication between neurons (**synaptic transmission**). While describing the functions of a neuron, we have already stated how neural impulses travel from one end of the neuron to the other end. The next thing to discuss is how neural impulses travel from one neuron to other neurons. Both these actions constitute the topic of neural transmission.

Synapse. *The synapse is a space between neurons that provides a junction for information transfer*. Neurons are not connected with one another. There is a small but important gap between the axon terminals (***terminal buttons***) of each neuron and the ***dendrites*** of the adjacent neurons. This gap is called the **synapse**. The width of the synaptic gap is about 100 angstroms (one angstrom unit is one ten-millionth of a millimeter). **The synapse is found between the axon terminal of one neuron and the dendrites of another**.

A single neuron in the brain may share very large number of synapses with other neurons. It is estimated that billions of neurons in the brain have trillions of synapses. The synapse serves very important and useful functions in making the organism's behavior adaptive and flexible. **The synaptic gap controls the rate of flow of nerve impulses**. If the impulse is of high intensity, the gap restricts the flow, and does the opposite when the stimulus is weak. Without the synaptic gap, the man would have been rigid like a machine.

Synaptic Transmission, The neural impulse travels through the length of the neuron along the axon, finally arriving at the terminal buttons or axon terminal. There is no direct physical connection to the next neuron. The impulse has to cross the gap called the synapse. Thus a sequence of events called synaptic transmission begins in which the information is relayed from one neuron to another across the synaptic gap (see Figure 3.3).

Pictures taken with electronic microscope revealed the complexities of the synapses. It has been observed that at the axon terminals, there are sacs or **synaptic**

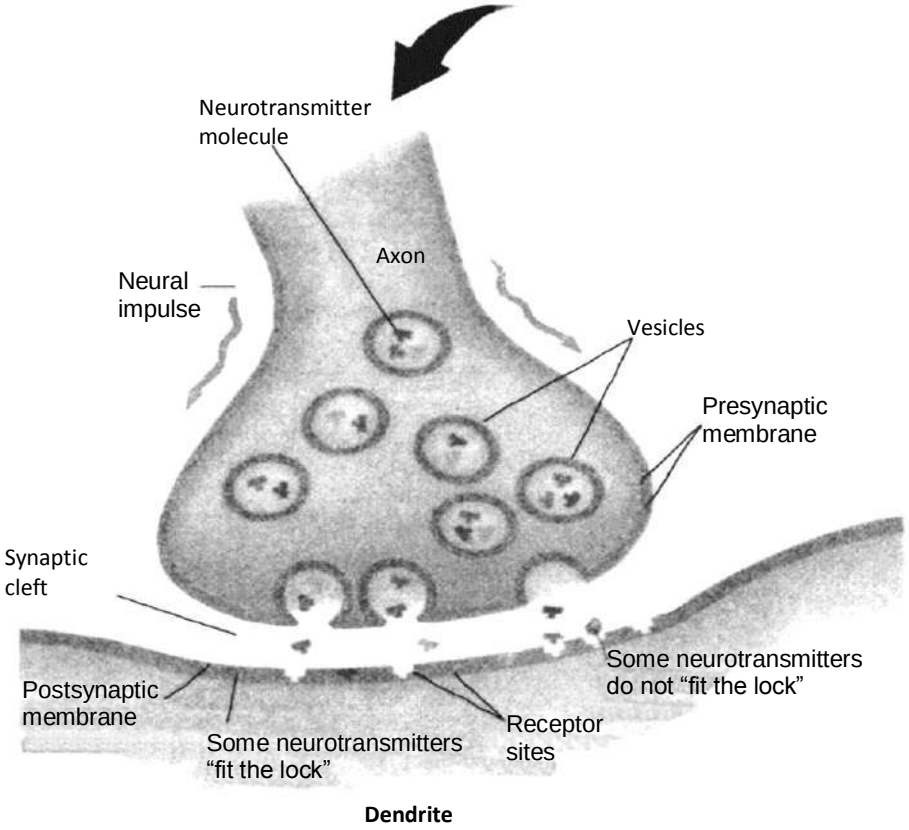


Figure 3.3 Transmission of the nerve impulse through the synapse.

vesicles. As the neural impulse reaches the axon terminal, the synaptic vesicles move from within the cell to the inner membrane of the terminal buttons. Each vesicle contains **neurotransmitters**, which are biochemical substances that stimulate other neurons. When the synaptic vesicles get fired, they release the neurotransmitters into the synaptic gap. The dendrites of the receiving neuron come in direct contact with these neurotransmitters, and receive the message. If the neurotransmitters are sufficiently stimulated, the receiving neuron will experience a change (either being excited into firing or inhibited from firing). The impulse so received will be conducted

within the neuron, and will be relayed from neuron to neuron until the message is completed.

The dendrites of the receiving neuron are not excited electrically no matter how intense is the electrical stimulation. Dendrites are excited only by the neurotransmitters. Thus the impulse crosses the synaptic gap chemically and moves inside the neuron electrically. **The process of neural transmission is electrochemical in nature**.

Nervous System and its Divisions

We have already discussed in this chapter that there are three kinds of neurons present in our body; namely sensory neurons, inter-neurons, and motor neurons. All these neurons taken together constitute the nervous system. It is a system of nerves, which is involved in perception, learning, thought processes, heartbeat, motor coordination and almost all the activities that we do. The nervous system is a complex structure that regulates bodily processes, and is responsible ultimately for all aspects of conscious experience. The nervous system of human beings is much more complex than that of any other organism.

All parts of the nervous system are interrelated. The system functions as a 'whole', but for purposes of theoretical discussion, the nervous system can be separated into two major divisions, each of which has further subdivisions as shown in the Figure 3.4.

The **central nervous system** includes all the neurons in the brain and the spinal cord. The **peripheral nervous system** includes all the neurons (sensory and motor neurons) connecting the brain and spinal cord to other parts of the body. The peripheral nervous system is further divided into the **somatic nervous system** and the **autonomic nervous system**. The somatic system carries messages to and from the sense receptors, muscles, and the surface of the body. It specializes in the control of voluntary movements. The autonomic system connects the internal organs and glands to the central nervous system. It is concerned with parts of the body that keeps us alive: the heart, blood vessels, glands, lungs, and other organs that function involuntarily without our awareness. The **sympathetic system** prepares the body to meet stressful emergency situations. In contrast, the **parasympathetic system**

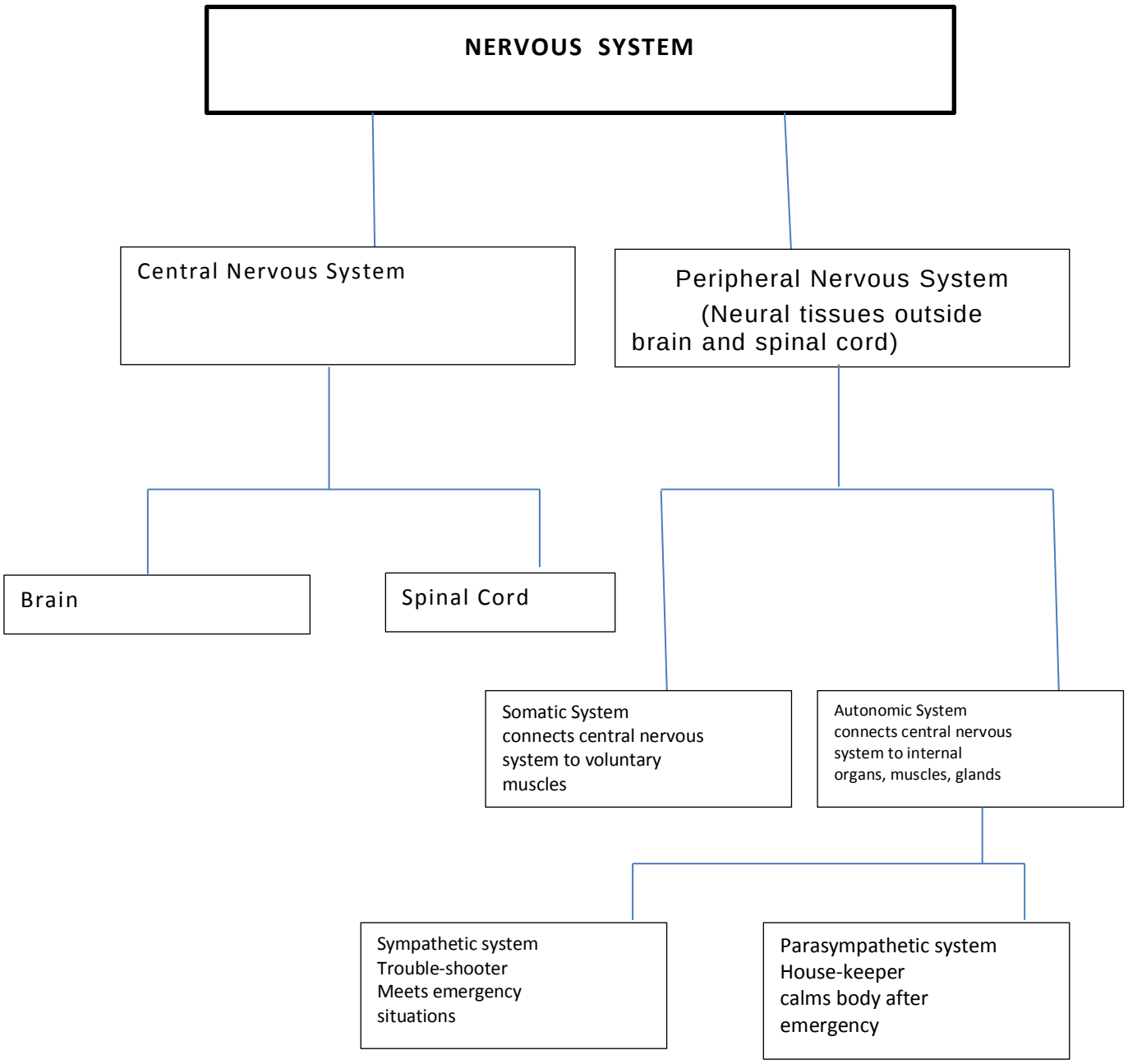


Figure 3.4 The major divisions of the nervous system.

maintains the routine vital functions of the body, and clams the body after emergency situation is resolved.

Let us now examine the nature and functions of the central and peripheral nervous system.

The Central Nervous System

The central nervous system is the center of all neural activities. It is well protected in the bony case of the skull and the spinal column. It integrates all incoming

information and controls all the bodily and psychological processes. **It consists of the spinal cord and the brain**.

The Spinal Cord

Structure. The **spinal cord** is a white, soft and cord (rope) like substance running through the backbone. The internal structure of the spinal cord is much simpler and more uniform throughout its various parts than that of the brain. No matter where it is sectioned, it gives the same general appearance. The interior of the spinal cord looks gray because it is filled with neurons without having myelin sheath in their axons (unmyelinated axons). In other words, the interior of the spinal cord is filled with some gray matter. Interestingly, the gray matter is so distributed that the interior looks almost as a butterfly whose essential form is the English capital letter "H". The outer of the spinal cord looks white as it is filled with some myelinated axons. In other words, the outer of the spinal cord is filled with some white matter. **The chief function of the gray part of the spinal cord is integrative in nature, whereas the chief function of the white part is communicative in nature**.

There are *thirty-one pairs* of peripheral spinal nerves connected to the spinal cord. The sensory spinal nerves are connected to the cord at the back or the dorsal part. In fact, there are two (left and right) dorsal roots through which sensory information enter into the spinal cord. The motor spinal nerves are connected to the cord at the front or the ventral part. There are two (left and right) ventral roots through which motor information go out of the spinal cord. The sensory information goes towards the brain in the two dorsal columns of neurons and motor information go downward of the spinal cord in the two ventral columns of neurons. There are also two sets of lateral (side) columns of neurons whose function is both sensory and motor in nature.

Functions. The spinal cord has two major functions: (a) *carrying information*, and (b) *coordinating reflexes*. First it receives sensory information through the afferent nerves from the sensory receptors throughout the body, and sends them to the brain. It also carries information from the brain through efferent fibers to the muscles and glands. Second, it coordinates reflexes without the involvement of the brain. Thus, **the spinal cord has both communicative and integrative functions**.

Reflex Actions. Except the above sensory and motor functions, spinal cord controls some other important functions also. These are called reflex actions. In order

to control reflex actions, the spinal cord does not take any assistance from the brain. **Reflex actions are automatic, unlearned, involuntary, and inborn responses**. Therefore, these actions are sudden in nature and have a purpose of protecting the individual or his organs from sudden danger. For example, if someone throws a stone towards you, suddenly you move your body to avoid the incoming danger of being hurt. The path through which reflex action is conducted is known as ***"reflex arc",*** which involves (a) receptor (b) afferent neuron (c) spinal cord (d) inter-neuron (e) efferent neuron (f) muscles or gland (see Figure 3.5).

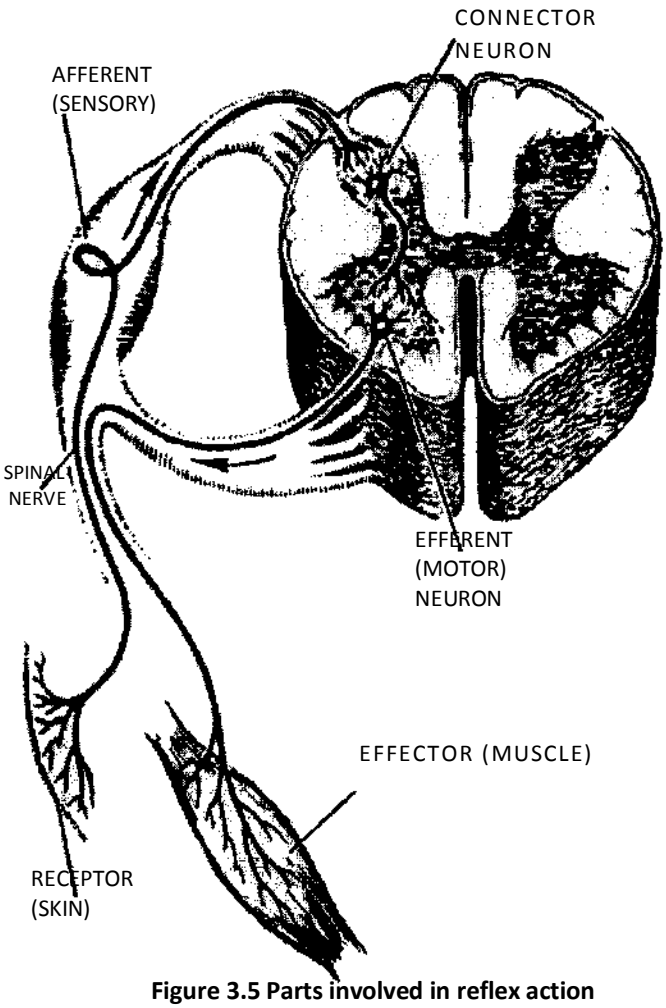


Figure 3.5 Parts involved in reflex action

The Brain

Unlike the spinal cord, the human brain is a very complex structure. As such, it is really very difficult to know the different structures of the brain and the functions they carry out. However, physiological psychologists have evolved some methods through which it is now possible to study some of the important structures of the brain and the functions they carry out. The methods for studying brain functions are presented later.

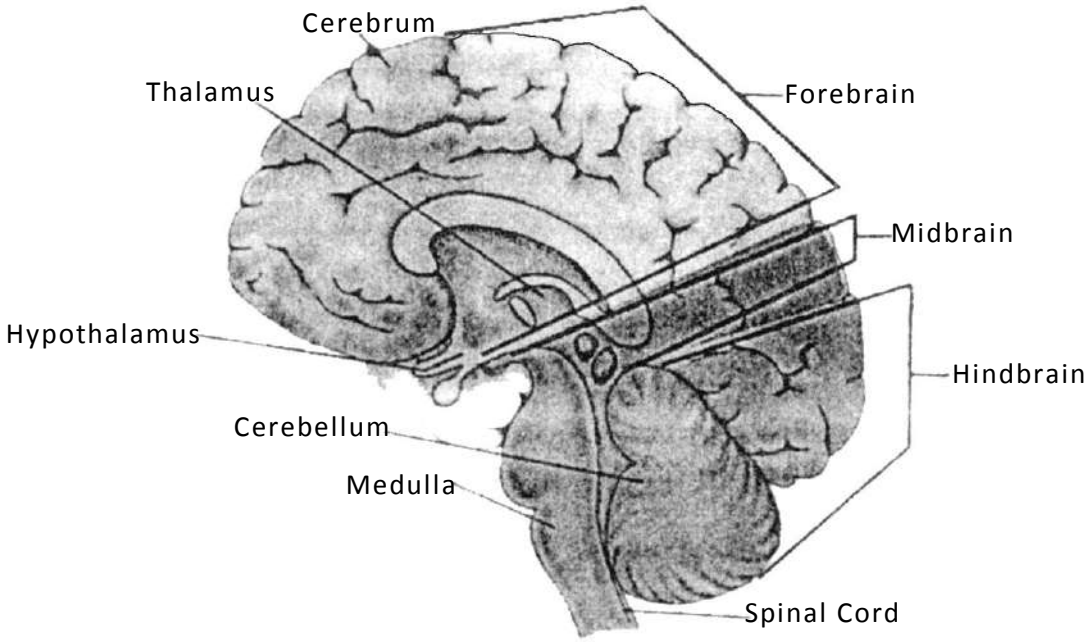
Brain controls almost all the activities that we do, except of course the reflex activities that are controlled by the spinal cord. Brain controls perception, learning, thinking, and different types of motor activities. Specific regions of the brain have

been identified by scientists, which control specific behaviour patterns. All the regions of the brain act in close cooperation with one another. Now, let us examine these different regions of the brain as they control different functions. We shall limit our discussions to some of the important structures of the brain only.

We shall begin with the back of the head, where the spinal cord rises to meet the brain. Gradually we shall come to discuss the front and upper portion of the brain through the middle. The brain can be divided into three main parts: the *hindbrain*, the *mid brain* and the *fore brain* (see Figure 3.6).

The hindbrain

The backside of the brain is called the hindbrain. It has three sub-divisions: *medulla, cerebellum* and *pons.*



Fiture 3.6 The structures located at different levels of the brain

Medulla. It is also called **medulla oblongata**. This structure is the most caudal (lowest) portion of the brain stem. **It is a link between the brain stem and the spinal cord**. 12 layers of nerves extending from the medulla connect some vital regions of the body; such as hearts, lungs, intestine, bladder, etc. Therefore, medulla controls some vital and autonomic functions such as respiration, circulation of blood, digestion of food, etc. It also plays a role in sleep, sneezing and coughing.

Cerebellum. Cerebellum is also called as the **'little brain'**. It is a miniature version of the cerebrum. Its outer surface looks gray and the interior white. It has two hemispheres. It receives input from almost all the sensory areas of the body. **Its vital function is to control body balance and posture**, as it is connected with the static or the vestibular sense organ. Injury to the cerebellum may lead to lack of motor coordination, stumbling, and loss of muscle tone.

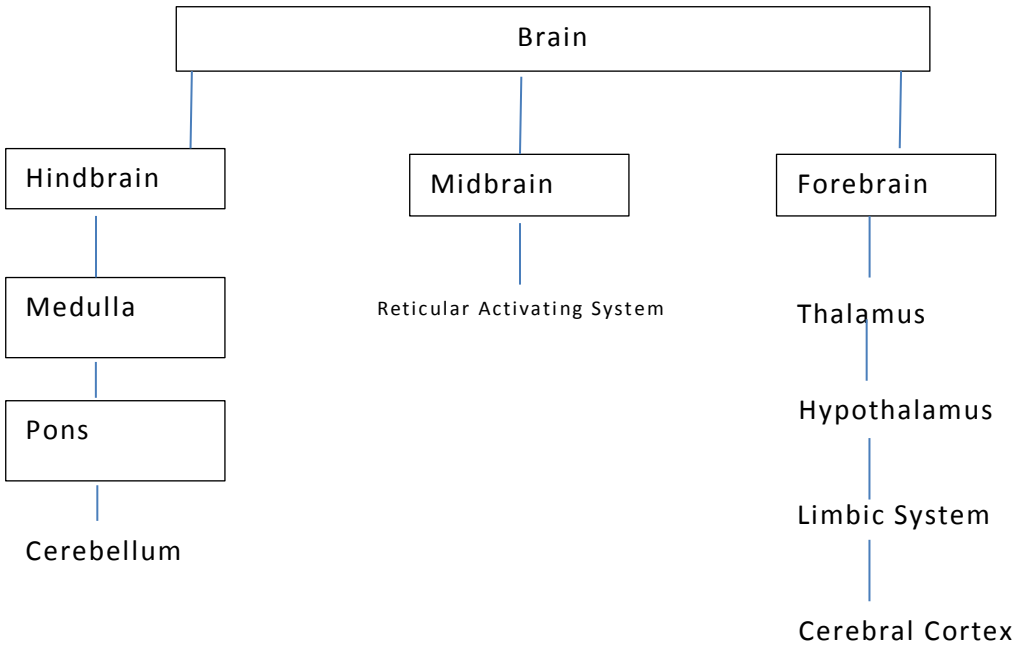


Figure 3.7 Structures included in three parts of the brain.

Cerebellum also controls ***biological rhythm*** or the ***perception of time***. In other words, **the biological clock is located in the cerebellum**. Therefore, many of us can tell the approximate time without looking at the wall clock in the middle of night if we wake up form sleep.

Some surprising new evidences have identified that the direct neural connections between the cerebellum and frontal parts of the brain are involved in language, planning, and reasoning (Middleton and Strick, 1994). These connecting circuits are much larger in human beings than in other animals. These and other evidences suggest that the cerebellum may play a role in the control and coordination of higher mental functions as well as in the coordination of movements.

Pons. The pons is a large bulge in the brain stem, lies between medulla and the midbrain, immediately ventral to the cerebellum. Pons is a Latin word, which means "***bridge***", but it does not look like one. It is so named because of the bundle of nerves

that passes through it. **The pons transmits information about body movement and is also involved in functions related to attention, sleep, and alertness**. It has important functions to carry out in dreams. The various cranial nerve nuclei in the pons play a significant role in feeling and facial expressions.

The midbrain

The mid brain is located approximately at the center of the brain and above the pons. It is a tube-like structure, the outside of which looks white and inside gray. Through this tube, a fluid-like substance called cerebrospinal fluid passes, which gives nutrition to the brain. Except this, it has got sensory and motor pathways. It contains primitive centers for vision and hearing. It plays a role in the regulation of visual reflexes. The midbrain consists of two important structures. They are the *tectum* and the *tegmentum.*

The *tectum* (roof) is located in the dorsal portion of the midbrain. Its principal structures are superior colliculi and inferior colliculi. The superior colliculi are a part of the visual system and help in locating visual objects. The inferior colliculi are a part of the auditory system and process the auditory signals before sending them to the actual auditory center (temporal lobe) of the brain.

The *tegmentum* (covering) consists of the portion of the midbrain beneath the tectum. Its function is the movement of the eye from one direction to the other. The midbrain contains an extension of the reticular activating system.

Reticular Activating System (RAS). The RAS begins in the hindbrain and ascends through the region of the midbrain into the lower part of the fore brain (see Figure 3.8). It is a network of neurons crossing each other. The RAS is vital in the functions of shifting of attention, sleep, arousal, and activity. Stimulation of the RAS causes it to send messages to the cortex, making us *more alert to sensory information*.

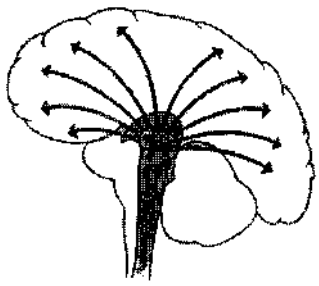


Figure 3.8 The reticular activating system (RAS)

Electrical stimulation of the RAS awakens sleeping

animals. But if the RAS is damaged, the animal may not die, but will sleep forever. This kind of sleep is called as *comatose* or simply coma. Another important function of RAS is *selective attention* or filtering of information through learning. It allows important information to go for processing by higher centers of the brain while screening out less important information. Thus, while you are inside the class, you listen only to the lecture, even though a lot of noise is taking place outside the class.

The forebrain

The forebrain is the most important part of the brain for it possesses virtually all the parts concerned with perception, coordination of behaviour patterns including those of emotion, motivation, learning, memory, language and thinking. The major parts of the forebrain are *thalamus, hypothalamus, limbic system* and *the cerebrum*.

Thalamus. The thalamus sits at the top of the brain stem in the central core of the brain. It consists of an egg-shaped cluster of neurons. It is a structure of three different types of nuclei, which process different types of sensory information and send them to the appropriate regions of the brain. For example, the lateral geniculate nucleus receives sensory information from the eye and sends them to the primary visual cortex; the medial geniculate nucleus receives information from the ear and sends them to the primary auditory cortex; and the ventral-basal nucleus receives information form the somato-sensory sense and sends them to the parietal lobe. Thus, the thalamus receives input from all of our senses except olfaction (smell), performs some preliminary analysis and then transmits the information to other parts of the brain. Therefore, it is called **the great relay station of the brain**. Except this relaying function, the thalamus is also involved in controlling sleep and attention in coordination with other brain structures, including the RAS.

Hypothalamus. The hypothalamus is a tiny collection of nuclei located beneath the thalamus. Even though, it is very small in structure (weighs about four grams), it exerts profound effect on our behaviour. **It regulates the autonomic nervous system**. In other words, it regulates such activities like sweating, salivating, shedding of tear, changes in blood pressure, etc. It plays a key role in **homeostasis** that is the maintenance of the body's internal environment at optimum levels. In other words, it controls body temperature, the concentration of fluids, the storage of nutrients and various aspects of motivation and emotion. When an organism is under stress,

homeostasis is disturbed and processes are set into motion to correct the disequilibrium. For example, when we are too warm, we perspire; and if we are too cool, we shiver. The purpose in both the situations is to store normal temperature.

Portions of hypothalamus seem to play a role in the *regulation of eating and drinking*. Stimulation of lateral nucleus of hypothalamus causes psychological hunger, and the person takes more and more food. If damaged, the organism refuses to take food. Similarly, if it is stimulated, the organism will go on taking more and more water, and if damaged, it refuses to take water. Ventromedial nucleus of the hypothalamus is the satiation center. If stimulated, the animal stops taking food and water. If damaged, this inhibition is impaired. However, it has been observed that if it is stimulated, the animal may take sweet food only.

The hypothalamus also controls the *activities of endocrine system*. Thus, it plays a role in *reproductive physiology and sexual behaviour*. The hypothalamus also plays a role in the *sensation of emotions* and our *response to stress producing situations*. Therefore, sometimes it is called the ***brain's stress center***.

Limbic System. The limbic system or the borderline system lies along the inner edge of the cerebrum. It consists of a group of structures that form a part of the old mammalian brain. The brain stem and the cerebellum are found in all vertebrates, but *only mammals and reptiles have limbic system*. It is a ring like structure having several other structures. Limbic system receives input from the olfactory sense, and as such is responsible for olfactory perception. It is structurally interconnected with the hypothalamus. Therefore, it is also involved in the drives of hunger, sex, aggression, and some of the behaviours regulated by the hypothalamus. The three principal structures in the limbic system are *amygdala, hippocampus,* and *septum*. The amygdala is involved in memory, and certain basic emotions. The damage to the amygdala causes an animal to be less fearful and over curious, hypersexual, and more exploratory.

The hippocampus has been observed to play a special role in *memory*. The effects of surgical removal of the hippocampus have demonstrated that people can retrieve old memories but cannot permanently store new information. In other words, damage to the hippocampus affects short-term memory. Destruction of another area of the limbic system, the septum, leads some mammals to respond aggressively, even with slight provocation.

Basal Ganglia. The basal ganglia are a group of nuclei buried beneath the cortex in front of the thalamus. They are involved in the control of postural movements and the co-ordination of limbs. Basal ganglia produce most of the brain's dopamine, which is a neurotransmitter. Degeneration of neurons in the basal ganglia has been linked to Parkinson's disease in which the patient finds it difficult to coordinate different limbs. Excess production of dopamine leads to a mental disorder called schizophrenia.

The Cerebrum. The cerebrum or the cerebral cortex is the crowning glory of the brain and is highly developed in humans than in any other animal. It is protected by the skull. Below the skull, there is a space filled with a fluid, which is gray in color and protects the cerebrum. The outside surface of the cerebrum is called the cerebral cortex. The cortex looks gray because it consists largely of cell bodies and unmyelinated fibers. The inside of the cerebrum beneath the cortex looks white as it is composed mostly of myelinated axons. The cortex has got many ridges called *gyri* throughout. In between the two gyri, there is a small depression called *sulcus* (valley) or fissure.

A very deep depression or fissure divides the cerebrum into almost two equal halves- the left hemisphere and the right hemisphere. The **left hemisphere** is connected with the right hand side of the body, and receives sensory information from right hand side of the body. The **right hemisphere** is connected with the left hand side of the body, and as such receives sensory information from the left hand side of the body. The two hemispheres are connected with each other by a thick fiber bundle known as **corpus callosum**.

Each of the hemispheres of the cerebral cortex is divided into four parts, or lobes by two fissures. On the top middle of each hemisphere, the **fissure of Rolando** or central fissure runs from the top vertically towards the bottom. Another fissure, the **fissure of Sylvius** or lateral fissure runs laterally in each hemisphere. The *frontal lobe* lies in front of the central fissure, and the *parietal lobe* lies behind it. The *temporal lobe* lies below the lateral fissure. The *occipital lobe* however is not clearly demarcated. For our purposes we can say that it is located at the rear of the brain (see Figure 3.9).

The **frontal lobe** is specialized for the **planning, execution, and control of movements**. The primary motor cortex, adjacent to the central fissure, contains

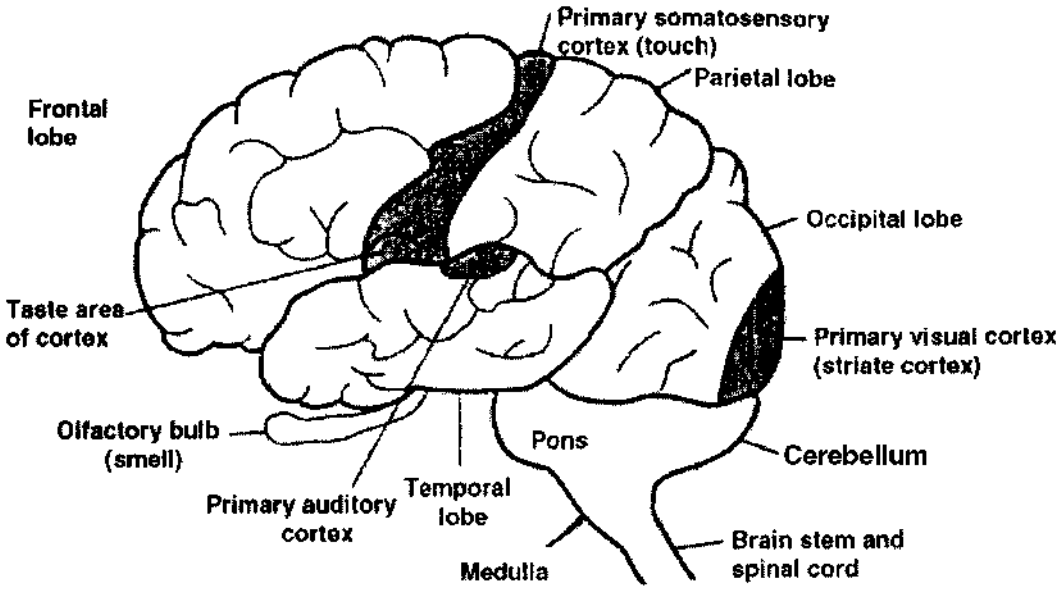


Figure 3.9 Four lobes of the brain

neurons that participate in the control of movements. Electrical excitation to different parts of the primary motor cortex causes movements of different parts of the body. Because the cerebral hemispheres are connected with the opposite sides of the body, stimulation of the right primary motor cortex moves parts of the left side of the body. Similarly stimulation of the left primary motor cortex moves the right side. In the motor cortex, the body is represented upside down. For example, the face is represented at the upper part of motor area of the brain, trunk further down face and tongue.

The posterior (back) lobes of the brain, such as the parietal, temporal and occipital lobes are specialized for perception and experience of touch, pressure and pain etc. The primary somato-sensory cortex lies immediately close to the central sulcus, i.e., in the **parietal lobe**. This cortex receives information from the somatic senses. Therefore, this area is specialized for touch, pressure and pain. The **occipital lobe** contains the primary visual cortex. It lies in the backside of the cortex. It receives visual inputs from the eyes. The **temporal lobe** contains the primary auditory cortex, which receives information form our ears.

Association Areas. The areas of the cerebral cortex that are not directly concerned with sensory or motor functions are called association areas. Each lobe is having an association area. The **association areas** are assumed to play a role in integrating the activities in the various sensory systems and in transmitting sensory input into programs for motor output. In addition, the association areas are involved in complex cognitive activities such as thinking, reasoning, learning and remembering etc.

The junction of the three posterior lobes is known as the **PTO** (parietal, temporal, and occipital) area. In this area, the somato-sensory, auditory, and visual functions overlap. Persons who sustain injury to PTO area may have difficulty in reading and writing.

In many ways, the left and right hemispheres of the brain are structurally and functionally equal. But they are not entirely equal. For 96 percent of those people who are right-handed, the left hemisphere contains the language functions. For 70 percent of those people who are left-handed, the left hemisphere also contains language functions. For 15 percent of left-handed individuals, the right hemisphere contains language functions. For the remaining 15 percent of left-handed persons, both the hemispheres contain language functions. The dominant hemisphere with regard to language functions as described above contains **Broca's area** and **Wernicke's area**. Damage to either area causes aphasia- that is, a disruption of the ability to understand or produce language. Broca's area is located in the frontal lobe and Wernicke's area is located in the temporal lobe.

Corpus Callosum. The two hemispheres of the cerebrum are connected with each other by a band of fibers known as corpus callosum. **Roger Sperry**, the Noble Prize winner in 1981, damaged corpus callosum in a series of experiments and observed that the right hemisphere is specialized in the functions of memory for patterns of stimulations or images, and the left hemisphere specialized in analytical, logical and mathematical functions. However, both hemispheres act in close cooperation with each other.

How Does Brain Function ?

Physiological psychologists from the days of Johannes Muller are trying to answer the question of whether or not the brain functions as a 'whole'? There are

differences in views. A group of researchers believed that each part of the cerebrum had a definite function. Other group of researchers believed that parts of the brain are functionally interchangeable. From the modern findings, the answer is that brain functions in parts as well as in whole. Experiments on localization by **Franz** and **Lashley** were carried out and their findings are expressed in two theories, i.e., *theory of equipotentiality*, and *theory of mass action*.

Theory of Equipotentiality

A monkey was trained to open a door by handling a switch after continuous training. After the learning was established, a portion of the frontal lobe was removed. It was found that the monkey could not perform the learnt skill of door-opening showing forgetting. Thus one can conclude that motor activity is dependent on a part of the motor cortex area of the frontal lobe. But it was found that the monkey could relearn the same trick. But when more amount of cerebral cortex was removed the animal could not learn again. Both Lashley and Franz carried out such studies repeatedly on several animals. Their findings were that ordinary maze learning was possible equally well in any part of the cortex. Difficulty of task needs more amount of cortex. **Lashley concluded that complex learning does not depend on any definite structure of a specific area of cortex. It rather depends on the total organization of the cortex.**

The theory of equipotentiality means capacity of the injured part of the brain to function as a substitute for another lesioned part in the brain. That means, according to this theory, all parts of the cortex are equally potential enough for simple learning functions.

The Principle of Mass Action

This theory put forth the findings that the brain basically functions as a whole, and therefore more parts of the cortex available, the better would be the learning capacity. By comparing decorticated animals with normal animals, Lashley found that animals having decorticated cortex demonstrated general reduction in sensitivity, exploratory activities and aggressiveness. Thus, the removal of any part of the brain affects the learning process in a general and global manner.

On the basis of the experimental findings with apes and injured persons, the two theories are found to be confirmed. Thus, according to these theories the brain functions as a whole and also in parts depending on the types of learning functions required.

The Peripheral Nervous System

The peripheral nervous system consists of the sensory and motor neurons that transmit messages to and from the central nervous system. Without the peripheral nervous system, our brain will be isolated from the world. It would not be able to receive any information and would not be able to control or show any activity. The peripheral nervous system has two divisions. They are the *somatic nervous system* and the *autonomic nervous system.*

The Somatic Nervous System

The somatic nervous system consists of sensory neurons, which run from our sense organs towards the central nervous system for perception, learning etc. and the motor neurons, which carry messages from the brain towards the striped muscles of the body for activities. As a result, we are able to experience the beauties and horrors of the world and also show such actions like moving our hands or legs, singing, running, jumping, riding, and so on. Thus, the somatic nervous system in general controls the striated or striped muscles of our body.

The Autonomic Nervous System

The autonomic nervous system regulates the glands and involuntary activities such as heartbeat, digestion, blood circulation etc. Thus, it controls the smooth muscles and glands of our body. The autonomic nervous system is called as 'autonomic' because many of the activities it controls are autonomous, or self-regulating and continue even when a person is asleep or unconscious. For example, digestion, blood circulation, etc. continue even when we are sleeping (see Figure 3.10).

The autonomic nervous system has two divisions: **sympathetic** and **parasympathetic** nervous systems. Both these divisions have survival functions for which the autonomic nervous system is often called as *survival nervous system*. One is to assist the organism to escape or cope with a life-threatening situation. The

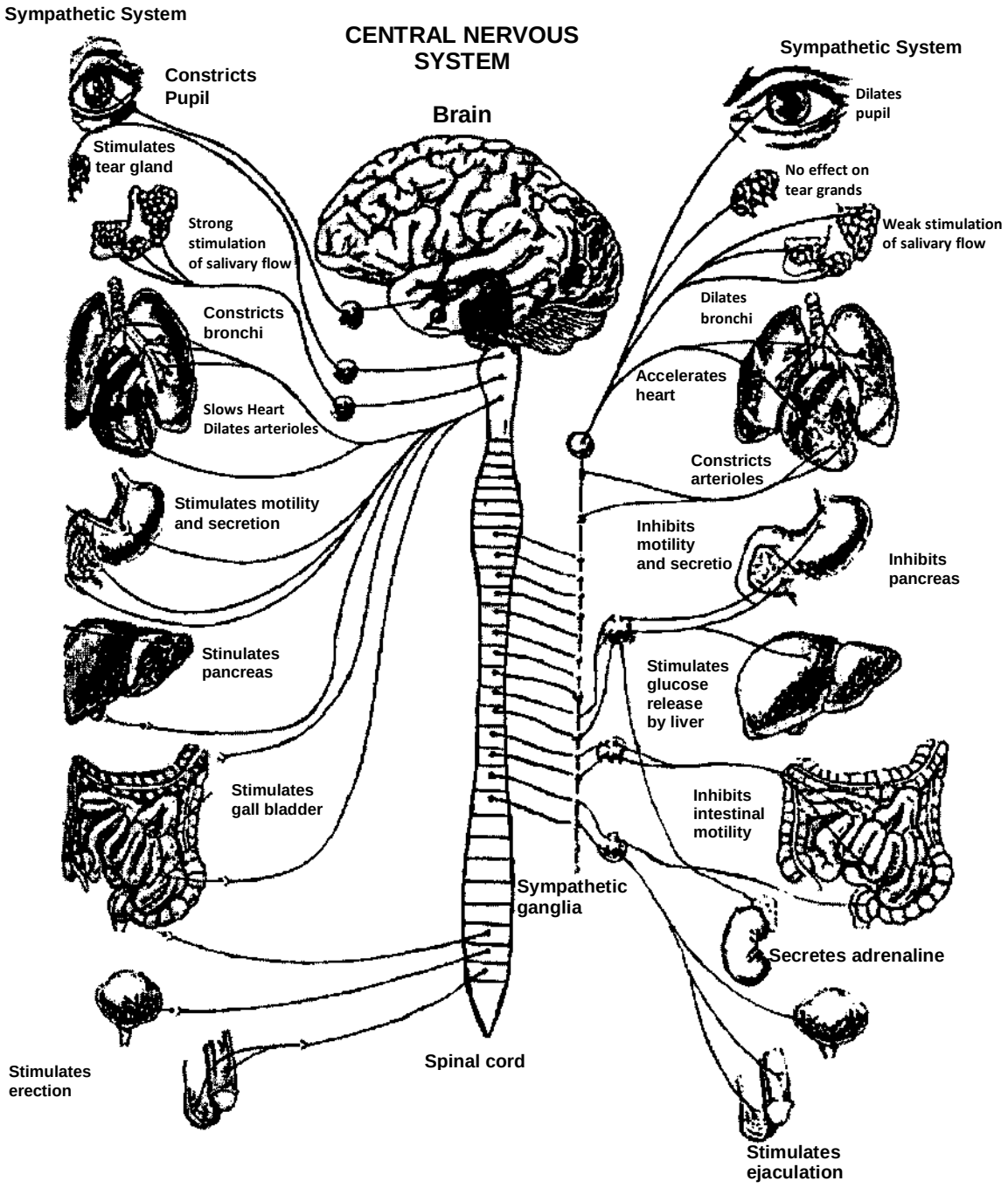


Figure 3.10 The autonomic nervous system

other is to co-ordinate, produce and conserve the bodily resources necessary to maintain the organism throughout its life span.

The autonomic nervous system is intimately connected with the spinal cord. The sympathetic nervous system outflow takes place through the *thoracic-lumbar regions* of the spinal cord. The parasympathetic nervous system outflow takes place in the *cranial-sacral* regions of the spinal cord.

The **sympathetic division** tends to act as a unit. It is excited in emotional situations. Thus, **sympathetic nervous system is the division for emergency survival**. During emotional excitement, for example, the digestion is stopped, heart-rate is increased, the arteries of the heart and skeletal muscles are dilated, blood flow to the internal organs is redirected to the skeletal muscles, the air passages in the lungs are opened to facilitate oxygen transfer and the endocrine system (ductless glands) is stimulated to release several chemicals that increase the effectiveness of the entire motor system.

Unlike the sympathetic nervous system, the **parasympathetic system** tends to affect one organ at a time. Whereas the sympathetic system is activated during violent emotions or excited activities, **the parasympathetic system is dominant and active during normal times or during quiescence**. It stimulates processes that conserve the bodily energy. Activation of this system slows heartbeat, lowers blood pressure and diverts blood away from skeletal muscles to the digestive system, and conserves and protects bodily resources.

At first glance, it appears that the sympathetic and parasympathetic systems compete with one another in a head-on clash. In fact, this is far form the case. **The sympathetic and parasympathetic systems function in a coordinated manner**. For example, if a person eats a very large meal in a feast, the parasympathetic system stimulates digestion while at the same time the sympathetic system increases sweating in order to eliminate excess heat.

The Endocrine System

The nervous system is one primary instrument of communication within the body. There is also another system which serves a similar function – the *Endocrine System*. This system consists of a number of ductless glands, called the endocrine glands. These

glands release chemicals called *hormones* into the blood stream and send messages throughout the nervous system via the circulatory system. The circulatory system carries hormones from the endocrine glands to various organs and systems of the body. The endocrine system is controlled by the Autonomic Nervous System activity. Like the nervous system, the endocrine system uses chemical substances to transmit information. In the nervous system, the chemical substances are neurotransmitters that excite or inhibit postsynaptic cell; in the endocrine system, the chemical substances are hormones that affect specially sensitive cells in the target organ. Since endocrine glands they release chemicals into the blood stream, their effects are slow compared to the neurotransmitters but the effect last for a longer duration. Some important endocrine glands are described below (see Figure 3.11).

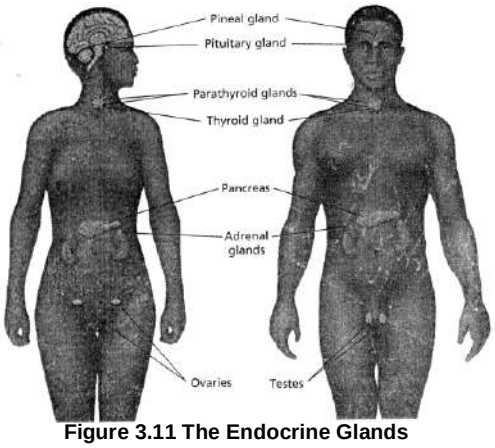


Figure 3.11 The Endocrine Glands

The Pituitary Gland

The major gland of the endocrine system is the pituitary gland. It is found just below the hypothalamus and is regulated by the hypothalamus. Pituitary is called the '*master gland'* of the body because it releases hormones that regulate and control the actions of other endocrine glands (adrenal, thyroid, pancreas, ovaries in females, testes in males etc.). Besides controlling other glands, the pituitary has also its own important functions. The hormones secreted by the pituitary gland control body growth. Extremely short people or unusually tall people have pituitary gland abnormalities.

The pituitary has two independently functioning parts – *posterior pituitary* and *anterior pituitary*. The *posterior pituitary* prevents loss of water through kidney and releases **oxytocin** which controls the production of milk in females. The *anterior pituitary* releases hormones that regulate the activities of other endocrine glands. The *anterior pituitary* releases **growth hormone** which is released steadily through childhood with extra spurt during adolescence. It also releases **gonadotropic hormone** that regulates the functions of sex glands (**testes** in the males and **ovaries** in the females).

Pituitary is also related to important brain locations that play a role in emotions. Though pituitary is the 'master gland', it is actually the servant of the brain because brain is ultimately responsible for endocrine system's functioning.

The Pineal Gland

The pineal gland is located in the brain nearer to the back. It secretes a hormone called melatonin, which regulates sleep-wake cycle.

The Adrenal Glands

The adrenal glands are located on the top of the kidneys. Each has two separate parts – *adrenal medulla* and *adrenal cortex*. The central area is adrenal medulla, which secretes *epinephrine* (also known as *adrenaline*) and *norepinephrine* (also known as *noradrenalin*). These hormones help the body to handle emergencies such as increased heart rate, blood pressure and blood sugar. These hormones stimulate hypothalamus as a result of which emotion in an individual stays even when the stressor has been removed.

The adrenal cortex secretes a group of hormones called corticoids which affect body's metabolism and blood pressure. These hormones are excessively produced when the individual remains under pressure and harm the body.

The Thyroid Gland

The thyroid gland plays a vital role in the regulation of body metabolism. It is located in the neck and produces thyroxin which influences body metabolism. Overproduction of thyroxin speeds up the metabolic rate. As a result, the person becomes highly active resulting in weight loss. Underproduction of thyroxin makes the person inactive resulting in weight gain. A low level of thyroxin during childhood is the cause of cretinism, a form of mental retardation.

Pancreas

The pancreas produces insulin which helps to break down glucose for use by the body and also for storage as glycogen in the liver. The rate of insulin production depends on how much sugar has been ingested and how much have been burnt through exercise. If it produces too little insulin, it results in diabetes. If it produces too much insulin, it results in hypoglycemia or low blood sugar. Diabetic patients who miss their meals or under physical and mental stress may lapse into insulin come because of lack of sugar.

The Gonads

The gonads are the sex glands including the testes in males and the ovaries in females are the gonads. They secrete hormones that regulate sexual behavior. The production of sex hormones in both sexes (testosterone in males and progesterone in females) increases during adolescence. Testosterone in males brings physical change such as growth of body hair, deepening of voice with age, increase in sexually oriented behavior and aggressive behavior. Progesterone in females controls the beginning of menstruation and if fertilization occurs, then it influences the fetal development. Both males and females produce estrogen and progesterone and it is the balance between them that determines gender behavior.

Methods of Studying Brain Functions

A variety of procedures are used by physiological psychologists to study the functions of different areas of the brain. Some of them are very old methods and outdated; some of them are most recent in origin and frequently used by modern investigators. The methods help us to study the localization of the functional areas of the brain.

Traditional Methods

Surgical Ablation or Method of Extirpation. In lesioning or extirpation, tissues at a particular part of the brain are destroyed electrically and the behavioral effects of such destruction are observed. In surgical ablation, a part of the brain is surgically removed. Human beings cannot be studied with these methods directly except in situations when an accident or disease requires a lesion or when the removal of abnormal brain tissue is essential to the well being of human beings.

Stimulational Method. A specific part of the brain may be stimulated either by electric current or by chemicals. Through electrical stimulation, we can only stimulate the desired part of the brain. But by chemical methods, we can stimulate or defunct a particular part of the brain for a fixed period of time and observe their effects on behaviour.

Electrical Recording or Action Potential Method. The rhythmical electrical discharges of the brain are recorded by an instrument called electroencephalogram (EEG). The EEG can detect minute electrical activities of the brain cells during sleep,

arousal, and activity. The brain parts having greatest electrical activity can be linked with behaviors and sensations of the body. This will tell how the body surfaces are represented in the brain.

Histology. The structural features of neurons and fiber connections can be studied through microscopic examination of brain tissues. This method is called as **histology**. Three important techniques of histology have been developed. They are: (a) *fixation* in which the tissue is preserved in a fixative such as formalin, *(b) sectioning* in which the tissue is sliced through a microtone (an instrument), and (c) *staining* in which the desired portion of the brain or cell is stained or dyed (colored) before its microscopic examination.

Scanning and Imaging Techniques

The advances in modern technology have made it possible to study the internal workings of the brain without having to cut surgically into a person's skull. The brain scanning are the mechanical and electrical measurements of biochemical and electrical activities of specified brain areas. Some of these techniques are discussed below.

Computerized Axial Tomography (CAT). Thousands of separate X-rays are taken at slightly different angles, and the computer constructs an image of the structures of the brain by combining these X-rays. It is very useful for showing abnormalities in the structure of the brain such as swelling and enlargement of certain parts. But it does not provide information about brain activity.

Magnetic Resonance Imaging (MRI). It produces a strong magnetic field in which the person's head is positioned. The radio waves directed at the brain cause the hydrogen atoms to emit signals, which are analyzed by a computer. The details of the MRI are superior to CAT scan, because it can distinguish between closely related brain structures.

Positron Emission Tomography (PET). It shows the biochemical activity within the brain at a given moment in time. The PET scan begins with the injection of radioactive water into the blood stream, which makes its way to the brain. The computer measures the location of radiation within the brain and determines which are the more active regions. The technique is good to provide a picture of brain's functioning.

Superconducting Quantum Interference Device (SQUID). It is sensitive to tiny changes in magnetic fields that occur when neurons fire. When neurons fire, they create an electric current, which gives rise to a magnetic field. This magnetic field is interpreted by the SQUID as neural activity. This helps to pinpoint the location of neural activity.

KEY TERMS

Receptors
Effectors
Exteroceptors
Interoceptors
Proprioceptors
Neuron
Cell body
Soma
Dendrite
Axon
Terminal Buttons
Axon terminal
Myelin sheath
Law of forward conduction
Afferent neurons
Efferent neurons
Inter-neurons
Glia cells
Absolute refractory period
Relative refractory period
Threshold point
All-or-none law
Neural transmission
Synapse
Synaptic vesicles
Neurotransmitter
Central nervous system
Peripheral nervous system
Somatic system
Autonomic nervous system
Sympathetic system
Parasympathetic system
Spinal cord
Reflex arc
Hindbrain
Midbrain
Forebrain
Medulla
Pons
Cerebellum
Reticular activating system
Thalamus
Hypothalamus
Limbic system
Amygdala
Hippocampus
Septum
Basal ganglia
Cerebrum
Left hemisphere
Right hemisphere
Association area
Corpus callosum
Frontal lobe
Parietal lobe
Temporal lobe
Occipital lobe
Equipotentiality
Mass action
Surgical ablation
Electroencephalogram
Action potential method
Histology
CAT scan
MRI
PET scan
SQUID
Reflex action

SUMMARY

1. A branch of psychology known as *physiological psychology* studies the biological bases of behaviour.

2. The study of behaviors and conscious experiences involves three physiological processes such as *receptor process, effector process,* and *processes of the nervous system*.

3. Receptors receive information; neurons conduct and effectors carry out activities.

4. *Neurons* are the basic building blocks of the nervous system, responsible for transmitting and integrating information. In general, the neurons have the following structures: (a) *cell body* or *soma*, (b) *dendrites*, (c) *axon*, (d) *terminal buttons* or *axon terminals*. The cell body contains the nucleus of the cell that sustains its life. The dendrites extend from the cell body and receive stimulations from other neurons or sensory receptors. The axon conducts information from the cell body to the terminal buttons. The terminal buttons convey messages to other cells.

5. The *glia cells* surround neurons and hold them in place. They insulate neurons from one another so that neural messages do not get scrambled.

6. The transmission of information inside the neuron takes place by the movement of positively and negatively charged *ions* across its cell membrane. The glia cells produce neuron's *myelin sheath*.

7. Neurons operate on *all-or-none law*, i.e., the neurons either fire or do not fire. It fires only when the stimulus intensity reaches a particular threshold. Following stimulation, the neuron comes back to *resting potential*.

8. *Action potentials* refer to rapid changes in the electrical properties of the cell membranes of the neurons and constitute the basic mechanism by which information moves through the nervous system.

9. The three types of neurons that constitute the nervous system are *sensory neurons, motor neurons*, and *inter-neurons*.

10. The *synapse* is the space between neurons that provides a junction for information transfer. As the neural impulse reaches the axon terminal, the *synaptic vesicles* get fired, and release *neurotransmitters* into the synaptic gap. The dendrites of the receiving neuron come in contact with the neurotransmitters and receive the message. The neural transmission is an *electrochemical process*.

11. The nervous system has two major divisions: *central nervous system* and *peripheral nervous system*. The central nervous system consists of the *brain* and the *spinal cord*. The peripheral nervous system has two divisions: the *somatic system* and *the autonomic nervous system*. The autonomic nervous system is further divided into the *sympathetic system* and *parasympathetic system*.

12. The spinal cord carries information to the brain via afferent nerves and carries information from the brain to muscles and glands via efferent nerves. It also plays a key role in coordinating reflexes.

13. The brain may be divided into three parts: *hindbrain, midbrain,* and *forebrain*. The hindbrain contains *medulla, cerebellum,* and *pons*. The medulla regulates heartbeat and respiration. The pons is involved in respiration and dreams. The cerebellum makes our bodily movements precise, smooth, and coordinated.

14. The *reticular activating system* (RAS), which is a part of the midbrain, is involved in regulating arousal, attention, and sleep.

15. The major structures of the forebrain are *thalamus, hypothalamus, cerebrum, limbic system,* and *basal ganglia*. The thalamus lies at the central part of the brain, and processes and relays sensory information on its way to the cerebrum. The hypothalamus located just below the thalamus regulates the autonomic nervous system and *bodily homeostasis*.

16. The *cerebrum* or the cerebral cortex is the seat of higher mental processes such as thinking, language, planning, reasoning, and memory. Buried within the cerebrum are clusters of gray matter known as *basal ganglia*. The three important structures of the limbic system are *hippocampus, amygdala,* and *septum*.

17. The cerebral cortex is divided into four lobes: *frontal lobe, parietal lobe, temporal lobe*, and *occipital lobe*. The *frontal lobe* is specialized for planning, execution, and

control of movements. The parietal, temporal, and occipital lobes are specialized for perception and experience. The *parietal lobe* contains the primary somato-sensory cortex; the *occipital lobe* contains the primary visual cortex; and the *temporal lobe* contains the primary auditory cortex.

18. The *peripheral nervous system* consists of the *somatic* and *autonomic nervous systems*. The somatic nervous system connects the central nervous system with sensory receptors, muscles, and surface of the body.

19. The *autonomic nervous system* regulates glands and involuntary activities like heartbeat, respiration, digestion etc. The autonomic nervous system is divided into *sympathetic* and *parasympathetic* nervous systems.

20. The *sympathetic nervous system* is most active during emotional responses that spend the body's reserves of energy such as fear and anxiety. The *parasympathetic nervous system* is most active during quiescence or during processes that restore the body's reserves of energy.

21. The *endocrine system* consists of a number of ductless glands, called the endocrine glands, which release chemicals called *hormones* into the blood stream and send messages throughout the nervous system via the circulatory system. The effects of hormones are slow but their effects last for a longer duration.

22. Some important endocrine glands are *the pituitary gland*, *the pineal gland*, *the adrenal glands*, *the thyroid*, *pancreas* and *the gonads*. The pituitary is the master gland of the body as it controls the functions of other endocrine glands. The hormones secreted by the pituitary gland control body growth.

23. The *pineal gland* located in the brain nearer to the back secretes a hormone called melatonin, which regulates sleep-wake cycle. The *adrenal cortex* secretes a group of hormones called corticoids which affect body's metabolism and blood pressure. These hormones are excessively produced when the individual remains under pressure and harm the body.

24. The *thyroid gland* located in the neck produces thyroxin which influences body metabolism. The *pancreas* produces insulin which helps to maintain the blood sugar level. If it produces too little insulin, it results in diabetes.

25. The *gonads* are the sex glands including the testes in males and the ovaries in females are the gonads. They secrete hormones that regulate sexual behavior.

26. The physiological psychologists use a variety of methods to study the functions of the brain such as *surgical ablation*, *electrical and chemical stimulation, electrical recording of the action potentials,* and *histology*. The contemporary imaging and scanning techniques include *CAT scan, MRI, PET scan,* and *SQUID*. The imaging techniques have proved very useful in detecting brain functions and abnormalities.

QUESTIONS

A. True-False Questions

(State whether the following statements are True (F) or False (F))

1. The glia cells in the brain are called neurons.

2. The synapse is a part of the neuron.

3. Reflex arcs are coordinated in the brain.

4. The temporal lobe contains the primary visual cortex.

5. The synaptic gap controls the rate of flow of neural impulses.

6. The hypothalamus controls the body temperature.

7. The soma sustains the life of a neuron.

8. Reflex action is not possible without the spinal cord.

9. The synaptic vesicles are in the dendrites.

10. The neural transmission is electrochemical in nature.

11. Thalamus is called the seat of emotions.

12. The somatic system controls the voluntary movements.

13. The dendrites convey messages to other cells.

14. The glia cells surround the neurons.

15. The sympathetic system meets the emergency situations.

16. The cerebellum is a part of the hindbrain.

17. The state of inactivity following neural stimulation is the absolute refractory period.

18. Neurons function according to all-or-none law.

19. The medulla controls the body balance and posture.

20. The cerebellum is called as the little brain.

21. The thalamus controls the functioning of the autonomic nervous system.

22. Damage to the hippocampus affects short-term memory.

23. Our body has five kinds of receptors.

24. The electrical charge in the neuron is positive when it is in a resting state.

25. Sympathetic division is a part of the autonomic nervous system.

26. The spinal cord is a part of the autonomic nervous system.

27. The midbrain contains the primitive centers of vision and hearing.

28. The limbic system contains amygdala.

29. The left hemisphere controls the right side of the body.

30. Lashley propounded the principle of mass action.

31. The parasympathetic system is dominant in normal times.

32. CAT scan is based on person's reaction in a strong magnetic field.

33. Terminal buttons receive impulses form the receptors.

34. Neurilemma helps regeneration of neurons.

35. Neurons obey the law of forward induction.

36. The biological clock is located in the cerebrum.

37. Hypothalamus is called the relay station of the brain.

38. Corpus callosum connects the two hemispheres.

39. The glia cells provide nutrients to neurons.

40. Histology is a brain imaging technique.

41. The endocrine system consists of ductless glands.

42. Hypothalamus regulates the functioning of the pituitary gland.

43. The adrenal cortex is known as the master gland of the body.

44. The endocrine glands release hormones into the respiratory system.

45. Endocrine system is an instrument of communication within the body.

46. Both males and females produce estrogen and progesterone.

47. Compared to neurotransmitters, the effects of hormones last for a shorter duration.

48. The functioning of the endocrine system is controlled by the brain.

49. Progesterone is a female sex hormone.

50. More adrenaline flows into blood stream when the individual is under too much pressure.

B. Multiple-Choice Questions

(Choose the correct alternative from the bracket to fill up the blank or answer the question):

1. The fatty substance that provides a protective coating to axons is called ..... (terminal button, myelin sheath, soma, synapse).

2. ..... contain neurotransmitters (dendrites, synaptic vesicles, axons, cell bodies).

3. The autonomic nervous system is controlled by .....(brain, hypothalamus, spinal cord, thalamus).

4. A sensory neuron is also called .....(afferent neuron, efferent neuron, synapse, soma).

5. The primary cortical area for somesthesis is located in the ..... lobe (temporal, frontal, occipital, parietal).

6. Motor neurons are also called .....neurons (afferent, efferent, cortical, inter).

7. ..... is a part of the autonomic nervous system (sympathetic division, spinal cord, frontal lobe, cerebellum).

8. The dendrites are at..... of neurons (receiving end, middle, delivering end, below).

9. ..... discovered the speech area in the brain (Broca, Miller, Moody, Stebbins).

10. ..... plays a significant role in emotional behaviour (thalamus, hypothalamus, frontal lobe, parietal lobe).

11. The receiving end of a neuron is called ..... (dendrites, axon. end brushes, nucleus).

12. Action potentials are recorded from .....(eyes, neurons, ear, frontal lobe).

13. Corpus callosum connects ..... (two cerebral hemispheres, cerebrum and cerebellum, medulla and pons, cerebral hemisphere and midbrain).

14. Unit of nervous system is .....(cyton, axon, neuron, dendron).

15. The biological clock is located in the ..... (medulla, hypothalamus, cerebellum, spinal cord).

16. ..... is called the relay station of the brain (hypothalamus, amygdala, cerebellum, thalamus).

17. ..... plays a key role in maintaining bodily homeostasis (hypothalamus, amygdala, cerebellum, thalamus).

18. ..... receive stimulations from the internal body organs (exteroceptors, interoceptors, proprioceptors, effectors).

19. ..... coordinates reflex actions (brain, spinal cord, hypothalamus, medulla).

20. ..... is a part of the hindbrain (medulla, amygdala, cerebrum, thalamus).

21. Damage to ..... leads to coma (RAS, thalamus, pons, medulla).

22. .....controls the activities of the endocrine system (thalamus, hypothalamus, medulla, cerebellum).

23. Damage to the ..... increases exploratory behavior (amygdala, hippocampus, septum, basal ganglia).

24. The ..... lobe contains the primary visual cortex (frontal, parietal, temporal, occipital).

25. ..... is not a method for studying brain functions (MRI, electrical stimulation, PET, electroconvulsive shock).

26. The endocrine glands secrete chemicals known as .....(neurotransmitters, hormones, pheromones, endorphin)

27. ..... gland is located just below the hypothalamus (pituitary, thyroid, adrenal, thalamus)

28. Insulin is secreted by ..... (pituitary, adrenal, pancreas, thyroid)

29. Kamalesh did not grow to be very tall. The doctor told his parents that ..... gland did not function properly (pituitary, thyroid, adrenal, gonad)

30. If pancreas secretes too little insulin, it results in ..... (hypothyroidism, dwarfness, diabetes, hypoglycemia)

31. .....is not a part of the endocrine system (adrenal, hypothalamus, gonads, pineal)

32. ..... regulates the functioning of other endocrine glands (pineal, adrenal, thyroid, pituitary)

33. The sleep-wake cycle is regulated by the ..... gland (pineal, pituitary, adrenal, thyroid)

34. The corticoids are secreted by the ……. (thyroid, pituitary, adrenal cortex, gonads)

35. Hormones secreted by the ……. controls body growth (adrenal, pituitary, thyroid, gonads)

36. Thyroid plays an important role in regulating ……. (body metabolism, blood pressure, sexual behavior, blood sugar)

37. The gonads secrete chemical to regulate ……. (blood pressure, metabolic rate, blood sugar level, sexual behavior)

C. Short-Type Questions

(Write the answer to each question in five sentences)

1. What are the functions of the receptors?

2. What is reflex arc?

3. Briefly state the structures of a neuron.

4. What is reflex action?

5. What is the function of parasympathetic division?

6. How are dendrites different from terminal buttons?

7. Differentiate between receptors and effectors?

8. Explain all-or-none law.

9. What are the functions of hypothalamus?

10. What is the difference between afferent and efferent neurons?

11. What is the role of autonomic nervous system during emotion?

12. Discuss the functions of the spinal cord.

13. Briefly state the functions of a neuron.

14. State the divisions of the cerebrum.

15. What are the major divisions of the hindbrain?

16. Does the human brain act as a whole?

17. Explain the law of equipotentiality.

18. Explain the principle of mass action.

19. What is neuron?

20. Explain synapse.

21. Briefly state the major functions of the autonomic nervous system.

22. What is the function of the cerebellum?

23. Which part of the human brain is responsible for temperature regulation?

24. What is neural transmission?

25. What are the functions of the sympathetic division?

26. Why the pituitary is called the master gland?

27. Briefly state the functions of adrenal glands.

28. What important functions gonads serve in the endocrine system?

29. What happens when thyroid gland functions abnormally?

30. What are the functions of the pancreas?

D. Essay-Type Questions

(Write long answers)

1. Describe the structure and functions of a typical neuron with the help of a diagram.

2. Describe the structure and functions of the human brain.

3. Explain the structure and functions of the central nervous system.

4. Describe the structure and functions of the autonomic nervous system.

5. Describe the structure of a neuron and explain the process of neural transmission.

6. Discuss the different methods used for studying brain functions.

7. Describe the endocrine system along with the functions of its different parts.

ANSWERS

A. True-False Questions:

1. F **2.** F **3.** F **4.** F **5.** T **6.** T **7.** T **8.** T **9.** F **10.** T **11.** F **12.** T **13.** F **14.** T **15.** T **16.** T **17.** T **18.** T **19.** F **20.** T **21.** F **22.** T **23.** F **24.** F **25.** T **26.** F **27.** T **28.** T **29.** T **30.** T **31.** T **32.** F **33.** F **34.** T **35.** T **36.** F **37.** F **38.** T **39.** T **40.** F
41. T **42.** T **43.** F **44.** F **45.** T **46.** T **47.** F **48.** T **49.** T **50.** T

B. Multiple-Choice Questions :

1. myelin sheath	2. synaptic vesicles	3. hypothalamus	4. afferent neuron
5. parietal	6. efferent	7. sympathetic division	8. receiving end
9. Broca	10. hypothalamus	11. dendrites	12. neurons
13. two cerebral hemispheres	14. neuron	15. cerebellum	16. thalamus
17. hypothalamus	18. interoceptors	19. spinal cord	20. medulla
21. RAS	22. hypothalamus	23. amygdala	24. occipital
25. electroconvulsive shock			
26. hormones	27. pituitary	28. pancreas	29. pituitary
30. hypoglycemia	31. hypothalamus	32. pituitary	33. pineal
34. adrenal cortex	35. pituitary	36. body metabolism	37. sexual behavior

Chapter 4
SENSORY AND PERCEPTUAL PROCESSES

This chapter covers :

a) Brief Ideas about Sense Organs

b) Nature and types of Attention and Determinants of Attention

c) Meaning and Operational Definition of and Processes involved in Perception (Receptive, Selective, Symbolic and Affective processes)

d) Principles of Perceptual Organization

e) Role of Needs, Past Experiences and Cultural Factors in Perception

f) Errors in Perceptual Process- Illusion and Hallucination

g) Brief Idea about Perception of Depth and Distance

After you go through this chapter, you would be able to :

- *Understand the nature of sensory and perceptual processes.*
- *Discuss the principles underlying perceptual organization.*
- *Appreciate how individual's needs, experiences and culture influence the way s(he) perceives.*
- *Distinguish between illusion and hallucination.*
- *Explain the principles underlying depth, distance, and movement perception.*
- *Gain an understanding of the structures and functions of the visual and auditory sense organs.*

CONTENTS

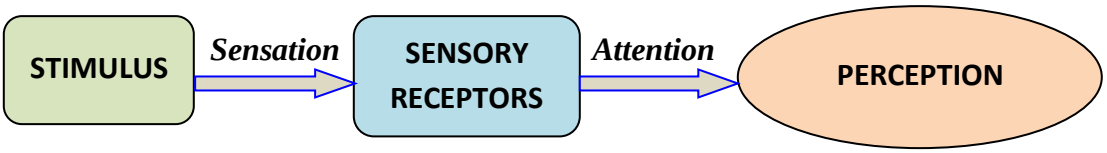
Chapter 4

Sensory and Perceptual Processes

Introduction

Perception is one of the many cognitive processes that help us acquire information from the environment. The environment consisting of various objects and events always excite us in some forms by creating its initial impression on our sense organs. Our first interaction with the environment begins when an external stimulus is sensed, attended to, and perceived. It is through these primary and basic mechanisms, we make sense of what happens in the world around us. We thus experience perception as one of the first psychological processes on which other higher psychological processes such as learning, thinking, memory, problem-solving etc. are based.

In the previous chapter on biological bases of behaviour, we came to know that we receive information from our environment through the sense organs. The information so received is transmitted to the brain for processing. ***Receiving information from the environment by any of the sense organs is called sensation.*** The sensation is the initial contact between the organism and the physical environment. The stimuli in the environment emit physical energy, such as light, sound, and heat. The sense organs detect this energy, and transform it into a code that can be transmitted to the brain. But sensation alone is not enough to gather relevant experiences about a particular object or event. It is a simple mechanical process of registering the environmental input, which is then carried to our central nervous system for processing. The information must be organized and interpreted; otherwise, they would be of no use to us. ***The process through which we organize our sensations to meaningfully interpret them, and thereby form a mental representation of our world is called perception.*** Perception is a complex mental process and is not mechanical in nature like sensation. It is not simply a passive process of decoding sensory information; it is a dynamic process based on the foundation of sensation. In our everyday life, **the two processes of sensation and perception are practically inseparable.**



Processes in Perception

Sensation is a simple and mechanical process; attention is filtering process; perception is an integrated and interpretative process for forming mental representations.

When you enter into your classroom, everything present there including doors, windows, walls, fans, blackboard, books, chalks, teacher, friends and so on impacts out sense organs. Everything in the classroom is *sensed*. But we selectively *attend* to only a few of them – for example, the blackboard and the chalk. We become increasingly aware of them. We attend to these objects and form a mental image of these objects in the context of our earlier experiences. We *perceive* the characteristic features of these objects. Then we can use such information for other psychological processes such as learning, thinking, memory, problem solving etc. Following our perception, we may judge that the blackboard needs to be cleaned and there needs to be more chalks placed near the blackboard.

Detecting the Sensory World

Sensation involves the basic elements of experience. Different types of stimuli activate different sense organs. The light stimuli activate the sense of sight, while the sound stimuli activate the sense of hearing. The stimulus energy arrives at our sensory receptors as physical energy, which is then converted to neural impulse. The process by which one form of physical energy is converted into another form such as neural impulses is known as **transduction**. Each stimulus that is capable of activating a sense organ can also be considered in terms of its strength and intensity. The issue of how the intensity of a stimulus influences our sensory responses is dealt by a branch of psychology known as psychophysics. ***Psychophysics is the study of the relationship between the physical nature of stimuli and the sensory responses they evoke***. Psychophysics provides the link between the external physical world and the internal psychological world. Classic research in psychophysics has examined two types sensory thresholds: ***absolute threshold,*** and ***sensory threshold.***

Absolute threshold. A stimulus requires a minimum intensity to activate the receptor cells of a sense organ; otherwise there would be no sensation and perception.

The minimum stimulus value, which is required to activate the receptor cells of a sense organ, is called the absolute threshold or the stimulus threshold for that sense organ. In German, it is called ***reiz limen*** (**RL**). A stimulus below this threshold value does not activate the receptor cells of the sense organ, and hence, the sensation does not pass on to the brain. Therefore, in order that a perceptual activity is conducted, the stimulus intensity must reach the absolute threshold. The value of absolute threshold varies from person to person, for different sense organs in the same person, and also for varying internal and organic conditions of a person.

For example, suppose a very dim and faint light is presented to you from a distance, you may not be able to see the light. Now, the intensity of the light is increased a bit, you also may not be able to see it. Intensity is increased a bit further; you still don't see the light. Now, if the intensity of the light goes on increasing this way, at one time you would be able to see the light. The light intensity which you can detect 50% of the times it is presented is the absolute threshold for your perception of light Thus, ***the absolute threshold is the least or minimum value of a stimulus which is perceived by a person at least in fifty percent of presentations***. The threshold for one person may not be the same for another person as individuals differ from one another in relation to their absolute threshold values for different senses.

Difference threshold. Two stimuli of a particular kind may vary from each other in intensity, but may not be perceived as different. For example, the brightness of two lights may be different, but if the difference is very small we do not notice the difference between them. Similarly, when we add a little more salt to our curry, we may not notice a difference in saltiness of the curry. Thus, in order to actually notice a difference between two stimuli of the same kind, we need a minimum difference in the intensity between the two stimuli. ***The minimum difference in the intensity of two stimuli, which is required to perceive them as different 50% of the times, is called the differential threshold or differential limen*** **(DL)**. Thus, the difference in stimulation produced by two similar stimuli should be at least above this threshold to generate any kind of a stable difference in sensation and perception of those stimuli.

Signal-Detection Theory. The signal detection theory is an alternative to the approaches of classical psychophysics. It emphasizes that the judgment about the presence or absence of a stimulus depends on two processes: (a) an ***initial sensory***

process, which involves subject's sensitivity to the intensity of a stimulus, and (b) a ***decision making process***, which reflects psychological factors within the individual. ***The signal detection theory explains the role of psychological factors in judging whether a stimulus is present or absent.***

Whether we perceive a single stimulus or a difference between two similar stimuli, our perception of events depends on several factors. The intensity of stimulation, described in absolute threshold and differential threshold is one of the factors. Background factor in our perceptual field is another important condition, which influences our perceptual process. Background factor refers to the presence of other stimuli in which the perceived stimulus is observed or embedded. In other words, how are the other stimuli happening in respect to our perceived stimulus is called the background factor. For example, it is easier to hear a sound in a quite room than in a noisy room. Here noise is in the background of our perception of the sound. The efficiency of the person's sensory system, which is involved in sensation, is also another factor in perception. For example, a normal child is experiencing so many varieties of visual sensations, which a visually handicapped child is deprived of. A young boy listens to different voices distinctly and clearly as compared to an old man. Besides these physical and biological factors, several psychological factors like learning, motivation, interest, and expectancy also influence our perception. For example, we fail to hear a loud noise very close to us probably because we do not want to hear it. **The signal detection theory holds that the physical, biological, and psychosocial factors of the individual determine his perception to a large extent.**

Attention

Nature and Span of Attention

The process of selecting a stimulus or a group of stimuli from a large pool of stimuli is called attention. Roediger views attention as *the focusing of perception that leads to a greater awareness of a limited number of stimuli*. According to Dumville, *attention is the concentration of consciousness upon one subject rather than upon another*. While attention has been defined in several ways, all the definitions point to the following facts.

a. Attention is essentially a process, not a product.

b. Attention is selective in nature.

c. Attention helps us in being conscious of our environment.

d. Attention is readiness to deal with stimuli and give a response.

e. Attention is determined by the properties of the individual as well as by the properties of the environment.

f. Though attention is basically a cognitive process, it is influenced by emotional and motivational factors.

Span of Attention

Span of attention refers to how many items (digits or letters) one can attend in single glance of attention in about one-tenth of a second which makes eye movement or counting impossible. The more items one can attend to, the greater is the span of attention. On the basis of many experiments, Miller concluded that span of attention varies within the limit 7± 2 (that is from 5 to 9 items). That is probably the reason why motor bikes and cars have number plates containing only four digit numbers with some alphabets. In case of traffic violations, a traffic police can easily read and note these numbers with alphabets.

Individuals vary in their span of attention. The span of attention of the same individual varies from one situation to another and from one type of stimuli to another. Younger children have lower attention span compared to the older ones. Fast readers have a greater span compared to poor readers. Span of attention can be determined in the laboratory by the use of an instrument called 'tachistoscope'. Variables like nature of material (letter, digit or word), stimulus size and color, exposure duration, mental set and age influence individual's span of attention.

Types of Attention

Attention has been classified in a number of ways. A process-oriented view divides it into two types: *selective attention* and *sustained attention*.

Selective attention *is bringing into focus a limited number of stimuli from a large pool of stimuli.* Our perceptual system has a limited capacity; if selection does not take place, the brain would be overloaded. How do certain stimuli get selected? Psychologists

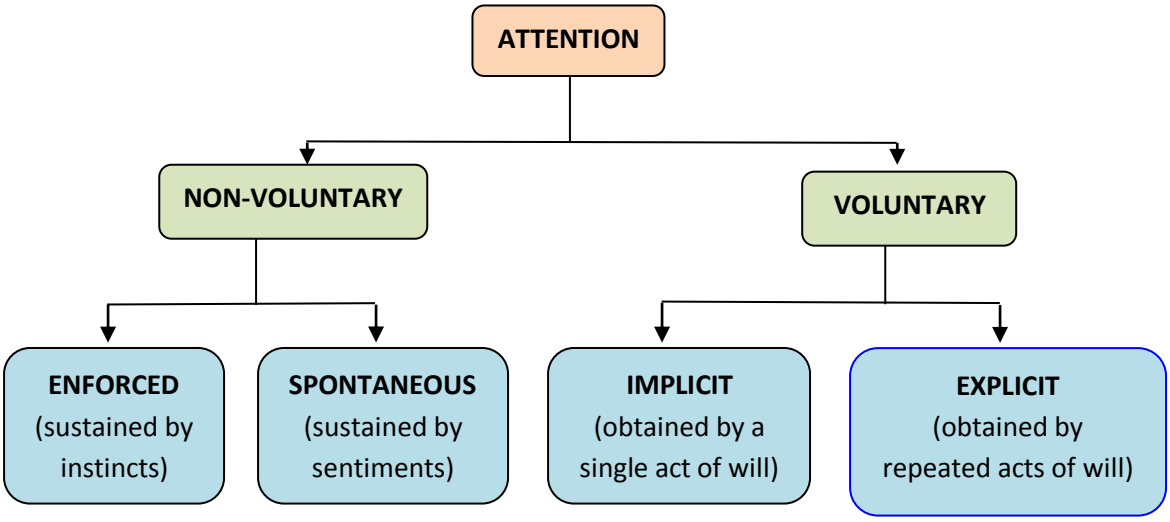
have identified a number of factors which may be classified as 'internal' and 'external'. External factors refer to stimulus properties in the environment such as size, shape, intensity, movement etc. Internal factors refer to qualities within the individual such as needs, interests, attitudes, mental set, emotional state etc. These factors are discussed at length later.

Sustained attention *is maintaining attention on an object for a relatively longer duration*. It is equivalent to '*concentration*' or '*vigilance*'. A high-achieving student has to concentrate on certain aspects of his studies for a longer period of time. The work of a driver, a pilot, an air-traffic controller and a radar operator are all examples of vigilance. They have to constantly watch and monitor signals and movements. They have to be right all the time because a single error can be fatal; they all have to be vigilant. Sustained attention is influenced by several factors such as *stimulus clarity* (intense stimuli are attended better), *sense modality* (performance is better for auditory than for visual stimuli), *temporal gap* (stimuli coming at regular intervals are attended better than stimuli at irregular intervals) and *spatial position* (attention is better for stimuli appearing at a fixed place than at random locations).

Sometimes we can also attend to two or more different things at the same time. This is called **divided attention**. An expert car driver can talk to a friend or attend to a phone call even while driving a car. Though driving takes a major share of attention, a part of the attention is also given to other activities. This is an instance of divided attention. Divided attention becomes possible only with highly practiced activities that can be performed almost automatically. Performance of these activities requires very little conscious mental effort. Even while talking with a friend, the driver can put on the break reflexively and unconsciously if he finds a person coming suddenly in front of the car. The processing is almost automatic.

Another type of classification was given by Ross in 1951.

Non-voluntary attention is aroused when we attend to an object without any conscious effort on our part. It can be *enforced* or *spontaneous*. **Enforced non-voluntary attention** is aroused by our instincts or curiosity such as attention towards members of the opposite sex or attention to a sudden loud noise or bright colors. When we make an appeal to the sex instinct or curiosity of a young man, he becomes quite attentive in the task. **Spontaneous non-voluntary attention** is aroused by sentiments. We



spontaneously attend to the object, person or idea to which we are connected sentimentally. Mothers non-voluntarily attend to their children. We non-voluntarily attend to our relatives in a gathering.

Voluntary attention requires conscious effort through the arousal of a single act or many acts of will. We attend to a task in order to accomplish a clear-cut goal. Voluntary attention can be *implicit* or *explicit.* **Implicit voluntary attention** is aroused by a single act of will. A student is warned by the teacher that he should complete the home task or else he would be punished. The student attends to his home task and completes it properly to avoid teacher's punishment. Here the attention is aroused by a single act of will – to avoid being punished. This is an example of implicit voluntary attention. **Explicit voluntary attention** is aroused by repeated acts of will. Here the person struggles hard to keep his attention focused on certain tasks to accomplish his goal. An example is: a few days before the examination, a student gathers his will power and attends to his studies against many odds and distractions to accomplish the goal.

Determinants of Attention

Attention is the process of selecting certain stimuli from the environment for further processing. How do certain stimuli get selected? In other words, which conditions are the determining factors of attention? The factors influencing attention are of two types: **External** or **Objective** factors (properties of the environment) and **Internal** or **Subjective** factors (characteristics within the individual).

External (Objective) determinants of attention

1. ***Nature of the stimulus***: The stimulus may be visual (to be seen), auditory (to be heard), olfactory (to be smelt), gustatory (to be tasted) or tactual (to be touched).

Among all sensations, visual and auditory stimuli attract more attention and between the two, visual stimuli are more attended than auditory stimuli. Pictures attract attention more readily than words. Among pictures, the pictures of human beings get more attention than those of animals and objects. Among human beings, those of beautiful women, handsome men or great personalities capture more attention. Among all pictures, one's own picture invites more attention. Colored pictures are more powerful than black-and-white pictures. In the auditory domain, melodious voices attract more attention. The advertisers capture these features to influence their customers.

2. ***Intensity of the stimulus***: Compared to a weak stimulus, a stronger stimulus attracts more attention. Our attention is easily directed towards a loud sound, a bright light, a strong smell, a heavy prick, or an acute pain. Against the buzzing sound in a market place, we easily hear the horn of motor vehicles. It is not just the intensity that determines our attention. Calling out our name in the midst of loud sounds in a market place attracts more attention from us. As a matter of fact attention does not depend on any single factor.

3. ***Size of the stimulus***: In the visual domain, as a general rule, the bigger size attracts more attention. A large building will be more readily noticed compared to small ones. A large-sized or a tall man will be more readily seen in a crowd.

4. ***Contrast***: The contrast factor is very powerful determinant of attention compared to intensity, size or the nature of the stimulus. A beggar in the market place, a dwarf person in a gathering, a woman in the midst of men, a westerner among Indians or a small advertisement against a very wide background are more readily noticed because of the contrast factor.

5. ***Change, Variety and Novelty***: Exposure to the same thing again and again diminishes our attention. Change and variety attract our attention. In order to capture attention, advertisers change their advertisements, we change our dresses on a daily basis or a good teacher changes his style of presentation depending on student competency. A teacher introduces variety to his lessons such as using maps, charts and activities to ensure student attention and keep them engaged. Variety along with novelty attracts better attention. We get compelled to attend to anything that is new and different because novelty breaks the monotony.

6. ***Duration of the stimulus***: Other things being equal, objects exposed for a moderate duration will catch our attention better than the one exposed for a shorter duration.

Visuals and sounds exposed for a moment escape our notice. A card containing digits or letters exposed for 30 seconds will invite more attention than if it is exposed for fraction of a second. The duration should be optimal to capture our attention. Presentation for too long a duration may not catch our attention. For example, a sudden flash of light in a dark night will attract our attention more than a continuous burning lamp. Noise at regular intervals will attract us more than a continuous noise. Exposure for a moderate duration is good for inviting attention.

7. ***Location of the stimulus***: Other factors remaining same, the location of the stimulus determines our attention. A visual stimulus located in front of our eyes attracts our attention than the one in the periphery. A student sitting in the far corner of the class or a man sitting in an isolated corner of the park will capture our attention. The appearance of an advertisement on different pages of a newspaper/magazine or at different places on the same page determines the amount of attention we would naturally give. Advertisements given on the front page or in the upper half of any page attract more attention.
8. ***Repetition of stimulus***: We may ignore a stimulus the first time but if it is presented to us again and again, it captures our attention. In a lecture, important points are repeated so that the attention of the audience remains focused on those valuable points. A misspelled word occurring three times in a paragraph is more likely to be noticed than if it occurs only once. Repetition should be used cautiously because too much repetition may be boring and we may cease to pay attention.
9. ***Movement of the stimulus***: In comparison to static objects, moving stimuli catch our attention quickly. We are more sensitive to stimuli that move in our field of vision. In a market place, we more readily notice the shop whose name is advertized with moving electric lights. In a class, the movement of a student quickly attracts the attention of the teacher.

   The advertisers, the shopkeepers and the businessmen make use of all the principles stated above to capture the attention of the customers.

Internal (Subjective) determinants of attention

1. ***Habit***: We attend to certain things because we have been accustomed to attending to these stimuli as a matter of habit. A man in the habit of rising early will attend to the clock as soon as he gets up. A farmer attends to crops, a housewife attends to kitchen, a teacher attends to his lesson plans and a student attends to studies because

of habits. As the person develops, he learns as to which objects he should attend and which he should not. In course of time, it becomes a matter of habit for him. He learns to attend to the necessary and the desirable and not attend to the unnecessary and the undesirable. Both these habits help him in following his daily routine.

2. ***Interest***: Interest is preference for one object or activity over another. We attend to objects in which we are interested and do not attend to objects in which we are not interested. If we are interested in buying shoes, our attention will be captured more by shoe shops than by shops of other varieties. A boy interested in cricket will enjoy watching a cricket match than a hockey match being played at the same time on adjacent grounds. A public speaker who pitches his lecture at the interest level of the audience will secure people's attention. Doctors, engineers, bankers and professors, all attend to their objects of interest. Even among the professors, objects that attract the attention of a professor of botany will not attract the attention of a professor of mathematics.

3. ***Needs and Motives***: The motives and urges of an individual direct his attention towards certain objects in the environment. Thirst, hunger, sex, curiosity and fear are some important motives that influence our attention. A hungry man will notice the smell of cooking, while a satiated man may not even notice a tasteful dish. A man afraid of snake will attend to objects resembling a snake and quickly hear the hissing sound of a snake. A curious individual will attend to even the smallest details of an object towards which he has curiosity. A normal person motivated by sex will attend more to individuals of the opposite sex. Even an inattentive student in the class will remain focused on a lecture on sexual practices of adolescents. Since the sexual need in humans cannot be fully satisfied, the advertisers draw the attention of the customers towards their products by stimulating their sexual needs.

4. ***Mindset***: Mindset is the orientation of the whole mind. A person would attend to those objects towards which his mind is set. A person having an intense disposition towards IPL cricket matches will quickly notice any discussion pertaining to cricket match and will not forget the time of its relay on television. At the time of examination, even the smallest thing concerning the examination will catch the attention of students. A spiritual disposition will attract the individual towards religious matters while a criminal disposition will attract him towards crimes.

5. ***Emotions***: Emotions dispose us in a certain way to interact with the environment. We attend to the smallest mistake of a person whom we hate while we do not even notice

the blunders committed by a person whom we love. While being in a happy mood, we attend to pleasant stimulations and in a bad mood, we attend to small and trivial annoyances. Owing to emotional involvement, a mother seldom finds faults with her children.

6. ***Attitude and Experience***: Our experience with objects helps us form either a favorable or an unfavorable attitude towards those objects. If we know from our experience that a person likes us, we will develop a positive attitude towards the person. We will attend to the advices given by him. On the other hand, we will not attend to the serious advices given by a person whom we hate. If we love a dog, we will attend to all its requirements. If a person is bitten by a dog, he will not attend either to the animal or to its requirements. In our daily life, positive and negative attitudes determine what we attend and what we do not.

   The factors listed above do not operate in isolation. These factors operate in combination to influence our attention. Though the factors have been explained separately, you may also notice a certain degree of overlap of one factor with another. Often the effectiveness of an objective factor may depend on the subjective condition of the person. In fact, an objective condition may not at all capture the attention if the person's subjective state (motive, interest, mood, attitude, mindset etc.) does not arouse the need for attention. Between the objective and subjective factors, the subjective factors play a more potential role in influencing attention. More than the stimulus characteristics, the person's psychological makeup determines which objects are to be attended and which are to be ignored and the intensity with which attention is to be focused.

Perceptual Process

Titchener defined perception as a group of sensations to which meaning is added from past experiences. In contemporary psychology, perception is commonly treated as an intervening variable dependent upon stimulus factor, learning set, moods, and emotional and motivational conditions of the organism. Thus, perception refers to assigning meaning to an object or objective event arising out of the stimulus conditions and organismic factors. Perception of the same thing by different persons is different because each individual perceives in terms of those aspects of the situation that have significance for him. The following statement is an operational definition of

perception. ***Perception is a cognitive mechanism of sorting out, interpretation, analysis, and integration of stimuli involving our sense organs and brain***.

Though perception represents a step beyond sensation, it is difficult to locate a precise boundary between the two. When the brain receives the sensory information, it automatically interprets those. Some psychologists prefer to call the dual process of sensation and perception as a unified information processing system or the perceptual system. **Perception is a receptive, selective, symbolic, and affective process.**

1. *Perception is a receptive process*. Sensation provides the raw materials for perception. Through sensation, we come in contact with various objects and events around us. Our sense organs are called the receptor organs, which help us to receive stimulations from our environment. Those stimulations are carried on to the central nervous system, where they are interpreted using our past knowledge, and we perceive the object or event. We cannot perceive without having a sensation. Recently, instead of treating sensation and perception as completely separate processes, psychologists prefer to talk about a perceptual system. **Perceptual system includes both sensation and perception**. Sensation, which is basically a receptor process, forms a part of the perceptual system. Hence, perception is regarded as a receptor process.

We have several sense organs or receptor organs. Some of them, such as the eyes, ears, nose, skin, and the tongue help us to receive stimulations from the outside world. On the other hand, the kinesthetic, organic, and vestibular organs help us to receive stimulations from the internal body conditions. We have different types of sensations and perceptions, each of which arises from the stimulation of different sense organs. We have visual sensation and perception, if our eyes are stimulated; we have auditory sensation and perception, if our ears are stimulated; and have kinesthetic sensation and perception, if our kinesthetic muscles are stimulated. However, in all these cases, the receptor organs must receive sensory information, which must be passed on to the appropriate center of the brain for processing. A visual stimulation, for example, is received by the visual receptor cells of the eyes and then transmitted to the primary visual context of the occipital lobe for processing. Thus, the **visual perceptual system** includes the visual receptor cells of the eyes

and the **primary visual cortex of the occipital lobe**. Similarly, the **auditory perceptual system** includes the auditory receptor ceils of the ears and the **primary auditory cortex of the temporal lobe**. The same principle holds true for all other perceptual systems.

2. ***Perception is a selective process*****.** Perception begins with the stimulation of the sense organs and is carried out through its interaction with psychological factors like learning, motivation, interest, beliefs, set, and attitude of the individual. At any given point in time, our sense organs are influenced by hundreds of stimuli from the outside world. But in fact, we don't perceive all those stimuli. We select a particular stimulus or only a few of them for further processing. ***This process of selecting a stimulus or a group of stimuli from among a large pool of stimulus is called attention.*** Our sense organs may be activated by a stimulus, but if we do not attend to it, we cannot perceive the stimulus. Therefore, attention is a basic and primary process essential to our perception. It works as a sensory filter by selecting some part of the sensory input for further processing. Broadbent conceived of attention as a selective filter that deals with the overwhelming flow of incoming sensory information by blocking out the unwanted sensory input and passing out the desired input. Therefore, attention is called the selective part of the perceptual process, or **pre-perceptive attitude**.

The involvement of attention in perception can be learnt from the following example. While you are inside a class, you may seem to be carefully listening to the lecture that you may not be really doing. Your sense organs are in tact; your teacher is very much present in front of you; he is delivering the lessons in a very loud voice. But you do not understand what he is saying (perceive) probably because you are not attending to him. Instead, you are attending to something else, such as what your friends are doing outside the class, or what else you must do after the class is over, and so on. Thus, in the above example, it is noted that **attention is a basic requirement for perception**.

The following experiment also provides evidence of how attention is a necessary component of the perceptual process. Hernandez Pion (1956) conducted an experiment with a cat. He directly stimulated the auditory receptor cells of the cat by sending sound waves into the ear through an electrode. When the stimulation reached

the temporal lobe, he measured the electrical vibration of the temporal lobe by electroencephalogram (EEG). In the EEG record, he observed that the cat perceived the sound waves. As stimulation of the auditory receptor cells was continuing, Pion placed a rat in front of the cat. Interestingly, electrical vibrations from the temporal lobe were immediately cut off. Instead, electrical vibrations were observed in the occipital lobe. He explained that the rat was a more desired object for the cat than the sound. Therefore, when the two stimulations were simultaneously presented to the cat, it attended to the preferred stimulus. As a result, perception of sound discontinued and vibration in the temporal lobe stopped. EEG vibrations were recorded in the occipital lobe because the cat visually attended to the rat.

In the above experiment, it is observed that even if an intense stimulation is received by any of our sense organs, **it cannot be perceived unless it is attended to**. Hence, attention is a basic part of our perceptual process, which helps us to select stimuli from among a large number of stimuli that influence our sense organs. An important nature of the attention process is that it always changes or shifts its focus from one sensory impulse to another, unless it is deliberately held steady. Two types of factors cause shifting of attention: (i) *the stimulus factors*, and (ii) *the subjective factors*.

The stimulus factors are called the objective factors, which are associated with the object or the event to which the individual is attending. Some of the important stimulus factors are stimulus intensity, contrast, size, novelty, color, stimulus change, and so on. In fact, advertisers capitalize on these stimulus factors to catch the attention of the consumers.

The subjective factors of attention are the characteristics of the person who attends to the object or the event. Important subjective factors of attention are motives, interests, beliefs and attitude, set and expectancy and so on. For example, if you are hungry, you will be attracted to food. You do not expect anything good in your enemy; therefore you will attend to his bad qualities more often than to his good qualities.

3*. Perception is a symbolic process*. Symbol is a substitute for some object or event. That perception is a symbolic process means that while carrying out the perceptual activity, we do not use the object or event in its actual form but use some

symbols representing the object or the event. **The symbols used in perception are called images**. In other words, an image is a cognitive product, which takes the place of an object or event in our mental processes. Hence, the mental picture is the image, which is a symbol for the actual object. For example, if you are asked to draw the picture of a mango, you can draw it. How is this possible for you when you do not see the mango right in front of you? You can draw it because you have seen the mango earlier and have formed an image of it. The image of the mango is a symbol for the real mango. Now, as you see a real mango, sensation or stimulation generated by the presence of the mango reaches the brain. Brain interprets the sensory stimulation in terms of your previous experiences with mango, which have been stored there as images or symbols. All these activities take place simultaneously to help you know about the mango, and thereby your perception of a mango is complete. These activities during your perception show that **perception is a symbolic process**.

4. ***Perception is an affective process*****.** It means that each act of our perception is associated with a pleasant or unpleasant feeling, and a liking or disliking toward the object or the event of perception. While you perceive the mango, you may remember its color, shape, taste, and the place of availability of similar types of mangoes that you might have seen in the past. Thus, you may like or dislike the mango as you come to know about it in terms of your past experiences with mangoes. Sometimes, perception is also associated with strong emotional consequences to the perceiver. For example, as you see a snake in the field, you tremble with fear. When you see your enemy, you shiver with anger. All these examples point to the fact that **the person experiences some sort of affection associated with each act of his perception**. This affective state may be pleasant or unpleasant. There is a great deal of individual differences with regard to how affection affects perception. In fact, the affective processes account for individual differences in the perception of the same object. We shall discuss the role of personal factors associated with perception later.

Perceptual Organization

Perception is defined as a primary mental ability in which we organize our sensations, meaningfully interpret them, and thereby form a mental representation of our world. The organization of sensory data is the beginning of the perceptual process. The world would appear confusing if we do not put together and organize the information

available to us through our millions of receptors. *The process by which we structure the input and create perceptual coherence is called* ***perceptual organization.***

In the early 1900s, the Gestalt psychologists first studied systematically several aspects of perceptual organization. Wertheimer, Koffka, and Kohler, the gestalt psychologists in Germany, have extensively studied and experimented on the phenomenon of perceptual organization. They have discovered a number of laws or principles relating to the organization of perception. Gestalt means the total, the whole or a configuration. According to the Gestalt psychologists, an individual organizes a multitude of environmental stimuli into meaningful structures and forms. He perceives patterns of stimuli rather than random collections of individual stimuli. In other words, the person integrates disconnected parts of sensory information into a meaningful structure, which results in the perception of a whole. Therefore, *perception of an object or event is something more than the sum total of its sensory input.* For example, when we look at a chair, we perceive the chair as a whole even though we do not see all parts of the chair at one time. In fact, the bits of sensory information that we receive from the chair are disconnected. We organize those bits of information into a meaningful whole by using some principles of organization.

In order to explain perception as an organizational process, the Gestalt psychologists have discovered a set of principles, which are popularly known as **Gestalt laws of perceptual organization.** Although the laws of perceptual organization are most obvious for visual perception, the Gestalt psychologists have observed that the laws of organization also apply equally well to other sense modalities. Let us take an example of auditory perception. Suppose, you consecutively tap on the desk for three times, take a pause and tap again for three times. You will observe that taps organize into two units of sound on the basis of nearness in their occurrence. You will later know that nearness is a principle of organization. Similarly, a number of persons standing close to each other are visually perceived as a group. You perceive the test of a curry, rather than the taste of different vegetables of which the curry is prepared. The above examples point to the fact that our perception is an organized activity.

The Gestalt laws of perceptual organization are based on three groups of laws. They are: (i) ***Laws of grouping,*** *(ii)* ***Figure-ground relationship,*** *and (iii)* ***Goodness of figures.***

Laws of Grouping

The laws of grouping, in general, propose how certain elements in the perceptual field of an individual go together. The following are some important laws of grouping.

The Law of Proximity (Nearness). According to the law of proximity or nearness, elements may be grouped according to their perceived closeness in time or space. In other words, ***elements that appear nearer together tend to be grouped together****.* Thus, due to the law of proximity, the eight lines given below (Figure 4.1) are seen as four pairs of lines.

Figure 4.1 The law of proximity

Similarly, as you notice the print in this book, you see rows of letters rather than columns. It happens due to the **law of proximity** because a letter is closer to the letters to the right and left than it is to the letters above and below.

The Law of Similarity. The law of similarity proposes that ***with the proximity among elements being equal, perceptual elements that are similar in some respect tend to be grouped together****.* Thus, in the following pattern (Figure 4.2) you see rows of triangles, squares, and circles rather than a column consisting of a triangle, a square and

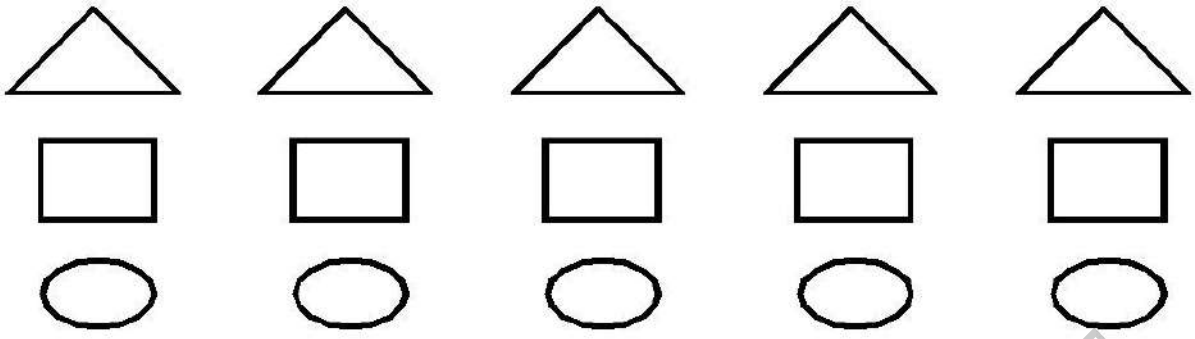


Figure 4.2 The law of similarity

a circle. Thus, we observe in the figure that triangles go with triangles, squares with squares, and circles with circles. You *may* also notice that there is uniform distance between triangles, squares, and circles for which law of proximity does not hold good.

The Law of Good Continuation. This law proposes that ***elements that appear to follow a particular direction, such as a straight line or a simple curve, are readily perceived as forming a group***. It is the tendency to perceive stimuli as a part of a continuous pattern. In the following figure, you see a zigzag line with a curved line running through it, so that each line continues in the same direction it was going prior to intersection.

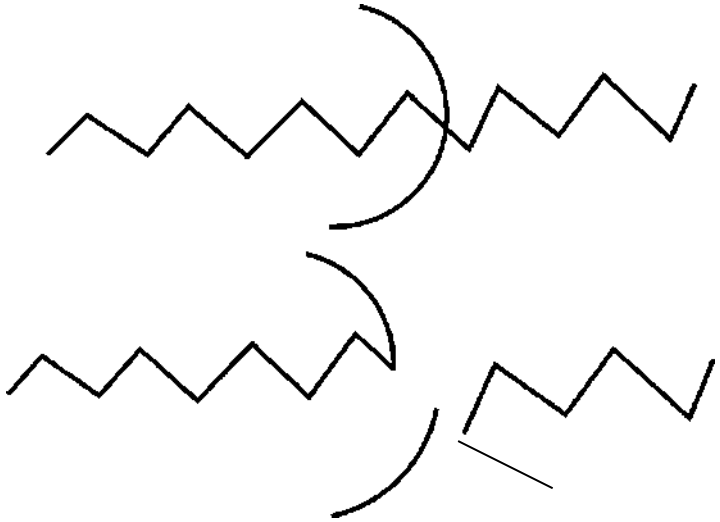


Figure 4.3 The law of good continuation

The Law of Closure. The law of closure is one of the important laws of perceptual organization. This law proposes that ***within limits, physically incomplete figures tend to be perceived as complete figures or as meaningful wholes***. In other words, in closure, grouping occurs in a way that favors perception of the more enclosed or complete figure. Thus, the following curved line is not perceived as a curved line; instead, it is perceived as a circle. The curved line is not perfectly closed. You see a circle because it is more tempting to perceive a complete figure than simply a curved line.

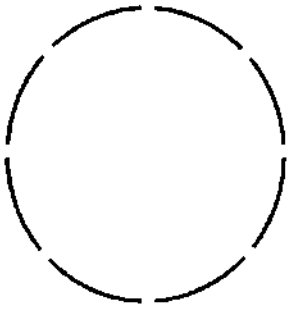


Figure 4.4 The law of closure

The Law of Common Fate. According to the law of common fate, ***elements that move in the same direction are perceived to be together***. This is a kind of grouping on the basis of similarity, but applied to moving objects. Thus a group of runners or a flock of birds when seen moving in the same direction appear as groups or units. You may have seen the Mexican wave created by the arm movements of fans at a sporting event. This can be taken as an example of law of common fate in perceptual organization. In the following figure (Figure 4.5), you can see how law of common fate operates in perceptual organization.

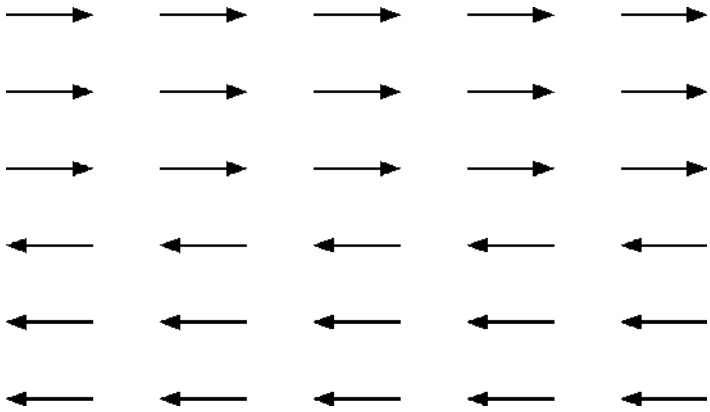


Figure 4.5 The law of common fate

Figure-Ground Relationship

Figure-ground relationship is also an important way in which perception is organized. Such relationship is fundamental to the form perception. Figure is the pattern that is most clearly perceived at a given time, while the rest of the perceptual field becomes the background. You see birds flying in the sky. Birds are the figures against the background of sky. You see the writings on the blackboard. Writings are the figures against the blackboard as the background. Thus, a figure stands against a background. We perceive the figure and not the ground because of some characteristics of the figure, which clearly differentiate the figure from the background. Gestalt psychologists who discovered some principles that govern figure-ground relationship in perception extensively studied the phenomenon.

A Danish psychologist, Rubin (1915/1958) observed the following differences in the characteristics of figure and ground relating to any perceptual activity.

1. *The figure has a definite shape, whereas the ground appears to have no shape*. The figure has the quality of a 'thing' and contour appears at the edge of the figure's shape. In contrast, the ground has the quality of a 'substance' and appears relatively formless.

2. *The figure seems to be present in front of the ground*. In other words, the ground seems to continue behind the figure.

3. *The figure seems to be closer to the perceiver with a clear location in space*. In contrast, the ground is farther away, and it has no clear location in space; it is simply somewhere in the background.

4. *In relation to the ground, the figure appears more impressive, dominant, and better structured*. The figure depicts more associations of meaningful shapes than the ground.

Besides the above four differences, Coren (1969) reported an experimental evidence for a fifth characteristic difference in the perception of figure and ground.

5. He observed that *the figure always looks brighter than the ground*. There should be clear differentiation between the figure and the ground, so that there will be a stable perception of the figure. In other words, the figure will be perceived as the figure always in different occasions. But, when figure-ground relationship is ambiguous, or is possible of being interpreted in different ways, our perception tends to be unstable. These are situations in which the figure and the ground reverse their positions frequently, i.e., the figure becomes the ground and the ground becomes the figure simultaneously. These reversals often appear almost spontaneously. Now, look at the picture below (Figure 4.6). What do you perceive? A vase or two faces?

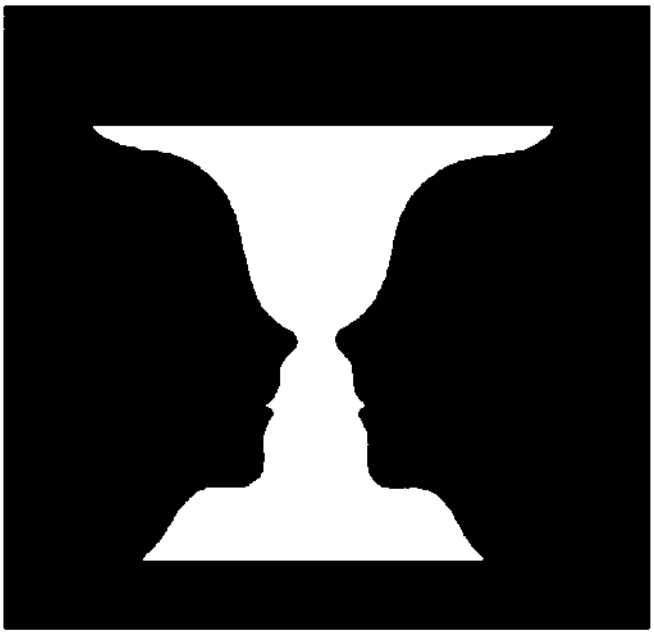


Figure 4.6 Rubin's face-vase reversible figure

Two other reversible figures can be seen in Figure 4.7.

The Law of Pragnanz (Goodness of figures)

According to the Gestaltists, the whole stimulus pattern determines the organization of its own parts. The Gestalt psychologists believed that all the grouping laws are particular examples of one general principle- *the Law of Pragnanz.* ***The law of pragnanz is a term to refer to the tendency to perceive figures as good, regular, and simple with minimum cognitive effort***. Therefore, this law is also known as the **law of good figure**. The laws of grouping and figure ground relationship operate to make us see good simple figures. On the other

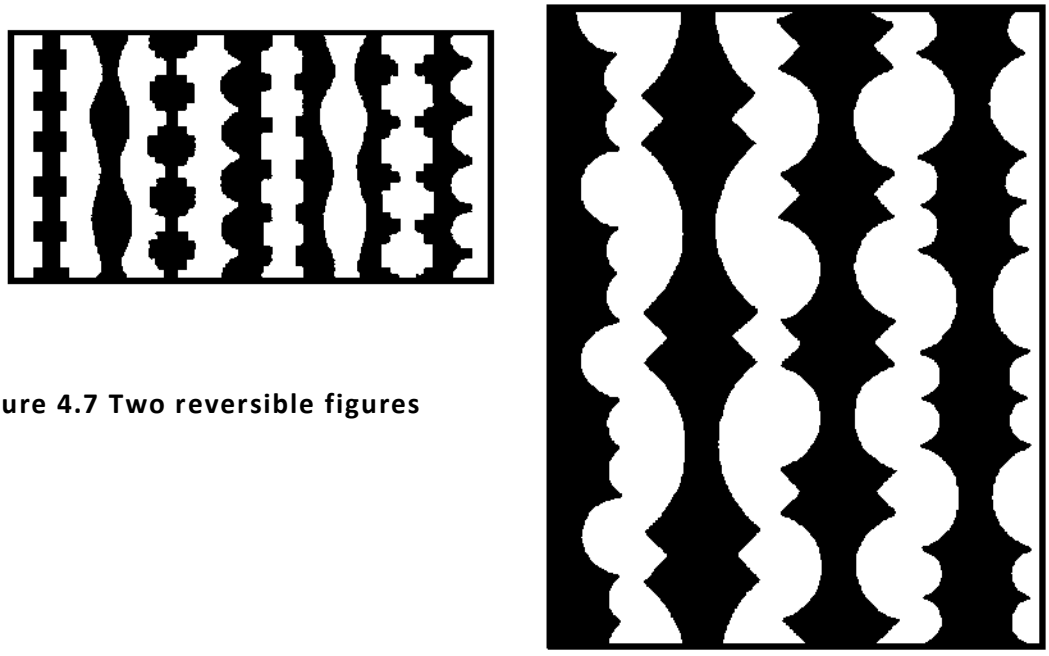


Figure 4.7 Two reversible figures

hand, the law of pragnanz operates on the fact that we like to see regular and simple forms, rather than irregular forms. According to the Gestalt psychologists, if there are irregularities in a figure, those are overlooked and the figure is perceived as a symmetrical, complete, simple, and good figure. The following picture (Figure 4.8) is perceived as a human face even though there are many irregularities.

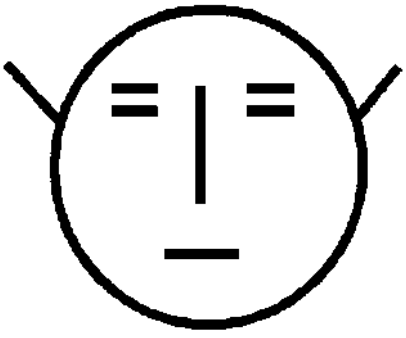


Figure 4.8 The law of good figure

In the laws of perceptual organization discussed above, the Gestalt psychologists emphasized the role of form qualities of objects in our perception. All these factors are called the structural factors in perception. Besides the above organizing factors, they have also recognized the importance of familiarity and set or attitude in influencing

our perception. For example, if some of the dots in a collection makeup the outline of a face or of any familiar object, we can easily perceive it out of the background. Similarly, if the observer is actively looking for a certain figure in an ambiguous presentation, he is more likely to see that particular figure.

However, the Gestalt psychologists have warned not to overemphasize the roles of such factors like familiarity and set. According to them, the laws of organization based on the form qualities of objects are more primitive factors influencing perception.

Perception of Movement

We see birds fly in the sky. We see the movement of different types of vehicles. We see the movement of people around us. How do we perceive movement? Do we perceive the moving objects the same way that we perceive objects, which are static? There are situations, where the objects are not actually moving, but we see a movement. What psychological processes are involved in the perception of movement?

How do we perceive the real movement of objects? One may say that we perceive motion of objects because the real motion correspondingly stimulates different parts of the retina serially. The serial nature of sensation in retina gives the impression of actual movement of the object. This phenomenon also holds true because of some laws of perceptual organization. However, movement perception can be attributed to these serially changing stimulations in the retina only partly, because sometimes we also perceive movement without the actual movement of the object in the environment. This phenomenon is called apparent motion in which, without any energy movement across the receptor surface of the retina, we still perceive movement. Therefore, let us see actually what happens in case of **real motion** and in case of **apparent motion**.

Real motion

To understand how we perceive real movement, recall what it is like to be on a train that has begun moving out of the station while the train on the adjacent track remains stationary. If your train does not lurch as it moves, you might think at first that the other train is moving. Sometimes, you may be in confusion with regard to which

train is moving. In order to be sure about the movement of your train, you look for objects you know are stable, such as the tea stall on the platform, sign boards, houses, trees, etc. If you are stationary in relation to them, you can know that your train is not moving. Observing people walking on the platform may not provide the answer as they are also moving and changing their positions in relation to stationary objects. You can also feel the movement in your body, though it is very difficult to say how. Therefore, ***perception of real movement is based on change of position relative to other objects within the visual field***. Whenever there is movement, the perceptual system must decide what is moving and what is stationary with respect to some frames of reference.

Apparent motion

Apparent motions are illusions of movement in which there is the perception of motion without any actual movement of the object. In other words, with our eyes, head, and body steady, and with no physical movement of an object, we see motions. Psychologists have studied several kinds of apparent movement. These include *auto-kinetic effect, stroboscopic motion,* and *the phi phenomenon.*

Auto-kinetic Effect

It is the tendency to perceive a stationary point of light in a dark room as moving. For example, if a person stares at or fixates on a small stationary spot of light in a completely darkroom, the spot will eventually appear to move. The auto-kinetic effect has been the subject of many experiments, but there is still no adequate explanation as to how it exactly happens. However, it has been observed that auto-kinetic effect is somewhat influenced by suggestion and subject's prejudice (Block and Block, 1951).

Stroboscopic Motion

It is a visual illusion in which the perception of motion is generated by a series of stationary images that are presented in rapid succession. It is a kind of motion that we see in movies and television. The so-called motion pictures do not consist of images that really move. Rather, with the help of a projector, 16 to 22 pictures, or frames per second are successively shown. Each frame differs slightly from the one preceding it. Hence, showing the frames in rapid succession

provides the illusion of movement, and continuity is observed because of minor systematic variations in the pictures. It has been observed that if fewer than 16 frames per second are presented to the observer, the motion picture looks jumpy and unnatural.

Phi-Phenomenon

It is the perception of movement as a result of sequential presentation of visual stimuli. We all have seen the light decoration in the streets during the festival of Durga Puja. It appears as if a light is moving in a row from one end to the other. Actually, the light does not move in a row. A large number of bulbs are alternatively connected in a row. The switch is so arranged that the two sets of light alternatively get on and off in quick succession. This quickness in the presentation of light gives the impression of movement of the light. Instead of perceiving a series of stationary lights, we perceive a linear movement of light across the row. This illusory movement of light is called the ***Phi-phenomenon***. The stroboscopic motion, and the Phi-phenomenon could be explained in terms of the laws of perceptual organization.

Depth and Distance Perception

The visual world is not composed of figures and objects organized two-dimensionally on a plane surface. Visual space is three-dimensional. Objects have depth; they are solid, and are located phenomenally as well as physically at various distances from the individual. A solid object forms a two-dimensional image on the retina of our eye, as our receptor cells are not capable of locating a third dimension. The question is: How do we perceive a three-dimensional world when the picture on the retina is a two-dimensional one ?

Some psychologists are of the opinion that as human beings we have an innate tendency to see depth and distance. The **visual cliff** experiments (see Figure 4.9), and experiments with the visually handicapped children suggest that depth and distance perception is to some extent innate in character. But it does not adequately explain the phenomenon of depth and distance perception. We make use of many different cues in forming our judgments about depth and distance perception. These cues may be **monocular** or **binocular** depending upon whether they can be seen with one eye or require the use of both the eyes.

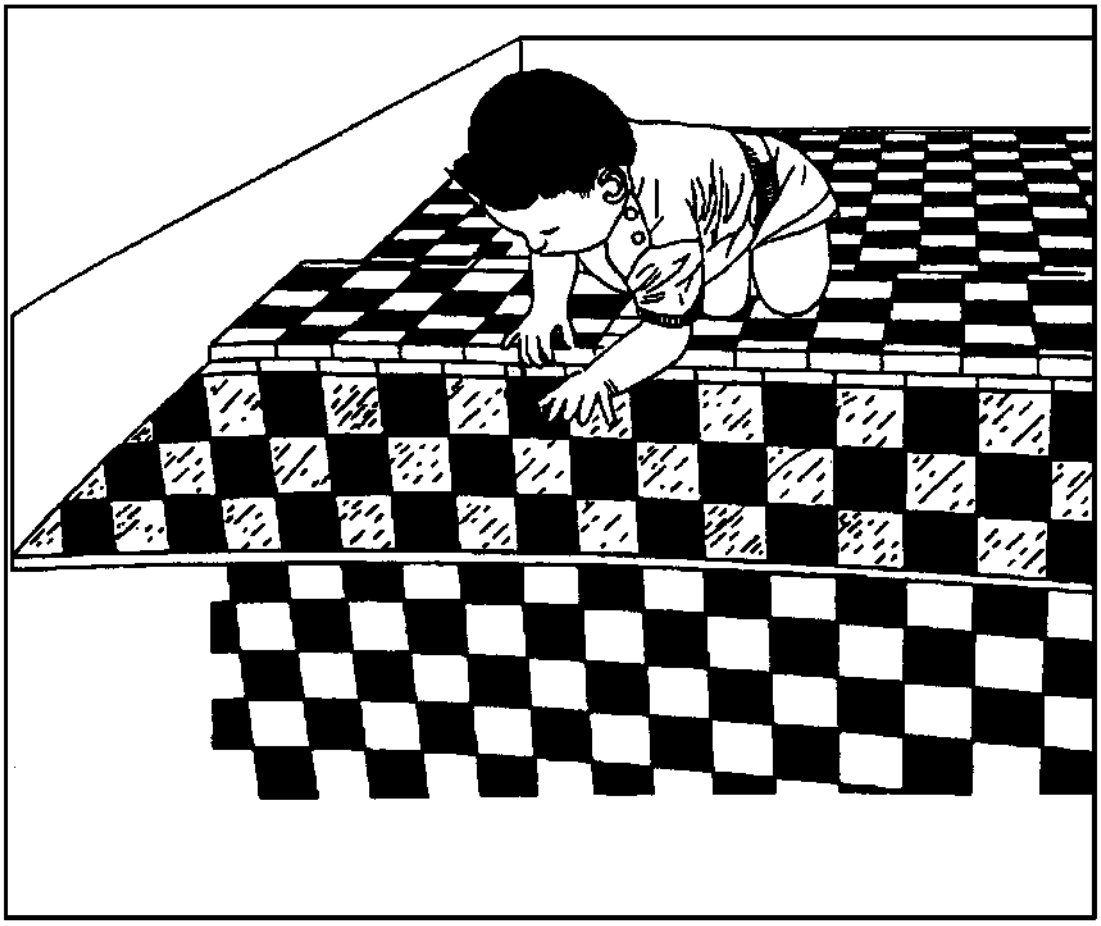


Figure 4.9 Study of depth perception with visual cliff

The **monocular cues** have been so widely used by artists that they have become known as pictorial cues. The monocular cues to depth and distance include the following.

1. Proximal size. Proximal size refers to the size of the image on the retina in relation to the distance of the object. It proposes that ***all other factors remaining constant, if the size of the image on the retina is larger, the object looks nearer, and vice versa***. In other words, as the object moves farther and farther, the retinal images become smaller and smaller. The object is perceived as farther away with the decrement in the size of the retinal image.

Proximal size is one of the factors of monocular depth perception. It does not hold true in all cases. For example, what happens to our retinal images of a person whom we know well, when he is 100 meters away from us and when he is very nearer to us. The retinal images of the person must be different when he is at different distances. But, we do not perceive any change in the size of the person. Size constancy is maintained here. Because of size constancy, which we develop by our interactions and communications with various objects, the objects maintain their size even if their retinal images vary. We shall discuss more about constancies in perception in a later section.

2. Brightness. It proposes that ***the brighter the object, the nearer it appears***. Thus, a distant mountain looks farther away in a hazy day than on a bright day. It is because haziness in the atmosphere blurs the fine details from the view of the observer. Ordinarily, if we see the fine details of an object, we perceive the object as nearer than in which we fail to see the fine details. In other words, nearer objects look clearer than distant objects, and this awareness provides clues for distance perception.

3. Shading. Shadowing also provides information about depth. It is based on the fact that opaque objects block light and produce shadows. Shadows and highlights give us information about the object's three-dimensional shapes and about their relationship to the source of light.

4. Texture gradient. It is a monocular cue for depth perception based on the fact that ***the closer objects appear to have rougher or more detailed surfaces***. Gradient is a continuous change in something, a change without abrupt transitions. In some situations, this gradation in texture in the visual field may be used as a cue for depth perception (Gibson, 1950). For example, when we look at a paddy field, we can see the details of the trees nearer to us. But as we look towards the distant field, it becomes fainter and no details of the field are visible. The continuous gradation of texture gives clues to the eye and the brain that can be used to experience depth perception.

5. Linear perspective. It is a monocular cue for depth perception based on the fact that ***the distance separating the images of far away objects appear to be smaller than the distance separating closer objects***. For example, if we stand near rail tracks and look at a distance, the gap between tracks would appear smaller, and

tracks would seem to run closer. This perspective provides clue for depth and distance perception.

6. ***Interposition.*** It occurs when one object obstructs our view of another. Out of two objects, ***if one object is completely visible and the other is partly covered by it, the first object is perceived as nearer*** (see Figure 4.10).

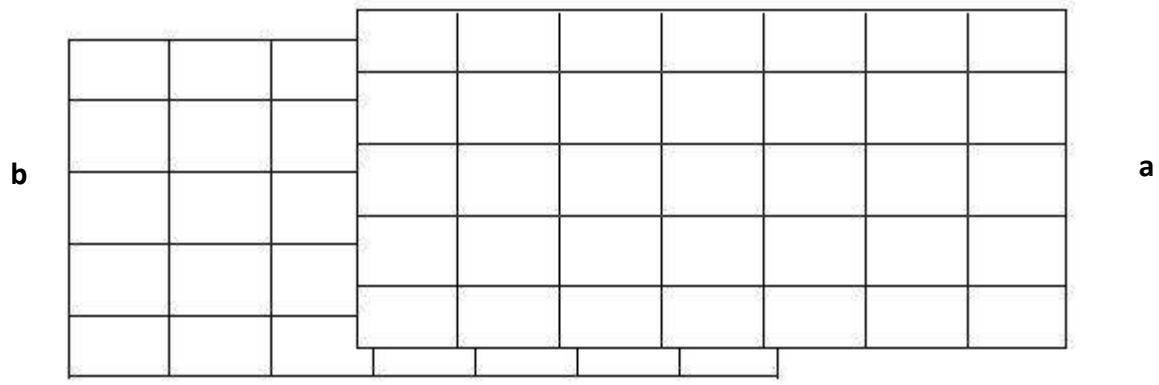


Figure 4.10 Object 'a' appears to be nearer in space than 'b' in the above

7. ***Movement parallax.*** It is a monocular cue for depth perception based on the fact that ***nearby objects appear to move faster in relation to our own motion***. Every one of us must have noticed that when we move in a bus or train, the distant objects such as mountains, stars or sun appear to move along with us. Objects at a medium distance seem to be stationary, while nearby objects, such as trees, roadside houses, people moving on the road, etc. seem to move faster in the opposite direction. Thereby, we learn to perceive objects that appear to move with us as being at greater distances, and the objects that appear to move backward as being nearer to us.

Besides the monocular cues, we also rely heavily on the ***binocular cues*** for depth information based on the coordinated efforts of both eyes. The following are the two binocular cues.

1. ***Retinal disparity.*** Some psychologists are of the opinion that retinal disparity is the main cause of depth and distance perception. By retinal disparity, it is meant that ***the two eyes produce two different and separate pictures of an object as viewed from different positions relating to each eye***. That is, the retinal images of the two

eyes for the same object are different from each other. With the right eye, we see more of the right side of the object; with the left eye, we see more of the left side of the object. We interpret distance by availing clues from the two different images of the same object. Retinal disparity as a cause of depth and distance perception has been proved by Thorner (1938), Martins (1939) and many others in a series of experiments. In these experiments, two pictures of the same three-dimensional object were taken simultaneously by a camera with two lenses positioned at a slight distance from each other. These two pictures, called the stereo pairs, were then presented to the subjects with the help of a stereogram. Subjects witnessed the third dimension of the object because of stereo fusion.

The above opinion maintains that two eyes are essential for visual depth perception as stereoscopic fusion would be possible only with two eyes. One-eyed persons cannot have depth perception. If they have, they simply have it in course of their learning and knowledge of depth of different objects. But experiments by Hofman (1939), and Engel (1966) proved that one-eyed persons could have depth perception also.

2. Convergence. This is a binocular cue for depth perception based on the difference in the image cast by an object on the retinas of the eyes as the object moves closer or farther away (Rathus, 1994).

In addition to retinal disparity, angular convergence of the eyeball has an important function in providing binocular cues for depth perception. It is the cue for depth perception based on ***the inward movement of the eyes as they attempt to focus on an object that is drawing nearer***. For example, if we try to look to the top of our nose, our eyes turn inward, or converge on it, giving us a cross-eyed look, but they are less converged when we look towards objects, which are at distant places. The binocular cues of retinal disparity and convergence are most efficient for depth and distance perception of objects, which are not too far away from the observer (Rathus, 1994).

Perceptual Constancies

The stability in our perception of the environment in spite of wide variations in the conditions of observation is called perceptual constancy. But

1990). For example, a blue car may be perceived as the same blue car even if we look at it in bright sunlight, in dim illumination, or under a yellow street light in the evening. But if we do not know the actual color of the car, we may perceive the color of the car differently in different illuminations. In such situations, when clues to know the actual color of the car are unavailable, our perception of color will depend upon wavelength of light reflected in our eyes.

3. Brightness constancy. It is ***the tendency to perceive an object as being just as bright even though lighting conditions change its intensity*** (Rathus, 1990). It is similar to the phenomenon of color constancy.

4. Shape constancy. It is ***the tendency to perceive an object as being of the same shape although the retinal image varies in shape with change in the angle of vision***. For example, we perceive a table as a rectangle from whatever angle we look at it. But actually the retinal image is a rectangle only when the table is seen from a straight position. From all other positions, the retinal image is a parallelogram. But we see the table as a rectangle from all locations of our vision. Similarly, in another example, a door is a rectangle only when viewed straight on. When we open the door, the retinal image becomes a trapezoid. But we perceive the door as the same rectangular door, and it does not matter from which angle we view it.

On the whole, it can be stated that we may have shape, size, color, and brightness constancies in our perceptions of the world as a result of our past experiences. The world therefore looks stable because of perceptual constancies. Had there been no perceptual constancies, our vision of the world would have been chaotic and unstable because of the frequent changes in our retinal image about the same object.

Individual Differences in Perception

We have discussed about the basic processes of perception, which are more or less the same for everyone. But all individuals do not interpret their sensory inputs the same way. What a person perceives and how he perceives it may also be determined by his past experiences, his interests, needs and personal values, his beliefs and attitudes, and above all his cultural practices. Therefore, some psychologists say that **we perceive things as we are, not as the things are**. In

other words, individuals differ with regard to their perceptions. Hence, different individuals depending upon their frames of reference perceive the same stimulus differently. The factors within the individual, which influence the nature of his perception, are known as functional factors or **subjective determinants of perception**.

Past Experiences

It has been stated earlier that perception involves the meaningful interpretation of the sensory input. Both **Helmholtz** and **Gibson** pointed out the importance of experience in explaining perception. The past experience prepares the individual to emphasize some sensory inputs and ignore others. Gibson defined **perceptual learning** as increased ability to extract information from the environment as a result of experience with stimulation coming from it. An ornithologist can distinguish the calls of birds which normal people would find very difficult to do. The remarkable auditory sensitivity of the blind people is a matter of perceptual learning. It is not true that the blind people are inherently more sensitive to auditory stimulation. In stead, the blind people, because of their necessity, learn to extract information from the environment not ordinarily used by the sighted people. These sorts of information help them to move around the world by avoiding obstacles with ease. The impact of past experience is so great that persons wearing special goggles that invert their view of the world quickly adapt to their new world and do everything from reading a book to flying a plane (Kohler, 1962). **Gibson provides many examples that demonstrate how perception is shaped by learning.**

Gibson and Walk (1956) raised rats from birth under two conditions. In the experimental condition, the walls of the cage in which the rats were reared up contained 4 metal plaques, two triangles and two circles. The walls of the control rats' cages were plain and white. Three-months after this treatment, the animals were given a learning task in which they had to discriminate between a triangle and a circle. It was observed that the experimental group of rats performed consistently better than the control group of rats, having about 90% correct choices, while the controls were still operating at a fifty-fifty chance level. The performance in the learning task was definitely influenced by the greater perceptual ability of the experimental rats, which had prior experience of triangles and circles.

Glenn (1965) made an interesting observation to explain the role of past experience in perception. He reported the experiences of a French expert in industrial management, who visited the United States to study the industrial policy and finance management in American industries. His objective was to gather knowledge for the rebuilding of French industrial set up. But he was disappointed as he visited more and more firms and industries in the United States. Finally, he wanted to know from the government officials why Americans were advocating for a free enterprise when in fact nearly all American industries were nationalized. When inquired as to how he arrived at such a conclusion, he pointed out that he had seen the United State's national flag flying over each industry. In fact he had wrongly perceived because of his past experience in France, where only nationalized industries fly national flags over their factory. On the other hand, there were no such restrictions in the USA. Glenn pointed out that the perception of the French industrialist was influenced by his previous experience of ownership of a factory in France.

An experiment of Bruner and Postman (1949) can be cited to account for the role of past experience in perception. Twenty-eight adult subjects were asked to name some playing cards exposed to them tachistoscopically. The cards contained some unusual ones like hearts in black shade and spades in red shade. You know that all hearts are red and all spades are black, Influenced by such type of past experiences, 27 out of 28 subjects perceived a red form of spade either as a red form of heart or a black form of spade. Thus, learning to extract information from the environment is of enormous practical and adaptive value. **The past experience serves as a reference point for extracting information from the immediate environment**.

Needs and Motives

A number of studies was conducted in the late 1940s and 1950s to show the impact of motives and needs on perception. Despite methodological limitations and inconsistencies, most of those studies point to the fact that our perception is largely guided by our immediate needs and motives. **We attend to and organize our sensory inputs in a manner that match our needs**. These studies in general maintain that people who are hungry, thirsty or sexually aroused are likely to pay attention to events in the environment, which will satisfy their needs. This viewpoint was known as the *"***newlook***"* in perception.

In a classic experiment, Bruner and Goodman (1947) demonstrated the effect of economic deprivation on perception. They investigated the hypothesis that the perceived size of a valued object would be greater than that of a neutral object of equal physical size. To test their hypothesis, they took 10-year old children to judge the size of various coins. One group of children was taken from the low socio-economic status, while the other group of children was taken from the high socio-economic status. The apparatus consisted of a wooden box with a screen at one end and a knob at the lower right hand corner. By turning the knob, the children could vary the diameter of the circle of light shining on the screen. The children were asked to match the size of the circle of light to the size of various denominations. **The children of the poor socio-economic status group were found to overestimate the size of coins to a much greater extent than the children of the high socio-economic group**. The investigators explained that poor children were in need of money, and were therefore, more motivated as a result of which they overestimated the size of the coins as compared to the rich children. In other words, **their needs and motives influenced their perception**.

Ashley, Harper, and Runyon (1951) manipulated the 'value' variable experimentally. Instead of taking poor and rich children, they hypnotized the subjects. One group of subjects was suggested as rich, and the second group as poor. A third group of subjects remained as the neutral subjects. Subjects were asked to judge the size of the coins. In general, **the subjects while in the poor state over-estimated the size of the coins and the subjects suggested as rich underestimated the size of coins**.

In an experiment, Sanford (1936) showed that hungry subjects completed word stems in such a way as to make more food related words than did the non-hungry subjects. For example, the word stem ME was more likely to be completed as MEAT or MEAL by hungry subjects than non-hungry subjects.

Levine *et al.* (1942) presented ambiguous drawings behind a glass-screen to hungry and non-hungry college students. **When asked to report what they perceived in the drawings, the hungry college students frequently perceived food objects in the drawings, while the non-hungry students reported perceiving several other things**. There are also other studies, which show that our perception is strongly influenced by our immediate biological needs and motives.

The projective tests like the **Word Association Test** and the **Rorschach Inkblot Test** are constructed with a mind to uncover the needs and motives of the individual that underlie his manifested behaviour. The pictures are ambiguous, and the individual's needs and motives mostly influence his perception and interpretation of the pictures. By analyzing his interpretations, a psychologist would be able to make inferences about the needs and motives of the individual.

All the evidences cited above lend credence to the theory that needs and motives play an important role in organizing our perception. For a psychologist, the message is clear. While evaluating the statements of individuals about certain events and phenomena, a psychologist should take into account the needs and motives of the perceiver, which would help him in making a proper assessment of the situation.

Culture

Perception is guided not simply by factors intrinsic to the person; the socio-cultural environment also has a role to play. The culture consists of the whole range of experiences during the process of socialization. **The physical as well as the cultural climate shape person's belief system, attitudes, and orienting dispositions to the environment**. The same stimulus event is likely to be interpreted differently by different cultural groups. Cultures prepare the individuals to see, feel, act, and behave in a particular way. A person with a set of personality traits may be respected in the Indian culture, while the same individual may be judged as abnormal in the western culture. Old people may be considered as wise individuals in one culture, and as less useful members in another culture.

Cross-cultural psychologists have argued that people in different cultures around the world have different everyday experiences, and as such they differ in their perception of some objects and events. In 1966, Segall and his associates reported a series of studies showing that culture plays a significant role in shaping responses to visual illusions. The cultural groups displayed illusory effects in accordance with their cultural background. **The Africans living in dense jungles showed greater illusions in vertical-horizontal figure, while the western people displayed greater Muller-Lyre illusion**. These differences are explained with reference to their past cultural learning.

Hudson (1958) did the first systematic work on pictorial perception to show how it is influenced by cultural factors. He discovered that his subjects interpreted the pictures in the **Thematic Apperception Test** as if they lacked the ability to perceive the pictorial depth, i.e., the ability to see that a picture represents an array of three-dimensional objects distributed in space. Later, reviewing a series of cross-cultural studies, Deregowski (1972) maintained that **perceiving perspective drawings is a specific cultural skill that is learned rather than automatic**. For example, Holmes (1963) and Shaw (1969) observed in Kenya that subjects sometimes perceived the picture of a tortoise as a snake because of the shape of its head and neck; sometimes as an elephant because of the shape of its feet; and occasionally as a crocodile because of the pattern of its shells on the body. To an Indian or a European, such type of perception of a tortoise by a Kenyan will certainly appear strange. To a European or American, kissing in public is perceived as a normal form of behaviour but to an Indian it is perceived as uncommon and unusual.

Broota and Ganguli (1974) observed that **Indian children tend to perceive those aspects of the stimulus situation, which are associated with punishment**. On the contrary, the **American children respond to stimulus events, which are associated with reward**. The cultural difference comes about because of differential child-rearing practices.

In view of the above facts and experimental findings, it is reasonable to say that individuals with different cultural experiences differ with regard to their perception. The same situation may be perceived differently in different cultures and in the same culture as differently in different times. In other words, it is justified to propose that sometimes **we perceive things as we are but not as the things are**.

Set

Set refers to a state of mental disposition to be alert to certain kinds of sensory inputs. A person having a definite set would attend to certain selected aspects of the stimulus situation. If the husband is expecting an important telephone call, he is more likely to hear the ring at night than his wife. The wife, on the other hand, is more likely to hear the baby crying during night. A psychologist is more likely to observe the intricacies of human behaviour compared to a botanist, who would probably notice the kind of plants in a garden that would escape the attention of a layman. The same

kind of behavior from a friend and an enemy is likely to be interpreted differently. The set may be positive or negative. **A positive set facilitates the problem solution, while a negative set works as an obstacle to perception and learning**.

Siipola (1935) conducted a very interesting experiment to demonstrate the effect of set on perception. In the experiment, subjects were required to respond to words presented to them tachistoscopically. Each word was presented for a brief period of 0.1 second only. The stimulus words were as follows:

1.	Horse	**6.**	Monkey
2.	Baggage	**7.**	Pasrort
3.	Chalk	**8.**	Berth
4.	Sael	**9.**	Dack
5.	Wharl	**10.**	Pengion

One group of subjects was told that they would be shown the words having to do with animals or birds, while the other group of subjects was informed that they would be responding to words in the category of travel or transportation. Since all words except horse, chalk, monkey, and berth were ambiguous words, the hypothesis was that the responses of the subjects would be in keeping with the set. For example, the first group might perceive 'sael' as 'seal', 'wharl' as 'whale' and the second group might perceive the same words as 'sail' and ' wheel', respectively. The responses were found to be on the expected line. The experiment suggested that **by inducing different sets or predispositions in people, their perceptions could be influenced**.

Murray (1933) described the picture of a man to some subjects before and after they played a game of murder. Before the game, they perceived less unfavorable qualities in the description of the man, but after the game, they perceived more unfavorable qualities in the character of the man. This is a demonstration of the effect of set on perception. You can think of many more examples from your real life experiences regarding how set influences perception.

Attitude and Prejudice

***Attitudes are learned predispositions to respond to our physical and social world in either a favourable or an unfavorable way*.** Attitudes have cognitive,

emotional and behavioral components. They are guided by a set of beliefs and thoughts (cognitive component); they encompass positive and negative emotional reactions (emotional component); they translate to some form of behavior (behavioral component). ***Prejudice is generally thought of as a negative judgment*** *(it can as well be positive)* ***of members of a group***. It hardly takes into account the characteristics of an individual member. A person is evaluated primarily on the basis of his membership in a group. Both attitude and prejudice reflect our belief system and influence our perception of people, objects and events. They are the subjective determinants of perception.

Carpenter and her associates (1956) asked people to complete sentences on sensitive topics, such as feelings of inadequacy, hostility, or sex. On the basis of their responses, the subjects were categorized as being either 'sensitive' or 'repressed'. The investigators found that participants showed differences in their reactions to stimuli. 'Sensitive' people perceived taboo or disturbing words more easily than normal people and 'repressed' people perceived such words less readily, which suggested that individual differences in values and attitudes are major factors in perception.

Allport (1954) described a study, which showed how prejudice could affect perception. The experimenter used a stereoscope, which is a device for presenting a separate picture to each eye at the same time. The participants were shown mixed-race pairs of individuals, with one member of each pair shown to each eye. In general, people were most accurate at picking out members of their own race. Allport interpreted the results as to how racist views influenced their perceptions.

Mood and Emotion

Emotions and mood changes form a part of our daily life experiences. Emotions change under different circumstances and color our perception of the world. When the person is in a happy mood, the world around appears beautiful and satisfying. But the same world is perceived as very disturbing when the person is in a bad mood. Leuba and Lucas (1945) conducted an experiment to see the impact of mood on perception. Subjects were hypnotized and suggested to be either in a happy mood, critical mood, or in an anxious mood. Then pictures were shown to them. It was found that the perceptions of these men varied according to their moods.

McGinnis (1949) presented his subjects with a set of words, some of which were neutral in affect and some were taboo or anxiety provoking words. Identification thresholds were measured by increasing the exposure duration of a word until the subject correctly read it out. At the same time their galvanic skin responses were also measured. It was observed that the taboo words had higher thresholds than the neutral words; during the pre-identification trials, the subjects gave higher galvanic skin responses to the taboo words than to the neutral words.

Errors in Perception

Our perception of the stimulus world is not always accurate. In certain occasions, the sensory information may be incorrectly interpreted. Such cases are known as illusions. A visual illusion occurs when two objects produce exactly the same retinal image, but are perceived as different images. **Illusions are errors in perception, but they are not abnormal**. They are experienced by normal human beings as well as by birds and animals. They can also be experienced by the stimulation of any of our senses. More than 200 different types of illusions have been discovered (Gillam, 1980), a few of which are discussed below. In this chapter, we will discuss only some forms of visual illusions. But it may be noted that there are numerous examples of illusions for other sense modalities including audition and touch.

All of us experience **moon illusion.** In the evening, the moon near the horizon looks bigger in size than in the midnight, when it is over our head. Similarly the rising sun looks bigger than the afternoon sun. Sun or moon does not change the size as it moves from the horizon. In other words, in such situations, our sense organs deceive us. The stimulus is wrongly interpreted. This wrong interpretation of sensory information is called **illusion.** We have heard people bet that they have seen ghosts. This is a false interpretation of sensory information often called as **hallucination.** Illusions and hallucinations are two kinds of errors in perception. Both are distortions.

Illusions

Illusions are wrong or incorrect perceptions. There is an external stimulation always present in such perceptions. These are not perceptions in the true sense, because ***in perception, the stimulation is correctly interpreted, whereas in illusions the stimulation is wrongly interpreted.*** Therefore illusions demonstrate

that what we experience depends upon processes, which go far beyond the sensory input (Morgan *et* a/, 1986). Illusions do not correspond to the objective situation as shown by physical measurement. There are illusions, which may concern most of the features of the physical world, such as distance, motion, shape, size, and direction, etc.

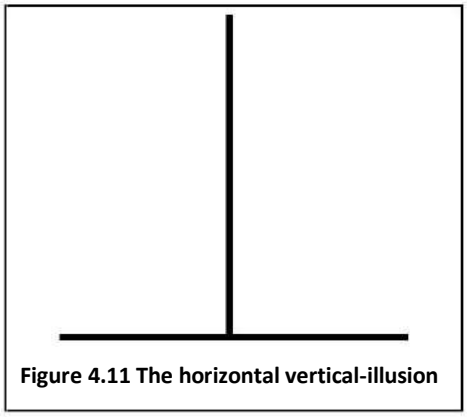


Figure 4.11 The horizontal vertical-illusion

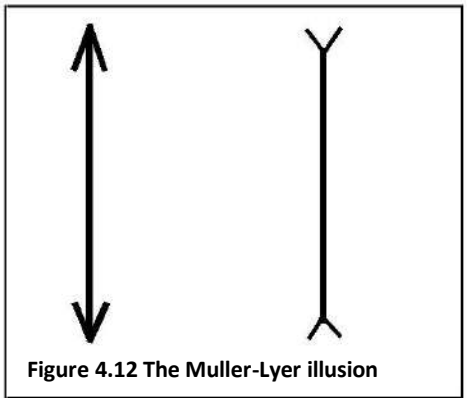


Figure 4.12 The Muller-Lyer illusion

Illusions may be caused by a number of factors. There are stimulus factors, psychological factors, and cultural factors. The following figures demonstrate illusions, which are caused by stimulus factors. Figure 4.11 is an example of the **horizontal-vertical illusion**. The vertical line looks longer than the horizontal line, when in fact the two lines are same.

Figure 4.12 is an example of the **Muller-Lyer illusion**. There are two lines of the same length; one line is having arrow-heads at both the ends, and the other line is having feather-heads at both the ends. The feather-headed line looks longer than the arrow-headed line. Is not it?

Figure 4.13 depicts examples of the **Herring illusions.** In these illusions, two parallel

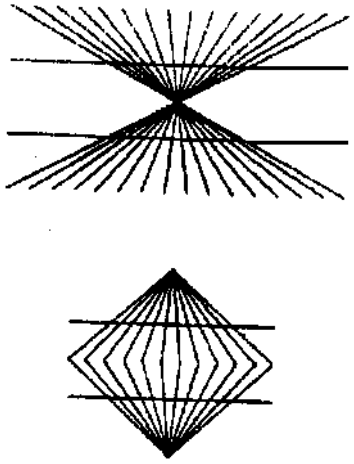


Figure 4.13 The Herring illusions

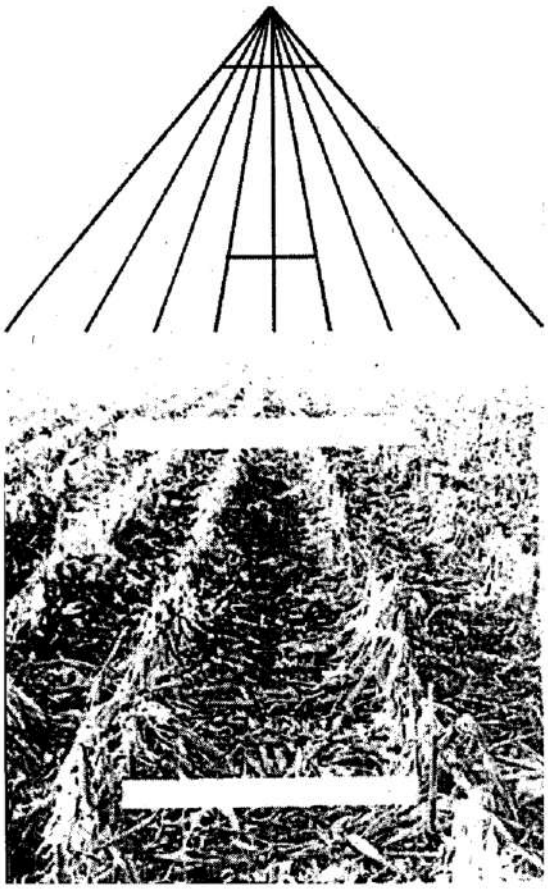


Figure 4.14 The Ponzo illusions

if a person is having some problems in his eyes, or in his sense organs, he is likely to have illusions. Similarly, if a woman has lost her son in snakebite, she is likely to see a rope as a snake. In fact, in low light, all of us may perceive a rope as a snake because of our excessive fear of snakes. However, the role of personal factors in perception is marginal. **Most illusions are universal phenomena.**

can see distortions in the parallel lines.

Figure 4.14 depicts examples of the **Ponzo illusions.** The two horizontal lines in each picture are actually of the same length. But they are not perceived as of the same length.

Figure 4.15 is the Poggendorf illusion in which the two diagonal lines appear as if they would not meet if extended towards each other. It is one of those illusions that consistently fool the human eye. You can examine with the help of a ruler that the two diagonal lines when extended would meet.

Illusions may be caused due to psychological or personal factors. For example,

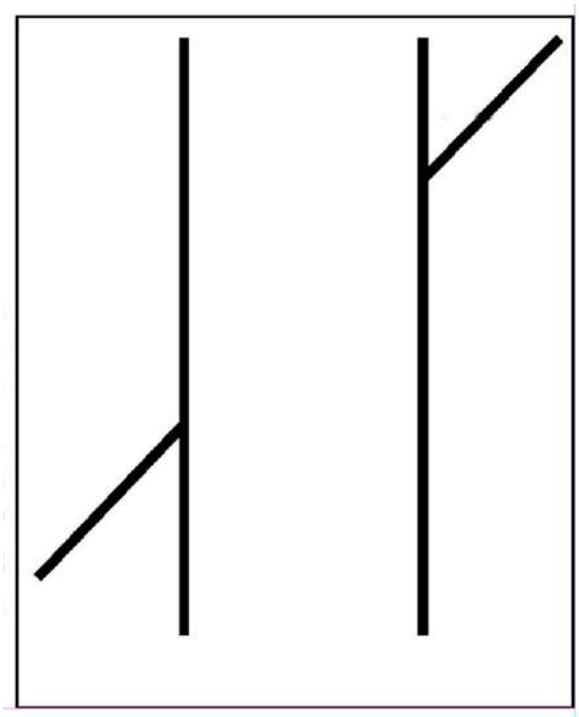


Figure 4.15 The Poggendorf illusion

Illusions are also caused by cultural factors. The Zulu people of South Africa do not suffer from Muller-Lyer illusions or the Sander Parallelogram illusions as much as the people of the carpentered-world. The Zulu people spend most of their time outdoors and are less familiar with carpentered objects having rectangular patterns. Their huts, their cattle, pen, etc. are circular in nature. The circle also is an important aspect of their religious activities. Therefore, they are less likely to perceive Muller-Lyer and Sander illusions because of their lack of experience with rectangular objects.

A number of explanations have been used to account for different types of illusions. Important among them are *the eye-movement theory, the perspective theory, and the inappropriate constancy scaling theory.* **The eye-movement theory** suggests that the feather-headed line in the Muller-Lyer illusion looks longer because our eyes move a longer distance to see the line than the arrow-headed line. Therefore, the feather-headed line occupies wider territory in the retina for which it is perceived longer than the arrow-headed line. But according to **the perspective theory,** the pictures represent some depth cues for which they are interpreted differently. For example, the feather-headed line represents the inside corner of a house which moves away from us and the arrow-headed line represents the outside corner of a house which is extending towards us. We know that an object, which is at a distant place, should look smaller. The two lines are actually of equal length, but one is perceived as moving away from us i.e., it is at a distance but having same retinal image like the other line, which is moving towards us. Therefore, the feather-headed line is perceived as longer.

The **moon illusion** has been described in terms of the **perspective theory**. Near the horizon, the moon looks bigger than the moon in the zenith i.e., when it is over our head in the open sky. The horizontal moon is seen with other objects such as trees, mountains, etc. The zenith moon, on the other hand, is seen in the empty sky. That it is just over our head means we perceive it nearer in space. The horizontal moon is perceived to be at a far away place. But the retinal images of the moon remain the same. We, therefore, interpret the retinal image of the horizontal moon to be larger in size because it is farther away.

The most appropriate theory to explain illusions is **the inappropriate constancy scaling theory** developed by Gregory (1963). In simple language, it could be stated that when perceptual constancy (described in a separate section earlier) fails, illusions

take place. To maintain perceptual constancy, the brain analyses several information just like a computer. These are: the distance of the object, retinal size, and the nature and characteristics of the object, several other depth cues, etc. Taking all these into consideration, the brain takes a decision with regard to the probable size and distance of the object. But at times, the brain does not get sufficient information to arrive at a definite conclusion. In such cases, constancy is not maintained and illusions take place. However there is not a single explanation for all types of illusions.

Hallucinations

Hallucinations are false perceptions. This means that without any actual stimulation, the person sees or perceives something. Perception of a ghost in a lonely night is the best example of hallucination. The person does not see a ghost when he is in a group. This is clearly an indication that the person being alone in a dark night experiences a strong emotional state. Therefore, an European may see an European ghost, while an Indian may see an Indian ghost, and more particularly near the spot or location where they know their ghosts reside. These are all very interesting and fun. Is not it?

Distinctions between illusion and Hallucination

1. Illusion is a kind of ***wrong perception***.	1. Hallucination is a *false perception*.
2. In illusion, an external stimulus is always present. In other words, illusions are ***caused by external stimulations***.	2. In hallucination, no external stimulus is present. Hallucinations are *caused by internal stimulations*.
3. Illusion is ***almost universal***.	3. Hallucination is a *personal experience*.
4. ***Normal persons*** suffer from illusions.	4. Hallucinations are mostly confined to *mentally ill persons* and to those people under the influence of drugs. The character of hallucination is determined by the individual's present and previous experiences.

5. The ***same situation arouses the same type of illusion*** in most people.	**5.** The ***same situation may not arouse hallucination in all***. There are individual differences with regard to hallucination. The same individual may experience different hallucinations in different occasions also.

Sense Organs

Sense organs are information-gathering systems in our body. Ten in all, eight of them collect information from the external world through vision, hearing, smell, taste, touch, warmth, cold, and pain. The other two senses maintain body equilibrium and provide information about the body position and the movement of body parts relative to each other. These two are called deep senses, and are respectively known as vestibular and kinesthetic senses. The sense organs serve dual functions for us: **survival function** and **sensuality function**. Our senses help us survive by sounding alarms of danger and priming us to take swift action to ward off hazards. Sensuality refers to the gratification of senses. It involves enjoying the experiences that are appealing to the eye, the ear, touch, taste, and smell. Our sense organs not only help us to have contact with our world, but also involve us in the richness of life's experience.

Our eyes and ears are two vital sense organs of our body. We receive more than 3/4th of our sensory information through these two sense organs. In comparison to ears, our eyes receive more information. In fact our two eyes are our windows into the world. As eyes are very valuable to a person, blindness is considered as a significant sensory loss. It is, therefore, important that we should know about the structure and functions of our visual and auditory sense organs. Though every sense organ is important for our survival, we will discuss here only the two important sense organs: the eyes and the ears.

Structure of the Eye

The physical energy received by our eyes is called light. Objects present around us reflect light energy. Light energy varies in intensity. Physicists have studied light energy in great detail. According to them, vision starts with the electromagnetic radiation that objects emit. This electromagnetic energy is the light described in terms of wavelengths. A light could be visible, if the electromagnetic spectrum stimulates the eye and produces visual sensation.

The wavelength of visible light determines its color. It has been observed by physicists that the wavelength of red is longer than the wavelength for orange; the wavelength for orange is longer than that of yellow, and so on. In the seven colors of a rainbow, violet is having the shortest wavelength in comparison to other colors.

The eye is often compared with a camera. Both the eye and the camera receive visual stimulations. The process of receiving visual stimulations is the same in both the cases except the fact that an operator operates the camera because it is a machine, whereas the eye has its automatic mechanism of operation. Moreover, the structure and functions of camera are simpler in comparison to the eye. In the eye, the light energy is converted to a neural code understandable to our nervous system.

The human eye is roughly spherical in shape. It consists of three layers: the outer layer ***(sclerotic coat),*** the middle layer ***(choroid coat),*** and the innermost layer ***(retina).*** The important structures of the human eye are discussed below (see figure 4.16).

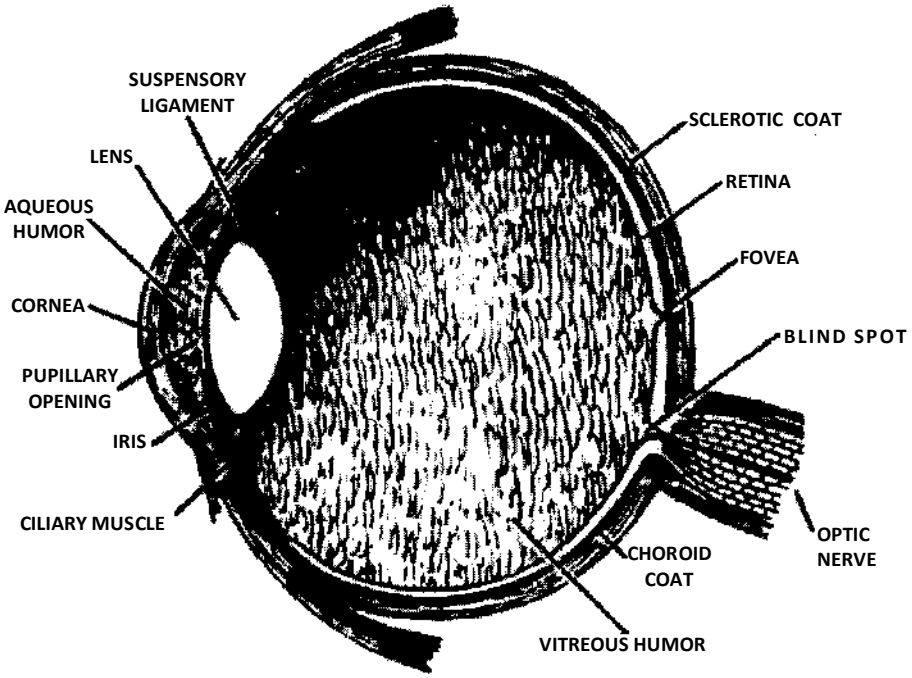


Figure 4.16 The structure of the human eye

Sclerotic coat *(Outer layer).* The outermost covering of the eye is called the *sclerotic coat* or the sclera. It gives protection to the inner structure of the eye. It is white in color and hard in texture. The white portion of the eye that we can see from outside is the sclera. Six external muscles are attached to it. These muscles help the eye for upward, downward, and side movements.

Cornea. The cornea is a part of the sclerotic coat. It is white, hard, and transparent because it does not contain any blood vessels. As it is situated in front of the eye, it can be seen and touched from outside. It is curved and convex in shape. **It is the part through which light rays enter the eye**.

Aqueous humor. The space between the cornea and the pupil is called the anterior chamber, and is filled with a transparent substance called aqueous humor.

Choroid coat *(Middle layer).* It is the second layer of the eye lying just interior to the sclerotic coat. This coat is filled with black-pigmented tissues to absorb stray light. It consists of blood vessels to supply nutrition to the retina. This layer ends at the back of the cilliary body to form the *iris.*

Iris: Located behind the cornea, and in front of the eye lens, **iris** is a circular muscle tissue of dark brown color. The iris is opaque. **It controls the amount of light that enters the eye, by either constricting the pupil, or expanding the pupil**. For example, in low illumination, the eye requires more light for which the iris expands the pupil. Pupil becomes larger in size and allows more light. On the other hand, in dim illumination, the iris contracts the pupil so that less light can enter the eye. The iris surrounds the pupil.

Pupil: Just behind the cornea, pupil is the ***aperture*** or the opening between the two irises. It is through the pupil, light rays enter the eye. The size of the pupil is controlled by the constriction and relaxation of the iris.

Lens: In the back of the pupil and iris, there is a rubbery, bean-shaped, transparent and crystalline lens, which bends the light rays onto the retina. It is surrounded by a circular mass of smooth muscles called the cilliary muscles. The cilliary muscles control the focusing of the lens for near and far vision. The lens becomes convex and thickening when we are looking at near objects and becomes concave and thinning when we are looking at the distant objects. This adjustment process of the lens is called accommodation.

Vitreous humor. The space between the lens and the retina is called the posterior chamber and is filled with a transparent substance called vitreous humor.

Retina *(Innermost layer).* This is the innermost layer of the eye. It is compared with the photo film of the camera. The basic function of the eye is to convert the light waves into neural signals that the brain can process. This function is carried out in the retina. The retina has several layers consisting of five types of neurons: (a) the receptor cells called the *rods* and *cones*, (b) the *bipolar neurons,* (c) the *ganglion cells,* (d) the *horizontal cells,* and (e) the *amacrine cells.*

Retina contains the real visual receptor cells of the eye i.e., the ***rods*** and the **cones.** The rods and cones appear at the rearmost layer of the retina. There are about 125 million rods, and 7 million cones. The rods are long and cylindrical, and the cones are short, thick, and tapered. The rods and cones are distributed unevenly throughout the retina. The cones are concentrated more at the center of the retina, while the rods are spread more in the peripheral regions of the retina. In the center of the retina is a very small region called ***fovea*** that contains nothing but densely packed cones. **The fovea is rod-free, and is the area of our sharpest vision.** Both color and spatial details are most accurately detected in the fovea. If you would focus on something of particular interest, you will probably center the image from the lens onto the fovea.

The rods and cones are not only structurally dissimilar, but they also play clearly different roles in vision. **The rods are responsible for black and white vision, while the cones are helpful for color vision**. The cones are active in bright illumination, whereas the rods are active in dim illumination. The rods play a key role in peripheral vision, i.e., seeing objects that are outside the main center of focus, while the cones record sharp visual details. Both are necessary to interact with the nature, both in bright light as well as in dim illumination.

Besides rods and cones, the retina contains other types of cells, as mentioned earlier. The ***bipolar cells*** are neurons, which combine impulses from the rod and cones and send the results to the ganglion cells. The ***ganglion cells*** combine the impulses from many bipolar cells and carry the visual information from the eye to the brain. The axons of the ganglion cells form the ***optic nerve.*** It is the optic nerve, which carries message to the brain. As the optic nerve exits the eye, it leaves a small

area of the retina without the receptor cells. This area is called the ***blind spot.*** The blind spot contains no rods and cones, and therefore, vision is not possible in this area. As it is not sensitive to any light, it is called the blind spot. We do not normally experience blindness because what one eye misses, the other eye registers, and the brain fills in the information that is most likely missing.

Functions of the Eye

Sending messages to the brain. The light ray first passes through the transparent cornea and aqueous humor, and enters the eye through the pupil. The size of the pupil varies according to lighting conditions: the less light present, the wider the pupil opening. These adjustments of the pupil are effected by the iris that contracts or expands to allow varying amounts of light to pass in. After entering through the pupil, the light rays pass through the lens, and vitreous humor. The lens helps us to focus on objects at varying distances. When we look at distant objects, the lens becomes thinner and flatter. Once, the light rays pass through the lens, it is projected onto the retina at the back of the eyeball. The lens bends the lights rays in such a way that the image projected onto the retina is upside down and reversed. But the brain reverses this image again allowing us to see objects in proper positions.

The chemical composition of the rods and cones in the retina changes when energized by light waves and thereby neural impulses are created. These neural impulses are then transmitted to the bipolar cells, which in turn are communicated to the ganglion cells. Ganglion cells collect and summarize the visual information. Then, the optic nerves carry them to the **primary visual cortex in the occipital lobe of the brain**. At this point, the brain sees and interprets what eyes have collected. The brain integrates information received through both the eyes. The light waves from the right half of the visual field fall on the left half of the retina in both eyes, and the neural impulses produced therein are carried to the left occipital lobe of the brain. Likewise, light waves from the left half of the visual field fall on the right half of the retina in both eyes, and the neural impulses created therein are transmitted to the right occipital lobe of the brain. This is the way that information from both eyes is combined and we see a single and unified object.

Dark adaptation. Dark adaptation is a function of the eye. It is a visual sensitivity, which increases as we move from bright light to an environment of dim

illumination, such as a cinema hall. When we enter into a movie hall, we may at first find the hall very dark and may not locate our seats readily. But after some time we come to see everything. The process of adjusting to conditions of lower lighting is called dark adaptation. The dark-adapted eye is about 100,000 times more sensitive to light than a light-adapted eye. Rods and cones adapt at different rates. Cones acquire sensitivity quicker than the rods. Adaptation to brighter lighting conditions takes place much more rapidly. For example, after coming out of the movie hall, we may find extremely brighter and stray light around us, but very soon such brightness dissipates as we adjust to it. The process is called light adaptation.

Visual acuity. Our visual system has the ability to resolve finer details. We can focus our eyes to get a sharp picture of the finer details of the object. There are two types of visual acuity. The first is static visual acuity, which refers to the ability to discriminate different objects when they are stationery. The static visual acuity is measured when the eye doctor asks us to read the familiar chart of letters. The second kind that is dynamic visual acuity refers to observing details in objects in motion. The ability to resolve finer details of the objects decreases as the speed of the object's image across the retina increases. The dynamic visual acuity is important for a cricket player taking a catch. Wearing eyeglasses by the cricket players improves visual acuity.

Eye movements. The eyes are so made that they move inward and sideways to focus our gaze on objects. There are two types of eye movements. The version movements move both the eyes together in the same direction so that we can track moving objects. The vergence movements move the eyes so as to converge or diverge. The convergent movements are very crucial for perception of distance and depth.

Seeing Colors. A person with normal color vision can discriminate up to 150 color differences across the visible spectrum (Bornstein & Marks, 1982). Different colors have different wavelengths. Our ability to perceive color depends on the eye's transmission of different messages to the brain, when lights of different wavelengths stimulate the cones in the retina. The following theories explain how lights of different wavelengths are perceived as different colors.

The **trichromatic theory** was originally developed by a British Scientist Thomas Young and was later supported by German physiologist Hermann Von

Helmholtz. This theory suggests that there are three different types of photoreceptor cells or cones in the retina each of which is maximally sensitive to a particular range of wavelength in light. As a result, some of these cones are sensitive to red light, some to green, and some to blue. Red, blue, and green are the three basic color systems. We see other colours when two different types of receptors are stimulated simultaneously. The perception of yellow, for example, would result from the simultaneous stimulation of receptors for red and green. The perception of white would result from the simultaneous stimulation of receptors for red, green and blue. Likewise, we see different colours from different combinations of the three basic colours.

The **opponent-process theory** suggests that there are three different color receptors, one of which is stimulated by green and inhibited by red, a second is stimulated by yellow and inhibited by blue, and the third is activated by achromatic stimuli, which can perceive differences in brightness from light to dark or white-black type. This theory is called opponent-process theory because these combinations are opponent systems. For example, when receptors for red are active, receptors for green remain inactive. Similarly, when blue member is active, yellow member remains inactive. These processes, either singly or in combination, mediate our experiences of different colour perception.

The **retinex theory** was developed by Land, which suggests a very convincing explanation of colour vision. This theory proposes that visual pigments in the eye are light-sensitive molecules. Each of these responds to a relatively wide band of light. There are four types of visual pigments. One type of pigments is sensitive to light and dark and is found in rods. The other three are found in cones. Each of them responds to different, but overlapping frequencies of light waves. Since different sensitivities of the cones overlap, it is erroneous to speak red-green, or blue-yellow system. Red, blue, or green, etc. are subjective experiences. It is the person who interprets a visual stimulus as red, blue, or green. They are not the properties of light waves. It is, however, not the final word about our experience of color vision. Further research is being carried out to explain our experiences of color perception in a more scientific way.

Sensing Sounds

Hearing is the second most important channel, next only to vision, through which we learn about and appreciate the world around us. Through hearing, we

understand speech, our chief medium for imparting and acquiring knowledge. It is, therefore, important that we know the mechanism of sensing sounds, which is called ***auditory sensation***.

When an object vibrates by an external pressure, the air molecules around the object vibrate. The vibration spreads to the neighboring molecules, which create a wavelike movement of the molecules. If you have marked a stone thrown into a pond, you must have seen how the waves created near the stone move along to all sides of the pond. Sound waves produced by the vibration of an object move in the same way as the ripples move on the surface of the water in a pond. However, sound waves move much faster than the waves of water. The speed of sound waves under normal temperature and atmospheric pressure is about 1130 feet per second. These sound waves are the physical stimuli for everything we hear.

Sound waves have two components, pitch and loudness. The pitch of a sound is determined by its frequency, which is the number of expansions and contractions in the wave that occur in a second. Hertz is the unit of measurement for pitch. The loudness of a sound is determined by amplitude or height of the sound waves. This is the amount of contraction or expansion that occurs in each wave. The unit of measurement of amplitude or loudness is called ***decibel*** (dB). The threshold of hearing is zero dB. How loud is zero dB? It is about as loud as the ticking of a watch 20 feet away in a quiet room. A sound wave of about 80 dB is perceived to be uncomfortably loud.

The sound waves are the physical energy received by our ears. Auditory sensation takes place when our ears receive the sound. Sound or auditory stimulation travels through the air in waves. Sound is caused by changes in air pressure that results from vibrations. Vibration is created by any object that vibrates, such as the vibration of a guitar string, vibration of the college bell, movement of a bus on the street, vibration of the vocal cord of a singer, and so on. Sound waves move in different directions in air. Thus, our ears come in contact with the sound waves and receive sound information. Sound waves can occur many times in one second. Our ear is sensitive to sound waves that vary from frequencies of 16 to 20,000 cycles per second.

When sounds of different frequencies are generated together, as in case of musical sounds, we perceive a third tone. When there is harmony or consonance in

the difference of frequencies, the sound is perceived as pleasant. But when there is disharmony or dissonance between them, the sound is perceived as unpleasant.

Sometimes in addition to producing the specified tone, a musical instrument may produce a number of tones that are greater in frequency. These are called overtones. Overtones resulting from vibrations elsewhere in the instrument and contributing to the richness of the sound are called timbers of a sound. Noise, on the other hand is produced because of a combination of dissonant sounds. It is perceived as unpleasant.

Structure and Functions of the Ear

What happens to the sound waves once they reach the ear? How do various structures of the ear transform sound waves so that the brain can understand them? The answers to these questions can be obtained by studying the structures and functions of the human ear (see Figure 4.17). The ear has three major structures: the *outer ear,* the *middle ear,* and the *inner ear.*

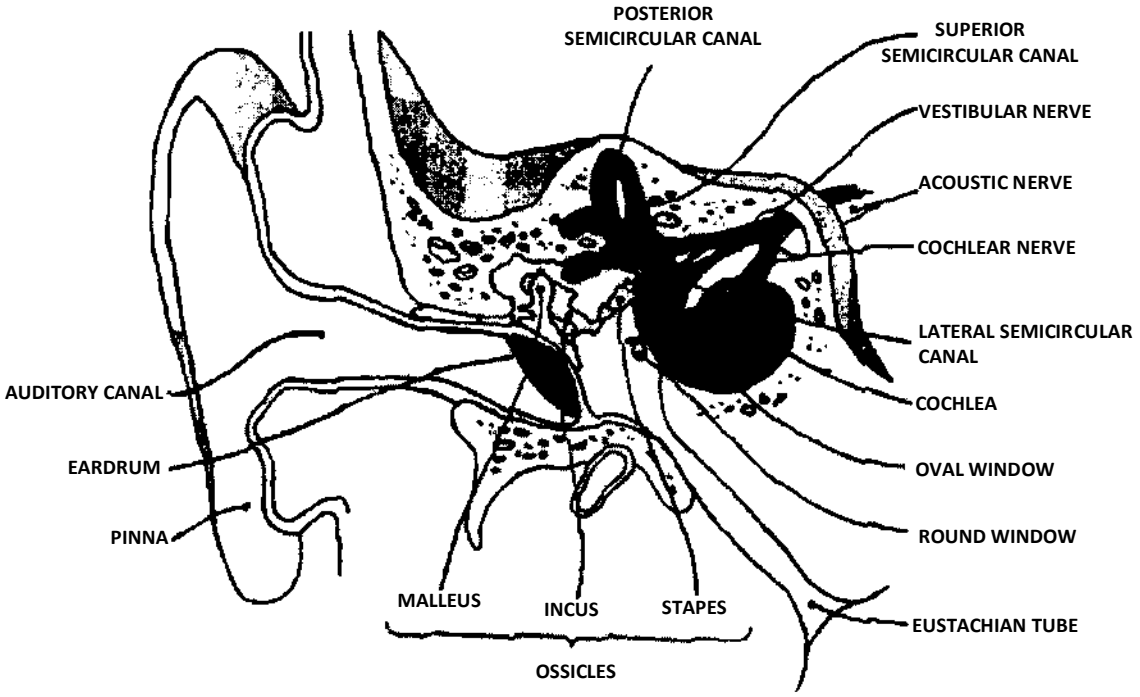


Figure 4.17 The structure of the human ear

Outer ear. It is the external or outer part of the ear which can be seen from outside. It is made up of the ***pinna*** and the ***auditory canal***. The pinna is the external part of the ear, which can be seen from outside. Sound waves arriving at the pinna are funneled into the auditory canal, which is a tube like passage leading to the eardrum. The auditory canal connects the outer ear with the middle year, which is a structure often filled with wax.

Middle ear. It contains the ***eardrum*** (the tympanic membrane), and three small bones. The three small bones are the ***hammer***, the ***anvil***, and the ***stirrup***. The bones are so named because of their structures. The eardrum works like a miniature drum, which vibrates when the sound waves hit it: The more intense the sound waves, the more the vibration in the eardrum. The sound waves then touch the three bony structures, which also vibrate and conduct the sound waves. The middle ear acts like an amplifier making us aware of sounds that would otherwise go unnoticed. The three bones have one important function: to transmit vibrations to the oval window, a thin membrane leading to the inner ear. The oval window, which is attached to stirrup, balances air pressure in the middle ear. **Hence the main function of middle ear is to give a mechanical framework to sound waves**.

Inner ear. The important structures of inner ear are the ***cochlea***, the ***basilar membrane***, and the ***organ of corti***. The inner ear is a portion of the ear that changes sound waves into a form that allows them to be transmitted to the brain. The **cochlea** has the shape of a snail shell. The cochlea has three fluid-filled canals spiraling around together and separated from one another by membranes. The three canals are *vestibular canal,* the *cochlear canal*, and *the tympanic canal*. One of the membranes lies coiled within the cochlea and is called the **basilar membrane**. Vibrations in the fluids within the canals of the inner ear strike against the basilar membrane. The waves in the canals reach the **organ of corti**, which is attached to basilar membrane. The organ of corti has thousands of hair-like structures, which are the real auditory receptor cells. The pressure waves in the cochlear canals produce bending movements of the fine hair like processes on the ends of the hair cells of the organ of corti. The bending of these receptor cells generates a neural impulse that is transmitted by the auditory nerves to the **auditory cortex of the temporal lobe** in the brain. Then we hear the message.

Auditory Perception

The discussion made above on the sensory mechanism of hearing reveals that we hear sounds because they cause vibrations in parts of the ear and information about these vibrations is transmitted by the auditory nerves to the temporal lobe of the brain. But how do we perceive the pitch or frequency of a sound? Some psychologists believe that sounds are perceived as being louder when more number of receptor neurons on the organ of corti get fired. But they are not so sure about the perception of pitch. We have got three theories to explain pitch discrimination: the *place theory* and *the frequency theory,* and the *volley theory.*

Place theory. The place theory was proposed by Helmholtz and was modified by the Noble Prize winner, Bekesy (1960). The theory holds that the pitch of a sound is determined depending upon which section of the basilar membrane vibrates in response to the sound. Bekesy observed that receptor neurons at different sites along the basilar membrane are excited in response to different frequencies of tones. The higher the pitch of a sound, the closer the responsive neurons lie to the oval window. However, tones that are of low frequency excite the entire basilar membrane.

Frequency theory. The place theory explains high-frequency sounds, but fares poorly with low-frequency sounds. A frequency below 400 Hz does not stimulate a particular spot on the basilar membrane; it is virtually registered by all parts of the basilar membrane on an equal basis. Thus, frequency theory suggests that the frequency of auditory nerve's firing is involved in our perception of sound. This theory argues that the basilar membrane vibrates as a whole at lower frequencies.

Volley theory. This theory proposed by Weven (1949) is a modification and expansion of the frequency theory to account for high-frequency sounds. A neuron has a maximum firing capacity of about 1000 times per second. Hence frequency theory cannot be applied accurately to sounds over 1000 Hz. This theory argues that sounds above 1000Hz can be accounted for by a team of neurons with each neuron of the team firing at a different time. The volley theory derives its name from the fact that neurons fire in a sequence of rhythmic volleys at higher frequencies. For example, for a tone of 3000 Hz, there would occur in the auditory nerve a spurt of neural activity, called volley every 0.003 second, with different groups of fibers responding each time, and some fibers because of their greater excitability contributing more of the spurt than others. Pitch, depends upon the frequency of volleys rather than the frequency carried by the individual fibers.

KEY TERMS

Attention
Selective attention
Voluntary attention
Divided attention
Sustained attention
Span of attention
Perception
Sensation
Attention
Psychophysics
Absolute threshold
Differential
Threshold
Signal-detection theory
Perceptual learning
Gestalt
Law of proximity
Law of similarity
Law of closure
Law of good continuation
Law of common fate
Figure-ground
Law of pragnanz
Auto-kinetic effect
Stroboscopic motion
Phi-phenomenon
Monocular cues
Binocular cues
Proximal size
Texture gradient
Shading
Linear perspective
Interposition
Movement parallax
Convergence
Perceptual constancy
Size constancy
Color constancy
Brightness constancy
Shape constancy
Perceptual learning
New-look theory
Mental set
Illusion
Hallucination
Moon illusion
Muller-Lyre illusion
Ponzo illusion
Herring illusion
Poggendorf illusion
Eye-moment theory
Perspective theory
Auditory perception
Vitreous humor
Cornea
Aqueous humor
Lens
Iris
Pupil
Cones
Retina
Rods
Dark adaptation
Bipolar cells
Ganglion cells
Opponent-process theory
Visual acuity
Trichromatic theory
Pitch
Retinex theory
Auditory sensation
Auditory canal
Amplitude
Pinna
Basilar membrane
Eardrum
Cochlea
Organ of corti
Inappropriate

SUMMARY

1. Sensation is a simple and mechanical process; attention is filtering process; perception is an integrated and interpretative process for forming mental representations.

2. *Sensation is the first and foremost requirement of perception*. We do not perceive with sensations only. Perception of an object or event is not possible unless it is attended to.

3. Receiving information from the environment through any one of the sense organs and transmitting them to the central nervous system is called sensation. Because sense organs are involved in perception, it is called a receptive process.

4. Stimulus information must have minimum intensity to stimulate receptor cells. The minimum amount of stimulation essential to generate experience is called *absolute threshold* or *reiz limen* (RL). A difference in physical energy must cross another threshold or *differential limen* to generate any kind of difference in sensation and perception. The *signal-detection theory* explains the role of psychological factors in judging whether a stimulus is present or absent.

5. The process of selecting a stimulus or a group of stimuli from among a large pool of stimuli is called attention. *Attention is called the selective part of the perceptual process* or pre-perceptive attitude.

6. *Span of attention refers to how many items (digits or letters) one can attend in single glance of attention* in about one-tenth of a second which makes eye movement or counting impossible and varies within the limit 7+ 2.

Variables like nature of material, stimulus size and color, exposure duration, mental set and age influence individual's span of attention.

7. Selective attention is bringing into focus a limited number of stimuli from a large pool of stimuli. Sustained attention is maintaining attention on an object for a relatively longer duration. Sometimes we can also attend to two or more different things at the same time. This is called divided attention.

8. Attention is influenced by External or Objective factors (properties of the environment: *nature, intensity, size, duration, location and movement of the stimulus, variety, novelty and contrast*) and Internal or Subjective factors (person's characteristics: *habits, interests, needs and motives, mindset, emotional state, attitude and experience*). The subjective factors play a more potential role in influencing attention.

9. *Perception is a process through which we organize sensations, meaningfully interpret them, and form a mental representation of our world*. It is not a mechanical process. The process of perception is dynamic in nature.

10. *Perception is a receptive, selective, symbolic, and affective process*. A host of environmental stimuli are received through the sense organs. But we do not attend to all; only a few of them are selected for further processing. The processing does not use actual objects or events; rather some symbols in the form of mental images are used in mental processing. Finally, perception has also an affective component.

11. According to the Gestalt psychologists, perception is organized on the basis of the form qualities of objects. In

other words, they have emphasized the stimulus factors affecting perception. According to them, perception of the whole is more than the sum total of its parts. In order to explain their viewpoint, they have talked about *laws of perceptual organization*.

12. The laws of perceptual organization are based on (a) *laws of grouping* such as *law of proximity, law of similarity, law of good continuation, law of closure*, and *law of common fate*; (b) *figure-ground relationship*; and (c) the *law of pragnanz* or goodness of figures.

13. We perceive *real movement* by sensing it across the retina and movement of objects in relation to *one* another. Distant objects appear to move more slowly than nearby objects, and middle-ground objects may give the illusion of moving backward.

14. *Apparent motions are illusions of movement* in which there is the perception of movement in the absence of physical movement of an image across the retina. Psychologists have studied several kinds of apparent movement such as *auto-kinetic effect, stroboscopic motion,* and the *Phi-phenomenon.*

15. Depth and distance perceptions involve both *monocular* and *binocular cues*. Monocular cues include *proximal size, brightness, shading, texture gradients, linear perspective, interposition,* and *movement parallax*. Some of the binocular depth cues are *retinal disparity* and *convergence*.

16. The stability in our perception of objects in spite of wide variations in the conditions of observation is called *perceptual constancy*. Through experience, we develop a number of perceptual constancies. For example we learn to assume that objects retain their size, shape, brightness,

and color despite their distance, their position, or changes in the lighting conditions.

17. *We perceive things as we are*. Individuals differ with respect to their perceptions. An individual's perception is determined by his past experiences, needs, interests, personal values, beliefs and attitudes, mood states, and his cultural practices. These intra-individual factors are known as functional factors or *subjective determinants of perception*.

18. *Illusions* and *hallucinations* are two kinds of errors in perception. Illusions are incorrect perceptions of objects. The object is always present but wrongly perceived by the perceiver. Illusions may be caused by stimulus factors, psychological factors, and cultural factors. However, illusions are generally caused by stimulus factors. Illusions may be explained in terms of *eye-movement theory, perspective theory,* and *inappropriate constancy scaling theory*.

19. *Hallucinations* are false perceptions as they occur without any actual stimulation. Hallucinations are sometimes caused because of fear or emotion.

20. The eye senses and transmits visual stimulation to the *primary visual cortex in the occipital lobe*. After the light rays pass through the cornea, pupil size determines the amount of light that can pass through the lens. The *lens* focuses light onto the retina, which transforms the light energy into a neural code understandable to the brain. The *retina* is composed of visual receptors called *rods* and *cones*, bipolar cells, and ganglion cells.

21. The *rods* are long and cylindrical, and are responsible for

black-white vision, and vision in dim illumination. The *cones* are short and thin, and are responsible for color vision. The bipolar cells combine impulses form many rods and cones, and send results to the ganglion cells, which transmit the information to the brain for interpretation.

22. The eye is involved in sending messages to the brain, dark and light adaptation, visual acuity, and seeing colors. The three theories advanced to explain color vision are the *trichromatic theory, opponent-process theory*, and the *retinex theory*.

23. The ear senses and transmits auditory stimulation to the *temporal lobe of the cerebral cortex*. Auditory sensation takes place when our ear receives sound. Sound is caused by changes in air pressure that results from vibrations. Sound waves have two components: pitch and loudness. Pitch of a sound is determined by its frequency, and loudness is determined by amplitude.

24. The *eardrum*, vibrating to sound, transmits auditory stimulation through the bones of the middle ear to the *cochlea* of the *inner ear*. The *basilar membrane* of the cochlea transmits stimulation to the *organ of corti*, and from there sound travels through the auditory nerve to the auditory cortex in the temporal lobe of the brain. Sound seems louder when more neurons of the organ of corti fire. Three theories account for the perception of pitch. They are *place theory, frequency theory,* and *volley theory*.

QUESTIONS

A. True-False Items

(State whether each of the following statements is 'TRUE' or 'FALSE')

1. Perception is a mechanical process.

2. Perception comes before attention.

3. Span of attention varies within 5 to 9 items.

4. Attention is not influenced by the emotional state.

5. All normal individuals have the same span of attention.

6. Receiving information through the sense organs is called perception.

7. Attention is equivalent to sensation.

8. Perception involves mental images.

9. Tachistoscope is used for measuring span of attention.

10. Attention is the selective part of the perceptual process.

11. The capacity of our perceptual system is limited.

12. Age does not influence span of attention.

13. Keeping attention for a longer duration is selective attention.

14. A person's attention varies depending upon the intensity of the stimulus.

15. Visual stimuli are normally more attended than auditory stimuli.

16. Sustained attention is closely linked to vigilance.

17. Attending to certain stimuli in a large array is selective attention.

18. Novelty is an objective determinant of attention.

19. Attention is not influenced by the attitude of a person.

20. Motive is a subjective determinant of attention.

21. The occipital lobe is involved in visual perception.

22. The parietal lobe is involved in auditory perception.

23. Attention is a selective filter.

24. The value of the absolute threshold is the same for every person.

25. Attention precedes perception.

26. We see as we are.

27. Perception is functionally selective.

28. The behaviorists developed the laws of perceptual organization.

29. The Gestalt psychologists were from Germany.

30. The Gestalt laws of perceptual organization are also applicable for auditory perception.

31. The law of common fate is applicable in case of moving objects.

32. The law of pragnanz is a general instance of the laws of grouping.

33. The movement of a light spot in a dark room is auto-kinetic effect.

34. The phi-phenomenon is a visual illusion.

35. Retinal disparity is a monocular cue of distance perception.

36. The Visual Cliff experiment suggests that depth perception is innate.

37. Texture gradient is a monocular cue for distance perception.

38. Retinal image for a distant object is smaller.

39. Emotional state influences the quality of perception.

40. Gestalt factors of perception are known as functional factors.

41. Perceptual learning suggests the role of past experience on perception.

42. Gibson conducted experiments on perceptual learning.

43. Poor children underestimate the size of the coins.

44. Culture has no role on visual illusions.

45. Set does not influence perception.

46. Illusions are false perceptions.

47. Illusions can be experienced by birds also.

48. Most illusions are universal phenomena.

49. The Zulu tribe does not suffer from the Muller-Lyre illusion.

50. Hallucination is experienced universally.

51. The cultural factors influence visual illusions.

52. Compared to the past experience, sex has a lesser role in perception.

53. The law of proximity states that similar objects tend to be perceived as a group.

54. Rods and cones are distributed equally all over the retina.

55. Cones are related to auditory functions.

56. Pupil is the aperture of the eye.

57. The rods are active in dim illumination.

58. Fovea contains densely packed cones.

59. The blind spot contains only rods.

60. Vision is not possible in fovea.

61. Cones are highly concentrated at the center of the retina.

62. Neither rods nor cones work at night.

63. Sensing sound is called auditory perception.

64. The pitch determines the loudness of a sound.

65. The inner ear consists of pinna.

66. The middle ear amplifies the strength of sound waves.

67. Sound stimuli are interpreted in the occipital lobe.

68. The magnitude of loudness is expressed in decibels.

69. Cricket players wear eyeglasses to improve visual acuity.

70. Partial vision is possible at the blind spot.

71. The retina contains more cones than rods.

72. Size constancy is purely innate.

73. The signal detection theory explains the role of psychological factors in perception.

B. Multiple-Choice Items

(Choose the correct alternative from the bracket to fill up the blank or answer the question)

1. Our pre-perceptive attitude is called …… (sensation, attention, perception, apperception).

2. Our span of attention normally has a range of ……. items. (5 to 10, 6 to 10, 5 to 9, 3 to 5)

3. ……. is used for measuring attention. (memory drum, metronome, tachistoscope, none of these)

4. Focusing attention on an object for longer duration is ……. attention. (selective, sustained, divided, non-voluntary)

5. ……. is not an objective determinant of attention. (attitude, novelty, variety, movement)

6. That we attend to objects that are connected to our instincts is an example of ……. (explicit attention, voluntary attention, non-voluntary attention, none of these)

7. Among the following, ……. would invite maximum attention. (colored pictures, pictures of human beings, pictures of beautiful women, one's own picture)

8. Focusing on a limited range of stimuli in a vast stimulus array is ……. attention. (selective, sustained, divided, none of these)

9. Among the following, ……. has least influence on attention. (variety, habit, mindset, gender)

10. A hungry man quickly notices the sight of food. This is more appropriately an example of ……. influencing perception. (mindset, motive, thinking, interest).

11. Sustained attention is equivalent to ……. (vigilance, consciousness, perception, attention span).

12. We attend to persons whom we like. This explains the influence of ……. on attention. (habit, need, novelty, attitude)

13. Divided attention is possible for actions that are ……. (automatic, well-rehearsed, highly practiced, all of these)

14. The conversion of the physical energy to neural impulses is known as …….. (organization, transduction, neural transmission, vision).

15. The minimum stimulus intensity required for activating sense organs is called …….. (DL, RL, signal detection, psychophysics).

16. Perception is not a/an …….. process (receptive, selective, affective, unconscious).

17. Seeing “ssslll” as two sets of figures rather than six separate figures is an example of the principle of…….. (similarity, closure, continuity, proximity)

18. The term Gestalt means …….. (perception, principle, whole, group).

19. The law of …….. is not a law of grouping (proximity, similarity, common fate, figure-ground).

20. The law of…….. states that the elements that appear nearer together tend to be grouped together (proximity, similarity, closure, common fate).

21. In a printed book, we see tows of letters rather than columns. This is an example of the law of ….. (proximity, similarity, closure, common fate).

22. The eyes of a color-blind person are devoid of……. (rods, cones, retina, lens).

23. ……. is a binocular cue for distance perception (proximal size, texture gradient, convergence, interposition).

24. Seeing a table as rectangular in form is an example of…….. constancy (shape, size, color, brightness).

25. The ‘new look’ theorists investigated the role of……. on perception (past experience, set, needs and motives, cultural factors).

26. ..... subjects are more likely to complete word-stems so as to form food-related items (thirsty, disadvantaged, motivated, hungry).

27. That people are most likely to attend to the members of their own race is an example of the role of..... on perception (mood, motive, set, prejudice).

28. The feather-headed line looks longer than the arrow-headed line. This is the case of the .....illusion (Herring, Muller-Lyre, Ponzo, Peggendorf).

29. ..... theory suggests that the feather-headed line occupies a wider territory on the retina compared to the arrow-headed line (eye-movement, perspective, inappropriate constancy, cognitive dissonance).

30. Seeing a ghost in a dark room is an example of..... (illusion, hallucination, perceptual defense, delusion)

31. To perceive an incomplete circle as a complete one is an example of the law of..... (similarity, proximity, closure, common fate).

32. False visual perception is called ..... (hallucination, illusion, delusion, false reaction).

33. In perception ..... is necessary, (stimulus, reward, feeling, external response).

34. ..... has least role in perception, (need, mood, sex, past experience).

35. Muller-Lyer illusion is ..... (fully universal, culture-specific, person specific, temporary).

36. Perception is a/an ..... process, (integrative,

symbolic, affective, all of these).

37. When I confuse a rope to be a snake, it is..... (illusion, perception, hallucination, image).

38. We are able to read most of the words in an old letter defaced by dirt because of the principle of .....(continuity, closure, similarity, figure-ground).

39. The blind spot is so called because of complete absence of ..... (rods, cones, rods and cones, nerves).

40. ..... regulates the opening of the pupil (cornea, iris, retina, lens).

41. ..... contains densely packed cones (fovea, cornea, retina, blind spot).

42. ..... help us see colors (rods, cones, pupils, lenses).

43. The axons of the ganglion cells form ..... (retina, visual cortex, blind spot, optic nerve).

44. ..... converts the light waves into neural signals for processing in the brain (retina, pupil, iris, lens).

45. the three small bones responding to the sound vibrations are in the ..... (inner ear, outer ear, middle ear, cochlea).

46. ..... changes sound waves to a neural code understandable to the brain (outer ear, inner ear, middle ear, auditory canal).

47. The organ of corti is located in the ..... (inner ear, middle ear, outer ear, auditory cortex).

48. Vision is not all possible in the ..... (fovea, blind spot, occipital lobe, retina).

C. Short -Answer Questions

(Write the answer to each question in 5 sentences).

1. What is span of attention?

2. Distinguish attention from sensation and perception.

3. Distinguish selective from sustained attention.

4. What are the objective determinants of attention?

5. What are the subjective determinants of attention?

6. Do needs and motives influence attention?

7. What is perception?

8. State the nature of perceptual process.

9. What is psychophysics?

10. What is perceptual organization?

11. State the five laws of grouping.

12. What is the law of pragnanz?

13. Give an example of law of similarity.

14. How is a figure different from its ground?

15. What is phi-phenomenon?

16. How do we perceive movement?

17. How does retinal disparity influence perception of distance?

18. Is depth perception innate?

19. Mention the monocular cues for distance perception.

20. What is perceptual constancy?

21. Explain the law of proximity in perception.

22. Give some examples of organizing factors of perception.

23. What is the 'new look' theory in perception?

24. Mention a few subjective determinants of perception.

25. How does culture affect visual illusions?

26. Does mental set influence perception?

Chapter 5

LEARNING

This chapter covers :

) Meaning and Operational Definition of Learning; Learning as Distinguished from Maturational Changes and Performance.

b) Processes of learning:

i) Trial-and-Error

ii) Classical Conditioning

iii) Operant Conditioning

iv) Cognitive Learning- Imitation, Insight

c) Factors Influencing Learning

i) Feedback

ii) Distribution of practice

iii) Whole and part learning

iv) Meaningfulness

v) Interest and Attitude

vi) Motivation

After you go through this chapter, you would be able to:

- *Understand the nature of learning.*
- *Explain different types of learning and the principles underlying each type.*
- *Understand the psychological processes involved in each type of learning.*
- *Discuss the importance to learning principles in the acquisition and treatment of deviant behaviours.*
- *Familiarize yourself with factors influencing the progress of learning*

CONTENTS

Learning

Introduction

Learning is one of the processes of acquiring knowledge about the world. It is a process of cognition. Any response that the organism has not inherited is said to be learned. Human beings have lesser inborn instincts compared to their learned responses. Animals lower in the developmental continuum deal with environmental challenges by relying on an innate set of responses, called ***fixed-action patterns***. The behaviours of human beings are controlled more by a set of learned responses. The things that we were not able to do before, but are capable of doing now are the results of learning. Knowing to ride a bicycle, to swim, to solve arithmetic problems, to use language, and to operate on a computer are some of the common examples of learning. Without learning, the world would have been still a booming, buzzing confusion.

Learning is a very fundamental topic for psychologists. It plays a central role in every branch of psychology. A psychologist studying perception might ask, “How do we learn that people who look small from a distance are far away, not simply tiny?” A developmental psychologist might inquire, “How do babies learn to distinguish their mothers form other women?” A clinical psychologist might wonder, “Why are some people afraid of frogs?” A social psychologist might ask, “How does a human child learn the etiquettes of his culture?” A psychologist studying animal behaviours might wonder, “How does a dog learn to obey its master, and not strangers?” These questions drawn from different fields of psychology can be answered only with reference to learning process.

What is Learning?

There are two types of definitions: operational and theoretical ***Operational definitions*** describe learning as a product that can be observed and measured. ***Theoretical definitions*** describe learning as a process.

Meaning and Operational Definition

Learning is *a* relatively permanent change in behaviour or behaviour potential produced by experience (Feldman, 1999). ***Kimble (1961) defined learning as a relatively permanent change in behavioral tendency as a result of reinforced practice trials*.** These two definitions share three important features. First, learning brings about a ***relatively permanent change****.* Second, this change is noticed in ***behaviour or behaviour potential****.* Third, learning is produced by ***experience****.* Kimble (1961), in addition, emphasizes ***'reinforced practice'*** *as* an essential component of learning. Let us examine each of these features.

1. A Relatively Permanent Change. To qualify as a learned behaviour, the change must be relatively permanent. Temporary changes in behaviour cannot be called learning. ***Reflexive behaviours*** (for example, an eye blink, a knee jerk) produced by stimulating the nervous system are temporary and therefore, cannot be called as learned behaviors. Temporary changes in behaviour as a result of drinking alcohol, or taking drugs, or being fatigued are not called learning. Upon entering a cinema hall, you will find it difficult to immediately locate seats and the known faces. After about five minutes, you would easily locate seats and people as you adapt to the light condition. Such a change in behaviour is only temporary and is attributed to adaptation, not learning. Learned changes, however, may not last forever; we forget many of the learned behaviours. The critical aspect is that learning always involves memory for what has been learned, so that on subsequent occasions, we can recall or do what we learned before.

2. A Change in Behavior or Behavior Potential: learning is not observed directly, but is inferred from changes in observable behaviour. The observed behaviour is **performance.** Performance provides an index for learning. But all learning may not always be translated into performance. In other words, performance may not always show everything that has been learned. The term '***behaviour potential'*** is very critical to distinguish learning from performance.

Learning may affect your potential for behaving in a particular way in future, if needed. For example, an inspiring lecture may increase your understanding of the Indian history. This understanding is hidden in you in the form of a potentiality. The

potentiality will manifest as performance while writing answers in the examination. Until the examination is held, learning is stored as a potentiality for future performance.

3. A Process Produced by Experience: Learning can take place only through experience. Experience includes taking in information and making responses that affect the environment. Kimble's (1961) concept of practice is related to experience. Without practice and experience, the behaviour would not qualify as being learned. A change in behaviour as a result of illness, or old age or maturation does not include practice or experience. Hence, such changes cannot be attributed to learning.

Some lasting changes in behaviour require a combination of experience and maturational readiness. For a child, the ability to crawl, stand, walk and run follows a specific timetable. No amount of training or experience would produce these behaviours before the child has matured. Thus by including the component of 'practice and experience', learning is distinguished from behavioral changes effected by maturation.

Thus, learning can be said to have taken place, when the three conditions listed above are met. It is not, however, always obvious to the person or the observer that these conditions are present. Learning of a very complex and broad nature, such as loving one's country, or respecting a value system, is very difficult to measure. But all such learning have the three components discussed above.

4. The Concept of Reinforcement. Kimble's definition has an added feature: ***the concept of reinforcement***. For behaviorists, reinforcement is essential for learning. You will learn later that certain forms of learning can take place without reinforcement. Whether or not reinforcement is important for learning has taken the shape of a major debate among psychologists.

It must be emphasized that changes produced by learning are not always positive. People are as likely to acquire bad habits as good ones. All the three conditions of learning apply as well to the acquisition of bad habits. Thus, learning does not necessarily result in the modification of behaviour. An earlier definition of learning, "learning is the modification of behaviour in the light of past experience" is no longer acceptable.

Theoretical Definition

Theoretical definitions describe the underlying mechanisms of learning. They identify 'the nature' of learning. Some of the theoretical definitions are physiological in nature. Hull defined learning in terms of '***receptor-effector***' connections. Bugelski defined learning as the process of formation of relatively permanent neural circuits.

Cognitive psychologists define ***learning as a reorganization of the perceptual, psychological, and behavioral world of the learner***. Kretch and Crutchfield (1948) defined learning as a reorganization of the cognitive field. According to cognitive psychologists, we do not learn a particular response; we learn the relationships between objects, events, concepts, and principles. Through learning, we discover new relations among objects, events, and responses.

Learning versus Maturational Changes

Learning is a process related to (a) change in *behaviour or behaviour potential*, (b) that is *relatively permanent*, and (c) is brought about by *experience/practice*. Learning of a specific nature can take place only when the child is maturationally ready.

Maturation is a process of biological growth and development. ***Maturation is the unfolding of the genetic code***, i.e., biologically predetermined patterns of behaviour. As the human child grows, he undergoes many physical changes. These changes bring associated changes in behaviour. Such changes are the results of maturation, not learning. To be able to crawl, sit, stand, and walk are mostly the results of maturation. But learning to crawl on a path, to sit on a fence, to walk on a rope, and to talk eloquently are acquired through practice and experience. Hence, such behavioral changes are attributed to learning.

It is difficult to separate the influence of maturation and learning, as most of our behaviours are combined products of both learning and maturation. Both interact in producing behavioral changes. **Maturation provides a necessary, but not a sufficient condition for learning to occur**. Similarly, learning also helps in accelerating the maturational process. Without training and experience, the maturational process will be stunted.

Let us take an example to explain the interacting nature of learning and maturation. A 7-8 year old child is not maturationally ready to carry on formal abstract thinking. Even if, expert instructors give him extensive training on Grade 10 geometry, he would hardly benefit. If he is given the same instruction at 13-15 years of age, he will be benefited, as he would be maturationally ready by then. But maturation alone, without necessary instructions, will not help him. A 5-6 year old is matured enough to read and write, which of course, he will not be able to do without training. Training imparted when the child is maturationally ready results in learning.

Learning also helps the maturational process. As a 4-year old learns to write alphabets, his muscular coordination matures. As a result, his handwriting looks better. Both maturation and learning are so intimately connected that it is difficult to examine the influence of one independent of the other.

Research has shown that the age range of 4-5 years is developmentally appropriate for teaching handwriting. Teaching handwriting to children before they are maturationally ready may result in faulty muscular coordination, and later on, in poor handwriting. Similarly toilet training given before 2 years of age is of little consequence, as the child is not maturationally ready to take in the experience. These examples show that maturation is important for learning.

When the child is maturationally ready, his learning depends upon the opportunity for practice and experience, his interest and motivation. Training before an appropriate maturational stage may result in frustration and withdrawal of interest from learning of a skill. Parents and teachers should ensure maturational readiness on the part of the learner before they attempt to teach him any new form of mental or physical skill.

Learning versus Performance

The definition given earlier states that learning brings a relatively permanent change in behavior or behavior potentiality. Changes in observable behaviors suggest that some amount of learning has taken place, but all forms of learning at all times may not be manifested in the form of a behavior that can be observed, **performance is the observable manifestation of learning**. For example, the riding of a bicycle or driving a car is a performance indicator of the fact that learning has taken place.

The learning may not always be witnessed as performance. Suppose you listen to a lecture or read a book or read a map to plan your route for driving from one city to another. After listening to a lecture, we do not observe measurable changes in your behavior. You are observably the same now as you were before listening to the lecture. In other words, there is no change in your performance, because you have not been given a chance to perform. But, does it mean that learning has not taken place? Obviously, the learning of some internal nature has taken place. As a result of the lecture, some changes have occurred within you both physiologically and psychologically. The lecture has left its impression in you in the form of neural traces, and has changed some aspects of your knowledge. These changes, either neural or psychological, are lying hidden within you in the form of potentialities to behave differently, when needed. While performance always refers to overt behaviors, learning may be overt or covert.

Consulting a road map in one's home to plan a trip results in learning, which is not converted to performance immediately. It waits until the right situation comes, that is, when you actually execute your plan of driving from one city to another. Your actual driving is performance. Even before this performance, learning has taken place, and has been available to the person as a behavior potentiality. While performance is a change in behavior, learning is a change in both behavior and behavior potentiality. **Performance is not possible without learning, and all learning would go waste, if they were not translated into performance, as and when needed.**

Processes of Learning

Learning is a key process in human behaviour. It plays a very significant role in every activity from a simple response of buttoning your shirt to a very complex response of policy making for the nation. Psychologists have tried to explain our varied experiences of learning with a few basic processes. We respond to things that happen to us (e.g.. being afraid of dogs after a dog bite); we act and experience the consequences of our behaviour (e.g., rewarded for securing the top position in the state), and form mental representations by observing what others say and do (e.g., imitating the actions of the person whom we like and respect). These three basic aspects of our experience form three main fundamental types of learning: *classical conditioning* (responding), *operant or instrumental conditioning* (acting), and *cognitive*

learning, which includes *observational learning* and *insightful learning.* The trial-and-error learning is a precursor to and a form of instrumental conditioning. The insightful learning is a form of cognitive learning, which emphasizes the internal processes operating within the organism. Early approaches to learning investigated the connection between stimulus and response without referring to cognitive or mental processes. In recent years, psychologists have emphasized how cognitive processes mediate the connection between stimulus and response. Both insightful and observational learning come under cognitive-social approaches to learning

Trial and Error Learning

E. L. Thorndike

The experimental study of animal learning by E. L. Thorndike (1874-1949) in the United States and his theory on trial-and-error learning provided the impetus for Skinner's experiments on instrumental or operant conditioning, which will be discussed later. Thorndike's doctoral research on '*Animal Intelligence'* in 1898 provided the psychological world the first miniature system of learning known as trial-and-error learning. His theory left a profound effect on American psychology then. It also continues to exercise its influence on contemporary psychological theorizing.

Thorndike's research was indirectly influenced by Darwin's theory of evolution. Darwin demonstrated that there is continuity in the bodily structures of many different species. This evidence favored Darwin's doctrine of evolution. What about continuity in the ability to think and reason? Can animals think, understand, and reason like human beings, although at a simpler level? The critics of Darwin argued that the essential difference between humans and beasts is that humans can think and reason, which animals are not capable of doing. Thorndike's research on animals (cats, dogs, fishes, chicks, and moneys) showed that learning is a matter of connecting responses to stimuli in a very mechanical way. There is no involvement of consciousness, thinking, reasoning or understanding. The animal performs responses mechanically. The responses that bring reward are learned; the responses that do not bring reward are

not learned. The animal does not show ability to understand, think, and reason. The animal learns mechanically through trial-and-error.

Indeed many forms of human learning, particularly the learning of sensory-motor skills, are achieved through trial-and-error. Learning to walk, to swim, or to ride a bicycle is based on trial-and-error. At the beginning, we make wrong movements and commit errors. As we go through a series of practice trials, errors are reduced and responses are mastered. ***The gradual reduction of errors over trials gives the name, trial-and-error form of learning***.

Thorndike's Experiments on Cats

Thorndike experimented on a variety of animals like cats, fishes, chicks and monkeys. His classic experiment used a hungry cat as the subject, a piece of fish as the reward, and a puzzle box as the instrument for studying trial-and-error learning. One of the typical puzzle boxes used by Thorndike is illustrated in Figure 5.1

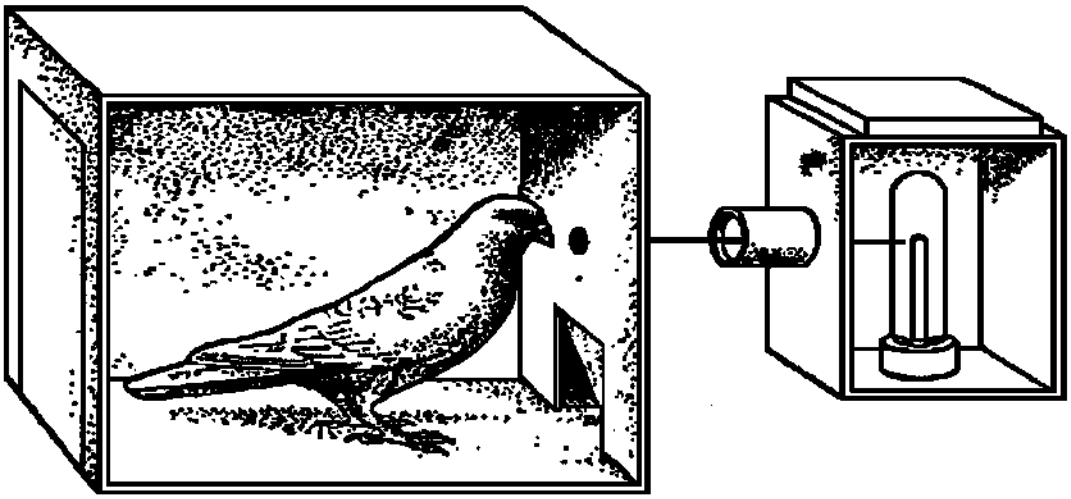


Figure 5.1 A typical Puzzle box used by Thorndike's Experiments on cats

In this typical experiment, a hungry cat was placed inside the puzzle box, and a piece of fish was kept outside the box. The cat could not reach the fish unless it opened the door. In order to escape from the box, the cat had to perform a simple action as required by the experimenter. The cat had to pull a loop or press a lever in order to open the door. Once the door was opened, the cat could escape and eat the fish.

What did the hungry cat do inside Thorndike's puzzle box? Initially it made random movements and ineffective responses. On the first trial, the cat struggled valiantly; it clawed at the bars, it bit; it thrust its paws out through any opening; it squeezed itself through the bars; it struck out in all directions. All the irrelevant responses continued for several minutes until the cat hit upon the correct response, by chance.

Accidentally, it pulled the loop and the door opened. The cat came out of the box and was allowed to take a small part of the fish. It was then put inside the puzzle box for the second trial.

In the second trial, the time taken to pull the loop reduced a bit. Every time the cat came out of the box and took a piece of fish, Thorndike put the cat inside the box again. Thorndike and the cat kept up this exercise for a while. With increasing trials, the time taken to pull the loop (response latency) decreased. The wrong responses (errors) that the cat was showing also decreased, as trials increased. Finally the cat learned the trick. As soon as it was put in the box, it pulled the loop to escape for a well-deserved reward. The name, trial-and-error learning comes from the fact that errors decreased over trials. The cat learned from its errors.

How did the animal learn? To answer this, Thorndike plotted the time taken on each trial by the cat to show the correct response (i.e., pulling the loop) (Figure 5.2). The plot indicated that there was a gradual decline in the response latency. If the animal would have shown some understanding of the requirements to reach the fish, the curve should have registered a sudden drop at some point. This did not happen. The declining nature of the curve suggested that the animal had no understanding of the situation; it was only performing some responses, one of which was getting mechanically connected with the stimulus situation. Thorndike concluded that animals do not learn through thinking, understanding and reasoning. This view also received a second line of support, when Thorndike failed to teach cats to pull the loop for opening the door. He held cats' paw over the loop, pulling it for them. If cats had understanding, they should find their way out in the box, particularly after Thorndike had taught them the method. It means that the animal cannot learn without acting. It has to make its responses to the situation. The findings suggest that the cat did hot have understanding of the solution. Thorndike explained cat's learning by the '**Law of Effect'**.

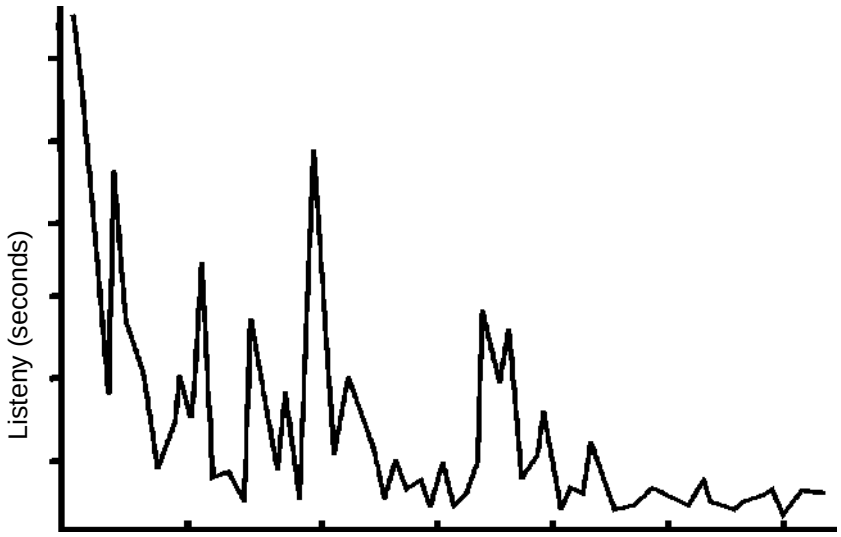


Figure 5.2 Learning curve of Thorndike's cat

Thorndike conducted similar experiments with other animals and obtained similar results. He said that the animal does not learn a new response; it only selects a response from its stock. All the responses that the cat showed in Thorndike's puzzle box were in animal's stock of responses. Only one response led to animal's satisfaction of obtaining a piece of fish. As a result, this response was selected from the stock automatically. The connection between this response and the stimulus situation got strengthened over trials. Very simply, **the 'Law of Effect' derives its name from the fact that whether a response would be strengthened or weakened depends upon the effect of the response**.

Stages in Trial-and-Error Learning

The trial-and-error learning proceeds in the following sequence.

1. A hungry animal is placed in a new situation. The ***hunger drive creates the need to obtain food***, and pushes the organism into action.

2. ***The organism exhibits a set of natural responses*** (clawing, biting, pushing and pulling) to seek adjustment with the new situation.

3. Accidentally, ***one of the responses from the organism's stock of responses turns out to be the correct response*** in helping it to reach the goal.

4. The successful response is reinforced and hence selected for further practice. The unsuccessful responses are gradually weakened and stamped out. ***The successful response is strengthened and therefore, stamped in.***

5. Gradually, ***the amount of time taken to exhibit the correct response (response latency) and the number of errors are reduced***. The successful response is practiced time and again.

6. Finally the successful response is strongly connected with the stimulus situation so that its probability of occurrence increases. ***A definite S-R connection takes place and becomes relatively permanent***. This is how learning takes place through trial-and-error.

Thorndike's Laws of Learning

Thorndike's consistent findings with various animal species led him to formulate some fundamental laws of learning which are explained below.

Law of Effect. This law concerns the role of reward in learning. ***It is known as the Law of Effect, because whether a response would be stamped in or stamped out depends upon the effect such a response produces***. If a response produces 'satisfaction', it will be strengthened, and is more likely to be repeated in the same situation. On the other hand, if a response produces 'discomfort', or 'annoyance' it will be weakened and is less likely to reappear. The greater the satisfaction, the greater the strengthening of the response. Similarly, the greater the discomfort, the greater the weakening of the response.

Thorndike explains the term 'satisfaction' and 'discomfort' in the following way. A state of affairs is said to bring satisfaction, if the organism does nothing to avoid it, but tends to attain and preserve it. A state of affairs is said to bring 'discomfort' or 'annoyance', if the organism tends to avoid it, and does nothing to preserve it. ***A satisfier is one, which the animal likes to obtain; a discomforter is one, which the animal likes to avoid.***

Many forms of human learning also obey the Law of Effect. When a child shows behaviour to the satisfaction of his parents, they approve of it. Parental approval serves as a reward for the child and gives him satisfaction. As a result, the child tends to repeat the same behaviour on a later occasion. On the other hand, if a particular behaviour of the child is disapproved, it gradually weakens. The child tends not to repeat the same behaviour again.

In Thorndike's experiment, the response of pulling the loop brought satisfaction to the animal. This response was strengthened and was repeated time and again. On the other hand, the random responses like clawing and biting brought discomfort and were weakened. The correct response appeared again and again while wrong responses gradually reduced, and finally disappeared.

The original form of the Law of Effect was known as the Symmetrical Law of Effect, because it proposed that the positive and the negative consequences are equal but opposite in their effects. But Thorndike's further research convinced him that ***discomforting affairs do not directly weaken the S-R connection***. As a result, in 1932 he had to abandon the second half of the Law of Effect. This modified version was known as the truncated Law of Effect. Thorndike still maintained that punishment carries some indirect value in the sense that it causes '**shift to right behaviour'** for which there is a reward. For example, when parents punish the TV-watching behaviour of children, the response of TV-watching is not weakened; it is only suppressed for a while, and is likely to reappear when parents are absent.

The Law of effect was also criticized on other grounds. All along, Thorndike's emphasis was on response connections, but he used terms like 'satisfaction' and 'annoyance', which only denote mental states, and are subjective. Secondly, how can the Law of Effect work in a backward manner? The response is rewarded only after it is executed. How can the reward go backward in its effect and strengthen responses that precede it. Finally, how do we know which are 'satisfiers' or 'annoyers'? It will be identified as a satisfier, if it strengthens the response. Then the question is: How is a response strengthened? A response is strengthened if it is followed by a satisfier. As you-may notice, Thorndike's explanation is circular in nature.

Law of Exercise. This law concerns the ***role of practice in learning***. It states that the strength with which a response will be connected with a situation depends

upon the number of times the response has occurred in that situation. In other words, if a response is practiced for a certain number of times, it will tend to be permanently established. Any repeated response gathers some strength. As a result, it becomes easier to repeat it again. Practice will result in strengthening of connections; its discontinuance will result in weakening of connections leading to forgetting.

The Law of Exercise operates only in conjunction with the Law of Effect. Practice alone will not strengthen connections; it only provides opportunity for reward to occur more frequently to strengthen connections. In a real experiment, incorrect responses occur more frequently and correct responses occur only once per trial. But only correct response, whenever it occurs, brings reward. So its connection with the situation is strengthened in proportion to the number of times it occurs. Thorndike verified this by means of a simple experiment. Students were asked to draw a 3-inch line while blindfolded. Some subjects were given one thousand trials. But their performance did not improve, as they did not get any feedback. So the Law of Exercise does not operate in isolation from the Law of Effect.

Law of Readiness. Law of readiness refers to ***a preparatory set on the part of the organism to learn***. It points out that ***one learns only when he is physically and mentally ready for it***. In other words, preparatory set on the part of the organism is an important condition for learning. When the organism is prepared to do some work, then the act of doing is satisfying, and not doing it is annoying. Conversely, when he does not want to work, forcing him to work is dissatisfying. If students are not willing to learn, forcing them to learn will cause dissatisfaction and annoyance. Many children soon get disinterested in learning, because they are forced to learn, when they are not physically and mentally ready for it.

In addition to these three primary laws, Thorndike developed some subsidiary laws. They are explained below.

Law of Multiple Responses. *It states that when one response does not bring satisfaction, it will initiate a new response*. For this reason, the animal goes on producing responses until some response brings satisfaction. The cat in Thorndike's puzzle box claws, bites and pushes until it pulls the loop to open the door. The cat, thus, unfolds its stock of responses and tries out one response after another. If one

response fails, and the animal sits passively, it would die of starvation. The release of multiple responses has an adaptive significance as it ensures organism's survival.

Law of Selective Responses. It states that *as learning proceeds, the animal selectively responds to certain elements of the stimulus situation, and ignores others*. The phenomenon is closely akin to discrimination. As trials proceed, the cat inside the puzzle box attends to the general area of the door, the loop, and the string. Unless the animal responds to some selected aspects of the puzzle box, it would never learn the escape route.

Law of Set or Disposition. It is related to the concept of drive or motivation. *The cat's disposition to learn is created by keeping the cat hungry*. The hunger drive initiates responses to be learned. A hungry cat would only make attempts to get out of the box. If it were well fed, it would rather prefer to rest than respond.

Law of Response by Analogy. It is a principle of transfer. How does learning in one situation is transferred to another situation? Thorndike explains '***transfer***' by means of '***theory of identical elements***'. The theory states that *transfer will occur if and only if there are elements in common between the two learning situations*. The cat, which has learned to pull the loop in one puzzle box, can show the same or a similar response in another puzzle box, provided that the two boxes share some common identical elements. If the new box would be entirely a different one, transfer will not take place.

Law of Associative Shifting. Associative shifting is similar to conditioning. *Responses learned to one stimulus condition may be learned to another stimulus condition, if the overall situation is not altered*. Pavlovian conditioning principle is similar to associative shifting. In Pavlovian conditioning, the dog that salivates in the presence of food learns gradually to salivate in the presence of bell. This is associative shifting.

Law of Belongingness. It states that *the reward or punishment to be maximally effective must be relevant to the situation*. Mere contiguity between the stimulus and the response would not ensure the effectiveness of the reward. While reading a paragraph, the last word of a sentence, and the first-word of the next sentence share physical proximity, but their association would be poor. For example, consider the following two sentences: 'Ramesh spoke loudly', 'Suneet went home'. The association

strength of the pair, 'Suneet-went' is more than that of the pair 'loudly-Suneet', though both pairs have same degree of physical proximity. Hence the first pair would be better remembered than the second pair, according to the Law of Belongingness.

Law of Spread-of-Effect. The principle states that *reward strengthens not only the response to which it belongs, but also the responses adjacent (after or before) to the rewarded response*. It gives rise to a gradient effect. The effect of reward is maximal for the rewarded response. Then its effect decreases for each step that a response is removed from the rewarded one. Because of temporal proximity, reward may even strengthen adjacent punished connections. If a response sequence, R_1-R_2-R_3-R_4-R_5 brings reward S, S-R_5 connection will obviously be strengthened. At the same time, the S would also strengthen the responses R_1 R_2, R_3, R_4 such that S-R_4> S-R_3> S-R_2>S-R_1.

Thorndike's laws and principles laid the groundwork for modern learning theories. Whatever may be the ultimate status of his theory, Thorndike surely carried a systematic study of animal learning for the first time. His work influenced the experiments on instrumental conditioning by B.F. Skinner. His investigation was systematic, experimentation sound, and explanations clear. The Law of Effect even rules the contemporary psychological theorizing.

Classical Conditioning

How Classical Conditioning Works: Pavlovian Experiment

The principle of **classical conditioning** was discovered by the Russian physiologist, **I. P. Pavlov** (1849-1936), while he was investigating the way the body digests food. Pavlov won Nobel Prize for his work on digestive system. Yet he is remembered not for his physiological research, but for his experiments on the basic learning processes.

Pavlov was studying secretion of stomach acids and salivation in dogs in response to varying amounts of food. He implanted a tube in dog's salivary gland in order to measure the amount of saliva secreted by the dog. While doing so, he observed a very curious phenomenon. One day, as Pavlov approached the dog with a tray of powdered meat, the dog began to salivate. Pavlov (1927) wondered, "Why did the dog salivate before eating the meat powder?" Pavlov thought that salivation at the

sight of the meat powder was the result of learning or as it came to be called, classical conditioning. In classical conditioning, an organism learns to respond to a neutral stimulus that normally does not bring about that response.

I. P. Pavlov

Pavlov's curiosity prompted him to begin formal experimentation (Pavlov, 1927). A hungry dog was made to stand on a pedestal in a sound proof room. A tube was attached to the salivary gland of the dog to precisely measure the amount of salivation. He sounded a bell, and just a few seconds later, presented the dog with meat powder. In response to the sound of the bell, the dog pricked its ears and made some exploratory movements. When the food was presented, the dog salivated and ate the food. The pairing of the bell and food was repeated for several trials with exactly the same amount of time elapsing between the presentation of the bell and food (see Figure 5.3 to observe Pavlov's experimental apparatus).

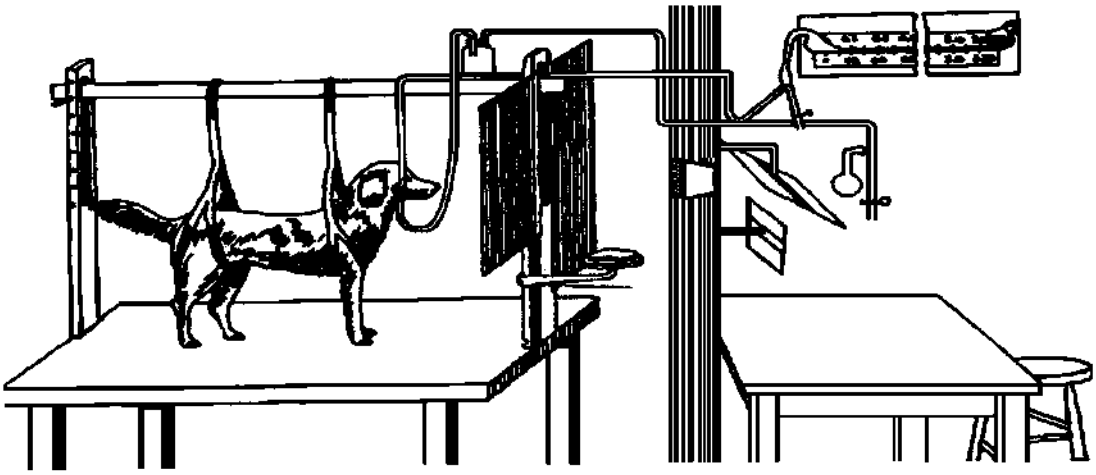


Figure 5.3 Pavlov's apparatus for studying classical conditioning

At first, the dog was salivating only to the food. But as the trials proceeded, the dog began to salivate at the sound of the bell. Even when Pavlov stopped presenting

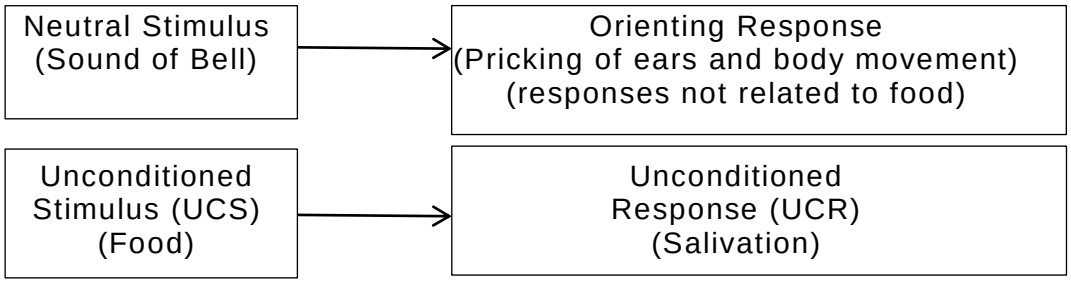
food, the dog still salivated after hearing the sound. Salivation is a natural biological response to food. There is no natural connection between the sound of the bell and salivation. Because bell and food repeatedly came together in the experiment, bell acquired the potentiality of evoking salivation. A new learning took place. In course of the experiment, the dog learnt to associate the response of salivation to the sound of the bell. The dog had been classically conditioned to salivate to the bell. ***Classical conditioning involves establishing a connection between a stimulus (bell) and a response (salivation), which are not naturally linked.***

Classical Conditioning Procedure

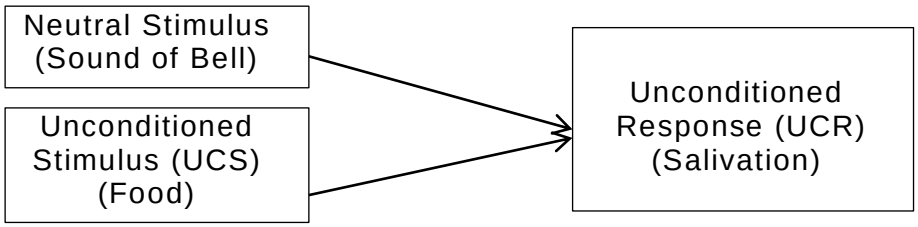
The main features of the classical conditioning procedure are illustrated in Figure 5.4. A new set of terminology grew with Pavlovian experiment. Consider the diagram in Figure 5.4. Before conditioning, the bell and the food are unrelated stimuli. Before conditioning, the bell is considered as a neutral stimulus, because it has no effect on the response of interest (salivation). It only generates certain orienting responses on the part of the dog, like pricking of ears and making minor body movements, Food is considered an **Unconditioned Stimulus (UCS),** because it naturally evokes salivation, which is an unlearned behaviour. The salivation caused by food is not associated with any previous learning. Hence salivation in response to food is called an **Unconditioned Response (UCR).**

Figure 5.4b illustrates what happens during conditioning. During conditioning, the bell is sounded just before the presentation of food. The goal of conditioning is that the bell should get associated with food and therefore, should bring about the same kind of response (salivation) as food does. During this phase, the amount of salivation gradually increases each time the bell is sounded. Finally, when conditioning is complete, the bell alone is capable of evoking salivation. The bell, which was initially a neutral stimulus, has now acquired the status of a **Conditioned Stimulus (CS).** At this time, salivation in response to bell, the conditioned stimulus, is considered the **Conditioned Response (CR).** Salivation to the bell is a learned response. This situation is depicted in Figure 5.4c. After conditioning, the CS evokes the CR.

a)Before Conditioning:



b)During Conditioning:



c) After Conditioning :

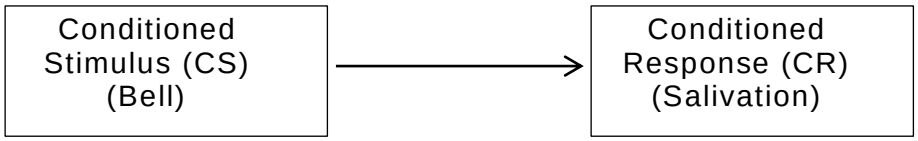


Figure 5. 4 : *Diagram of classical conditioning procedure: (a) Before conditioning, the sound of the bell does not bring salivation, making the bell a neutral stimulus, which only brings some orienting responses. The food, the unconditioned stimulus, naturally brings about salivation, the unconditioned response; (b) During conditioning, the bell is sounded just before food is presented, and the food brings about salivation; (c) After conditioning, the sound of the bell brings about salivation. The bell, which was previously a neutral stimulus, now is considered the conditioned stimulus, to which salivation is conditioned. Salivation is treated as the conditioned response.*

Neutral Stimulus **:** A stimulus that, before the conditioning, has no effect on the desired response.

Unconditioned Stimulus (UCS) **:** A stimulus that naturally evokes a response, without having been learned (e.g., food in classical conditioning).

Unconditioned Response (UCR) : A response that is natural and is produced by the UCS without any training (e.g., salivation at the smell of food).

Conditioned Stimulus (CS) : A once-neutral stimulus, which by being paired with the UCS brings about a response that was formerly caused only by the UCS (e.g., bell evoking salivation).

Conditioned Response (CR) : A response which, after conditioning, is elicited by the previously neutral stimulus (e.g., salivation to the bell).

The following are the essential features of any experiment on classical conditioning.

1. Choose an **unconditioned stimulus (UCS)** that naturally elicits a measurable unconditioned response. If the response elicited by the UCS would not be of measurable quantity, conditioning cannot take place. Because the UCR cannot be associated with the neutral stimulus, the S-R relationship would not be established.
2. Choose a **neutral stimulus** that originally does not evoke the UCR or a response similar to the UCR. In case the neutral stimulus does so, we would not know the difference between the CR and the UCR, and therefore, not know when the conditioning was established.
3. The CS and the UCS must be paired during the course of conditioning. *A time interval of about 0.5 seconds between the CS and the UCS results in better conditioning*. If the CS-UCS interval would be long or both the stimuli would be separated sufficiently in space, conditioning is less likely to take place.
4. Finally, the CS must be presented alone to see if it elicits a response similar to the UCR. If it does not elicit the response, obviously conditioning has not taken place.

Time-Interval Between CS and UCS

The time gap between the CS and the UCS is an important aspect of conditioning process. We can vary the time interval between these two stimuli and generate four types of conditioning procedures as shown in Figure 5.5.

If the CS and the UCS come on at the same time and end at the same time, the procedure is known as **simultaneous conditioning.** In **delayed conditioning,** the CS is presented a little before the UCS and continues along with the UCS for sometime. The CS ends before the UCS stops. Bell is sounded a few seconds before food is presented, the bell continues along with food for some time and then stops before the food is taken away. If the CS starts and stops before the UCS is presented, the procedure is known as **trace conditioning.** Bell comes first and is then taken away; then food is presented. In **backward conditioning,** the UCS is presented before the CS comes on, but continues for sometime with the CS. The presentation of CS and UCS is done in a backward manner. Food comes first; after a while bell comes on.

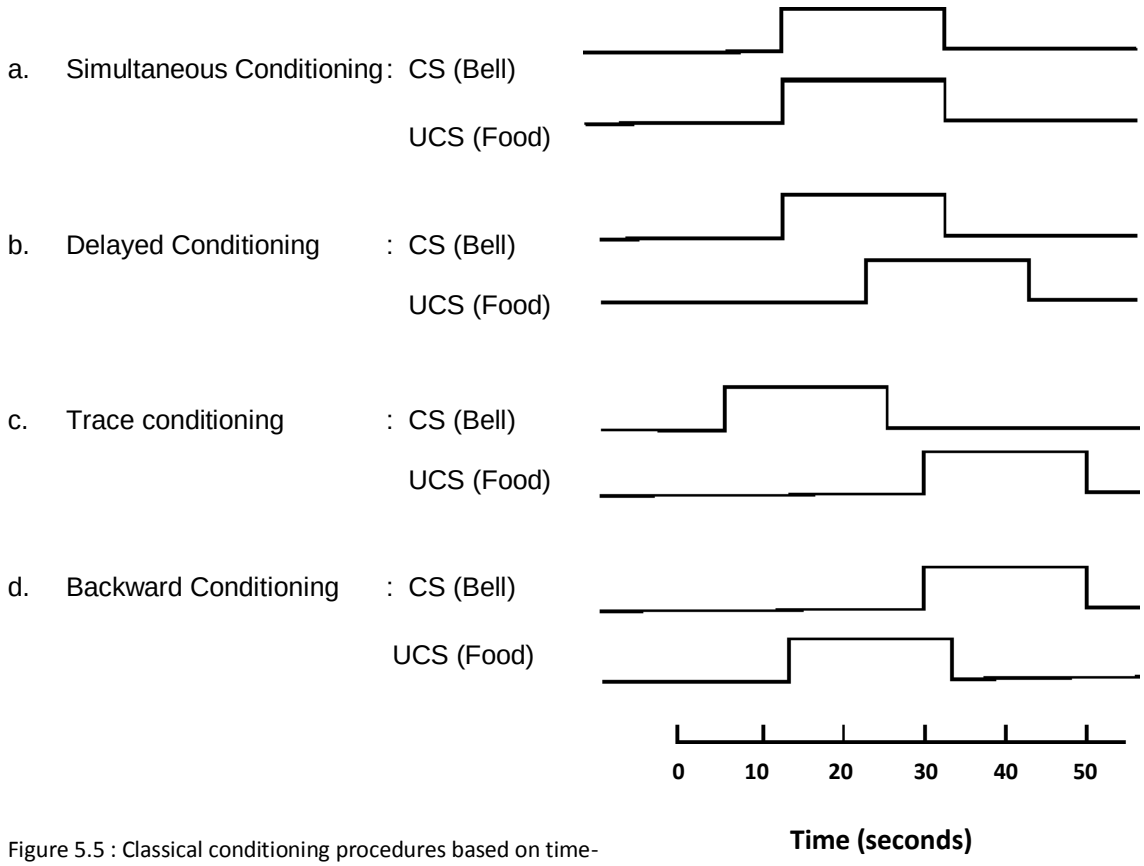


Figure 5.5 : Classical conditioning procedures based on time-interval between the CS and the UCS. (A rise in the line indicates presentation time of the CS or the UCS)

The procedural variations significantly affect the strength of conditioning. **Conditioning is best when the CS precedes the UCS by about half a second**. Hence delayed conditioning is better than the trace conditioning and both yield better results compared to the simultaneous conditioning. The backward conditioning is the worst of all. **As the time interval between the CS and the UCS increases, the strength of conditioning declines**.

How do we make sense of these facts? Pavlov suggested that CS serves a signaling function. The CS signals that UCS is to come, and hence the organism is prepared to receive the UCS. The signaling function of the CS is best served in the delayed and trace procedures, but not in simultaneous and backward procedures. It is clear that in classical conditioning the organism learns something about the relationship between the two stimuli. Hence some theorists regard classical conditioning as a **stimulus-stimulus (S-S) type of learning**.

Basic Processes in Classical Conditioning

Classical conditioning represents an extremely simple form of learning. Since it is very elementary, classical conditioning is regarded as the building block of all forms of learning form simple to the most complex. Some of the basic processes involved in classical conditioning are discussed below.

Acquisition

Each paired presentation of the CS and the UCS is called a trial. ***The period in which the organism learns the association between the CS and the UCS is the acquisition phase*.** With each passing trial, the CS becomes potentially stronger to elicit the CR. Panel in Figure 5.6 shows the acquisition phase of a hypothetical experiment. Presenting UCS with the CS during the acquisition phase is a critical operation in classical conditioning. The UCS serves as a reinforcer, as it reinforces the connection. Trials on which UCS occurs are called **reinforced** trials; trials on which UCS is omitted are called **un-reinforced** trials. It may be seen in the panel of Figure 5.6 that at the beginning trials of the acquisition phase, the strength of CR increases rapidly. As the reinforced trials continue, the strength of CR increases but not as rapidly as it used to be in the beginning trials. **The curve of acquisition is negatively accelerated**.

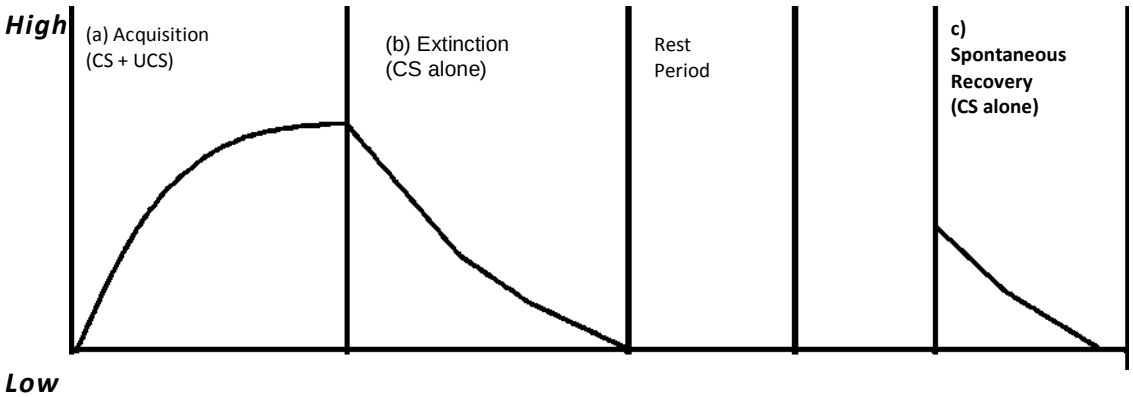


Figure 5. 6: The strength of CR during acquisition, extinction, and spontaneous recovery: (a) During acquisition, when the CS and the UCS are paired, the strength of the CR increases rapidly; (b) During extinction, when the CS is presented alone without UCS following the CS, the strength of CR drops to zero; (c) After a rest period, the CR partially reappears, even when CS is presented alone, without UCS following it. The reappearance of the CR is called spontaneous recovery, which also drops to zero if CS is repeatedly presented without the UCS.

The rate of acquisition during the reinforced trials depends on several factors. The important factors are (a) *the time-interval between the CS and the UCS*, (b) *the intensity of the CS*, (c) *the intensity of the UCS*, and (d) *the reliability of the CS in predicting the onset of the UCS*.

The strength of acquisition is known from several measures: (a) **rate of responding-** the organism responds at a rapid rate, (b) **response magnitude-** the amount of CR increases, (c) latency- the time gap between the presentation of the CS and the occurrence of the CR decreases, and (d) **resistance to extinction-** the CR persists for a long period of time in response to the CS, in the absence of the UCS.

Extinction

If CS is repeated without the UCS, the CR weakens gradually, and then disappears. ***The disappearance of the CR because of non-reinforcement is called extinction,*** or experimental extinction. Figure 5.6b shows the extinction phase of a hypothetical experiment. In Pavlovian experiment, if the bell is presented time and

again without food (reinforcement), the amount of salivation becomes less and less, and finally disappears. Salivation that was conditioned to bell is extinguished. It suggests that once a CR is acquired, it does not stay with the organism forever. When the reinforcement is withdrawn, the CR fails to appear.

Extinction is not forgetting. When the CR drops to zero at the end of the extinction session (Figure 5.6b), it does not mean that the organism has forgotten the response. The CR is only temporarily suppressed because after a rest period, a part of the CR reappears.

Spontaneous Recovery

***Reappearance of an extinguished CR after a rest period is known as spontaneous recovery*.** The CR is partially recovered after a rest period. Figure

Phase	Trial	CS and UCS presentation	Effect
Acquisition	1	CS + UCS (Bell + (Foods)	UCR
	2	CS + UCS	UCR
	16	CS + UCS	UCR
	17	CS (Bell)	CR (Salivation)
Extinction	1	CS (Bell)	CR (Salivation)
	2	CS	CR (reduced)
	9	CS (Bell)	No CR (No Salivation)
Spontaneous Recovery	1	CS (Bell)	CR (Some Salivation)
	2	CS	CR
	5	CS (Bell)	No CR (No Salivation)

Figure 5.7 : A schematic presentation of the sequence of acquisition, extinction, and spontaneous recovery.

5.6c shows the phase of spontaneous recovery of a hypothetical experiment. In Pavlovian experiment after the salivation response was extinguished, the dog was given a rest period for half-an-hour. After the rest period, bell (CS) was presented without food (UCS), following it. Some amount of salivation to bell suddenly reappeared. If the response is successively extinguished when it reappears, spontaneous recovery diminishes. Finally, the CR fails to be shown even following the rest period. This is known as **permanent extinction.**

A schematic presentation of the sequence of acquisition, extinction and spontaneous recovery is given in Figure 5.7

Stimulus Generalization

Once a CR has been conditioned to a particular CS, stimuli similar to the CS may also elicit the response, even if these stimuli have never been paired with the UCS. If conditioning has been established to a high frequency tone, a lower frequency tone may elicit the CR. ***This automatic extension of CR to similar stimuli that have never been associated with the UCS is called stimulus generalization***. A child bitten by a big dog is likely to be afraid of smaller dogs, or all furry animals. The greater is the similarity between the new stimulus and the CS, the greater the degree of generalization. As the stimuli become more and more dissimilar, the intensity of the CR successively diminishes, thus giving rise to a generalization gradient. Figure 5.8 shows the ***stimulus generalization gradient*** of a hypothetical experiment.

The phenomenon of stimulus generalization has a highly functionally adaptive value as it extends the range of learning beyond the original specific experience. **Because of stimulus generalization, a person learns to respond to similar events in similar ways**. If we do not generalize our learning to new, yet similar situations, the world would still remain as a booming buzzing confusion.

Stimulus Discrimination

Discrimination is a process complementary to generalization. **Whereas generalization is reaction to similarities, discrimination is reaction to differences**. ***Discrimination is a process by which an organism learns to respond in one way to a particular stimulus, and in another way to a different stimulus***. Discrimination is established by reinforcing a response to one stimulus and not to another.

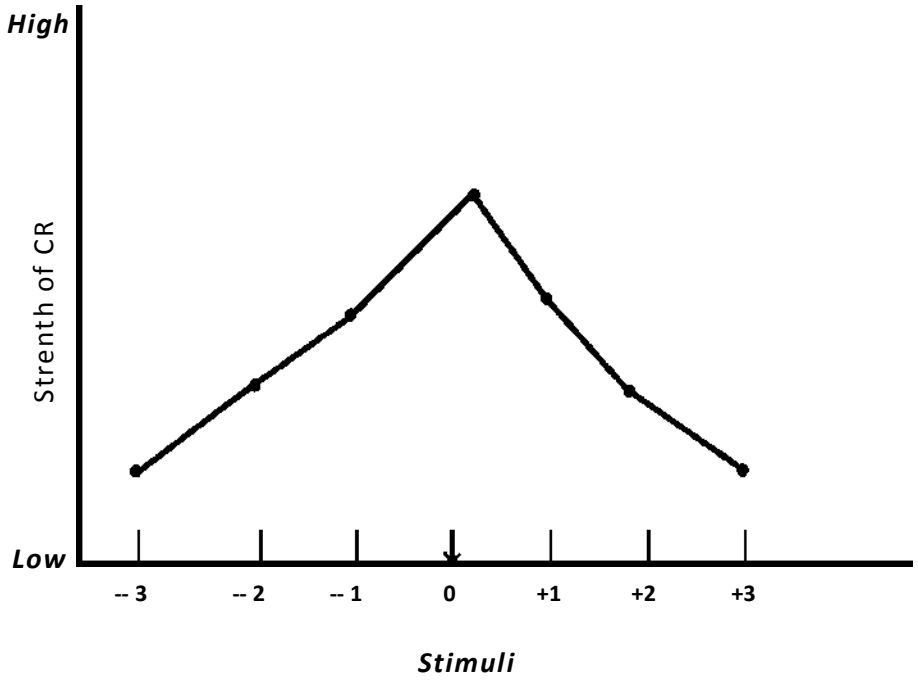


Figure 5. 8: *Stimulus generalization gradient for a hypothetical experiment. Stimulus '0' denotes the CS to which the organism was conditioned. Stimuli +1, +2, and +3 represent stimuli of higher intensity. Stimuli -1, -2, and -3 represent stimuli of lesser intensity The amount of generalization decreases as the difference between the test-stimulus and the CS increases thus giving rise to a* ***stimulus generalization gradient****.*

In an experiment conducted by Pavlov, the dog was conditioned to salivate to a specific tone. The CR generalized to a second tone similar in characteristics to the first one. Then a new experimental procedure began. The first tone (CS) and the second tone (new stimulus) were presented on alternate trials. The first tone was followed by food (reinforcement), and the second was never followed by food (no reinforcement). As a result, the CR to the first tone was maintained, and the generalized response to the second tone underwent extinction. The dog learned to salivate to the first tone and to withhold salivation to the second tone. The dog discriminated between the two stimuli because of differential reinforcement. **Discrimination training is a combination of conditioning and extinction techniques.**

Discrimination, like generalization has an adaptive significance. **Too much generalization is being over-responsive, while too much discrimination is being**

over-selective. The balancing act between these two counter-acting tendencies results in optimum adaptation. Ideally, conditioning is a process in which discrimination ultimately wins over generalization.

External Inhibition

In course of his experiment, Pavlov observed that if a new stimulus is presented along with the CS during the acquisition phase, the strength of CR is reduced. As the conditioning was in progress, Pavlov presented a sudden flash of light along with bell (CS) and found that the amount of salivation decreased. ***The decrement in CR because of the sudden appearance of a novel stimulus along with the CS in the acquisition phase is known as external inhibition***. The novel stimulus is the external inhibitor.

Higher-order Conditioning

A conditioned stimulus, after having acquired the ability to elicit CR may be used as a UCS for further conditioning. This phenomenon is called higher order conditioning.

In one experiment, Pavlov fist conditioned a dog to salivate to the beat of a metronome with meat powder as the UCS. This was first-order conditioning. The metronome beat acquired reinforcing properties and became capable of evoking CR. In the next phase, Pavlov presented the animal with a black square followed by the metronome beat but without food. Eventually, the sight of the black square produced salivation. Thus a second order conditioning was established. In this manner, Pavlov succeeded in establishing third order conditioning but only when unpleasant stimuli like electric shock was used as the UCS. Food is a **primary reinforcer**. The metronome beat, by being associated with food acquired some reinforcing properties. The metronome beat is regarded as the **secondary reinforcer**.

In most cases, higher order conditioning is fairly weak. The CR in second-order conditioning was about half the strength of the first-order one. Third order conditioning was difficult to establish, while fourth-order conditioning was impossible altogether.

What is Learned During Classical Conditioning?

Stimulus-stimulus connection

Pavlov explained classical conditioning in terms of ***stimulus substitution***. During conditioning, the CS and the UCS are connected together (stimulus-stimulus connection), so that the animal responds to the CS just as it does to the UCS. **CS really comes to substitute for the UCS**. Pavlov believed that when CS and UCS are paired consistently, the center in the brain corresponding to the CS is excited and finally stimulates the center normally aroused by the UCS. The connection between CS and the UCS is established in a mechanical, unthinking, and involuntary way. The animal plays a ***passive role***.

Pavlov's explanation does not include any aspect of thinking, expectation or cognition on the part of the animal. His explanation has weaknesses. If the animal responds to the CS just as it does to the UCS, then the CR and the UCR should be identical. This is not the case because salivation to food (UCR) is richer and thicker than salivation to bell (CR). Other aspects of behaviour to the CS and the UCS are different. Given food, the animal leans forward for the food; given the CS the animal looks as it is expecting the UCS. Thus CR prepares the organism, while UCR actually performs the task for which the organism is prepared. It is thus doubtful that CS becomes a substitute for the UCS. Pavlov's explanations were not acceptable to contemporary psychologists.

Stimulus-Stimulus Expectancy

The contemporary psychologists (Kamin, 1969; Rescorla & Wagner, 1972) offered cognitive explanations for classical conditioning. What is acquired in classical conditioning is ***expectancy***. Given the CS, the organism expects that the UCS would come. ***Instead of working as a substitute for the UCS, the CS signals that UCS would come***. Hence the CR and the UCR would not be exactly the same.

The CS serves as a sign for the UCS. The signal value of the CS depends on its ***information value*** *or* ***predictability for the UCS***. If the CS contains information regarding the oncoming of the UCS, it has a predictive power. The animal would treat CS as a sign for the UCS and would respond accordingly. When CS and UCS are randomly paired, CS does not contain information about the UCS and hence

conditioning would hardly take place. The phenomenon of **blocking** lends support to the notion of S-S expectancy. Suppose a dog is conditioned to tone (CS) with food as the UCS. Further conditioning is done by adding light as a second CS to the tone. If classical conditioning happens because of repeated pairings of the CS and the UCS, then light, as the CS should evoke salivation, when presented alone. In fact, this does not happen. Why? Because the food was already predicted by the tone as the first CS. Light as the new CS did not provide any additional information. Thus in the presence of light, the organism did not expect that the UCS would come.

The cognitive perspective has also weaknesses. Contemporary theorists believe that classical conditioning involves more than forming simple associations. They believe that conditioning involves rich mental imagery and processing of information with regard to physical setting, context, and complexity of the situation (Rescorla, 1988).

Applying Conditioning Principles to Human Behaviour

Pavlov's conditioning with food is an example of appetitive conditioning, where UCS has a positive value for the organism. However, classical conditioning can also take place using painful UCS, such as electric shock. The organism reflexively avoids the painful UCS, and the avoidance response can be conditioned to a neutral stimulus (CS). Because of classical conditioning, we jerk our hands away before they are burned by fire, and we move out of the way of a rapidly approaching truck. We learn the language and emotional reactions through classical conditioning. This simplest form of learning describes many forms of human learning, and carries a great deal of survival value for the individual.

Classical conditioning plays a key role in most of our **emotional behaviours**, particularly in the acquisition of fear. **Phobias** are irrational fears, which many psychologists believe, are caused by classical conditioning. Watson and Rayner, in 1920, conducted an experiment to induce fear of white rats in a little boy named Albert. Initially Albert was not afraid of white rats. He was given a white rat to play with. As he played with it, a loud noise was sounded behind his head. After only seven

John B. Watson

pairings of loud noise (DCS) with white rat (CS), Albert began fearing (CR) the white rat. Albert's fear soon generalized to a rabbit, to dogs and to white furry objects. (It is now considered unethical to conduct such experiments). Probably this phobia (irrational fear) remained with Albert. Watson did not take any steps to remove this fear. Watson is criticized for this unethical experimentation.

Watson explained the acquisition of phobia as a case of classical conditioning. In recent years, however, an alternative explanation has emerged. The alternative explanation is based on **observational learning**. It suggests that phobia results from observing another individual's behaviour to a fearful object. For example, a young boy develops fear for dogs because he observes another child being scared of or bitten by a dog. A person reads about someone being afraid of high places and then develops the fear himself. Still then psychologists believe that there is a classical conditioning component (e.g., memory and imagery) in observational learning.

Classical conditioning is practically useful in reducing and eliminating fears. **Counterconditioning** is helpful for reducing fears. In counter conditioning, the conditioned response of fear is weakened as the fear-provoking stimuli are conditioned to a new response incompatible with the CR (fear). Different forms of counterconditioning are: *implosive therapy, flooding, systematic desensitization,* and *aversion therapy*.

In **implosive therapy,** a person suffering from **phobia**, such as fear of public speaking, is asked to imagine the fearsome situation (CS), while the psychologist assures him that nothing terrible will happen (no UCS). After experiencing the situation in this way without any negative consequences, the person tends to become less fearful (extinction of the CR). The images and thoughts of fearsome situation gradually lose their capacity to elicit emotional reactions.

In **flooding,** a person suffering from phobia, such as fear for high places, is forced to confront the fear-eliciting stimulus without any avenue for escape. For example, the therapist would help the person to walk onto a high place and would keep him there for a while under his careful supervision. Because the person does not experience any harm, he may eventually become less fearful of heights. His conditioned response of fear is gradually extinguished.

In cases, where the fear-provoking thoughts or stimuli are too painful to deal with directly (the person may faint), the procedure of **systematic desensitization** is followed. It is a progressive technique designed to replace fear with a relaxation response. The person is asked to set up a hierarchy of fearful stimuli. Then he is asked to imagine the least fearful stimulus situation while simultaneously relaxing. It continues until the person imagines the most fearful stimulus while at the same time learning to relax. The basic assumption is that fear and relaxation are incompatible. Hence, as relaxation is strengthened, fear is weakened (Wolpe, 1961).

In systematic desensitization, an attempt is made to establish a positive CR (e.g., relaxation) in place of a negative one (e.g., fear). In **aversion therapy,** a negative emotional reaction is established in place of a positive one. For example a person who abuses alcohol or any other drug (CS) may be given an emetic (an UCS that induces vomiting, the UCR) so that each time he takes alcohol, he vomits. Gradually he learns to hate alcohol. Aversion therapy consists of establishing a negative CR (e.g., vomiting) in place of a positive one (e.g., satisfaction resulting from taking alcohol). This technique is useful in treating drug-addicts.

Thus, classical conditioning not only explains many forms of human learning, it also has many practical uses in reducing and eliminating unpleasant emotional reactions and treating the drug addicts.

Operant Conditioning

Classical conditioning is one of the two main forms of simple learning. The other is **instrumental conditioning,** which is also known as **operant conditioning.** When a dog responds (e.g., sitting) to the commands of its master to get some biscuits (reinforcement), the dog has learnt an instrumental response. As a consequence of its response, the dog is rewarded. In other words, dog's response was instrumental in fetching a sought after reward.

On the face of it, there are many similarities between this form of learning and classical conditioning. Compare the example above with Pavlov's dog that has learnt to salivate to bell. In both cases we have a stimulus, which determines whether a response is to be made (the bell and the command of the master). In both cases, response occurs more frequently with training (salivation and sitting in response to

the command of the master). Finally, in both cases, we have reinforcement, which maintains a response (meat powder and dog biscuits).

Despite these similarities, there are also important differences. In instrumental conditioning, reinforcement is given only when the response is made. But in classical conditioning, the UCS is presented irrespective of what the animal does. In classical conditioning the UCS evokes or elicits a natural biological response, on which the organism has little control. But in instrumental learning, the animal emits a voluntary response, which is either strengthened or weakened depending on its positive or negative consequences. Furthermore, in Pavlovian conditioning, the organism learns the relation between two stimuli, the CS and the UCS. Pavlov has called it **S-S learning**. In instrumental learning, the animal has to learn the connection between a stimulus and a response, which is an **S-R type of learning**. The organism performs deliberately to produce a desirable outcome. The term '**operant**' emphasizes this point. The organism operates on its environment to produce some desirable result. Hence, instrumental conditioning is also known as operant conditioning. The similarities and differences between classical and operant conditioning would be discussed in greater detail later. We now turn to early research on the behaviour of cats and rats.

The experimental study of instrumental conditioning began a decade before Pavlov. While Pavlov was studying dogs in Russia, Edward L. Thorndike (1874-1949), an American psychologist was studying cats in puzzle boxes. His brilliant doctoral dissertation on *'Animal Intelligence'* gave American psychology the theory of trial-and error learning and the 'Law of Effect'. His theory has been discussed in detail earlier.

Thorndike put a hungry cat inside a puzzle box, and a piece of fish outside. To escape from the box, the cat had to learn how to open the latch inside the box. At first the cat made a number of ineffective responses. Accidentally, while moving inside the box, the cat happened to pull the loop that opened the door, allowing the cat to come outside and eat the food. The cat was returned to the box. It then made random movements until it pulled the loop for the door to open. On subsequent trials, the cat made fewer and fewer random movements, and more and more correct responses leading to the goal. With increasing trials, errors reduced and the correct response was learned.

Thorndike developed **the Law of Effect, which states that behaviours followed by positive outcomes are strengthened and behaviours followed by negative outcomes are weakened.** It is called Law of Effect, because whether a response would be strengthened or weakened depends upon the effect such a response produces. Thorndike believed that the law of effect operates naturally and automatically as leaves fall off a tree during autumn or as animals breathe to live. Through trial and experience, the animal makes a direct connection between the stimulus (total stimulus situation inside the puzzle box) and the response (motor reaction of pulling the loop). The organism learns an S-R connection.

Thorndike's early research provided the foundation for the advanced work on instrumental conditioning by one of the century's most influential psychologist, **B.F. Skinner**.

Skinner's Experiment

B.F. Skinner (1904-1990) is regarded as one of the most influential psychologists of the twentieth century. He began his experiments on operant conditioning in the 1930s. Thorndike's 'puzzle box' allowed the cat to learn the S-R connection in successive discrete trials. Skinner wanted a better control over the learning situation, which allowed the organism to freely operate in its environment. To do all this, he invented Skinner Box, which is also called the **operant chamber** (Figure 5.9) There is a device in the box which can deliver food pellets into a tray at random. Inside the box, there is a lever which when pressed activates the device for delivering food pellets. A hungry rat is left inside the box. The rat exhibits random activities while exploring the box. Accidentally the rat presses the lever and a pellet of food is delivered. The first time it happens, the rat does not learn the connection between the response of lever pressing and food pellets. Sooner or later, the rat learns that the consequence of lever pressing is positive; lever pressing brings food.

B.F. Skinner

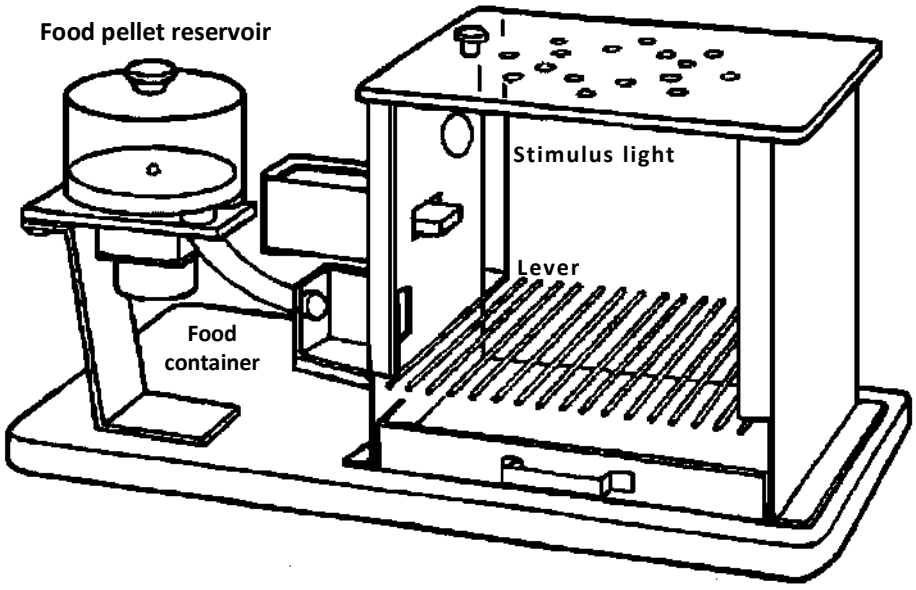


Figure 5.9 : A Skinner Box used to study operant conditioning (often called an operant chamber)

The experimenter counts the number of lever presses. The number of responses within a particular unit of time is called the **rate of response.** Skinner used the rate of response as a measure of learning. The rate of response is recorded and graphically shown by a cumulative recorder.

As rats are trained to press a lever, pigeons are trained to peck at a 'key' to produce positive consequence (Figure 5.10). Pecking the 'key' activates the mechanism of food delivery, which serves as a positive reinforcement. Since lever pressing and 'key' pecking responses are positively reinforced, they increase in frequency. The basic principle in operant conditioning is that the probability of occurrence of a particular response depends on the consequence of the response.

The basic processes of classical conditioning that were discussed earlier holds good for the instrumental conditioning. After the rat has learnt to press the lever, we may dissociate food delivery (positive reinforcement) from the lever pressing response. If the rat now presses the lever, but does not get food, the response rate would gradually decrease, and finally disappear. The disappearance of response because of non-reinforcement is extinction. If a rest period is given, the response will reappear

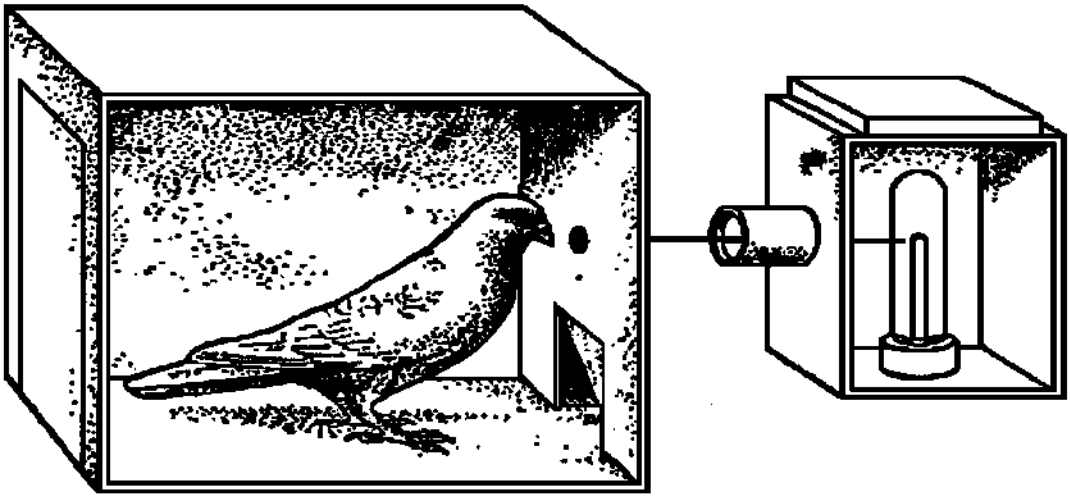


Figure 5.10 : A key-pecking apparatus for pigeons. The pigeon is reinforced for pecking the key

with a lowered strength, which is known as spontaneous recovery. Similarly the phenomena of generalization and discrimination are also observed in operant conditioning.

Strengthening or Weakening the Response Probability

The probability of a response depends on the consequence that follows it. Psychologists generally agree that these probabilities are determined by four basic procedures, **two of which strengthen the rate of response, and two of which weaken the response**. Procedures that strengthen behaviours or responses are termed reinforcement, while those that suppress behaviours are termed punishment.

The stimulus event, which increases the probability that behaviour will reoccur, is called a **reinforcer** (or reward). The impact or consequence generated by a reinforcer is called **reinforcement**. By contrast, the punisher is a stimulus event that decreases the probability that behaviour will reoccur. The impact of punisher is **punishment**. If someone smiles at you, when you are talking with him, you continue the talk, because smile has reinforced your talking response. However, if someone frowns at you while talking, you discontinue the talk, because frowning has punished your talking with the individual.

Organism obtains reinforcement in two ways: (a) ***by obtaining a pleasant stimulus***, and (b) by ***avoiding a painful stimulus***. There are two types of reinforcement, positive reinforcement and negative reinforcement. In **positive reinforcement**, the probability of a response increases, because it is followed by a pleasant stimulus. In **negative reinforcement**, the response probability increases, because the response removes an unpleasant stimulus. When you continue talking with a person because he smiles at you, it is an example of positive reinforcement. We close doors and windows to prevent loud noise outside, which is an unpleasant aversive stimulus. This is an example of negative reinforcement. If a father constantly nags at the son to clean his own room, the son gets tired of father's nagging and cleans the room. The response (cleaning the room) removed the unpleasant stimulus (father's nagging). Torturing the criminals also works the same way. The policemen inflict torture (an aversive stimulus) on the criminal to extract truth. The criminal is more likely to tell the truth so as to avoid the unpleasant stimulus. These are examples of negative reinforcement.

To repeat, **the positive and negative reinforcements are procedures that increase or strengthen behaviours**. In contrast, the two procedures that decrease or weaken the behaviours are **punishment** and **omission training**. ***Punishers are aversive stimulus events, which follow a response and therefore weaken that response***. Punishment refers to the impact of punishers. Punishment is more likely to be confused with negative reinforcement since both involve an aversive stimulus that the individual likes to avoid or escape from. ***Remember that negative reinforcement increases the response probability whereas punishment decreases the response probability***. When an alcoholic takes liquor to reduce an uncomfortable experience, the rate of drinking behaviour is increased. Reduction of uncomfortable experience is a negative reinforcer. But if drinking behaviour results in a harmful accident, the rate of drinking behaviour decreases. Meeting an accident is a punisher. Table 5.1 provides an overview of the distinctions between positive reinforcement, negative reinforcement, punishment and omission training.

Omission training is the term used to describe the weakening of a response because something pleasurable is removed/terminated. Parents sometimes withdraw the privileges from the teenagers to decrease the rate of their undesirable behaviours.

For example, parents do not provide access to the family vehicle, when children spend longer time with their friends outside at the cost of their study. The basic aspects of omission training are summarized in Table 5.1.

Table 5.1: ***Positive Reinforcement, Negative Reinforcement, Punishment and Omission Training.***

Process	*Type of Stimulus*	*Effects on Response*	*Behavioral outcome*	*Example*
1)	(2)	(3)	(4)	(5)
Positive Reinforcement	Pleasant (e.g., food, pleasure, praise)	Strengthens	Organism learns to show responses that produce positive reinforcement.	An individual invests more money in business after making a good deal of profit.
Negative Reinforcement	Unpleasant / Aversive (e.g., electric shock, rebuke, too much cold)	Strengthens	Organism learns to show responses that help him to escape from negative reinforcers.	Father rebukes you for not keeping the room clean. You clean it to avoid father's anger and rebuke.
Punishment	Unpleasant / Aversive	Weakens	Organism learns to suppress the d response to avoid unpleasant consequences	An individual does not invest money in business after meeting frequent losses.
Omission Training	Pleasant	Weakens	Organism learns to suppress the response that leads to the removal of pleasant consequences.	The teenager reduces the time spent with his friends to avail / access the family vehicle during holidays.

Operant Conditioning: Some Basic Aspects

The important features that determine the effectiveness of operant conditioning in controlling behaviour are: (a) *time interval*, (b) *shaping and chaining*, (c) *primary and secondary reinforcement*, (d) *schedules of reinforcement*, and (e) phenomena of *extinction, generalization* and *discrimination*. We shall consider each of these features.

Time Interval

As with classical conditioning, the time interval between the response and the stimulus should be short rather than long. Shorter the interval between the response and its consequence (the stimulus event), the more efficient is operant learning. If the reinforcement/punishment immediately follows the response, learning is more quick and efficient. Delayed reinforcement/ punishment retards learning. But, why? Because delay in consequence allows other responses to occur during the same period and are likely to be reinforced at the cost of our target response.

Shaping and Chaining

The lever-pressing response by the rat and the pecking response by the pigeons are very simple responses that these animals naturally emit. But how can behaviours (e.g., the monkey riding a bicycle in the circus) that are not spontaneously emitted be learned? They are learned by a process termed as **'*shaping*'. Shaping is based on the principle that a little learning can lead to final mastery**. In shaping, each small step that the organism makes to reach the goal is reinforced, rather than only the final response. This is done by the **method of successive approximations.** At first, actions that are faintly similar to the target behaviour are reinforced. The organism learns to show responses that closely approximate the target behaviour. When a baby child emits the sound 'mmmuuhh', the parents immediately pour out affection on the child. Initially, the family attends enthusiastically to any sound that the child makes. Gradually, they only respond to and reinforce the child's utterances that closely resemble the actual words. Shaping involves constructing a complex behaviour by the method of successive approximations.

To reach a complex sequence of behaviours, shaping is combined with ***'chaining'***. **In chaining, the trainer establishes a chain of responses, the last of which leads to reward**. After the last response is learned, the next-to-last one is

reinforced and so on. Shaping and chaining have important implications for human behaviour.

Animal trainers use both shaping and chaining to teach complex chains of behaviour to animals. Two psychologists, Keller and Breland used shaping and chaining to teach pigs deposit silver coins into a 'piggy' bank, and chickens to distribute prizes to waiting customers. But how long these tricks work? There are biological constraints on instrumental conditioning. For Keller and Breland, as time went on, the pigs began to throw coins into the ground instead of making deposits in the 'piggy' bank. The animals returned to their natural form of behaviour, which Breland termed as **instinctive drift.** While the power of reinforcers and punishers are great, natural tendencies are also important in influencing the course of operant conditioning.

Primary and Secondary Reinforcement

Positive reinforcement can be ***primary*** or ***secondary*** (conditioned) reinforcement. **The primary reinforcers satisfy our innate biological need**. The organism does not require training to respond to them. Examples are food for the hungry, water for the thirsty, sexual satisfaction for the adolescent.

Secondary reinforcers acquire their capacity to work as positive reinforcers by being associated with the primary reinforcer. They are also called **conditioned reinforcers** as their reinforcing status is established through conditioning. Examples are social reinforcers such as praise, smiles, welcome message, money etc. When a dancer is praised or given Rs.1000 for her excellent performance, the probability that she will dance well in future is increased. Money often is referred to as a token reinforcer, because money can be exchanged for food, which has biologically reinforcing value.

Both primary and secondary reinforcers for one person in one situation may not act as a reinforcer for another person in another context. For example, food will serve as positive reinforcer when you are hungry, but not when you are sick or have taken a large meal. Rupees 1000 for an amateur dancer may serve as a secondary reinforcer, but not for an accomplished artist. Thus, the reinforcing value of a stimulus has to be judged with reference to the individual and the context of its application. Stimuli, in and of them do not carry reinforcing value.

Schedules of Reinforcement

In most of life's experiences, we are not reinforced every time we make the response. For example, a smile may not evoke a smile in others always; a footballer does not win every tournament he enters into; a student is not patted at the back every time he receives Grade A. In many real life instances, reinforcement comes on and goes off unpredictably. In many other instances, reinforcements are delivered according to rules. We receive salary every month and the new vehicles receive free service according to rules. How do these rules - known as ***schedules of reinforcement*** - affect behaviour?

The reinforcement may be continuous in which every occurrence of behaviour is reinforced. This simplest form of reinforcement delivery is termed a **continuous reinforcement schedule** or CRF. If a rat receives a food pellet every time it presses the lever, it is on a continuous reinforcement schedule.

Other type of schedule is called **partial reinforcement** (***intermittent reinforcement***) schedule. In partial reinforcement, response is not rewarded every time it occurs. This schedule is more important in maintaining learnt behaviours. Once a response is learned under partial reinforcement schedules, it takes longer to be extinguished. The four types of partial reinforcement schedules are: *fixed-interval, variable-interval, fixed-ratio* and *variable-ratio*.

In the **fixed-interval** schedule, the organism is rewarded for the first response occurring after a fixed interval of time. The rat can be rewarded for the first lever pressing response occurring after one-minute interval. In such cases, the organism responds at a low rate immediately after the delivery of the reinforcement but then gradually responds more and more as the time for next reward approaches. Students increase their study hours as the examination approaches, and very little study takes place after the examination is over. This is an example of behaviour on a fixed-interval schedule.

In the **variable-interval** schedule, the organism is rewarded after a variable amount of time has elapsed. The rat gets the first food pellet after 2 minutes, the next one after 5 minutes, the third one after 3 minutes and so on. The organism responds at a steady rate in the variable interval schedule as reinforcement may come any

time. Gambling behaviour is maintained by a variable interval schedule. Employees engage in steady work when they know that their supervisor checks their work at irregular intervals. Players and athletes refrain from taking drugs, because they do not know when the next drug test will occur.

The **fixed-ratio** schedule delivers reinforcement only after a fixed number of responses. The organism is rewarded for the every n^{th} response it makes. This schedule yields a high response rate, though there is a brief pause after each reinforcement. Pauses occur as the organism takes a little rest period after hard work. People, who collect bottles, newspapers, cans, polythene etc., work on a fixed-ratio basis.

The **variable-ratio** schedule is in operation, when organism is rewarded after variable number of responses. The rat may be rewarded the first time after 5 responses, the second time after 9 responses, the third time after 3 responses and so on. Variable-ratio schedule produces high and steady response rate. Gambling is learned and maintained through variable ratio schedule. These behaviours are highly resistant to extinction

The interval schedules are related to time interval, while ratio schedules are based on the number of responses. Both interval and ratio schedules may be fixed or variable. Table 5.2 summarizes the four partial reinforcement schedules.

Table 5.2. ***Four Partial Reinforcement Schedules***

	Time Interval (Interval)	**Number of responses (Ratio)**
Predictable (fixed)	**Fixed-Interval** L*ow response rate after each reinforcement*	**Fixed-Ratio** *High response rate with brief pauses after each reinforcement*
Unpredictable *(Variable)*	**Variable-Interval** *Steady response rate*	**Variable-Ratio** *High and steady response rate*

Different schedules of reinforcement produce distinct patterns of responding (see Figure 5.11). The steeper the slope of the curve, the higher is the response rate. The small lines signify the occurrence of reinforcement.

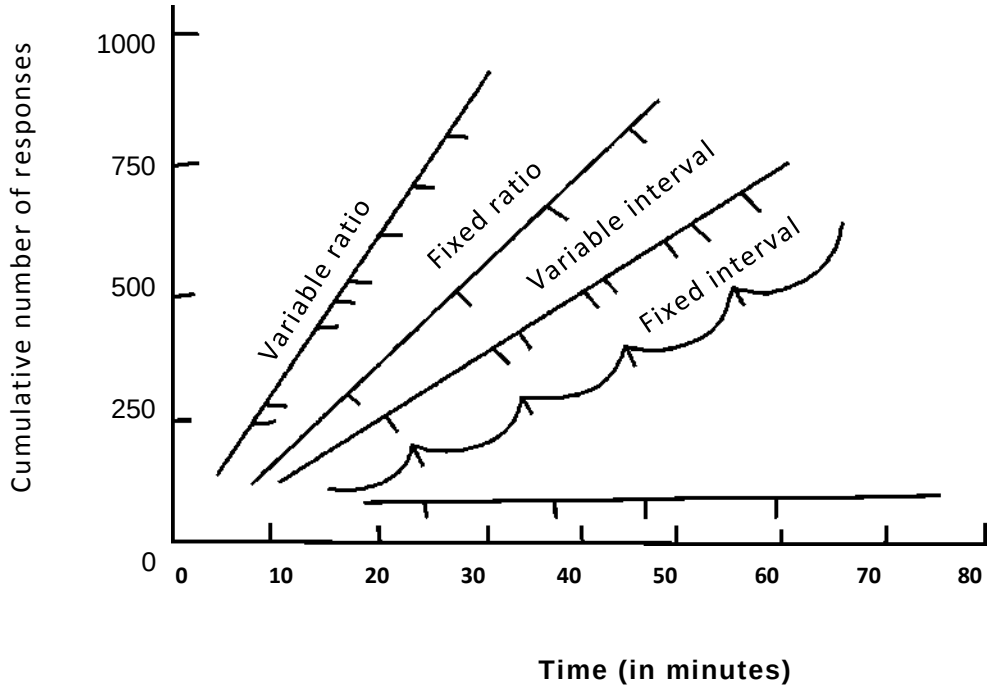


Figure 5.11 Performance curves produced by four schedules of reinforcement

Extinction, Generalization and Discrimination

As with classical conditioning, the operant response also undergoes **extinction**, when reinforcement no longer follows the response. If reinforcement is no longer given after the rat has learnt the lever pressing response, the tendency to press the lever gradually weakens. Over a period of time, the response extinguishes and is not shown. Following a rest period after extinction, spontaneous recovery takes place.

Once the response is acquired to a particular stimulus, the organism shows a similar response to a similar stimulus. Pigeons were reinforced for pecking at the disc of a particular color. These pigeons also pecked at the discs that are close in color to the original disc. This phenomenon is known as **generalization.** In operant conditioning, **discrimination** is the process of responding in the presence of one stimulus and not responding in its absence or in the presence of another stimulus. After the rat has learnt to press the lever, suppose a light is turned on. The rat is rewarded when it presses the lever in the presence of light and the lever pressing response is not

rewarded in the absence of light. Here light is the signal that tells whether lever pressing will bring reward or not. Light is the **discriminative stimulus.** The rat learns to discriminate between the presence of light and other stimulus conditions. As a consequence, it responds when the light is on, and does not respond when light is absent and other stimuli are present. This is discrimination learning. The light signal serves as a stimulus to control the behaviour of the rat. In other words, rat's behaviour comes under the **stimulus control** of light. Teenagers show disciplined behaviours in the presence of their parents. Students study hard, when the teacher is present. Parents and teachers are discriminative stimuli. The behaviours of the teenagers and students have come under the stimulus control of their parents and teachers respectively. Discrimination learning accounts for great many life experiences representing complex human behaviour.

How does Reinforcement Work in Operant Conditioning?

Skinner's View: Reinforcement Theory

Skinner advocates a behaviorist point of view, which he terms as ***experimental analysis of behaviour***. For Skinner what are important are the responses and the role of reinforcement in shaping the responses. He does not admit any role of cognition in operant conditioning. If we understand the nature of reinforcers, and the schedule on which they are given, we can accurately predict behaviour. The internal state of the organism, its belief, expectancies or anticipations is in no way involved in operant conditioning.

Cognitive Perspective

The cognitive theorists believe that operant conditioning involves purposeful understanding of the situation rather than the automatic reinforcement of specific responses.

A common observation suggests that students who read to receive good grades in the examination learn by rote, show poor conceptual clarity, show less interest in reading, and forget quickly after the examination is over. For these students the motivation to read is external. Their action is a consequence of external motivation. Those who read for the fun of it, because they like doing so are internally motivated. They learn better, show better conceptual clarity and retain the material for a longer

period of time. Thus reinforcement in the form of getting a good grade works less effectively compared to **intrinsic motivation** of the learner. The presence of an external reward always in a learning situation may damage the intrinsic motivation of the learner. The internal belief and expectations are crucial factors in determining the effects of reward.

The cognitive theorists view learning as an active organizing of information in accordance with learner's goals. The role of reward is to confirm the learner's expectations for reaching a goal. If the reinforcer does not satisfy the organism's expectation, it loses its reinforcing value. Cognitive theorists cite a number of evidences in support of their view.

Tolman considered himself a behaviorist. Yet he believed that the learner has a purpose in performing responses. The organism learns by being exposed to the environment, even if its responses do not bring reinforcement. In a classic experiment Tolman allowed rats to run through a maze several times a day without receiving any reward. When reward was later given to the rats on the eleventh day, they learnt very quickly. It suggests that rats learnt something during the first ten days even in the absence of reward. This is called **latent learning.** The learning was latent and manifested when reinforcement was given. Tolman theorized that the rats formed a **cognitive map**, or in other wards a mental representation of the maze.

Edward C. Tolman

Tolmans' experiment on **place learning** adds further support to the cognitive view. He showed that rats learn to approach the place where food is kept even if they are left at different directions from the 'food' box. They just do not learn a series of left-turn and right-turn responses to reach the box where food is kept. In other words, rats form a cognitive map of the maze, and use their understanding to execute responses.

The third evidence comes from studies on **contrast effect.** When rats are shifted from a smaller reward to a larger reward, performance level increases rapidly. This is positive contrast effect. Conversely, when they are shifted from a larger reward to a smaller reward, their performance sharply declines, reaching a level lower than

that of animals receiving only smaller reward- a negative contrast effect. It appears that, it is not just the level of rewards, but also the evaluation of the reward value that determines animal's responses. Salary for the employees is a reward. When there is an unexpected fall in the salary, performance sharply declines.

The cognitive theorists, thus, view instrumental learning as a matter of forming mental representations and expecting positive consequences for the behaviour.

Applications of Operant Conditioning

It is not only that we learn many behaviours through operant conditioning, we can also eliminate or modify unacceptable behaviours using operant procedure. Most of the maladaptive behaviours are learned with the assistance of reinforcement, either visible or invisible. A child throws temper tantrums when his needs are not immediately satisfied. An adolescent girl and her parents have intense arguments. A preschool child repeatedly throws glass and breaks them. A child wets his bed during night. All these maladaptive behaviours are learnt, and can therefore be modified using techniques of classical and operant conditioning. The process of modifying these behaviours is called **behaviour modification,** which emphasizes changing behaviour by reinforcing desired target behaviours. In clinical psychology, behaviour modification is usually referred to as **behaviour therapy.**

Behaviour modification intends to replace unacceptable and maladaptive responses with adaptive ones. A child throws temper tantrums or a preschool child throws glasses as a means of inviting adult attention. Their behaviours may be receiving too much attention from parents and teachers. In such cases, parents and teachers should remove attention (*withdrawal of reinforcement*) form the undesirable behaviours and transfer it to more adaptive behaviours such as roaming quietly or playing cooperatively with the peers. The intense arguments between the adolescent and the parents can be reduced by asking both to sign a *behavioral contract*, which stresses on reinforcing only adaptive interactions between both. The bed-wetting behaviour can be treated through *shaping using the method of successive approximations*.

Earlier it was believed that voluntary responses could only be conditioned through operant procedure. Involuntary behaviours such as blood pressure, pulse

rate, muscle tension can also be controlled by operant conditioning through **biofeedback.** In biofeedback, the individual is given information about his bodily processes so that they can change. For example, individual's muscle tension is fed back to him in the form of an audible tone. As muscle tension rises, the tone becomes louder; as it drops, the tone becomes softer. When the information is fed back to him, the individual learns to control his muscle tension.

The principles of operant conditioning have been applied in the field of education. The two important applications are **computer-assisted instruction** (CAI) and **programmed instruction.** In CAI, the student learns from an active interaction with a computer programme. The program engages the student in a learning activity, paces the program at the student's rate of progress, provides immediate feedback on correct and incorrect answers and permit students to enter branch programmes for special help in areas of weakness. In CAI, the student takes greater responsibility for his performance as compared to teacher-led instruction, because he treats the computer as impersonal and therefore 'fairer'. Programmed instruction follows the same principles as CAI, and can be put forth in the form of a programmed learning booklet.

The operant conditioning principles have been applied in any practical settings. It is almost impossible to describe all of them here. To name only a few, the principles have been applied to personalized system of education, crime control, energy conservation, health care issues, employee productivity and company profits etc.

Classical and Operant Conditioning Compared

The distinctions between classical and operant conditioning are made on operational and procedural grounds. Theoretically, both the conditioning techniques are possibly governed by the same basic processes. In other words, both are two different forms of the same learning process.

It is almost impossible to carry out classical and operant conditioning experiments separately. In each operant conditioning experiment, there is a component of classical conditioning. Similarly, we cannot perform a pure classical conditioning experiment without having a component of operant conditioning. Let us see how. In operant conditioning, the organism emits a response following which it receives a reward. This response occurs in a stimulus situation (the sight and the smell of all the

situational cues in the Skinner Box). The situational cues are the conditioned stimuli (CS), which occur in the presence of food (UCS). The organism is conditioned to exhibit the lever pressing response (CR) in the presence of these stimuli (CS). This procedure parallels that of a classical conditioning. Hence, in each operant conditioning experiment, there is also an arrangement for classical conditioning to take place.

Let us consider how operant conditioning is also involved in classical conditioning experiment. In a typical classical conditioning experiment, the food (UCS) elicits salivation (UCR), which gets conditioned to the bell (CS). Just after the bell and before the food is presented, the organism shows anticipatory salivation preparing itself to receive food. After a few trials, a part of the salivation occurs after the bell (CS) and before the food (UCS). Because of this anticipatory salivation, the organism enjoys food intake, which serves as a reinforcement. Without this prior salivation, the taste of food would be different, and less enjoyable. Here the reinforcement came after the response, which is an operant or instrumental conditioning procedure. Since both classical and operant conditionings are intertwined processes, it is difficult to make theoretical distinctions between the two. However, we can make procedural distinctions between the two conditioning techniques.

Similarities

Just before we mention the distinctions, it is important to point out that both the conditioning techniques possess many features in common. Both display the same basic principles like acquisition, extinction, spontaneous recovery, generalization, and external inhibition. Both respond almost similarly to the manipulation of experimental variables.

Differences

Psychologists like Hull and Guthrie maintain that distinctions between the two techniques can be made only at operational or procedural level. Table 5.3 summarizes the distinctions between the two conditioning techniques along several important dimensions. The distinctions between the two conditioning procedures are explained below.

In classical conditioning, the organism learns the relationship between one stimulus (bell) and the other (food). The CS and the UCS are connected together so

Table 5.3: Distinctions Between Classical and Operant Conditioning Procedures

Dimensions	Classical Conditioning	Instrumental Conditioning
1. Nature of association	1. It is ***S-S type learning***. The organism learns associations between two stimuli (bell and food).	It is *S-R type learning*. The organism learns the association between a stimulus (food) and a response (lever pressing)
2. Nature of responses	2. The response is ***elicited***. The food (UCS) elicits the response of salivation (UCR)	The response is *emitted* by the organism. The organism shows the lever pressing response on his own, and only then, it is reinforced. The UCR (random movements inside the box) and the CR (lever pressing) are *different*.
3. Response-Reinforcement Sequence	***3.*** The UCR (salivation to food) and the CR (salivation to bell) show a great deal of ***similarity.***	Most responses that can be instrumentally conditioned are *voluntary* (shown by the organism on its own). However involuntary responses can also be brought under voluntary control.
4. Nature of the CS	***4.*** Most responses that are amenable to classical conditioning are ***involuntary.***	*Reinforcement is given after the response*. Reinforcement depends upon the response of the organism. *The CS is a stimulus field or stimulus situation*. All the situational cues serve as the CS, where the organism is free to respond or not to respond.
5. Role of the Organism	5. ***Response is given after the reinforcement***. Reinforcement does not depend on the response.	The organism plays an *active role*. The organism is free to act and has to act to get reinforcement. The more it acts, the more reinforcement it gets.
6. Basic Principle	***6. The CS is a specific identifiable stimulus (e.g., bell).***	It is governed by the *Law of Effect*. Whether or not a response would be learned depends upon the effect (either reinforced or not reinforced) the response produces.
7. Effect of Partial Reinforcement	7. The organism plays a ***passive role***. It has less freedom for action. The organism would salivate in the presence of food. 8. It is learning by contiguity. ***Law of contiguity*** important. ***9. Partial reinforcement reduces the rate of learning***. Partial reinforcement does not affect extinction in a very important way.	*The learning of the response is quicker under partial reinforcement conditions*. When the response is learned under partial reinforcement schedules, it takes longer to be extinguished. The organism responds for a longer period of time even when reinforcement is not given.

that the animal learns to respond to the CS just as it does to the UCS. The bell by being paired consistently with food acquires the potentiality of evoking the same response (i.e., salivation) as was evoked by the food. Pavlov termed classical conditioning as **Stimulus-Substitution**. But in operant conditioning, the organism learns the relationship between a response (i.e., lever pressing) and a stimulus (i.e., food). While classical conditioning is **S-S type of learning**, the operant conditioning is **S-R type learning**.

The UCS (i.e., food) **elicits** the natural and biological response of salivation (UCR). In operant conditioning, the response has to be spontaneously **emitted** by the organism. Among several responses emitted, one response is followed by reinforcement. The probability for the occurrence of that response increases, and the probabilities for other responses decrease. Since the response to be given in operant conditioning is to be shown by the organism, the response is under the **voluntary control** of the organism. In classical conditioning, the UCS evokes a natural response; so the nature of the response is **involuntary**. Since involuntary responses (i.e., blood pressure, pulse rate) can be brought under voluntary control, they can also be instrumentally conditioned. It has been mentioned earlier, that biofeedback is a method of bringing involuntary responses under voluntary control.

In classical conditioning, the UCR (salivation to food) and the CR (salivation to bell) show a great deal of similarity. But in operant conditioning, the CR and the UCR are usually different, and sometimes, radically dissimilar. All the movements of the rat inside the Skinner Box (e.g., jumping, scratching, crawling etc.) in the first trial before it has received food constitute the UCR. The CR is the response of lever pressing, which is very different from the UCR.

In classical conditioning, **the response comes after the reinforcement**. The reinforcement is powerful to elicit a natural biological response. The arrangement in operant conditioning is such that the reinforcement is given only after the correct response is made. While in classical conditioning response follows the reinforcement, in the operant procedure, **reinforcement follows the response**.

The CS, in classical conditioning is a specific identifiable stimulus like the bell or the light. In the operant conditioning, the array of stimulus cues present in the box

serves as the CS. The sight of all the parts of the Skinner Box, and the smell form a stimulus field where the organism's response takes place. All these serve as the CS in the instrumental procedure.

In the classical procedure, the type of reinforcers given determines the organism's response. It has less freedom for action. Thus the organism plays a **passive role**, while in operant conditioning, the organism plays an **active role**. It has more choices for operating on its environment, and its actions determine whether or not it will receive reinforcement.

The classical conditioning is governed by the principle of **contiguity**, which means that the response and the stimulus must be very close in time. When the bell (CS) is sounded, the response of salivation (UCR) elicited by food (DCS) must occur within a very short time. If the time gap is more, the conditioning will not take place. The important law for the operant/instrumental conditioning is the **Law of Effect**. Whether or not a response would be learned depends upon the effect of the response. If the response brings reinforcement, it will be learned; if it does not, it will not be learned.

Reinforcement can be continuous or partial. How do the two procedures respond to partial reinforcement, that is when reinforcement is not given on all occasions? In classical conditioning, partial reinforcement (i.e., food is given on some trials and not given on others) reduces the rate of learning. The organism takes more trials to learn the response. The extinction of a response learned under partial reinforcement is slightly delayed. The **Partial Reinforcement Effect (PRE)** is different for operant conditioning. The rate of response is higher in operant conditioning under conditions of partial reinforcement. If the response is learned under partial reinforcement schedules, it takes longer to be extinguished, because organism fails to discriminate between the acquisition phase and the extinction phase. In the operant/instrumental procedure, the partial reinforcement results in greater resistance to extinction.

In summary, the operational distinctions between the classical and the operant conditioning techniques make a reader sensitive to the subtle differences existing between the two techniques, even if it is difficult to conclude that they generate different kinds or forms of learning. Both may as well be the different forms of the same basic learning process.

Cognitive Learning

You have learnt in this chapter about the cognitive explanations of classical and operant conditioning. Unlike behaviorists, the cognitive theorists believe that conditioning is a matter of developing an understanding regarding how the learning situation is organized. Conditioning is just not learning of simple S-R associations. The earlier discussions on the phenomena of latent learning, place learning, and contrast effect support the view that learning is cognitive by nature. In each instance of learning, the organism is processing information about the environment to reach a desired goal.

Cognition refers to processes of acquiring knowledge about the environment, which has an internal mental representation. Learning refers to a relatively permanent change in behavioral tendency. The two terms are put together to generate the term '**cognitive learning**', which refers to a change in the way information is processed as a result of organism's experience. The cognitive theorists have shown that even animals demonstrate intellectual capacity for cognitive learning. The two forms of cognitive learning that will be discussed next are: (a) ***insightful learning,*** and (b) ***observational learning*** or learning by imitation. Both these forms of learning are clearly different from classical and operant conditionings. **Wolfgang Kohler** developed insightful learning, while **Albert Bandura** advanced the concept of observational learning. Both of them held ideas clearly different from those of Thorndike, Pavlov, and Skinner.

Pavlov, Thorndike, and Skinner, all behaviorists, investigated a form learning that was simple and *mechanical. Firstly* The behaviorists largely ignored the study of learning based on reason and intelligence. Imagine a doctor making a diagnosis of a disease, a student suddenly hitting upon a solution for an arithmetic problem, or a mechanic figuring out why an engine does not work. Pavlov, Thorndike and Skinner ignored these instances of complex learning based on insight.

Secondly, the boxes used by Thorndike and Skinner were too artificial. The boxes did not allow the animals to do anything other than blind guessing to accidentally emit a correct response. The situation did not allow the animals to truly understand the problem. The animal's natural behaviours are different from the behaviours shown in the box. Kohler showed that animals like chimpanzees are capable of insightful behaviour, which is based upon an understanding of the learning situation.

Thirdly, the behaviorists placed undue emphasis on external determinants of behaviour. According to the behaviorists, the organism learns to connect a response to a stimulus, so that when the stimulus comes, the response is given. In other words, animal's behaviour is under the control of the external stimulus. Behaviorists designed all their experiments to study factors operating as external stimuli. Behaviorists designed all their experiments to study factors operating in the environment, and ignored the factors operating within the organism. The behaviorists did not consider the internal processes such as expectation, understanding and insight of the organism to be important determinants of learning. The cognitive theorists emphasized the internal processes.

Gestalt psychologists like Kohler showed that the chimpanzee perceives and thinks, while it learns. The chimpanzee evaluates the information in the learning situation, and combines the piecemeal information into a meaningful whole, and learns to reach a goal by developing insight. The distinctions between the insightful learning and the trial-and-error learning will be discussed later.

Insightful Learning

Kohler's Experiments on Insightful Learning

Wolfgang Kohler (1887-1968), a German psychologist, arrived at Tenerife, a small island off the West Coast of Africa to take charge of an institute for the study of the anthropoid apes. When the World War I broke out, Kohler was forced to stay in the island. He spent these years on an intensive study of how the chimpanzees perceive, think, and learn. The results of his experiments during the period 1913-1917 were published in German. Then they were translated into English in 1925 with the title, '*The Mentality of Apes*'.

Wolfgang Kohler

Kohler employed five types of problems to study how chimpanzees solve complex problems. He also used dogs, hens, and a little girl as his subjects for these problems. The two most fascinating and important problems were the **'stick' problem** and the **'box' problem**. Both the problems involved insightful solution.

In the **'stick' problem**, Kohler placed a chimpanzee named **Sultan** inside a cage. Sultan was hungry. A bunch of banana was kept outside the cage beyond the direct reach of the chimpanzee. Two hollow bamboo sticks, one long and the other short, were kept inside the cage. Since the sticks were hollow, one stick could be pushed into one end of the other to form a longer stick. The banana was placed at a distance such that neither of these sticks alone would be sufficiently long enough to reach the banana. However, if the two sticks are joined, banana could be reached.

Since Sultan was hungry, his goal was to fetch the banana for eating. Initially he showed all customary reactions that a chimpanzee shows inside a cage. He used one of sticks to draw the banana towards him, but was unsuccessful. He tried the other stick but failed. After some unsuccessful attempts, Sultan gave up trying and sat in one corner of the cage. After a while, it started playing with the sticks. He pushed one stick out as far as it could go, and then pushed the first stick with the other until the first touched the banana. Kohler reports that Sultan showed considerable satisfaction at this actual contact. But since the sticks were not joined, the banana could not be drawn into the cage. Kohler also gave a hint to Sultan by putting his finger in the bamboo stick, while the animal watched. But this hint did not work. Sultan took an hour-long trial but did not succeed. He started playing with the sticks again, and accidentally one of the sticks went into the hollow end of the other. A sudden insight dawned upon Sultan. Mentally, he solved the problem. He used the two sticks to form a longer stick, and with its help pulled the banana inside the cage. On the next day, when Sultan faced the same problem, he solved it immediately. ***Seeing the relationships among various aspects of the problems is described as learning by insight***.

Kohler also demonstrated insightful learning in the 'box' problem. In the **'box' problem**, a banana was hung from the ceiling of a cage, which the chimpanzee could not reach ordinarily (Figure 5.12). There were several boxes inside the cage. After an initial period of trial and error, the animal stacked several boxes, and stood on the top box to fetch the banana. In this case, the chimpanzee also developed insight by observing the relationships among various aspects of the stimulus field.

Stages in Insightful Learning

1. The organism must have the need to reach a goal by solving a problem.

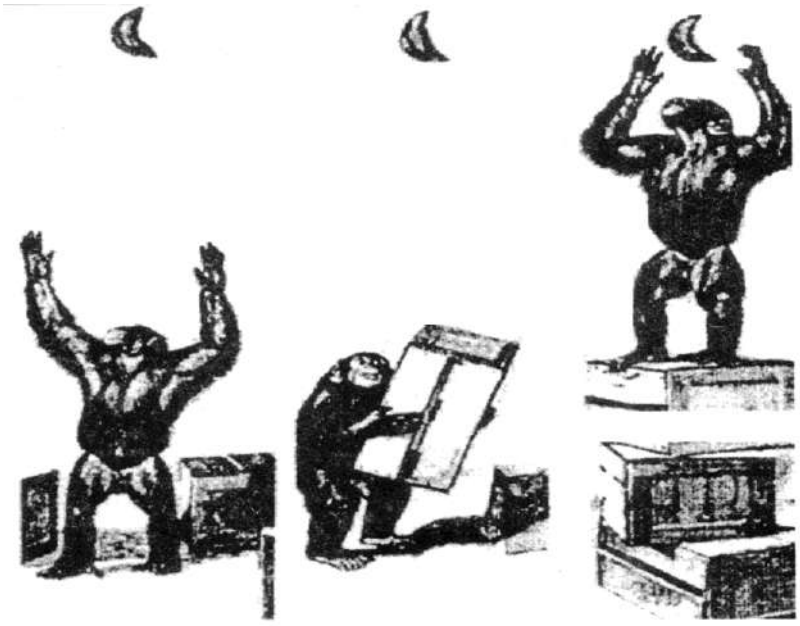


Figure 5.12 The chimpanzees' insightful solution using boxes to reach the banana

2. The learner makes various surveys, inspections, and examinations of the problem and the stimulus field.

3. After an initial period of trial and error, the period of incubation begins, when all overt activities are suspended. The organism sits silently, and thinks over the problem.

4. Suddenly the organism develops insight into the problem.

5. The organism makes practical verification of his idea or insight about the problem.

6. Once the insight is achieved, and the problem is solved, the organism repeats the same method of solution without any hesitation.

7. While solving further problems of similar nature, the organism attends to the relevant aspects, and ignores the irrelevant ones.

Descriptive Characteristics of Insightful Learning

What does Kohler mean by insight? The common features of the experiments on insightful learning are as follows:

1. The nature of the experimental situation is very important for insightful learning. The organism must be able to perceive the relationships among all relevant parts of the problem before insight can occur.

2. The organism reacts to the whole situation, not to its component parts.

3. The organism perceives the relationships between means and the goal, and restructures the perceptual field.

4. Insight follows a period of trial and error behaviour. In the trial-and-error period, the organism does not, however, exhibit blind and random attacks as shown by Thorndike's cat. On the other hand, it tests behavioral hypotheses in the form of accepting some and discarding others.

5. The insightful solution comes all on a sudden.

6. Once the insightful solution is reached, the organism shows high degree of retention and transfer to similar problems.

7. Insight is closely related to the organism's capacity to learn. The capacity for insightful learning depends on age, experience, and individual differences.

Comparing Insightful Learning with Trial-and-Error Learning

The trial-and-error form of learning is behaviorist in orientation. It emphasizes and studies only observable forms of behaviour, and disregards any internal processes occurring within the organism. On the other hand, the insightful learning is the contribution of the Gestalt psychologists from Germany. It emphasizes that learning, and particularly complex forms of learning require an insight into the nature of the problem. The internal processes occurring within the organism are important. Most forms of human learning are governed by insight. Table 5.4 summarizes the distinctive features of the trial-and-error and the insightful learning. The distinctions are explained in detail, below.

The cat in Thorndike's puzzle box learns to connect a response with a stimulus, which is subsequently rewarded. The learning by trial-and-error is a matter of S-R

connection. Kohler's chimpanzee learns to perceive the relationships between various aspects of the stimulus situation. Establishing the relationship between one stimulus

Table 5.4: Distinctions Between Trial-and-Error and Insightful Learning

Dimensions	Trial-and-Error Learning	Insightful Learning
1. Nature of association	1. It is ***S-R type of learning***. The organism learns to connect a response with a stimulus.	It is ***S-S type of learning***. The organism learns the relationships among various stimulus situations.
2. Nature of responses	2. The process of learning is ***gradual.*** The probability of correct responses increases gradually through a series of trials. 3. The organism's response or reaction is made to a part of the stimulus situation. Since the response is made to a specific stimulus, the response is ***molecular*** in nature. ***4.*** It depends heavily on ***practice and repetition***.	The learning by insight occurs ***all on a sudden***. The organism develops insight into the problem solution all on a sudden. The organism perceives and responds to the stimulus situation as a whole. The organism's reaction to the whole situation is ***molar*** in nature. It involves less of practice and repetition and ***more of insight***.
3. Role of Organism	***5.*** It is of simple type and is involved mostly in the acquisition of ***motor skills.*** ***6.*** It is a stimulus response connection, and therefore ***does not involve insight.*** ***7.*** The organism plays only a mechanical and therefore a ***passive role.*** 8. It is more often the characteristic mode of response in ***lower order animals and children***. 9. The organism shows a lot of random activity and the solution comes ***by chance.***	It is higher-order learning and is more effective in ***cognitive and verbal learning.*** It involves some amount of trial and error at the beginning. ***The actual learning act involves insight***. The organism plays an ***active role*** in determining what finally leads him to reach the goal. It is very rare in lower-order animals and is observed in animals higher in phylogenetic scale like ***human beings and chimpanzees***. The organism surveys, inspects, observes, and examines the problem situation, and the problem solution is a ***purposive activity***.
4. Strength of Learning	10. It is more or less ***temporary.*** When practice is discontinued, the acquisition of skill fades. 11. ***The transfer of learning is relatively poor***.	It is relatively ***more permanent*** and stays for a long time, even if practice is discontinued. Solution, once reached is ***transferred easily to similar stimulus situations***.

and the others is the core principle of insightful learning. The insightful learning is of S-S type.

The trial-and-error learning is gradual. The cat in Thorndike's puzzle box takes a number of trials and learns step-by-step to reach the correct response. The insightful learning occurs all on a sudden. The organism moves from a state of no solution to a state of solution very quickly. While pulling the string in Thorndike's puzzle box, the cat is showing responses to only some specific stimuli. It does not have to attend to the whole stimulus field. But insightful learning involves perception of the whole situation, as the organism has to see the relationships among various stimuli.

The nature of the response is molecular in trial-and-error learning and molar in insightful learning. Practice and repetition are extremely important in trial-and-error learning, while insightful solution is important for insightful learning. Of course, certain amount of trial-and-error occurs before insight takes place. But the trial-and-error form of learning primarily does not involve insight. The physical and motor skills are acquired mostly through trial-and-error. The insightful learning is of higher order, and is involved in cognitive and verbal learning.

The two forms of learning differ with respect to the role of the organism in the learning situation. Animals lower in the phylogenetic scale acquire through trial and error. Their role in the learning situation is only mechanical and passive. The organism's approach in trial-and-error consists of random blind activities and the solution comes by chance. On other hand, the organism in insightful learning, surveys, inspects, observes, and examines various aspects of the problem situation, and thereby takes an active role in learning. Higher-order animals including chimpanzees and human beings are capable of insightful learning.

Both the trial-and-error and the insightful learning differ with respect to the strength of learning. The trial-and-error learning is more or less temporary, depends on continued practice, and weakens when practice is discontinued. The insightful solution, once acquired, stays for a long time and does not easily fade away when the practice is discontinued. Finally, in trial-and-error, the transfer of learning is poor; skills acquired in one situation are not easily transferred to another situation. On the other hand, learning by insight is easily transferred from one situation to other similar situations.

Observational Learning: Learning by Imitation

It is true that a part of how human beings learn can be explained by the principles involved in animal learning. But as we know, human learning is much more creative and is based on intelligent actions. Most forms of human learning are far more complex than a dog salivating to Pavlov's bell, or a rat pressing a lever in the Skinner box, or a cat pulling a loop to come out of Thorndike's puzzle box or a chimpanzee joining sticks to pull banana into Kohler's cage. **Human learning is not just an unthinking mechanical connection of a response with a stimulus**.

Consider how a person learns to drive a car. Of course, some amount of sensory motor learning is involved. We should not ask the person to drive down the road, make mistakes, and learn from his mistakes through trial-and-error. In learning to drive a car, the person does not get behind the wheel, and makes random movements until the key is accidentally put into the ignition. It is not that he makes many false starts and the car accidentally moves forward, thereby delivering a positive reinforcement. On the other hand the person carries some knowledge about driving that he gathered by observing others drive. A great deal of human actions is learned through observation right from the childhood. **Through observation, an individual can learn behaviour even without having any direct experience of carrying out that behaviour.**

According to Psychologist **Albert Bandura** and his colleagues, a major part of human learning consists of observational learning, which is otherwise known as **learning by imitation** or **modeling**. But observational learning is far more complex than learning by imitation. ***Bandura defined observational learning as learning through observing the behaviours of another person, called a model***. The model is capable of stimulating learning in the observer. In a classic experiment, Bandura demonstrated that young children imitate the aggressive behaviour of the adult models almost identically. The young children saw the film of an adult model,

Albert Bandura

which was aggressively hitting a 5-feet tall toy. Then these children were given opportunity to play with the same toy. They showed the same kind of behaviour, sometimes repeating the aggressive behaviour of the adult almost identically.

It is not that negative behaviours are acquired through observational learning. Observational learning can also eliminate undesirable behaviours. In another experiment, children who were afraid of dogs were exposed to their peers as models playing with dogs. Children watched that playing with the dog does not bring unpleasant consequences. As a result, these children approached a strange dog with less fear. The children who were not exposed to the peer models continued to be afraid of dogs. Observational learning also helps in learning adjustment behaviour in critical situations. For example, imagine that you have gone to a marriage celebration, where a food item is served, and you do not know how to take it. Then you observe the behaviors of others in relation to this food item, and repeat the same kind of behavior to deal with this new food item.

Observational learning explains, in a very useful way, the impact of observing violence and antisocial acts in the media on the viewers, particularly on the minds of young children. Young minds exposed to the models in films or advertisements imitate the behaviour of the models. Watching the violent and aggressive behaviours of the TV models leads the young children to act in an aggressive manner, because children view aggression as a legitimate response to particular situations. In order to reduce the impact of TV violence, psychologists explicitly teach children that TV violence is unreal and that they should not imitate behaviour seen on televisions. These lessons appear to be effective. The children receiving these lessons tend to show aggressive behaviour less frequently.

Observational learning is far more complex than imitation. Bandura viewed observational learning as an ***information processing activity***. As the individual observes, information about the world is transferred into cognitive representation that guide our actions. In novel and unfamiliar situations, you wait for a while, observe what others are doing and then act the same way to avoid any form of embarrassment. We discussed about the method of shaping earlier under operant conditioning. Observational learning is important for acquiring skills in which shaping is inappropriate. For example, piloting a plane or performing a

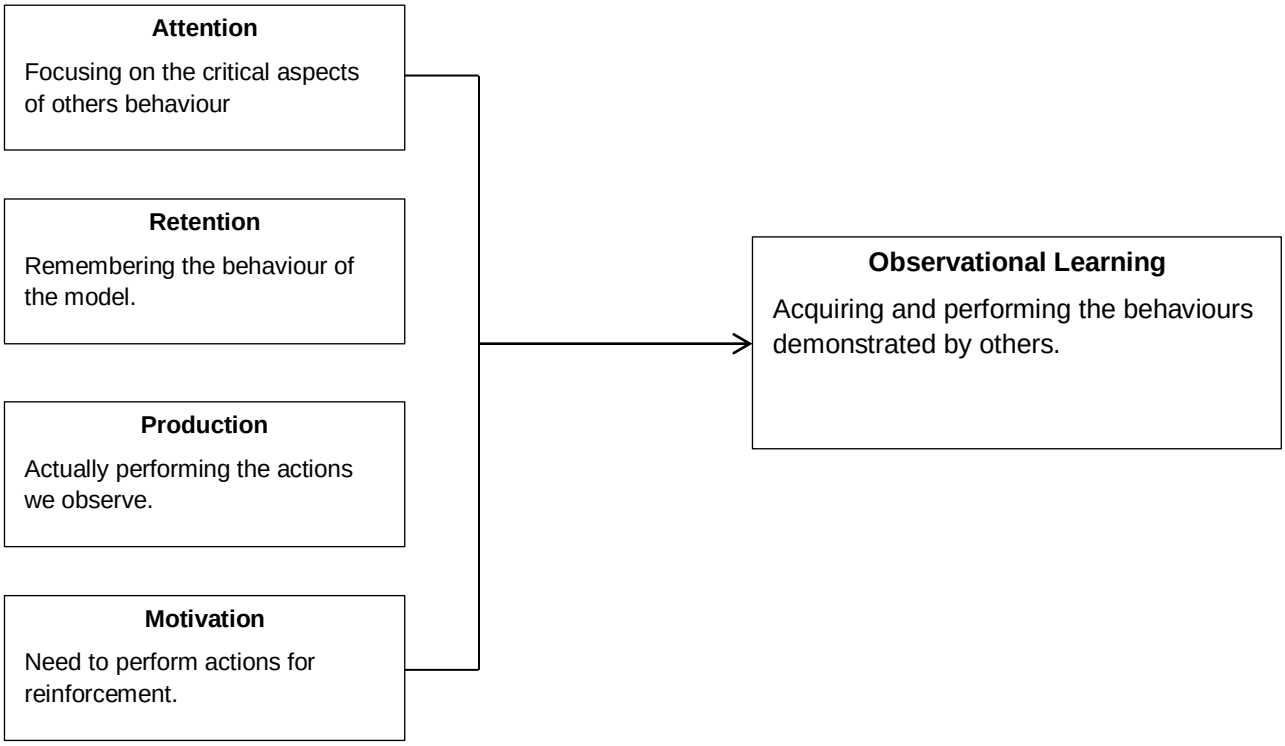
brain surgery cannot be learned through shaping or trial-and-error, because the cost would be high. Observational learning is important in acquiring higher-order skills. A new employee watches an experienced employee perform the task, and then performs the same actions himself under the guidance of the senior. A child observes the daily routine activities of his parents and models his behaviours accordingly. In numerous occasions, we learn by watching the behaviours of others and the consequences of their behaviours. This form of learning is known as **vicarious learning**. The reinforcement one receives by repeating the behaviours of the model is known as **vicarious reinforcement**.

Whether we would imitate a model depends on the consequences of the model's behaviour. If a particular behaviour of the model is rewarded, we would more likely learn that behaviour. If the model is punished for his behaviour, we still learn the behaviour, but are less likely to perform it. If we observe a friend being rewarded (receiving higher percentage of marks) for his hard work, we are more likely to learn to be hard working. Instead, if we see our friend being punished for telling lies, we learn the act of telling lies, but are less likely to engage in that behaviour. When the act of telling lies would be reinforced, we would tend to engage in that behaviour.

What factors or conditions determine the extent and strength of observational learning? The four important conditions are: (a) ***Attention***- *focusing on the critical aspects of other's behaviour*, (b) ***Retention***- *carrying the mental representation of the behaviour of the model*, (c) ***Production***- *actually performing the actions we observe*, and (d) ***Motivation***- *need to perform actions to secure reinforcement*. The key conditions of observational learning are presented in Figure 5.13.

Factors influencing Learning

It is true that conditioning and observation lie at the roots of any complex learned behavior. But human learning is far more complex than what simple conditioning principles can account for. The mastery of concepts, principles, and language characterizes human learning. Unlike, other animals, human beings rely heavily on language to understand their environment. They acquire knowledge about objects, events, and situations largely in terms of words, concepts, and principles. The factors influencing human learning are innumerable, and some selected ones are discussed below.



Feedback

Learning is more effective, and maintained better, if we get some feedback regarding what are the consequences of our activities. If we have to walk to a distant destination, we often stop on the way to assess the distance covered. This mental exercise provides us feedback on the current level of performance suggesting ways to change our method of learning, if necessary. Similarly, the feedback or the knowledge of result at appropriate times during the course of learning tends to enhance the rate of learning and the quality of performance. Feedback initiates a self-reflective exercise of knowing one's strengths and weaknesses. Students, while studying, should create conditions so that they can get feedback on their mastery of each unit or chapter covered. Feedback can help them monitor their progress of learning and maintain their level of motivation for the targeted task. It will tell the students what they have mastered and what are their weak spots.

In experiments with animals, the **reinforcement works as a kind of feedback to the organism in terms of strengthening a response**. The feedback or the ***knowledge of result*** for the responses made by humans carries a cognitive connotation. In human conceptual learning tasks, feedback is important because of the information it provides the learner, both with respect to what hypothesis seems to be correct, and to the elimination of incorrect hypothesis.

The nature of feedback may range from getting information about how bodily processes work (biofeedback) to receiving knowledge of the results of our mental performance. ***Biofeedback*** is a behavior modification technique emanating from the principles of operant conditioning. How does biofeedback work? Suppose we want to reduce an individual's muscle tension. His muscle tension is monitored and fed back to him. The degree of muscle tension is linked to the loudness of a tone. So the individual observes that the loudness of the tone increases as muscle tension rises, and decreases as the muscle tension drops. This is the biofeedback technique through which, the individual learns to control muscle tension. The reinforcement is the raising or the lowering of the tone as a feedback to tell the individual about the degree of muscle tension. It is this awareness that helps in learning the desired behaviors.

In cases of simple learning such as a drawing a line, the feedback exercises a powerful influence in altering subject's mode of response. A simple illustration will drive the point home. Ask a person, while blindfolded, to draw a line five inches long, and keep a record of his performance in successive trials. You will observe, there will be ho improvement from trial to trial. Then ask someone to do the same thing, but this time, provide feedback to the person regarding whether he is doing it right or wrong. Then observe his performance. You will notice that errors would decrease rapidly, and improvement in performance would be noticed. Such a simple experience would convince you that feedback or knowledge of results serves as a powerful tool in increasing the rate and accuracy of learning.

For more complex forms of learning as is evident in learning school lessons, feedback or knowledge of results maintains learner's motivation by keeping him on the task. One aspect of feedback that has been examined is the

time delay between the learner's response and informative feedback. The correct learning should be immediately followed by a feedback. Immediate knowledge of results helps the learner distinguish between the right and the wrong responses, and prevents the wrong associations from being unintentionally reinforced. In animal learning experiments, the delay of reward produces a marked effect on learning, but in human learning, particularly relating to concepts and principles, the delay of feedback does not produce as pronounced an effect.

Distribution of Practice

Starting from simple conditioning to more complex forms of verbal learning, the learning trials may be massed or distributed. The ***massed training*** refers to a situation, in which the learning trials are given in a rapid succession with minimum possible time interval in between trials. In contrast, in ***distributed training***, some longer time interval is allowed in between learning trials. The point here is the relative economy of either of the training procedures. Which one is better - massed or distributed- in terms of the rate and amount of learning? It has been generally found that the distributed trials result in faster learning compared to the massed trials for simple conditioning as well as for complex forms of verbal learning. Underwood has cited several studies to show that conditioning takes place more rapidly by distributed than by massed trials.

Contents of Learning (Whole Versus Part)

Should the to-be-learnt material be mastered as a whole or in parts to be combined later to form the whole? If a task can be divided into component parts, it is pertinent to ask if learning the parts separately, and then putting the parts together to form the whole will yield better learning than learning the whole from the outset. In ***part learning***, the whole task is divided into different parts, and then each part is learnt separately in succession to be finally put together to construct the whole. In the ***whole method***, the individual learns the entire task as a whole. For example, consider a poem consisting of 5 stanzas. Each stanza is mastered at a time and after complete mastery of each stanza, the stanzas are recited together in succession to master the whole poem. Here learning is done using the part-method. In contrast, in the whole method, the poem may be mastered as a single piece.

In the laboratory set up, a 20-item list of nonsense syllables may be divided into four parts, each consisting of 5 nonsense syllables. Each part may be mastered separately, and then combined together at the time of recalling the list. In the whole method, all the 20 nonsense syllables would be learnt as a whole without breaking the list into component parts. In operant conditioning experiments, using mazes, the rats may be trained to learn each part of the maze under conditions of reinforcement, and then tested for the whole maze learning. The results of the experiments done on animal maze learning and human motor and verbal learning do not suggest a universal conclusion either in favour of the part or the whole method of learning. The findings have been contradictory in that the whole method is found to yield better learning than the part-method, and sometimes, the trend has just been the opposite. **Which method is superior to the other depends on many factors including the nature of materials, subject's level of intelligence and motivation, and the relationship of one part to the other in the whole text**. The whole method facilitates the progress of learning for more intelligent and motivated subjects, for meaningful materials, and for those texts, where the parts are highly interrelated to one another. For the skills that are simple and not organized, the part-method yields better learning than the whole method.

Woodworth suggests that learning by parts is easier because it creates an opportunity for the learner to get adjusted to the demands of the task. With each part mastered, he carries over his skills and knowledge to the subsequent parts. But he finds it difficult to put the parts together, because this activity itself requires additional effort. By learning through parts, he might have saved time at the beginning, but he has to spend a great deal of time and energy to combine the parts together, particularly for tasks, which are difficult. The less intelligent and the less motivated subjects would find this activity most difficult. Practically speaking, it is advisable that one starts with the whole method and then depending on his requirement, he may seriously concentrate on any part of the task at any time, and master it fully before proceeding to learn the whole task.

Meaningfulness of Materials

The more meaningful are the materials, the easier the learning and retention. It has been consistently shown that words are better remembered than nonsense

syllables, and that the concepts and interpretations of scientific principles are retained better than the factual and separate pieces of information. Figure 5.14 describes theoretical curves for materials with varying degrees of meaningfulness.

How do we know if the materials are meaningful or not? The meaningfulness of the materials depends on (a) *familiarity and frequency of usage*, (b) the *number of associations elicited within a fixed amount of time*, and (c) *relations among the words in the list*. **Since meaningful materials evoke links with information stored in the LTM, their recall becomes easier than the meaningless materials (nonsense syllables). Ebbinghaus** was the first person to have conducted memory experiments on himself using nonsense syllables. A nonsense syllable is a meaningless set of three-letters with one vowel in between two consonants, which can be pronounced in a single articulation.

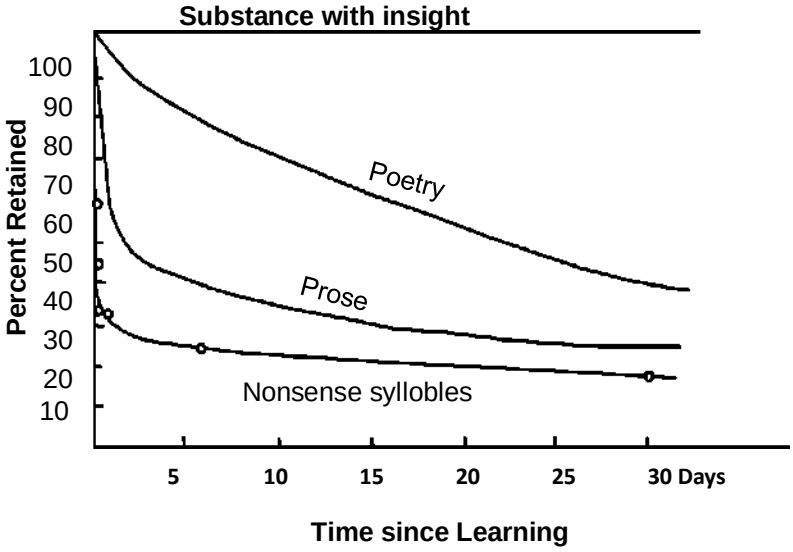


Figure 5.14 Theoretical curves for materials varying in meaningfulness

However, familiarity or associational value is not the only factor related to meaningfulness. There is also a factor of **patterning of memorization**. Meaningful materials are more likely to be organized into different groups if subjects are allowed to recall the materials freely. Bousefield demonstrated the phenomenon of category clustering, which suggests that when participants are allowed to recall freely, they recall words not in their order of presentation, but category wise. For example, if subjects are presented nine words belonging to three categories (animals, vegetables, vehicles) in the following order: potato, car bean, dog, bus, cat, pumpkin, truck, monkey, they tend to recall potato, bean, pumpkin, car, bus, truck, dog, cat,

monkey. They learn the list by placing the items into different categories. At the time of recall, the items are organized into groups, which means that category clustering occurs with meaningful, not meaningless materials. The nature and the degree of category clustering differ from person to person depending upon how meaningfully the materials are related to subject's LTM.

Interest and Attitude

With greater interest, the processing of information at the time of learning becomes deeper. At the deepest level, the information is processed semantically, and is linked by a network of associations with various cues in the LTM. Therefore, they are learned and remembered better. A person interested to play cricket or read novels or collect stamps would learn the act more quickly and maintain it for a longer period of time. **The amount of effort spent on learning the skills that are interesting is much less as the processing is automatic**.

Individuals differ in their favorite ways of learning and remembering. Materials that are not interesting are not attended to at the time of learning. Materials that are unpleasant and painful are repressed back into the deep chamber of unconscious, and therefore, are not available for conscious recall.

A learner has his unique learning style, which has been developed during the course of socialization. His approaches to the learning materials are based on his cultural background and unique pattern of abilities. Some have *analytic,* while others have *relational approach* to learning. Those with a *relational learning style* learn materials best through exposure to a full unit or phenomenon. Parts of the unit are understood only by understanding their relationship to the whole. In contrast, people with an *analytical learning style* do best when they carry out an analysis of the principles and components underlying a phenomenon. After they master the fundamental principles and components, they are best able to understand the full content. The distinction between the two learning approaches is analogous to top-down and bottom-up processing.

William James remarked that the greatest discovery of our generation is that **human beings can alter their fate by changing their attitudes of mind**. Attitude determines the subject's emotional and motivational dispositions towards the learning

material. Most cognitive and complex forms of learning are greatly influenced by whether or not the subject has the right kind of attitude towards the learning situation.

Motivation

Motivation is an internal process that activates, guides and maintains the behaviors of human beings and other organisms. A rat in the Skinner box acts in a direction so as to obtain food, because of hunger. Hunger provides it the motivation to act to satisfy its needs. As the rat acts, it learns that lever pressing brings food. Motivation, thus, is related to learning. A motivated animal or a human being would learn faster and better than a less motivated one. Although, the motivational variables have been studied extensively in animal learning experiments, much less attention been given to motivational variables in human learning. Motivation is induced into animals by depriving them of food and water. But this cannot be done with human subjects.

Why do some students obtain better grades in the examination than others? Those who perform well are better motivated, and as such, they put in more hard work to reach their goals. The nature of motivation may be extrinsic or intrinsic. A student's motivation to learn may arise from two sources, because the activity is very enjoyable, or because the activity helps him to obtain rewarding experience from the environment. **Intrinsic motivation** refers to persons' participation in an activity for their own enjoyment, not for the reward it will get them. People are said to be **extrinsically motivated** when they participate in an activity for a tangible reward. A student is intrinsically motivated when he likes to read for his enthusiasm to acquire knowledge, but is extrinsically motivated, when he reads for the sake of obtaining an external reward, such as a good job.

Research findings suggest that we are able to work harder and show higher quality performance when motivation is intrinsic, rather than extrinsic. Some psychologists suggest that providing rewards for desirable behaviors may reduce the level of intrinsic motivation resulting in less enthusiasm for work. Parents must think twice before offering monetary rewards to children for getting good report cards. Better results can come, if they are reminded of the pleasures of learning and mastering a body of knowledge. The intrinsic motivation explains why a child learns cycling

quickly without any substantial help from the parents. He does so, because he likes to do it, or in other words, he is intrinsically motivated to learn cycling.

Learning might be either incidental or intentional. **Incidental learning** occurs when individuals are engaged in doing something other than what they are required to show their competence in. Incidental learning is 'unmotivated' learning. There is no specific motive-incentive condition present to make people want to learn the incidental task. For example, students might be asked to rate the familiarity of certain uncommon words, and then be suddenly asked to recall the words they have rated. The learning of the words is incidental in nature. The learning of a target task with appropriate level of motivation is **intentional learning**. Under nearly all conditions, incidental learning is poorer than intentional learning. Such a result is due to the weaker motivation of the subjects to learn the incidental material.

The motivation will result in better learning provided that it does not cause a high level of emotional arousal in the learner, as emotion would interfere with complex performance. With increased arousal, motivation would turn to anxiety, which would not at all be helpful for learning. **What is important is that the learner must be optimally motivated and must practice the task efficiently**.

***Additional factors*.** Besides the factors mentioned above, there are many minor ones, which influence the progress of learning. A detailed discussion of how these factors influence learning is beyond the scope of this chapter. They are only mentioned here briefly for the sake of completeness and to create in you a sense of awareness regarding how the complex process of learning is influenced by a multitude of variables. These factors include recitation, use of imagery, and active participation in the learning process.

KEY TERMS

Learning	*Fixed-action Patterns*	*Behavior potential*
Reinforcement	*Maturation*	*Performance*
Classical conditioning	*Operant conditioning*	*Instrumental conditioning*
Trial-and-Error learning	*Cognitive leaning*	*Insightful learning*
Observational learning	*Learning by imitation*	*Law of effect*
Law of exercise	*Law of readiness*	*Law of multiple responses*
Law of selective responses	*Law of analogy*	*Law of set or disposition*
Law of associative shifting	*Law of belongingness*	*Law of spread-of-effect*
Neutral stimulus	*Unconditioned stimulus*	*Conditioned stimulus*
Unconditioned response	*Conditioned response*	*Simultaneous conditioning*
Delayed conditioning	*Trace conditioning*	*Backward conditioning*
Acquisition	*Extinction*	*Spontaneous recovery*
Stimulus generalization	*Stimulus discrimination*	*External inhibition*
Higher-order conditioning	*Blocking*	*Counter-conditioning*
Implosive therapy	*Flooding*	*Systematic desensitization*
Aversion therapy	*Rate of response*	*Response probability*
Positive reinforcement	*Negative reinforcement*	*Punishment*
Omission training	*Successive approximations*	*Primary reinforcement*
Secondary reinforcement	*Instinctive drift*	*Partial reinforcement*
Continuous reinforcement schedule	*Fixed-ratio schedule*	*Fixed-interval schedule*
Variable-interval schedule	*Variable-ratio schedule*	*Discriminative stimulus*
Stimulus control	*Intrinsic motivation*	*Latent learning*
Place learning	*Contrast effect*	*Behavior modification*
Biofeedback	*Computer-assisted instruction*	*Programmed instruction*
Massed trials	*Distributed trials*	*Whole method*
Part-method	*Incidental learning*	*Intentional learning*

SUMMARY

1. *Learning is a relatively permanent change in behavior or behavior potential produced by experience*. It is a process that must be assessed indirectly.

2. *Maturation is a process of growth and development.* Learning is different from maturation, and both interact in producing most of human behaviors. Performance provides an index for learning, but all learning may not always be translated to performance.

3. The three basic forms of learning processes are *classical conditioning, operant conditioning,* and *cognitive learning* which includes *insightful learning* and *observational learning*. *Trial-and-error learning* is a form of instrumental conditioning. Insightful learning is a cognitive learning based on the interactive influence of all the three basic processes.

4. The trial and error learning experiments conducted by Thorndike suggest that animals learn stimulus-response connections mechanically without any understanding. Learning involves gradual strengthening of the correct response and weakening of the incorrect ones over trials. Thorndike proposed *Law of Effect, which states that the tendency to perform a response is strengthened, if it is followed by reward, and weakened if it is not.*

5. Besides the Law of Effect, Thorndike's laws of learning included (a) *Law of Exercise* (b) *Law of Readiness*, (c) *Law of Multiple Responses*, (d) *Law of Selective Response* (e) *Law of Set or disposition*, (f) *Law of Response by Analogy*, (g) *Law of Belongingness* and (h) *Law of Spread of Effect*. Thorndike's laws laid the groundwork for modern learning theories.

6. The basic form of learning is classical conditioning, which was discovered by Pavlov. Classical conditioning involves establishing a connection between a stimulus and a response, which are not naturally linked. The neutral stimulus

(*conditioned stimulus*) by being constantly paired with a stimulus (*unconditioned stimulus*) that evokes a natural response (*unconditioned response*), acquires the potentiality of evoking a same/ similar response (*conditioned response*).

7. The *time interval* between the CS and the UCS significantly influences the rate of conditioning. Among the four types of conditioning based on CS-UCS interval the *delayed conditioning* is the most effective followed by *trace, simultaneous,* and *backward conditioning*. A CS-UCS interval of .5 seconds produces optimal conditioning.

8. The basic processes in classical conditioning are: *acquisition, extinction, spontaneous recovery, generalization, discrimination,* and *higher-order conditioning*.

9. The rate of learning is affected by (a) *CS-UCS interval*, (b) *CS intensity*, (c) *UCS intensity*, and (d) *the reliability of the CS in predicting UCS*. The measures for the strength of acquisition are: *response rate, response magnitude, response latency,* and *resistance to extinction.*

10. *Extinction* occurs when a previously learnt response decreases in frequency and eventually disappears. Extinction is not a passive process. Following a rest period after extinction, the response is partially recovered. This is known as *spontaneous recovery.*

11. *Stimulus generalization* occurs, when the organism responds to stimuli similar to the conditioned stimulus. The greater is the similarity between the new stimulus and the conditioned stimulus, the greater the likelihood of generalization. The converse phenomenon, *stimulus discrimination* occurs when the organism learns to respond to one stimulus and withhold the response to another. Generalization is reaction to similarities, but discrimination is reaction to differences.

12. During conditioning, if a novel stimulus is presented along with the CS, the strength of the CR reduces. This is known as *external inhibition*, and the new stimulus, the external inhibitor.

13. *Higher-order conditioning* occurs, when the CS is used as a UCS for further conditioning. The neutral stimulus by being paired with the CS tends to evoke the original conditioned response.

14. Pavlov explained classical conditioning in terms of *stimulus substitution* (the CS works as a substitute to the UCS). The contemporary psychologists believe that given the CS, the organism expects that the UCS would come. Thus CS is not a substitute, but a signal for the UCS.

15. Classical conditioning explains the acquisition of emotional behaviours and phobia, which can be treated by *counterconditioning* consisting of *implosive therapy, flooding, systematic desensitization,* and *aversion therapy.*

16. *Operant* or *instrumental conditioning* occurs when behaviour is affected by its consequences. Moving from Thorndike's early research and statement of the Law of Effect, Skinner developed operant conditioning. When behaviour is followed by reinforcement, its probability of recurrence increases. *Primary reinforcers* are naturally effective, as they satisfy biological needs. Stimuli that acquire reinforcing properties by being associated with the primary reinforcers are known as *secondary reinforcers*.

17. *Positive reinforcers* lead to an increment in the preceding response. *Negative reinforcers* are stimuli that remove something unpleasant from the environment. *Punishment* is the administration of an unpleasant stimulus following a response. Removal of a positive reinforcer works as punishment. Punishment is meant to decrease or suppress behaviour.

18. Operant conditioning involves the principles of time-interval, shaping and chaining, primary and secondary reinforcement, schedules of reinforcement, as well as extinction, generalization and discrimination.

19. *Schedules of reinforcement* are the rules determining the timetable for reinforcement delivery. Generally, *partial reinforcement schedules* (when reinforcement is not delivered on every trial) produce stronger and longer-lasting learning compared to the *continuous reinforcement schedules*.

20. In explaining how the operant conditioning works, Skinner believes that the external reinforcement determines and controls the behaviour of the organism. The cognitive theorists cite the phenomena of *latent learning, place learning* and *contrast-effect* to provide supportive evidence for their belief that operant conditioning involves understanding, forming of mental representations and expectations regarding the consequences of the behaviour.

21. The principles of operant conditioning are used for *behaviour modification*, which consist of changing maladaptive behaviours in favour of the adaptive ones. Operant conditioning principles are used for *biofeedback, programmed instruction,* and *computer-assisted instruction.*

22. The classical conditioning is S-S type learning, where usually an involuntary response is elicited by the reinforcement with the organism playing a passive role. On the other hand, operant conditioning is S-R type of learning, where a voluntary response emitted by the organism is followed by reinforcement with the organism playing an active role. The classical conditioning is learning by contiguity, while operant conditioning is governed by the Law of Effect.

23. *Cognitive learning* refers to the way information is processed as a result of organism's experience, and includes *insightful learning* and *observational learning* or *learning by imitation*.

24. The Gestalt psychologists studied the role of understanding and insight in learning. Insightful solution comes all on a sudden and is based on subject's understanding of the relationships among various aspects of the environment. The transferability of the insightful solution is very high.

25. *Insightful learning* is different from *trial-and-error learning*. The trial-and-error learning is of S-R type, where learning is gradual; response is molecular, organism's role mechanical, and transfer of learning poor. Insightful learning is of S-S type, where learning is sudden, response is molar, organism's role active, and transfer is quick.

26. *Observational learning* occurs when an individual learns from some one else's behaviour. In order for such learning to occur, we must pay attention to other person's behaviours, remember the behaviour, and convert our mental representation to actual performance with proper motivation.

27. Observational learning explains how young minds may be inclined to show new ways of aggression after exposure to violence in TV and films. When children are explicitly taught that TV violence is unreal, they tend to benefit from these lessons.

28. The learning of concepts, principles, and language characterizes human learning, which is far more complex than simple conditioning and observational learning. Human learning is influenced by many factors including (a) *feedback,* (b) *distribution of practice trials*, (c) *whole and part method of learning*, (d) *meaningfulness*, (e) *interest and attitude,* and (f) *motivation*.

29. Learning is more effective and better maintained if immediate *feedback* is given regarding the consequences of the learning activity. The nature of feedback may range from biofeedback to receiving knowledge of results regarding a mental performance.

30. The *distributed practice* trials result in faster learning compared to the *massed* trials for simple conditioning as well as for complex forms of verbal learning. This happens because the inter-trial rest periods allow fatigue to dissipate, the neural traces to become more organized and consolidated, and the incorrect associations to fade away.

31. It cannot be conclusively said that the *part method* of learning is better than the *whole method*. The superiority of one method over the other depends on many factors including the nature of materials, subject's level of intelligence and motivation, and the relationships among the parts.

32. The meaningful materials are better learned and retained than the meaningless materials, and allow category clustering to take place at the time of recall.

33. With greater interest, the processing of information becomes deeper, and consequently, learning better and quicker. Persons with different attitudes and learning styles show unique differences in the way they master the learning materials.

34. Appropriate level of *motivation* quickens learning. Persons work harder and show higher quality performance when motivation is *intrinsic* rather than *extrinsic*. If motivation causes high degree of arousal and turns into anxiety, it interferes with learning.

QUESTIONS

A. True-False Questions

(State whether each of the following statements is True (T) or False (F))

1. Extinction occurs due to forgetting of the CR.

2. Reinforcement follows the response in instrumental conditioning.

3. Kohler developed insightful learning.

4. Solution comes all on a sudden in insightful learning.

5. Learning sometimes refers to change in behaviour as a result of fatigue.

6. Learning is dependent only on practice.

7. Any change in behaviour is called learning.

8. The trial-and error learning was introduced by Pavlov.

9. Salivation in classical conditioning is the conditioned stimulus.

10. In instrumental conditioning, the organism acts on the environment.

11. If a pat on the back makes a student work faster, the pat is called a reinforcer.

12. The CS-UCS interval should be long for effective conditioning.

13. Maturation fully depends on learning.

14. In trial-and error learning, the mistakes are gradually reduced through practice.

15. Maturation is a necessary condition for learning.

16. Reward seldom influences learning.

17. When a CS no more elicits a CR, the process is known as learning.

18. Acquiring a bad habit is also an instance of learning.

19. Maturation provides a necessary but not sufficient condition for learning.

20. Theoretical definitions describe the processes underlying learning.

21. Pavlov discovered the principle of trial-and-error learning.

22. The dog is instrumentally conditioned to salivate to the bell.

23. A stimulus that naturally evokes a response is called a conditioned stimulus.

24. The conditioning is the best when the CS precedes the UCS by about .5 seconds.

25. The strength of acquisition is known from the rate of responding.

26. Disappearance of the CR because of non-reinforcement is called discrimination.

27. The phenomenon of spontaneous recovery suggests that extinction is the same thing as forgetting.

28. Through generalization, a person learns to respond to similar stimuli in similar ways.

29. Discrimination is a complementary process to generalization.

30. Money is a primary reinforcer.

31. Classical conditioning is otherwise known as stimulus-substitution.

32. The CS serves as signal for the UCS.

33. Irrational fear is acquired through classical conditioning.

34. Fear can be reduced through counterconditioning.

35. The Law of effect was propounded by Skinner.

36. Negative reinforcement is called punishment.

37. In partial reinforcement, the response is not rewarded every time it occurs.

38. Cognitive theorists view learning as an active organizing of information.

39. Tolman conducted experiments on place learning.

0. The principles of operant conditioning are used to modify behaviour.

41. The instrumental conditioning is S-R type learning.

42. The CR and the UCR are exactly the same.

43. In classical conditioning, the response is given after the reinforcement.

44. The organism plays a passive role in classical conditioning.

45. The instrumental learning is S-S type of learning.

46. Transfer of insightful learning is quicker and easier.

47. In insightful learning, the organism's reaction is molecular in nature.

48. Certain amount of trial-and-error activity precedes insightful learning.

49. Thorndike proposed the Law of Effect.

50. Skinner introduced the theory on trial-and-error learning.

51. Meaningful materials are more likely to be organized into different sets at the time of recall.

52. Extinction is faster if the trials are massed.

53. Reading for the sake of enjoyment is an example of extrinsic motivation.

54. Anxiety interferes with the progress of learning.

55. Incidental learning is poorer than intentional learning.

56. Feedback maintains the person's motivation to learn.

57. The processing of information becomes deeper with greater interest.

58. Massed method results in better learning than the distributed method.

59. The rest period in between learning trials helps consolidation of neural traces.

60. Part method of learning is always better than the whole method of learning.

61. Learning is a cognitive process.

62. Thorndike was a behaviorist.

63. Salivation to bell is a conditioned response.

64. Latent learning supports cognitive explanations of learning.

B. Multiple-Choice Questions

(Choose the correct alternative from the bracket to fill up the blank or answer the question)

1. In classical conditioning, the food is the_____.(conditioned response, unconditioned stimulus, orienting response, conditioned stimulus)

2. In _____schedule, reinforcement is given in 5 to 1 response pattern. (variable-ratio, fixed-ratio, variable-interval, fixed interval)

3. The Law of effect was introduced by____. (Skinner, Thorndike, Pavlov, Kohler)

4. ____ is one of the important conditions for operant conditioning. (interest, intelligence, practice, punishment)

5. Mirror drawing apparatus is used for____learning. (social, maze, sensory-motor, serial)

6. Undesirable behavior is removed by_____. (counterconditioning, punishment, positive reinforcement, backward conditioning)

7. The trial-and-error leaning was introduced by____. (Wertheimer, Thorndike, Skinner, Pavlov)

8. Skinner box is used in _____.(problem solving, creative thinking, verbal learning, skill learning)

9. In classical conditioning, a specific stimulus is used to____ a specific response. (emit, elicit, suppress, regulate)

10. When a CS no more elicits the CR, the process is known as____. (suppression, generalization, forgetting, extinction)

11. Conditioning method was introduced by _____.(Freud, Pavlov, Thorndike, Skinner)

12. For effective conditioning, the CS-UCS interval should be____ seconds. (.5, 1, 1.1, 5)

13. The child learns to open a lock through a number of trials. This is due to learning by_____. (classical conditioning, trial-and-error, instrumental conditioning, insight)

14. The reappearance of an extinguished response after a rest period is known as_____. (reconditioning, spontaneous recovery, acquisition, discrimination)

15. Conditioning takes place due to close temporal contiguity between____. (CS and UCS, CS and CR, UCS and UCR, UCS and CR)

16. Which of the following is not an important condition for learning to take place? (contiguity, punishment, reinforcement, practice)

17. _____is not a learning theorist. (Maslow, Skinner, Tolman, Kohler)

18. The dog's salivation to the bell is a____. (CR, UCR, orienting response, natural response)

19. When the UCS is presented before the CS, it is known as _____ conditioning. (backward, simultaneous, delayed, trace)

20. Which of the following is not a measure of the strength of acquisition? (CS-UCS interval, response rate, resistance to extinction, response magnitude)

21. Which of the following indicates that extinction does not take place because of forgetting of the CR? (generalization, spontaneous recovery, discrimination, higher-order conditioning)

22. Responding to similar stimuli in similar ways is a case of ____. (discrimination , higher-order conditioning, conditioning, generalization)

23. _____is a complementary process to generalization. (discrimination, acquisition, extinction, inhibition)

24. When conditioning is done, the bell serves as a _____. (primary reinforcer, secondary reinforcer, natural stimulus, discriminative stimulus)

25. Pavlov termed classical conditioning as_____. (stimulus control, stimulus substitution, stimulus-response connection, none of these)

26. Albert's fear for the white rat was established through____. (operant conditioning, classical conditioning, counter conditioning, observational learning)

27. Distributed method of learning allows _____ to dissipate during the rest period (interest, neural traces, fatigue, excitation).

28. Learning for the sake of acquiring knowledge is an example of _____. motivation (extrinsic, intrinsic, social, psychological).

29. Trial-and-error learning provided the foundation for _____. (operant conditioning, insightful learning, observational learning, classical conditioning)

30. The gambling behavior is maintained through _____ schedule of reinforcement. (fixed-ratio, variable-ratio, fixed-interval, variable-interval)

C. Short-Type Questions

(Write the answer to each question in five sentences)

1. Define learning operationally.

2. How is learning different from maturational changes?

3. What is extinction?

4. Briefly explain the classical conditioning procedure.

5. What is meant by schedules of reinforcement?

6. Distinguish insight from trial-and-error learning?

7. What is spontaneous recovery?
8. Explain implosive therapy.
9. Explain the concept of reinforcement.
10. Distinguish between learning and performance.
11. What is the Law of Effect?
12. What is generalization?
13. Name the factors influencing learning.
14. What is discrimination?
15. How does time-interval influence classical conditioning?
16. What does the organism learn in classical conditioning?
17. Briefly state the stages of insightful learning.
18. What is systematic desensitization?
19. What is shaping?
20. What is the contribution of Kohler?
21. What is the contribution of Skinner to learning?
22. How do cognitive theorists explain the role of reinforcement in operant conditioning?
23. What is behavior modification?
24. Which results in better learning - intrinsic or extrinsic motivation?
25. What is Law of Exercise?
26. What is cognitive learning?
27. State the key factors in observational learning.

28. How does motivation influence learning?

29. Is distributed learning better than massed learning? Why?

30. Briefly explain trial-and error learning.

31. How does feedback influence the progress of learning?

32. How does meaningfulness of materials affect the rate of learning?

33. Is whole method better than part method of learning?

D. Essay-Type Questions *(Write long answers)*

1. What is learning? Describe the conditioning experiment of Pavlov and the processes associated with it.

2. Define learning operationally. Discuss the operant conditioning experiment and the contributions of Skinner to the field of learning.

3. Describe the classical conditioning procedure and explain what is learned in classical conditioning?

4. How are the classical conditioning principles applied to understand and control human behavior?

5. What is learning? Compare the procedures and principles of classical and instrumental conditioning.

6. What is operant conditioning? Discuss some basic aspects of operant conditioning.

7. Explain the phenomenon and laws of trial-and-error learning.

8. Discuss the characteristics and stages of insightful learning citing Kohler's experiments.

9. Distinguish between trial-and-error and insightful learning.

10. What is cognitive learning? Discuss the phenomenon of observational learning.

11. Discuss the factors influencing the progress of learning.

ANSWERS

A. True-False Questions:

1. F **2.** T **3.** T **4.** T **5.** F **6.** F **7.** F **8.** F **9.** F **10.** T **11.** T **12.** F **13.** F **14.** T **15.** T **16.** F **17.** F **18.** T **19.** T **20.** T **21.** F **22.** F **23.** F **24.** T **25.** T **26.** F **27.** F **28.** T **29.** T **30.** F **31.** T **32.** T **33.** T **34.** T **35.** F **36.** F **37.** T **38.** T **39.** T **40.** T **41.** T **42.** F **43.** T **44.** T **45.** F **46.** T **47.** F **48.** T **49.** T **50.** F **51.** T **52.** T **53.** F **54.** T **55.** T **56.** T **57.** T **58.** F **59.** T **60.** F **61.** T **62.** T **63.** T **64.** T

B. Multiple-Choice Questions :

1.	unconditioned stimulus	2.	fixed-ratio	3.	Thorndike	4.	practice
5.	sensory-motor	6.	counter onditioning	7.	Thorndike	8.	skill learning
9.	elicit	10.	extinction	11.	Pavlov	12.	.5
13.	trial-and-error	14.	spontaneous recovery	15.	CS and UCS	16.	punishment
17.	Maslow	18.	CR	19.	backward	20.	CS-UCS interval
21.	spontaneous recovery	22.	generalization	23.	discrimination	24.	secondary reinforcer
25.	stimulus substitution	26.	classical conditioning	27.	fatigue	28.	intrinsic
29.	operant Conditioning	30.	variable-ratio				

Chapter 6

HUMAN MEMORY

This chapter covers :

a) Memory Process
   - **i)** Encoding
   - **ii)** Storage
   - **iii)** Retrieval

b) Kinds of Memory
   - **i)** Episodic Memory
   - **ii)** Semantic Memory
   - **iii)** Procedural Memory

c) Three Systems of Memory
   - **i)** Sensory Memory
   - **ii)** Short-Term Memory
   - **iii)** Long-Term Memory

d) Measurement of Memory
   - **i)** Recall
   - **ii)** Recognition
   - **iii)** Saving or Relearning

e) Forgetting
   - **i)** Encoding failure
   - **ii)** Storage failure
   - **iii)** Retrieval failure

f) Improving Memory- Mnemonics: Method of Loci, Number and Letter Peg system. Chunking

After you go through this chapter, you would be able to:

- *Understand the nature of memory from an information-processing perspective.*
- *Describe the types of information stored in memory.*
- *Distinguish between sensory, short-term, and long-term memory.*
- *Explain the methods for measuring memory.*
- *Understand the nature and causes of forgetting.*
- *Know some of the ways of improving memory.*

CONTENTS

Human Memory

Introduction

Memory is an important cognitive process, which helps us to record the past so that we can refer to it later, as and when required. Without memory, there would be no past, but only the present. We would not be able to execute all the psychological processes that depend on our past experiences. We would be perpetual beginners for every activity that we perform everyday. If we do not retain information over time, and retrieve it for present use, we would not be able to recall names, recognize faces, and understand the concept of time. Even the present would not be our own, because there would be no concept of self-identity. An individual would wake up every morning, and doubt who he is, and would have to rediscover his identity every day, every hour, every second, and even every millisecond. The identity of the individual would be lost, and the whole world including him would appear to him as a booming buzzing confusion.

The feeling of personal identity is based on a continuous stream of memories that link our yesterdays to today. Since memory is an important cognitive phenomenon, psychologists have devoted considerable time and effort to understand the process of memory, and the strategies to improve memory. ***Memory is the retention of information over time***. It has to be retrieved from its store for present use.

Psychologists and philosophers have opined differently at different times on the concept of memory. But the contemporary cognitive psychologists are of the belief that the raw physical energy that impinges upon the sense organs is transformed, and passes through various stages consisting of sensory memory, short-term memory and long-term memory. Here the basic or initial information is successfully modified and reduced.

Hermann Ebbinghaus published a book titled '*On Memory'* in the year 1885. This book opened the avenues for further research on memory. Before Ebbinghaus,

there had been only speculative discussions on memory by the philosophers. **Plato** (427-347 B.C.) believed that "*the mind is a block of wax into which sensory experiences can be imprinted*". **Aristotle** opined, "We remember things by virtue of contiguity, similarity, and contrast. Further experiences are transmitted by the blood and that memory is stored in the heart".

The conceptualization of memory underwent several transformations, but all were philosophical in nature until **Hermann Ebbinghaus** (1885) carried systematic research on the assessment of memory. Before him, it was thought that the effect of higher mental functions can only be observed, but cannot be measured. The assessment of memory started with the initial experiments of Ebbinghaus, who collected most of the evidences by experimenting on himself. Ebbinghaus himself memorized and then recalled hundreds of lists of nonsense syllables (meaningless combinations of letters having no association value, such as XOQ, and ZOF). His findings about how materials are remembered or forgotten stood the test of time. One of his important findings is that at first, forgetting is very rapid; gradually the rate of forgetting slows down. The contemporary psychologists accept memory as a process in which information is registered, processed, stored, and retrieved, when needed.

What is Memory?

Memory is the retention of information over time. It is a crucial aspect of cognition, as it provides the basis for all cognitive processes. The term 'memory' has been derived from the Latin word, '***memoria***', which means *historical account* or *long remembrance*. Modern approach to memory has gone far beyond the simple yet significant beginnings made by Hermann Ebbinghaus (1885). The contemporary psychologists take an information processing view of memory, which relies on the computer as a model. Like computers, the human mind receives information from the external world, stores it in some form for a period of time, and recalls it, when needed. ***Memory may be defined as a process by which we encode, store, and retrieve information.*** As you will know later, there are three distinct memory systems, which carry out the basic functions of *encoding, storage,* and *retrieval*. These three interrelated components of memory are discussed below (see Figure 6.1).

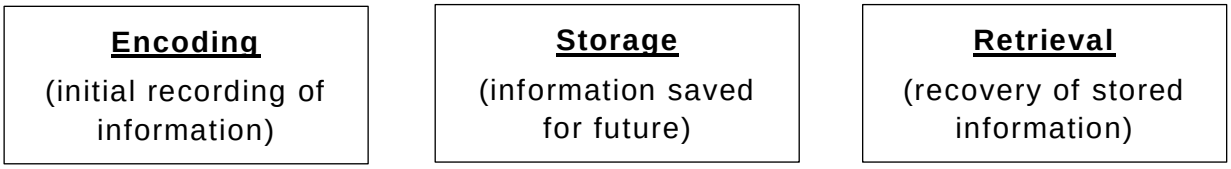


Figure 6.1 : *Three basic processes of memory*

Encoding

Encoding refers to the processes through which information is converted to a form that can get an entry into memory system. The information from the external world is received in the form of physical energies, and transformed into a neural code that the brain can access. At the time of reception, certain strategies are used for efficient encoding. These strategies consist of rehearsal or practicing the information, organizing it into different groups or chunking, and relating it to the already stored information. The nature of storing information, and its retrieval for later use depend to a large extent on how the information was coded in the first place. **Encoding, thus, may be considered as an active process of representing information in the memory system**.

Storage

Storage refers to retaining the encoded information in memory over a period of time. If the information were not stored, it would not be available for later use. The storing takes place in the form of neural traces. The encoded information tends to be lost, when it cannot be linked to already stored information. The stored information is to be periodically practiced or used for retaining it for a longer period of time. Depending on the utility of the information, some are only stored for a short period of time. Thus, **storage refers to the holding of the information in the memory system for future use**.

Retrieval

Retrieval refers to the process of recovering the stored information from memory. Even if information were stored in memory, it would be of little use, if it cannot be accessed at the time of need. Whether or not the stored information can be

easily accessed depends on how the information was encoded and stored. When you meet a friend of yours after a long gap and are able to recognize him and remember his name, you are retrieving information from your long-term memory. The two most common methods of testing retrieval are recall and recognition. Recall means reproducing the information already in memory, while recognition means identifying the present stimuli as having been learned earlier. The encoding and storage would be of little help, if we were not able to recover information from memory storage at the time of our need.

Memory Systems

In late 1960s, many researchers in the field of memory believed that human memory model is based on the connectionist approach. Martindale (1991) viewed that the information processing explanation of memory is a well-researched framework for examining human learning and memory. Information processing view of memory uses computer as a model for understanding memory systems, though human memory and computer memory are definitely not identical (Lewandoswky & Murdock, 1989). Like the computer, the human mind takes in information, performs operation on it to change its form, stores the information, retrieves it when needed, and generates responses. The three basic tasks that are performed in this process are *encoding, storage,* and *retrieval*.

Several important models of memory, which rest firmly on this (information processing) approach, have been proposed. Of these, the model proposed by **Atkinson and Shiffrin** (1968) is the most influential one. According to this model, there are three kinds of memory systems: (i) **sensory memory** (sensory register), (ii) **short-term memory,** and (iii) **long-term memory.** These storehouses vary in terms of their functions and the length of time they retain information.

In the **Atkinson-Shiffrin model** (see Figure 6.2), memory starts with a sensory input from the environment. This is held for a brief period of time (a fraction of a second). Information that is attended to and recognized in the sensory register may be passed on to the **short-term memory (STM),** where it is held for **15 to 25 seconds**. Some of the information reaching short-term memory is processed by being rehearsed again and again, and then passed on to the long-term memory, and information not so processed is lost.

When items of information are placed in **long-term memory**, they are organized into categories, where they may reside for days, months, and years or for a lifetime. When you remember something, you first search for it in the STM; if it is not found there, you begin searching in the LTM. The mental representation of the item is retrieved from the LTM, and transformed to the STM, where you can then consciously deal with it. A diagrammatic representation of such a model is given in Figure 6.2. The three memory systems are discussed separately below.

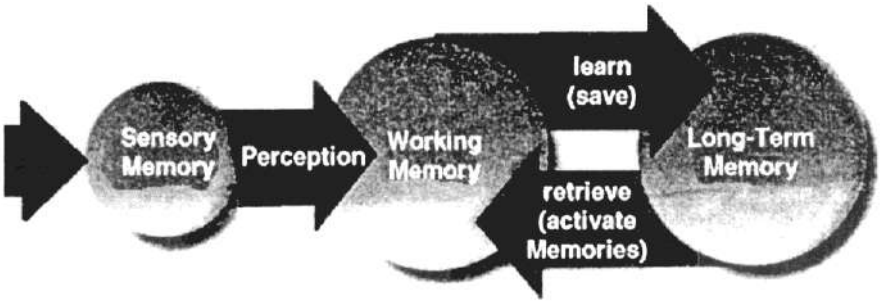


Figure 6.2 Three distinct memory systems

Sensory Memory

Sensory memory is the initial momentary storage of information lasting only an instant. Sensory memory, also known as '**sensory buffer'** or '**sensory register'** refers to the recorded or transcribed raw physical input. Stimuli from the environment (sights, sounds, smells etc.) constantly bombard our receptors. Receptors are the body's mechanisms for seeing, hearing, tasting, smelling, and feeling. The sensory memory holds all these sensations for a brief period of time until such information are transformed to other memory stores. If the

transfer is not virtually instantaneous then the information gets lost.

It is generally accepted that there are as many sensory memories as are sensory registers. But the researchers have mainly focused on the *visual* (**iconic**), and *auditory* (**echoic**) sensory memories. The following are a few important basic characteristics of sensory memory: (i) The capacity of the sensory memory is very large, (ii) The duration of sensory memory is fragile (short duration), (iii) The content of sensory memory resembles the sensations from the original stimulus, (iv) The visual sensory register holds information for less than a second and (v) The auditory memory lasts for up to 2 to 4 seconds. If information from the sensory memory does not pass to the short-term store, it is lost for good.

Short-Term Memory

It is the memory system that holds limited amount of information for relatively a short period of time. After the information is processed from the sensory store, and has been recognized and attended, it moves into short-term memory. But the sensory information does not reach the short-term memory directly; rather it reaches in a coded form. Once noticed and transformed into patterns of images or sounds, the information in sensory memory is readily available for further processing. Short-term memory is otherwise known as '**working memory**', which is the 'workbench' of the memory system, the component of memory where new information is held temporarily and combined with knowledge from the long-term memory. Unlike sensory memory, working memory is temporary, active and conscious and is like the workspace or screen of a computer- its content is activated information or what you are thinking about at the moment. For this reason, some psychologists consider the working memory to be synonymous with 'consciousness'. When you hear the telephone number of your friend, you store it for a short period of time in your STM.

According to **Broadbent** (1958), STM is interpreted as a bioelectric process in the form of a close neural circuit and is strongly susceptible to forgetting (*filter effect*), and interfering influences. Short-term memory is more selective and more permanent than sensory memory. It is quite possible to retain information in working

memory through **maintenance rehearsal processes** by repeating the information to oneself.

Short-term memory or working memory has certain characteristics. They are:

1. ***The storage capacity of STM/working memory is quite limited***. Some psychologists argue that working memory is limited not by the number of bits of information it can store, but by the amount of information it can hold in a rehearsal system of about 15 seconds. The STM can hold seven units of information or items plus or minus two, i.e., 7 + 2.
2. Thus, ***the duration of information, in the working memory lasts for about 15 to 20 seconds***. This is why working memory has been called 'short-term memory'. Keele (1973) found from his experimental study that material in STM disappears in 15 to 25 seconds if it is not practiced.
3. ***The content of information in working memory may be in the form of images or may be structured more abstractly, based on meaning.*** According to Baddeley (1986) and Jurden (1995), there are actually two working memory systems: one for language based information, and another for nonverbal, spatial and visual information. Craik and Lockhart (1972) viewed that there are two types of rehearsals involved in the process. They are- **maintenance rehearsal**, which involves repeating the information in one's mind like remembering phone numbers, and **elaborative rehearsal**, which involves connecting the information by associating it with something else that one has already come across. For example, suppose you meet a person on the road whose appearance looks like

that of your brother. In order to keep him in your memory, one has to make the association of appearance of the brother with the person. Rehearsal, thus, plays the role of executive control process that affects the flow of information through the information processing system. So, the information from the environment reaches the sensory memory, and after screening, reaches the working memory where it is rehearsed over and over to ourselves, and after enough of such rehearsal, it goes into long-term memory.

Long-Term Memory

It is the memory system that stores large amount of information over a long period of time. Long-term memory is the third stage of memory. It is a permanent storehouse of memory having unlimited capacity of storage. Long-term memory holds the information that is well learned. For example, recalling the telephone numbers of all of your friends is an example of LTM. Thus, long-term memory is the memory system for the retention of large amount of materials over long period of time. It may be noted that the information enters working memory very quickly. To move information into long-term memory requires more time and a bit of effort. But once the information is stored in the long-term memory, it remains there permanently for days, weeks, months, years and even a lifetime. In the long-term memory, the information is stored in an organized, categorized and classified manner.

Psychologists suggest that information is stored in long-term memory as either visual images or verbal units or both. Psychologists who agree with this point of view believe that information coded both visually and verbally is easier to learn. Long-term memory represents permanent

changes in the brain. When we think about memory, we generally mean long-term memory. It includes almost anything that you remember which is essential for your self-identity and proper functioning. The long-term memory can be *episodic, semantic,* or *procedural*. These three types of long-term memory are discussed later in this chapter.

Distinctions between Short-term memory (STM) and Long-term memory (LTM)

The short-term memory differs from the long-term memory in the following ways:

1. ***Short-term memory is viewed as a rapidly decaying system.*** Most psychologists believe that short-term memory does not involve permanent changes in the brain. However, some temporary changes occur in this case. The physiological nature of the traces is such that they fade quickly. ***The long-term memory appears to be permanent.*** A permanent change occurs in our brain when we remember things for a longtime. Long-term memory has a more or less enduring impression on the brain. Because of the consolidation of traces, the traces are relatively permanent.
2. Short-term memory has limited storage capacity resistant to overcrowding in any form. ***It just cannot take any overload***. On the other hand, ***long-term memory is limitless for all practical purposes***. Any information transferred from short-term memory to long-term memory will have a place for permanent storage.
3. ***Short-term memory is an active system involving rehearsal***. We need to keep the items actively in STM relearning them constantly. On the other hand, ***the***

long-term memory is rather passive in nature; it is not easily disturbed by interruption, unlike short-term memory.

4. Long-term memory differs from short-term memory in the kind of information that is most easily stored. ***Information is usually stored in short-term memory in terms of the physical qualities of the experience*** (what we see, do, taste, touch, hear etc.) with a special emphasis on acoustic (sense of hearing) codes. Although sensory memories can be stored in long-term memory, ***information is primarily stored in LTM in terms of its meaning or semantic codes.***

5. There is a difference between long-term memory and short-term memory in the process of recall. ***When we are looking for a bit of information in STM we scan the entire contents of this store***. But as the amount of information stored in long-term memory is lost, ***we cannot scan the entire contents of the LTM,*** when we are looking for a bit of information. We use a cue relevant to the information we need and retrieve only that information instead of the entire contents of LTM.

6. Short-term memory also differs from long-term memory in the way forgetting occurs. ***Short-term memory is characterized by trace dependent forgetting***. If information is not rehearsed or processed immediately, then the memory transformed by the information fades rapidly and the item is permanently lost or completely erased from the memory. In contrast, ***long-term memory is characterized by cue dependent forgetting.*** The information is permanently recorded in LTM. But our ability to retrieve it depends upon having the appropriate

cues.

7. The different stages of memory are handled by different parts of the brain. ***Short-term memory is primarily a function of the frontal lobe of the cerebral cortex***, while information that is stored in long-term memory is first held in the ***hippocampus*** and then transferred to the ***areas of the cerebral cortex involved in language and perception for permanent storage***.

There is no universal acceptance of a distinction between short-term memory and long-term memory. However, clinical evidence from patients suffering from **Korsakoff's syndrome** (where chronic alcoholism produces both *retrograde* and *anterograde* amnesia) or from severe head injury shows that short-term memory in such occasions is severely impaired while the long-term memory remains intact.

It is to be remembered that even though short-term memory and long-term memory are conceptually different from one another, they are highly interdependent. **Rehearsal in STM leads to memories in. LTM and LTM is necessary for STM encoding**.

Kinds of Long-Term Memory

If memory is a storehouse of information, what kind of information does it store? It stores a wide variety of information. After careful research, psychologists have tried to categorize LTM into distinct categories. A comprehensive classification given by **Tulving** suggests that there are three types of long-term memory: (i) *episodic memory*, (ii) *semantic memory*, and (ii) *procedural memory*.

Episodic Memory

Episodic memory refers to the memories of the

events that we have experienced personally. Since, this stores biographical details of our individual lives, it is also known as **autobiographical memory**. It allows us to move back in time so as to locate what was the event, and where and when the event took place. Our childhood memories are episodic in nature. Which was your happiest birthday? When did you go to the movie the last time? What happened during the get together of your friends last year? These and many other similar experiences are contained in the episodic memory.

Episodic memory usually has an emotional content. When past personal experiences are recalled, the earlier events are experienced partly at the conscious level. The very pleasant or the very painful experiences are remembered better than the non-emotional events. Episodic memory can be surprisingly detailed. It is also true that the episodic memory is prone to forgetting. Everyday, we experience innumerable events of which only some are important. The unimportant ones are quickly forgotten. Extremely significant and emotional experiences are almost permanently stored in memory. In episodic memory, the events are recalled and experienced through a process of reconstruction. Every time the past experience is recalled, it gets more coherent and abridged. Sometimes the event gets distorted. **Hence, episodic memory may not always be a reliable reproduction of earlier personal experiences**.

Semantic Memory

Semantic memory is the sum total of our general abstract knowledge about the world. It stores the basic meanings of words and concepts, and the understanding of the formal rules to deduce other facts and solve problems. All that you would learn and store in your memory after reading this chapter is semantic memory. It is somewhat like a mental

dictionary of facts and principles. **The semantic memory is hardly dependent on the time and place of the experience**. Those who participate in television quiz shows have rich semantic memory. Semantic memory allows us to operate on events and situations that are not experienced directly through senses.

Procedural Memory

This memory system stores information regarding how things are done. It is sometimes referred to as **non-declarative memory**. On many occasions, we remember how a skilled action is performed, but fail to express it verbally. These experiences are stored in the procedural memory. This memory system refers to memories for skills and habits such as riding a bicycle or playing cricket. It is primarily the result of basic learning processes. One can consciously recall the skill memories during the early phase of performance. With increasing practice, the skill becomes automatic. The experts perform advanced level skill without consciously recalling the appropriate skill memories. **Procedural memory is important, because without it, we would not be able to retain many skills once they are learned**.

Measurement of Memory

Memory is an internal and unobservable process. At times we feel that we don't remember all that we had learnt earlier. In such a situation, we come face to face with the imperfect nature of our own memories- our cognitive system for learning, storing, and retrieving information, throwing a challenge for its assessment. The credit for the first systematic assessment of memory goes to **Ebbinghaus** (1900). Since then several studies have been reported in which various methods of assessing (measuring)

memory have evolved. The amount of information retained in memory can be inferred from observable performance on various tasks. There are both direct and indirect methods of measuring memory. The direct methods of assessing memory are: (i) *recall*, (ii) *recognition*, (iii) *relearning*, and (iv) *reconstruction*. The indirect method focuses on the amount of transfer of previous learning to a subsequent learning situation.

Recall

The most widely used method of testing memory or measuring retention is the method of recall. It is a passive, but direct method of measuring retention. ***Reproduction of learnt materials after a time span is recall***. It is actually the repetition of learned material, i.e., *verbatim* (word for word) recitation. For example, one may recall a poem by reciting it, even if he does not remember the circumstances under which he had learned.

Recall involves verbal reproduction or repetition of previously learnt material. Recall becomes easier when materials are meaningful, interesting, short, and over learned. Recall is often categorized into: (i) *Free Recall* and (ii) *Serial Recall*.

Free Recall. Free recall allows us to summon up pieces of information out of order. For example, we may listen to a lecture and afterwards remember a few important quotes without recalling the order in which they were presented. Thus, ***in free recall, pieces of learnt materials may be recalled freely without following any specific order***.

Serial Recall. In serial recall ***the material is recalled in a very specific order i.e., in which it has been learned***. For example, there are people (who) when asked the question-

what is twelve multiplied by seven- may start from the beginning of multiplication chart twelve, and only then can recall the correct answer.

Ebbinghaus (1885) used recall method for studying remembering and forgetting. He was of the view that retention can be tested either by the method of (i) *immediate recall* or, (ii) *delayed recall*. When recall is made immediately after learning, it is called '**immediate recall**'; whereas, when recall is made after an interval of time, it is called '**delayed recall**'. It may be noted that failure to recall does not necessarily mean that there has been no retention. Failure to recall despite retention is known as **recall amnesia**. Sometimes due to emotional disturbances like fear, anxiety and sudden shock, one fails to recall. Further, when the subject is motivated to learn, she/he can recall the items easily. Thus, motive plays a major role in recall.

Recognition

Recognition is considered as a sensitive method of measuring retention. It is an active process where identification of elements takes place. Recognition is a common experience which refers to the fact that once the remembered event or word is in front of us, we know that we have stored it away before; it is familiar to us. **Guilford** (1917) viewed that **recognition means knowing again**. Further, the essential difference between recall and recognition is that in the first case, the stimulus is not there for one's identification, whereas it is there in the second case. Thus, recognition is the identification of learnt material or object from a combination (combined list) of learned and unlearned materials. The correct identification will provide the raw retention score. The percentage of recognition can be derived

by using certain formula:

Percentage of Recognition = $\left(R-\frac{W}{K-1}\right)\times\frac{100}{N}$

Where, R = Total number of items correctly recognized

W = Total number of items incorrectly recognized

K= Total number of alternatives given for recognition (old + new)

N= Number of items originally presented for learning

For example, let the learner recognize 4 out of 10 items with 10 alternatives.

Then, percentage of recognition = $\left(4-\frac{6}{20-1}\right)\times\frac{100}{10}=36.8\%$

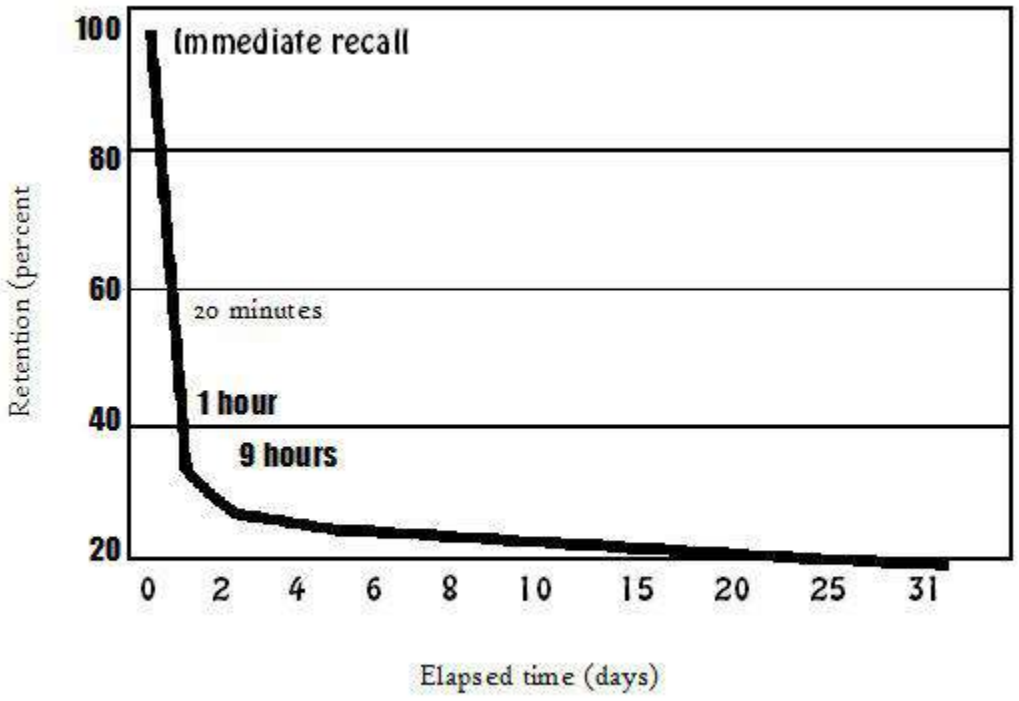


Figure 6.3 Curve of forgetting

Recognition is easier than recall, because in recognition, the object is present in a mixed form with certain new elements. The sensitiveness is greater in case of recognition, which is sometimes influenced by the subject's attitude, prejudice, values, and other inner motives.

Seeleman (1940) conducted an experiment on the role of motivation in recognition and observed that the pleasant experiences are better remembered than the unpleasant experiences. Further, it has been reported from other studies that with the increase of similarity between original learning materials to that of the new materials, recognition becomes difficult. While studying the process of recognition, usually two kinds of errors are noticed. They are: (i) failure to recognize the familiar items, and (ii) false recognition of the new and unfamiliar items.

We fail to recognize the familiar object, when it is seen under changed circumstances. We accept a new stimulus as the old stimulus when there is a lot of similarity between the two. The greater amount of similarity facilitates larger error in recognition. Studies conducted by Skaggs and Robinson suggest that "**as similarity between the interpolated activity and original learning is reduced to a near identity, retention falls to a minimum and then rises again, but with decrease in similarity it never reaches the level obtained with maximum similarity."**

Relearning

The method of relearning is the most sensitive among all measures of retention. This method is otherwise known as the method of '**saving**', which was introduced by Ebbinghaus (1885) for measuring the quantitative aspect of memory. In this method, a list of materials is presented to the subject up to perfect learning, and after a time gap, she/he is presented with

the same list to relearn. The experimenter records the number of trials and time taken by the subject in relearning condition. The percentage of saving is found by the formula :

$$-\left(\frac{OLT - RLT}{OLT}\right)x100$$

Where OLT = *Original learning trials*

RLT = *Relearning trials*

For example, if a child takes 8 trials to learn the original task and 6 trials to relearn it, then the percentage of saving is = $\left(\frac{8-6}{8}\right)x100 = 25\%$

Reconstruction

Reconstruction involves the reproduction of the learned materials. ***Reconstruction technically means rearranging the parts of an original task, presented randomly***. In this method, the stimuli are first presented in a certain arrangement, then this arrangement is broken up and the stimuli are handed over to the subject with instruction to reconstruct the original order.

Suppose the parts of a plastic doll are joined to get a full figure of a doll. Then the experimenter breaks it into pieces and asks the subject to rearrange the items to form a doll. If the subject can rearrange, then she/he gets the full credit for the test. Similarly while writing an essay on Second World War, we recall that the United States entered the war in 1941 after the attack on Pearl Harbour, and an atom bomb was dropped on Hiroshima in 1945. Hence, we are able to reconstruct the events that took place between these two times. **The limitation of this method is that only such materials, which are breakable into parts, can be used for experimentation**.

The methods of testing retention i.e., recall, recognition, re-learning and reconstruction are the basic units of assessing memory. But the question of how information is stored in memory has encouraged the researchers in the past. **William James** distinguished memory into ***primary memory*** and ***secondary memory***. But with the advancement of research and electronic devices, the idea of multiple memories came into light. Most researchers believe that computer memory can be used as a rough working model for understanding human memory.

Nature of Forgetting

We are most aware of our memory when it betrays us, i.e., we fail to remember information that we need at a particular moment. Many experiences that we want to remember are forgotten in course of time. Forgetting is an inevitable process of life having both positive and negative values. Generally, ***psychologists use the term forgetting to refer to the apparent loss of information already encoded and stored in memory***. It is the opposite of remembering and is inferred from our inability to remember something at a given point of time. **Forgetting is the difference between what one has learned and what one has retained**. To forget means not to be able to remember a material learned earlier. According to **Underwood** (1968), "**retention and forgetting are thus reciprocal terms for the quantitative aspect of memory, with retention indicating the amount remembered under specified conditions and forgetting the amount not remembered under same conditions.**"

The first attempt to study forgetting was made by German psychologist **Hermann Ebbinghaus** about a century ago. Using himself as his only subject, he memorized lists of three-letter nonsense syllables. A nonsense syllable is a meaningless set of three letters with two consonants and a vowel in between, such as XOQ, and YUC. A nonsense syllable can be pronounced in a single articulation, and has no associational value.

Ebbinghaus's experiments were designed to explore the rate of forgetting as a function of time. His curve of forgetting (see Figure 6.3) suggested that **forgetting is rapid at first, but slows down with the passage of time**. As the Figure 6.3 indicates, the most rapid forgetting occurs in the first nine hours, and particularly in the first hour. After nine hours, the

rate of forgetting slows down, and declines little, even after the passage of many days. His study had profound influence on subsequent research on memory and forgetting.

Causes of Forgetting

Why do we forget? As you already know, memory has three interrelated components, i.e., *encoding, storage,* and *retrieval*. Forgetting may occur because of problems experienced at any one these stages. If the materials were not properly ***encoded***, the relevant aspects of what is to be remembered would not be stored. Even after efficient encoding, if the materials are not properly ***stored*** in the LTM, they cannot be retrieved at the time of need. Even if the storage is proper, the learnt material may not be retrieved because of some ***interference***. Besides all these, some painful experiences may be ***repressed in the unconscious***, and not available to our consciousness. In other words, we forget some painful experiences, because we want to forget those. All these causes of forgetting are discussed below.

Encoding Failure

The process through which information is converted into a form that can be entered into memory is known as encoding. You know that the informational impact at the sensory register should be properly processed to be passed on to the STM, and then to the LTM. Massive forgetting occurs at the level of encoding. **Without deep level processing, materials may be lost at the level of encoding itself.**

Sometimes, we think that we have forgotten because what we remember does not match with what actually occurred. Constructive processes distort what is stored in memory and we remember the distortions. For instance, we

remember the gist or meaning of what we have read or heard in a conversation but not the actual words themselves. We remember inferences constructed at the time the information was encoded for storage, or we encode only selected portions of the to-be-remembered information. Strictly speaking, such faulty remembering is not forgetting. In fact, we remember what was encoded, and stored.

Much of what we think we have forgotten does not really qualify as being forgotten, because it was never encoded and stored in the first place. According to the information theory, some information might not have reached STM because of lack of attention. Due to inadequate encoding, the information may not have been transformed from the STM to the LTM. If the encoding is not proper, the information reaching the STM might have been knocked out, because the STM has a limited storage capacity. Thus, **a person may forget because of encoding failure**. What are the different factors that influence the encoding of the materials?

The factors operating at the time of encoding are (i) *strength of original learning*, (ii) *nature of material*, (iii) *method of learning*, and (iv) *speed of learning*. Although amount of retention cannot increase indefinitely as a function of the degree of over learning; over learning is preferable than under-learning. Forgetting involves both verbal and nonverbal learning. Meaningful and rhythmic materials decrease the rate of forgetting because of their associative value. Motor learning is retained for a long period in comparison to verbal learning. Speed of learning is conversely related to the degree of forgetting. According to Underwood, "**when learning is rapid, forgetting will be slow and when learning is slow forgetting will be rapid"**.

Attitude towards learning material, motivation and interest to learn are also important determinants influencing the nature of encoding. Emotional shock such as failure in examination, suspension from job etc. seriously interferes with encoding and leads to forgetting.

The rate of forgetting varies from individual to individual. It is found that some forget sooner than others. Some people easily learn and retain certain materials in comparison to others. So, **whether forgetting will be slow or fast depends upon the individuals, the situation, and the nature of the information to be remembered.**

Storage failure

Even if the encoding is proper, materials may be forgotten because of improper storage. As you know, materials have to be finally stored in the LTM to be retrieved at the time of need. ***Forgetting takes place because either the material is not properly stored in the LTM, or the storage is affected by interference or disuse***. The LTM storage may face problems because of several factors.

The oldest and simplest view of forgetting is that information entered into memory fades or decays with passage of time during which it is not used. Thus, **forgetting is a function of the passage of time**. This explanation assumes that learning leaves a trace in the brain, which is known as memory trace or *engram*. The memory trace involves some sort of physical changes not present prior to learning. With the passage of time, the normal metabolic processes of the brain cause a fading or decay of the memory traces so that traces of material once learned gradually disintegrate and eventually disappear. As a result, the memory storage is greatly disturbed. This theory fits our common sense understanding of forgetting and is consistent with our informal day-today

experience.

Often information we acquired quite sometime ago is more difficult to remember than information learned only recently. Does it mean that the memory traces of earlier learning are completely wiped out? Considerable evidence suggests that decay is probably not the key mechanism in forgetting. If the material is relearnt, it could be done quickly. The process is known as **saving.** Furthermore, in many instances, learning (e.g., motor skills like cycling, driving etc.) is retained for a long period of time with no intervening practice. Even in some cases, verbal materials may be retained over long periods of time. For example, we may recall a poem learned in the XI standard and yet be unable to remember a part of a play we learned in XII standard. Why should the decay process affect the second material and not the first?

Another evidence, which goes against the trace-decay theory, rests on the recovery of memory supposedly lost. People approaching senility, who can barely remember the events of the day, often vividly recall events of their youth. Findings of the study by **Jenkins and Dallenbach** (1924) and **Minami and Dallenbach** (1964) argue against the suggestion that forgetting is primarily the result of gradual decay of information over time. It appears that simple passage of time is a cause of forgetting both in the sensory register and in short-term memory, but not in long-term memory. Memory traces seem to be permanent once they make it into long-term memory. Forgetting does not seem to happen in long-term memory because of disuse overtime. Forgetting may simply be a matter of retrieval failure in that some other additional experiences may interfere with the systems at the time of retrieval.

Retrieval failure

The failure of retrieval provides the most important explanation for forgetting. ***Even when the material is properly coded, and stored in the LTM, if for some reason, the material cannot be retrieved when needed, it is deemed to be forgotten***. There are several factors influencing retrieval from the LTM. One of them is the **context of memorization.** If our memory for persons and events has taken place in one context, and we are asked to recall it another context, some amount of retrieval failure may take place. Many of us fail to recall the names of our high school classmates, when we meet them later in the out-of-school settings. This means that we have lost social-context-retrieval cues that we used while forming the initial memories of those classmates. Hence, the change of the memorization context leads to retrieval failure, and consequently, poor memory. It seems that many memory failures are due to poor encoding and inadequate retrieval cues rather than loss of memories. Failure to call up memories cannot be taken as a positive proof that memory was not there.

Another important source of influence for memory failure comes from **interference**. ***The theory of interference suggests that forgotten memory is neither lost nor damaged, but is only misplaced***. The memories for other materials interfere with the retrieval of the one that is sought. Our inability to remember the names of our high school friends is similar to what happens when a clerk fails to locate a letter that he received a year ago. The letter is still somewhere in his file but it has been buried among a host of other letters that the clerk filed before and after this letter. The modern theorists accept interference as a major cause of

forgetting.

The interference takes place in two different forms such as **proactive interference**, and **retroactive interference**. ***Proactive interference refers to a phenomenon, when old memories displace or block out new memories***. ***On the other hand, when new memories knock out the old memories, the phenomenon is known as retroactive interference***. A vast amount of experimental evidence as well as everyday experiences indicate the occurrence of both proactive and retroactive interferences. When you fail to recall the names of your high school classmates, because you had so many new friends in colleges, you are experiencing the phenomenon of retroactive interference. On the other hand, if you had difficulty recalling the names of your college friends because of your memories for close friends in your high school, you are experiencing what is called proactive interference. Memory interferences are easily demonstrated in the experimental laboratory.

Suppose you want to demonstrate experimentally the retroactive interference that affects retrieval memory. The prefix '**retro**' means '**backward acting**'. **Retroactive interference occurs when a new learning works backward, and interferes with the previously learnt material**. In a typical experiment, there are two groups known as the control group and the experimental group. The control group learns some materials such as a list of nonsense syllables (List A), and is tested after a specified rest interval. The experimental group learns the same list (List A), and then learns a second list (List B) during the period when the control group takes rest. The learning of List B by the experimental group is an ***interpolated activity***. Then both the groups are asked to

recall List A, which was previously learned. The experimental procedure for retroactive interference is given in Table 6.1.

Table 6.1: ***Experimental procedure for studying retroactive interference***

Group	Phase-I	Phase-II	Phase-III
Experimental	Learning List A	Learning List B	Recalling List A
Control	Learning List A	Rest	Recalling List A

Proactive interference refers to the interfering effect of previously learnt materials on the learning of new materials. The prefix '**pro**' means '**forward acting**.' The old memory acts in a forward direction to interfere with the new memory. The phenomenon of proactive interference can be demonstrated in the laboratory by taking an experimental group and a controlled group. The experimental group learns a list of nonsense syllables (List A), while the control group takes rest. Then both the groups learn List B. The next step is to ask both groups to recall List B. It is generally found that the experimental group recalls less number of nonsense syllables of List B, compared to the control group. Thus, the initial learning of List A by the experimental group worked forward in interfering with the recall of List B. The control group did not experience the interference of List A, and therefore, performed better in the recall test of List B. The experimental procedure for proactive interference is given in Table 6.2.

Table 6.2: ***Experimental procedures for studying proactive interference***

Group	Phase-I	Phase-II	Phase-III
Experimental	Learning List A	Learning List B	Recalling List B

Control Rest Learning List B Recalling List B

In both types of experiments, the experimental group performs worse on the recall test, compared to the control group. The most obvious predictions emerging from the interference theory is that **memories, undisturbed by other memories, will last longer**. It has been shown that subjects, who go to sleep after learning a material, recall it better the next morning than those who spend their time in usual activities after learning. Both retroactive and proactive interferences point to retrieval failure in the memory process. There are three general principles, which govern interference.

Similarity of Materials. The similarity between the two sets of materials influences the degree of interference. The general principle is that the greater the similarity between the original and the interpolated materials, the greater the interference. Interference primarily comes from similar memories. The Skaggs-Robinson hypothesis states, "**As similarity between interpolated and original learning is reduced from a near identity, retention falls to a minimum and then rises, but with decrease in similarity it never reaches the level obtained with maximum similarity**." When the two activities are completely dissimilar, there is less confusion, and therefore, less retrieval failure.

Meaningfulness of Materials. Meaningless materials are more likely to be forgotten than meaningful materials. Meaningful materials evoke associational linkage with subjects' personal knowledge and experiences. They are, thus, related to a few familiar cues. A person can fall back on these cues at the time of recall. But meaningless materials do not carry any associational links

with person's store of knowledge in the LTM. That is why it is more difficult to memorize nonsense syllables such as ZOQ, QIX, KEZ than the meaningful words like KEY, SUN, and PIG. If both original and interpolated materials are meaningless, retrieval failure would be more.

Nature of the Interpolated Task. The more difficult the interpolated task, the more it will interfere with the memory of materials learned earlier. If you study a course on psychology, and then a course on anthropology for the examination, the contents of anthropology would interfere more with the memory for psychology. If the interpolated task were simpler such as cleaning clothes, you would experience less interference with memory for psychology. If the interpolated activity has emotional content, forgetting will be more. The temporal location of the interpolated task is also another important factor. **Interpolated task given just after learning or just before the recall heightens the influence of retroactive interference**. Minimum interference occurs if the interpolated task is introduced in the middle of a long retention interval.

Motivated Forgetting

Freud, the father of the psychoanalytic school, believed that ***we forget what threatens us***. The threatening, shocking, painful, stressful, and ego-dissatisfying experiences are pushed back to the unconscious. In other words, these experiences are repressed in the unconscious, and cannot be retrieved when needed. Hence, motivated forgetting is a case of retrieval failure. Freud observed, "**Forgetting in all cases is founded on a motive of displeasure**." **We forget, because we like to forget**. Repression is the key mechanism underlying

forgetting. In case of **repression**, there is no loss of retention but there is a strong inhibition to recall, and this inhibition causes the retrieval failure. Since such type of forgetting occurs because the subject intends to forget anxiety-provoking and ego-dissatisfying experiences, this is also called intentional or ***motivated forgetting.***

The retrieval of the repressed memories is possible only under special circumstances using a few psychoanalytic techniques. These techniques are *free association, hypnosis,* and dream-analysis. This theory of forgetting explains why pleasant materials are better remembered than the unpleasant ones. The unpleasant materials are ego threatening, and therefore, may be repressed in the unconscious. Our motivational needs not only prevent'retrieval of certain memories but even change the tone and the content of the memories that we retrieve.

Improving Memory

Individuals differ in their abilities to memorize. Some have more impressionable mind than others. Therefore, the materials they learn get more easily and more effectively registered as a result of which they show better abilities for recall and recognition. Is it possible to improve one's memory? Yes, more specific aids to memory are available. Some of the general principles that you have learned in this chapter can be applied to improve your memory. Psychologists have developed ***mnemonics***, which means the art or system of memory strategies. By using the techniques described below, one can improve one's encoding, storage, and retrieval capacities.

Mnemonics

The word 'mnemonics' comes from the Greek word for memory and refers to specific memory improvement techniques.

The 'mnemonics' consist of a set of strategies, which includes the use of visual imagery, method of loci, number and letter peg systems, chunking, and narratives. Most of the mnemonic techniques link the newly learnt materials with the organized set of images and concepts in the long-term memory. These firmly established LTM images serve as reminder cues for retrieval. These reminder cues are called pegs as though the to-be-remembered items are hung on these pegs. The pegs act as mediators for remembering something long and complex.

The Method of Loci

Its literal meaning is ***method of locations***. The memory pegs in this system are parts of your images of a scene or places. It helps in remembering a number of terms serially. Suppose you want to remember the following five terms serially: house, man, tree, water, and book. You need to go through the following three stages:

a) ***Visualize a series of places with which you are very familiar*** (for example, visualize five rooms in your educational institution like principal's room, staff room, classroom, laboratory, and toilet in that sequence)

b) ***Create a visual image of each term you have to remember*** (for example, create the images of horse, man, tree, water, and book)

c) ***Associate the terms one by one with the places in your imagery*** (for example, associate horse with principal's room thinking that the room has a big photograph of a horse, then associate staff room with man, classroom with tree and so on).

One can also use the same set of images for remembering

an additional list of items. The method of loci has proven to be helpful in remembering separate terms in an order.

Number and Letter Peg Systems

Here the memory pegs are numbers or letters. ***The to-be-remembered items are linked to the visual images formed with numbers.*** For example, you may create a rhyming system for the numbers 1 to 20. Think of words that rhyme with numbers such as 1 with man, 2 with shoe, 3 with tree, 4 with door, 5 with hive and so on. Now if you want to remember a list, associate each term serially with the images of the numbers. Suppose the first few items of the list are cake, door, chair, book, and pen. You may create associations as follows: man is eating the cake, shoe is in front of the door, chair is hanging from a tree, a door is created by arranging books, and the pen is hidden in the bee hive. In each case, you associate the number image with the items to be memorized.

Using letters as pegs follows a similar method. In this case, let each letter stand for a word that starts with that letter. The images of these words are linked to the items to be remembered. These methods not only help in remembering the items serially, but also help in recalling the 9^{th}, 16^{th} or 21^{st} item. Any numbered item can be retrieved from memory. It is shown that more bizarre the images of the items to be remembered, the easier it becomes to store and retrieve.

Chunking

Chunking refers to recoding information into a single meaningful unit. Suppose you want to remember a seven-digit phone number, 2350478, it will be helpful if you break the number into two chunks such as 2350, and 478. One chunk consists of four digits, and the other consists of three digits. In fact seven units of information are reduced to two longer units called chunks. **By doing this you**

automatically increase your working memory capacity. You can further aid your memory, if you associate the numbers 2350 and 478 with some facts firmly established in your LTM. For example, in order to remember a phone number 610365, a person told me to divide the number into two chunks, 610 and 365. He further helped me to associate the numbers with some knowledge in the following way: We are busy from 6 a.m. to 10 p.m. every day, and for all the 365 days. I have never forgotten that phone number. Similarly you have to create your memory linkages. Chunking is a powerful and oft-used mnemonics to aid memory.

First-Letter Technique

If you need to remember a set of concept names, you can take the first letter of each concept, and combine them to form words, though not meaningfully. When children remember the seven colors of the rainbow in the form of 'VIBGYOR', they use this technique. We remember the word through their abbreviations such as ICU for Intensive Care Unit, IEC for Information, Education, and Communication, and UNICEF for United Nations Children's Emergency Fund. In this method, the order of the words or concepts is important.

Narratives

In order to remember a list of unrelated words, you may create a story using these words. Suppose the items to-be-remembered are tree, water, gate, sun, and forest. The made-up story might go as follows, "A crow on a tree needing water flew over the gate under the hot sun to the forest." While recalling the items, the story would help you to retrieve the items from the LTM.

All the mnemonics discussed above provide useful techniques to improve one's memory. But as you know, **memory**

is far more complex a process, and these techniques have limited applications, when higher-order memory processes are involved. The contents of a college level course are far more complex. In fact, you cannot rely on a single and simple method for improving your memory for the course. Several other additional factors and considerations are important. Ability to memorize depends on the internal characteristics of the learner, the characteristics of the items, and the methods of learning. First of all, the person must feel the need to improve his memory, and must be highly motivated to do so. He needs to have good physical and mental health. In order to be able to store the items and recall those later, he must use efficient coding devices, pace his rate of learning, use effective methods for learning the items, rehearse the learnt material for proper storage, take rest in between learning sessions, and from time to time engage in exercises of recall to assess the status of storage. If you are motivated to improve your memory, you may consult the teachers of psychology in your college.

KEY TERMS

Memory
Cognitive Process
Nonsense syllable
Encoding
Storage
Retrieval
Sensory register
Sensory memory
Iconic memory
Echoic memory
Working memory
Rehearsal
Information processing
Episodic memory
Semantic memory
Procedural memory
Recall
Free recall
Serial recall
Recognition
Re-learning
Saving
Reconstruction
Forgetting
Encoding failure
Storage failure
Retrieval failure
Proactive interference
Retroactive interference
Interpolated task
Motivated forgetting
Repression
Mnemonics
Method of loci
First-letter technique
Narratives
Chunking
Number and letter peg systems

SUMMARY

1. *Memory is an important cognitive process by which information is registered, stored, and retrieved, when needed*. Hermann Ebbinghaus was the first person to have carried systematic research on the assessment of memory.

2. The basic functions in memory are *encoding, storage*, and *retrieval*. In encoding, the information is converted to a form that can get an entry into the memory system. Storage refers to retaining the encoded information over a period of time. Retrieval refers to the process of recovering the stored information from memory.

3. The most influential memory model proposed by Atkinson and Shiffrin proposes that there are three memory storage systems: *sensory memory, short-term memory (STM),* and *Long-term Memory (LTM).*

4. *Sensory memory, known as 'sensory register', is the initial momentary storage of information lasting only an instant*. Visual and auditory sensory memories are called *iconic,* and *echoic* memories, respectively. The contents of the sensory memory resemble the sensation from the original stimulus. It has a large storage capacity but only for a short duration. While the iconic memory holds information for less than a second, the echoic memory lasts for 2 to 4 seconds.

5. *Short-term Memory (STM), also known as 'working memory', holds a limited amount of information only for about 15 to 25 seconds*. The span of STM is 7 ± 2. The information is retained in STM through *maintenance rehearsal,* and *elaborative rehearsal.* Then the information is passed on to the LTM.

6. *The long-term memory (LTM) stores large amount of information over a long period of time as either visual images or verbal units or both*. The LTM contains *episodic, semantic* and *procedural memories*.

7. While the STM is a rapidly decaying system, the LTM appears to be permanent. The STM is an active system involving rehearsal, and has a limited storage capacity. In contrast, the LTM is rather passive, and has an unlimited capacity for storage. While STM stores information usually in terms of physical qualities of the experience, the information is stored in LTM in terms of meaning and semantic codes.

8. To retrieve information from the STM, we scan the entire contents of the store. The information from LTM is recalled by using a cue relevant to the information instead of scanning the entire content of the LTM.

9. While STM is characterized by *trace-dependent forgetting,* the LTM is characterized by *cue-dependent forgetting*. STM is primarily a function of the frontal lobe, but the information stored in LTM is first held in the hippocampus and then transferred to the cerebral cortex involved in language and perception for permanent storage. Though STM and LTM are conceptually different, they are highly interdependent in that rehearsal in STM leads to memories in the LTM, and LTM is necessary for LTM encoding.

10. Tulving suggests that there are three types of LTM: episodic memory, semantic memory, and procedural memory. *Episodic memory* refers to the memory of events that we have experienced personally, and usually has an

emotional content. *Semantic memory* is the sum total of our general abstract knowledge about the world. *Procedural memory*, otherwise known as non-declarative memory, stores information regarding how things are done.

11. There are both direct and indirect methods of measuring memory. The direct methods are (i) *recall,* (ii) *recognition*, (iii) *relearning,* and (iv) *reconstruction*. The indirect method focuses on the amount of transfer of previous learning to a subsequent learning situation.

12. *Recall* is the verbal reproduction of previously learnt materials. *Recognition* is the identification of learnt materials from a combination of learned and unlearned materials. Recognition is easier than recall. *Relearning* involves presenting the materials to the subject up to one perfect learning and then presenting the same material after a time gap to be learnt again. The lesser the number of trials taken in the relearning situation, the better is the memory. *Reconstruction* means asking the subject to rearrange the parts of an original task.

13. *Forgetting refers to the apparent loss of information already stored in memory*. Ebbinghaus was the first person to have conducted experiments on forgetting. His curve of forgetting suggested that forgetting is rapid at first, but slows down with the passage of time.

14. Forgetting occurs because of failure experienced at one or all of the stages of *encoding, storage*, and *retrieval.* The psychoanalysts believe that we forget because we like to forget experiences that are stressful and threaten our ego.

15. The failure to retrieve information from the LTM because of interference is regarded as the major explanation of forgetting. Thus, forgetting occurs because of *proactive interference*, and *retroactive interference*. Proactive interference occurs when old memories block out new memories. If the reverse takes place, it is known as retroactive interference.

16. The three important principles which govern interference are (a) *similarity of materials,* (b) *meaningfulness of*

Chapter 7

MOTIVATION AND EMOTION

This chapter covers :

a) Meaning and Operational Definition of Drive and Incentive

b) Brief Idea about Types of Motives: Biological, Social and Psychological

c) Meaning, Operational Definition and Nature of Emotion

d) Different Bodily or Organic changes during Emotion

After you go through this chapter, you would be able to:

- *Understand the nature of human motivation as shaped by needs, drives and incentives*
- *Explain different types of human motives.*
- *Gain an understanding of the measurement of human motives.*
- Learn about the nature of human emotion.
- *Discuss the organic changes accompanying emotional state and the role of different biological structures and systems in emotion.*
- *Explain the development of common emotional patterns from early childhood.*
- *Understand two important theories of emotion.*

CONTENTS

Motivation and Emotion

Introduction

You must have noticed that some of your friends work hard to get good grades in the examination, while others who are equally intelligent take it easy, and set their priorities on things other than academic pursuits. Everybody's behavior is driven and pulled towards a goal, but the goals are different for different individuals. Why do people behave as they do? The answer lies in the concept of motivation. Motivation focuses on the *'**why**'* aspect of behavior. It directs individual's behavior towards a goal. The motives within us to reach a target lead us to act in a specific way.

Even when we are motivated to reach a target, our behavior depends to a large extent on how we feel at a given moment. The world looks beautiful when we are in a good mood, and very unappealing when we are in a bad mood. Though we are rational beings and would like to satisfy our motives in an intelligent way, our daily life encounters are full with feelings of pleasure and disgust. When the feelings become intense and prolonged, they take the shape of emotions. We are basically emotional beings. Our emotions have the power to motivate our behaviors. Both motivation and emotion explain a variety of activities that we pursue vigorously. This chapter will help you understand the nature of motivation and emotion.

MOTIVATION

Meaning and Operational Definition

Motivation is any internal or external process, which is involved in instigating, directing, and terminating behaviour. All our involuntary responses are reflexes, whereas all our voluntary activities involve motivation. But one's motivation cannot be observed directly. It is inferred from the behaviour of the organism. Motivation is a driving state. It is also a behaviour-arousal state within the individual. Motivation directs the behaviour towards a goal. It is thus an internal or external condition of the organism that forces him / her into action.

Motivation has the following three aspects: (a) a ***driving state*** within the organism that is set in motion by bodily needs, environmental stimuli, or mental events, (b) the ***behaviour*** aroused and directed by this state and (c) the ***goal*** towards which the behaviour is directed.

We never observe motives directly. Rather we infer their existence from what people say about the way they feel and from observing that people and animals work towards certain goals. In other words, motives are inferences from behaviour. If our inferences about motives are correct, we have a powerful tool for the explanation of behaviour. **Truly speaking, most of our everyday explanations of behaviour are in terms of motives**.

Here is a simple question- "Why are you going to a college?" The answer is given usually in terms of "motivation". You are going to the educational institution because you want to learn something or you need a college degree to get a good job or it is a suitable place to make friends. You are a student in that college because you think it is expected of you, and one of your goals is to conform to what is expected.

It is true that you are going to college most likely to meet some combination of these needs. Someone who understands your motives can see why you do the things the way you do. For this reason, clinical and personality psychologists who study the behaviour of individuals place so much emphasis on motives.

Sometimes motives do not tell us exactly what will happen, rather they give us an idea about the range of things a person will do. So, in other words, **motives help us to make predictions about behaviour.**

Motivational Cycle

Most of our motives have a cyclical nature- they are aroused, they trigger behaviour, which leads to a goal, and finally, after the goal is reached, they are shut off. The behaviour that is related to drive state is called "***Instrumental Behaviour***" because it is instrumental in bringing about the goal or the satisfaction of need. A diagram of a simple ***motivational cycle***, especially useful in understanding motives with a biological basis is given in the Figure 7.1.

The first stage of the motivational cycle is the ***driving state,*** simply called as **drive**. This term is often used when the motive state has a biological or physiological basis. It is regarded as impelling a person or animal to action. ***Drives can originate when an organism lacks something***. Drives can also be aroused by environmental stimuli, such as advertisements from newspaper, magazines and television etc. For example, when someone sees a sexy picture in a magazine, his sex drive is aroused. Besides all these factors, some cognitive factors like thoughts and memory can also trigger driving states. Very often, the term "**need**" is used to refer to the driving state. Drives can originate when an organism lacks something in its needs. This is one meaning of the word need. The need creates a drive state in the organism. It acts as if it pushes the organism to behave in a certain fashion to satisfy its need.

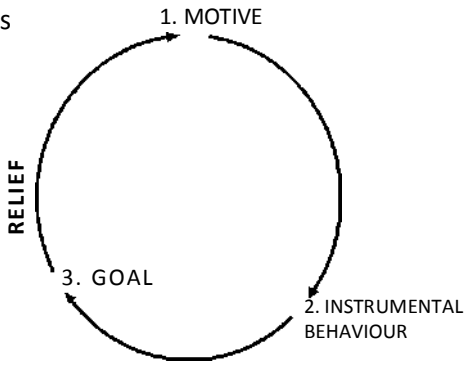


Figure 7.1 Motivational cycle

The second stage of the motivational cycle is the ***instrumental behaviour***. It is instigated by the driving state. Thirst, for example, drives an animal to explore water. Sooner or later this behaviour succeeds, thereby reducing both the need and the drive state. In other words, the animal's exploratory behaviour is instrumental in finding water and reducing the thirst drive.

When an instrumental behaviour achieves its goal, the need is satisfied and there follows a temporary period of relief. This is the third stage of the motivational cycle. For example, in thirst, lack of water in the body produces a need and a drive state (*first stage*); the organism has shown some exploratory behaviour (*second stage*) and finally he quenches his thirst by drinking water i.e., reaching the goal (*third stage*).

When the thirst is satisfied, motivational cycle is over. But when the need for water will build up again, the organism will once again go through the motivational cycle.

Goals may be *positive* or *negative*. Food, sexual satisfaction and companionship are some of the examples of positive goals. These are the goals,

which the individual approaches or tries to reach. On the other hand, negative goals are those, which the organism tries to escape from or avoid. Dangerous, unpleasant and embarrassing situations are some of the examples of negative goals. However, goals depend upon the drives or needs, which are active.

Needs, Drives, and Incentives

The terms such as need, drive and motive are frequently used interchangeably. But each term is distinguished from the other.

Motive is a general term, which refers to any process internal or external involved in instigation, direction and termination of behaviour. All voluntary responses involve motivation. Motivational process consists of (a) a drive state in the individual, (b) the behaviour aroused and directed by this state and (c) the goal towards which the behaviour is directed. Thus motivation is one of the determinants of behaviour. ***Motivation is considered to be a state of the individual where his/her energies are mobilized selectively towards the attainment of a goal***. It is an internal or external state of an organism that forces it to action- to start upon a sequence of behaviour. Therefore motivational states are specific to particular "**drives**" and "**needs**" and are explained in terms of specific goals and the directions it takes. Motives cannot be directly observed. It is inferred from the behaviour of the organism.

Needs are the physiological or environmental imbalances that give rise to "drives". A need is the absence of something desired, required for the organism's welfare. Individual is aware of his needs when she/he is in a state of deprivation. When a person is hungry, he/she needs food, when thirsty needs water, and when alone, needs social companion.

Drives are the effects of the deficits and lacks, which define needs. Drives are the tendencies or urges to act in specific ways, determined by the nature of the need that gives rise to the drive. For example, on account of fasting, the need for food gives rise to the hunger drive. The hunger drive may then be seen as a motive for behaviour relating to eating.

Incentives are motivators of behaviour. Like need and drive, incentive is a motivational concept, which is associated with drive-reduction components or subjective value attached to a goal.

Incentive means value or effectiveness of the goal as a motive for behaviour. For example, attractiveness of dress material determines one's behaviour of purchasing it. But goals or objectives do not possess the same incentive value for a person; they have low or high incentive values. Therefore ***incentives are conditions or objects that are perceived as satisfier of some need***. The greater the value of an object the greater is its perceived incentive.

Further, a supplementary reward for example, a bonus in a company job, a merit promotion in an office serves as incentive before reaching the goal. Annual prize ceremony in schools for high rank holders is an incentive for better performance in examinations.

Types of Motives

Every behavior of an organism has motivational causes. The reasons of human behaviour can be known through explaining why some one behaves as he/she does. But explaining a particular behaviour comes from various branches of psychology. For example, the learning theories describe how behaviour changes; developmental theories put forth a description of changes that take place between conception and death; perceptual theories describe how physical events are translated into neurological events and responded to; personality theories describe how individuals are unique; and social psychology attempts to explain the influences of others on the individual. Finally **the motivational theories describe why we behave as we do.**

What we do is performance. **Performance refers to the actual manifested behaviour of the organism**. Some performances are innate and do not depend on learning. But there are many performances, which are learned. There are situations where learning is not reflected directly in performance. For example a trained animal does not repeat continuously the act only because it has learnt. The animal's performances do not demonstrate learning all the time with trained abilities and skills. **That means performance depends on something more than learning. It depends on appropriate motivation**. Thus motivation explains the factors that account for actual behaviour, its initiation, direction, and the end. The accounts of motivation for different behaviours are many. Thus important motives have been classified by psychologists into some categories. These categories are: *biological motives, social motives,* and *psychological motives.*

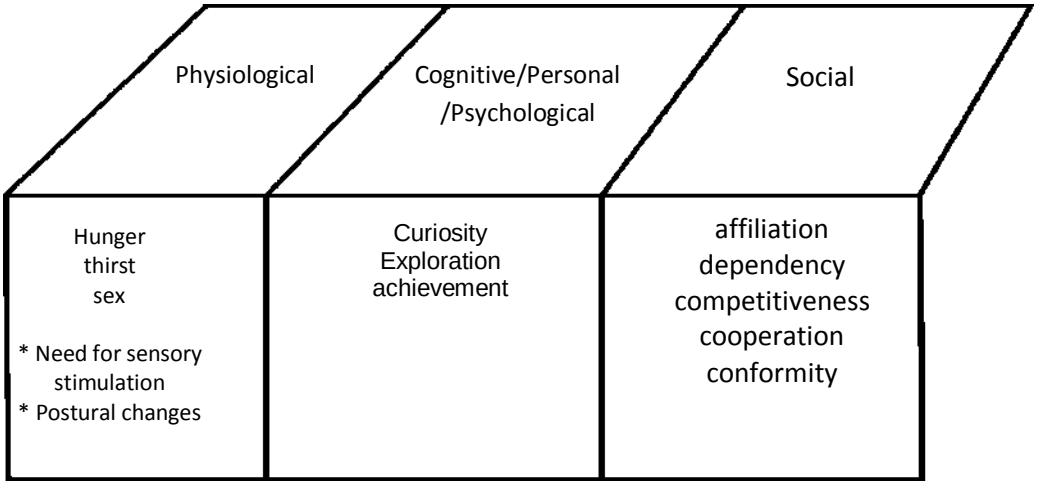


Figure 7.2 Types of motives

Hunger, thirst, and sex are the most obvious *biological* or *physiological motives*. They are physiological because they are associated directly with physiological systems involved in survival. Drinking and eating are essential for our biological survival. Thus biological motives are also called physiological motives.

Biological Motives

Biological motives are directly related to individual's physiological needs, Drinking and eating are necessary for individual's biological survival. Sex is essential for survival of the species.

These are also called ***primary drives***, which are deeply rooted, in our biological make-up. Satisfaction of these drives is necessary because our body needs certain substances for its growth as well as its day-to-day maintenance with a view to keeping the balance of various physiological processes within the body. Some of our most powerful motives, e.g., hunger, thirst, sex, sleep, avoidance of pain, are rooted in our physiological make-up and are actually regulatory in their nature.

In other words, we can say that **many biological needs are triggered by departures from balanced physiological conditions of the body**. Our body tends

to maintain a balance, called ***homeostasis***, in many of its internal physiological processes. This balance is very important for life. For example, body temperature must not get too high or too low; there must be enough water in the body tissues The homeostatic mechanisms are mainly responsible for maintaining the acidities, water level, sugar level, temperature, blood pressure and numerous other highly complicated bodily processes. The working of these physiological processes and homeostatic equilibrium of the body are made possible by our efforts to supply the requirements of the body.

On the whole, ***the tendency of motivated behaviour to maintain a balanced condition within the organism is called homeostasis***. According to a renowned physiologist, “The living being is an agency of such sort that each disturbing influence induces by itself the calling forth of compensatory activities to neutralize or repair the disturbance”.

There are many automatic mechanisms, which maintain the balanced condition of homeostasis. Consider the automatic physiological control of body temperature at a point of 98.6°F. Our body temperature usually stays around this point because of automatic mechanisms that allow the body to heat and cool itself. It the temperature of our body rises too high, perspiration lowers the temperature. When the temperature falls, we shiver, causing our bodies to burn fuel faster to generate extra heat.

Physiologists have discovered that the automatic physiological mechanisms, which maintain homeostasis, are supplemented by regulatory or motivated behaviour. For example, falling temperature creates a drive state to which we respond by regulatory behaviour- putting on a sweater or closing the doors and so on. So **the biological motive states are aroused by departures from homeostasis**.

Hunger Drive

Experiments done earlier in the century revealed that the source of the hunger drive is stomach contraction. This was shown by using subjects who were trained to swallow a small balloon with a rubber tube attached. The balloon was inflated in the stomach and the rubber tube was then connected to a kymograph recording mechanism, so that each spasm of the stomach muscles could cause a mark on the smoked drum.

Again, the subject was also asked to press a key, whenever he felt hunger pangs. Therefore, a mark was made on the drum just below the record of stomach activities. The abnormal breathing of the subject was also recorded, so that the investigator could decide whether the spasms represented in the record were due to stomach or abdominal movements. It was found that hunger pangs coincided with stomach contractions, but were not related to movements of the abdominal muscles.

Recent works on hunger drive have revealed that the relationship between stomach contractions and hunger is weak. Both psychologists and physiologists have tried to find other conditions of the body, which trigger hunger. Some physiologists held that changes in the metabolic functions of the liver when fuel supplies are low provide body's stimulus for hunger. Here the liver can signal a part of the brain called ***hypothalamus*** that more fuel is needed which triggers hunger drive. Experimental findings also confirmed that two regions of hypothalamus are involved in hunger drive- lateral hypothalamus and ventro-medial area. Lateral hypothalamus is considered to be the excitatory area. Animals eat when this area is stimulated. When it is damaged, animals stop eating and die of starvation. The ventro-medial area is located in the middle of the hypothalamus, which is otherwise known as hunger-controlling area. Experimenters consider it as the inhibitory region of the hunger drive.

Experimental studies have shown that when this area is damaged, animals develop voracious appetites; they eat huge quantities of food. But their hunger drive is somewhat different from that of normal animals. Some experiments have also shown that .the cessation of eating or satiety is controlled by a hormone called Cholecystokinin (CCK), which is released into the blood stream, when food reaches the intestine (Gibbs and Smith, 1973). From the above discussion, **it is obvious that both hypothalamus and blood chemistry are, no doubt, responsible for hunger**.

Thirst Drive

When we are deprived of water over a period of several hours, the mouth and the throat become dry, which reflects dehydration of body tissues in general. So, we drink. A local stimulus theory suggests that drinking is triggered by a dry mouth. But physiologists have shown that dry mouth does not result in enough drinking to regulate the water balance of the body. Rather, thirst and drinking are controlled by processes within the body itself.

It was found that when water is placed in the stomach directly via fistula, a short span of time elapsed before the thirst experience ceased. It is obvious that the water must get into the tissues sufficiently to remove the dryness of mouth and throat. Then only, the thirst is removed effectively. It has been seen that merely wetting the mouth temporarily removes the thirst experience.

Like hunger, some unknown conditions, aroused by a state of deficit, must regulate both thirst and water consumption. Of course, the important condition appears to be **cellular dehydration**. The physiologists feel that the dryness of mouth and throat is one of the factors in this regulation, but it does not explain the whole story. It is true that when the water level in the body goes down, it stimulates tiny nerve endings in the mouth and throat, and produces awareness of thirst. Again it was established that thirst couldn't be relieved by simply taking water in the mouth, without swallowing it. So dryness of mouth and throat is only a secondary mechanism to explain thirst drive.

Recent experiments have revealed that it is the anti-diuretic hormone, which seems to be the key factor in regulating the water supply to the body. The researchers feel that the thirst drive and drinking of water are mainly triggered by two mechanisms. The first one is that when the water level of the body goes down, certain neurons located within the hypothalamus begin to give out water. The thirst, which results from this mechanism, is known as ***cellular dehydration thirst***. Further experiments revealed that the loss of water from the cells in the particular region of the hypothalamus might arouse the drinking behaviour. The experimenters concluded that the neurons in the preoptic region of the hypothalamus known as the osmoreceptors are somehow responsible for controlling drinking behaviour of the organism.

The second mechanism, which is responsible for triggering drinking behaviour, is known as ***hypovolemia*** or the condition of low blood plasma volume. Studies have shown that kidneys respond to hypovolemia by formation of a chemical known as angiotensin, which when released in the blood stream, triggers drinking.

It is believed that all these mechanisms work together to regulate water intake of the body. The mechanisms, which explain the intake of water, also seem to be responsible for stopping the intake of water. Others have pointed out that the role of

stimuli resulting from the intake of water in stomach must have something to do with stopping of drinking. However, it can be concluded that the precise physiological mechanisms underlying the thirst drive are yet to be understood.

Sex Drive

The sex drive is considered as a powerful drive both in animals and human beings. It depends on many physiological conditions, especially in lower animals. But in case of human beings, the sex drive is very closely regulated by social restrictions. The conflict between sex motive and cultural restrictions makes sex one of the most powerful forces in influencing behaviour. Sometimes it is very difficult to classify sex purely as a biological drive. Although it is a biologically rooted drive, it differs considerably from the other two biological drives such as hunger and thirst. Sexual drive is not a response to lack of some substance in the body. **It is, therefore, not triggered by homeostatic imbalance.**

Physiologists are still trying to find out the exact location of the internal control of the sexual drive. They are certain that the intensity of sexual urge is dependent upon chemical substances circulating in the blood, known as sex hormones. Studies on animals as well as human beings have clearly revealed that this urge is profoundly influenced by the presence of hormones produced by testes in males and ovaries in females. However, **in case of human beings, socio-cultural and emotional factors seem to play a pivotal role**.

Generally the hormones secreted by **gonads**, i.e., testes in males and the ovaries in females, are responsible for sexual motivation. The male sex hormones are known a **testosterone**. These hormones come from the testes. The ovarian hormones are known as **estrogens**. Experiments revealed that estrogenic hormones activate the female rats, and provide a high level of sexual motivation. In human females, the same hormones are present; but their production becomes greatly accelerated at puberty.

Observation indicated that purely biological processes like hormone secretions seem to play a very minor role in the sex drive. Studies have shown that women have greater sexual desire immediately before and after the menstrual period than during the fertile period, which corresponds to the heat period of animals. Studies with animals,

as well as clinical observations on human beings have demonstrated that sexual motivation is also influenced by other endocrine glands, such as *adrenal* and *pituitary glands*. Of course, the pituitary gland plays a key role.

In case of human beings, sexual drive is primarily stimulated by external stimuli and its expression depends upon cultural learning. Hence a psychologist has advanced a theory that sex is more a learned drive than a biological one.

Need for Sensory Stimulation

Physiologically human beings have many sensory organs, i.e. eyes, ears, skin, nose, tongue, cochlea (or labyrinthine receptor deep in the inner ears-responsible for the sensation of one's body position in the space), deep joints and muscles (kinesthetic receptors) and internal receptors, such as viscera. These receptors are the gateways of information about both environments and the conditions within. **Studies indicate that human beings are in constant need of some kind of sensory stimulation**.

Hebb and Heron (1957) conducted sensory deprivation studies and recorded its effects on college students. The students were deprived from tactual, auditory, and visual stimulation to a great extent and were kept in controlled sensory restrictions for a prolonged period (Zubek, 1969). It was found that the subjects could not tolerate the sensory isolation for long. They experienced impairment in perceptual and intellectual functioning. Tasks, which were once very simple before the onset of sensory deprivation, became extremely difficult after longer periods of sensory deprivations. A great deal of emotional fluctuations such as nervousness, irritability, anger, and fear were marked in these subjects. Hallucinations also appeared in some subjects. Thus the findings were that the effects of sensory deprivations are manifold. **Psychologists are of the view that human beings are in need of a variety of sensory stimulation in the absence of which abnormal reactions may occur.**

Need for postural changes

One of the physiological needs is to change our body-postures constantly at some intervals. Photographic evidences show that during sleep at night, a person changes his/her posture more than four hundred times. Although it appears apparently that one continues to sit in a single posture throughout the period in the class, there are minute shifts in his/her body position. Thus postural changes are also physiological needs.

Social Motives

Social motives are otherwise known as acquired or learned motives. **These are some complex forms of motives, which result mainly from man's interaction with his social environment**. These motives are called social because they are learned in social groups. These peculiar human motives can be looked upon as general states that lead to particular behaviours. Social motives are general characteristics of a person and since they are learned motives, their strength differs greatly from one individual to other.

The social motive that will activate an individual is dependent upon an individual's own social experience. It is unique to him and depends upon his ways of perceiving things. For this reason, the psychologists have always found it difficult to arrive at a commonly agreed list of social motives as they have done in case of biological motives. Since these motives are inferred from behaviour, it is very difficult to measure these motives. This type of difficulty stems from the problem that we do not know which particular type of behaviour is associated with which particular motive.

Need for Affiliation

Sometimes we find people trying desperately to get close to people, to seek their help, and to become members of their group. ***This type of behaviour of seeking other human beings and wanting to be close to them both physically, and psychologically is called affiliation.*** In other words, affiliation refers to the need that people have to be with others. This affiliation need is aroused when individuals feel threatened or helpless and also when they are happy. Psychologists have tried to rank people according to the degree of their need to affiliate. People high on this need are motivated to seek the company of others and to maintain friendly relationships with other people.

Studies have revealed that fear and anxiety, are closely associated with the affiliation motive. But where the degree of anxiety and threat is very high, such affiliation behaviour is often absent. Results of situational tests also indicated that early learning experiences influence this motive. It was found that the first-born or only children have stronger affiliation motives than those born later. It is because children use to receive more parental attention during early years. Different studies also revealed

that children who are brought up to be dependent or raised with close family ties show a stronger affiliation motive than those coming from more loosely-knit families that encourage early independence. Affiliation needs are stronger in some cultures than in others. For example, **Indian society is strongly affiliating in nature compared to many of the western societies**.

Need for Power

As an independent motive, the need for power expresses itself in behaviours, which tend to control and influence the course of events including the behaviours of others. Traditionally it was believed that power was desired by people as an instrument to satisfy other motives like greed, aggression, affiliation etc. In the past, we have seen that mankind has always struggled for power. Cities have been destroyed and wars waged by people in reckless manner to increase their power. However, in recent years, emphasis has been placed on power motive as independent in itself and not derivable from other motives. Such a view was expressed by McClelland.

David McClelland (1975) has also described four general ways in which power motivation is expressed:

People do things to gain feelings of power and strength from sources outside themselves. For example, we express power motivation by reading stories about sports or we may attach ourselves to a leader from whom we can draw strength.

People do things to gain feelings of power and strength from sources within themselves. For example, an individual may express power motivation by building up the body and by mastering urges and impulses. A person may express power by trying to gain control over things- collecting pistols, fancy cars, credit cards and so on.

People do things as individuals to have impact on others. For example, a person may argue with another person or may have competitive attitude for another individual in order to have impact or influence on that person.

People do things as members of organizations to have an impact on others. For example, the leader of a political party may use the party apparatus to influence others or an army officer may express the need for power through the chain of command.

For any individual, one of these ways of expressing power motivation may dominate. But a combination of power motives cannot be ruled out. However, the dominant mode of expression often changes with age and life experiences of a person.

Different studies have shown that women seem to have less strong needs for power than men. Generally women are said to express their power motivation by being counselors, advisors and resource persons for other people. In this way, they have indirect impact and influence.

Dependency Motive

Dependency refers to interpersonal relationships where an individual behaves in a way in order to gain attention, reassurance, assistance, comfort, and support from fellow men. People use to spend more time with parents, or intimate friends when in difficult situations. They seek advice and mutually depend upon one another in working on the solution to various problems. In other words, individuals appear to be more dependent on social interactions and approval. Research studies indicate that the girls tend to be more dependent and more affiliative than boys (Maccoby and Jaklin, 1974).

In times of stress, people want to resort to dependency, i.e., they are in need of some one's care, and thus rely on the other (or others) for emotional, economic, and other support like love and security etc.

Cooperation Motive

Cooperation is an acquired motive. ***It is a condition manifested when two or more individuals or groups work together to achieve a common goal***. Cooperation signifies lack of mutual disagreement and opposition among fellow group-members, and absence of rivalry. Citizens of Zuni of New Mexico, Pacific are found to be extremely cooperative. Goleman reports that being wealthy in Zuni brings no status. On the other hand status is derived not from power or landed property but from friendships. A happy and successful Zuni is who has the most friends.

Studies of altruism among children provide evidence that helping-behaviour can be fostered through the use of models. Peulson (1974) compared 36 children who had watched all programmes in the Sesame Street Series with those who had

not been exposed to the series. He found significantly more cooperative behaviour among the experimental group.

Conformity motive

Conformity generally refers to the tendency to allow one's opinions, attitudes, actions, and even perceptions to be affected by prevailing opinions, attitudes, actions and perceptions. There is behavioral conformity, i.e., the tendency to "go along with the group"- to act in ways consistent with the majority. When changes in attitude, and belief take place because of pressures from significant others, attitudinal conformity takes place. There is also conformity of personality traits, i.e., underlying characteristics of a person undergo changes according to the norms of society.

F.H. Allport (1935) described, the conformity motive phenomena with the help of a conformity curve, which reflects that most people exhibit complete conformity to social norms with fewer and fewer people having deviations. **Norms are rules or laws or implicit moral standards of a society**. Norm refers to behaviour that is usual, or expected, acceptable and socially prescribed. Conformity to social norms takes many forms such as "Honor you mother", or "Love your country", which are very encouraging. Norms are also discouraging, i.e., "Do not steal", "Do not lie". They take widely held beliefs, and opinions, and are manifested in forms of dress, speech, manners, and fashions. Our submissiveness to social influences is due to conformity motives to the norms of society in which we live.

Psychological Motives

The psychological motives are also known as personal motives. These motives are personal in the sense that they are very specific to the personal psychological make up of the individual.

Curiosity

Curiosity is a motivational tendency to act, which does not have specific and identifiable goals. It is simply gaining pleasure by obtaining information, experiencing, or doing. It is the tendency to seek for the novel. Curiosity describes behaviours whose primary motives appear to remain in the activities themselves rather than on objectives.

Dember (1956), Fowler (1958), and other researchers demonstrated by using “T” and “Y” mazes that rats preferred novelty, change, and complexity. Animals who were allowed to become thoroughly familiar with a maze, when put in a structurally changed maze, spent more time exploring the altered maze.

In a number of studies, Harlow (1953) presented monkeys with mechanical puzzles. They were never rewarded nor punished for playing with these. Yet, they found, the monkeys spent several hours trying to dismantle them and finally succeeded.

Berlyne (1960) while experimenting on motivational behaviour investigated some of the variables that are associated with curiosity and exploratory behaviour. Berlyne identified a number of curiosity variables, termed as “collative” variables that are involved in curiosity-motivated behaviour. These are *novelty, complexity, intensity,* and *change*. He also mentioned about curiosity that is directed towards acquisition of knowledge. Curiosity leads us to explore. Thus curiosity is not manifested simply in perceptual exploration, but in cognitive explorations as well.

Curiosity motives and the needs for sensory stimulation are also conducive for the motive of exploration. It is true that we are driven to explore the environment by our curiosity and our need for sensory stimulation. Very often we ask a simple question- “What will happen if. . . ?” This stimulates intellectuals to find answers. This motive is otherwise known as “curiosity behaviour.” It is not an exclusively human trait. Animal experiments proved that curiosity behaviour is also found in many animals (Buttler, 1954).

Evidences indicated that the curiosity motive could be unlearned. It is true that interest in a novel object tends to diminish with time, but the motivation does not diminish. It appears early in human infants as well as in naive animals.

The need for changing sensory stimulation is closely related to curiosity. It is the basic motive, and exploration and curiosity are just two expressions of it. Besides all these motives, competence motivation also plays an important and persistent role in human behaviour. Sometimes we are motivated to master challenges in the environment. This is called competence motivation.

Exploration

Always people want to explore the environment. On many occasions we want to visit new places and “points of interest” by spending time and money. Further, we

watch television, cinema and sports, and read newspapers and magazines to know about the world. The motive behind all the activities is to find out "What's new?" by exploring the world around us. Small children always try to explore something. A baby's life is dominated by this motive. They also seem .to receive satisfaction from being allowed to explore. Very often, they smile and babble excitedly when exploring their world. When the motive to explore has been frustrated, children become distressed the same way as adults are bothered by frustration.

Achievement Motivation

The need to meet some inner standard of excellence is called achievement or competence motivation. Achievement motivation is a personality variable, which appears to differ from one individual to another. Some individuals are highly achievement-oriented and competence-oriented, and others are not.

As we know, what is most striking about man is his achievement. It arises out of a tendency to define one's goals according to some standards of excellence in product or performance attained. This motive has been investigated most extensively by cognitive psychologists like David McClelland and John Atkinson. For the first time, they used the projective methods to measure achievement motivation.

Generally people with a need for achievement seek to accomplish things, and to improve their performance. Many studies have been done to find out the relationship between the achievement motivation and performance. The results indicate that people who are high in achievement motivation generally do better on tasks than those who are low. Further studies indicate that people high in need for achievement are motivated to succeed. Therefore, they do not choose to work on very difficult tasks in which the probability of success is very low. Obviously they prefer to work at tasks where the possibility of success is great. **In general, people with high achievement motivation prefer tasks that are moderately difficult and that promise success.**

In some studies, child psychologists viewed that parents can teach their children to approach challenging tasks with the idea of mastering them. Children who are successful at little tasks gain confidence and seek other challenges. Further success enhances the tendency to try to do one's best to accomplish things and to improve performance. Consequently, this approach to life's problems becomes persistent and very much a part of the child's personality.

Extrinsic motivation and intrinsic motivation are closely related to the achievement motivation. Extrinsic motivation programmes are extensively applied in education, industrial and clinical settings. A person's need for feeling competent and self-determined in dealing with his environment is termed as "***intrinsic motivation***". It is called intrinsic because the goals are internal feelings of achievement and competence. ***Extrinsic motivation*** is directed towards goals external to the person such as money or grades. But intrinsic motivation has practical aspects because they are powerful motivators of human behaviour. The intrinsically motivated activities are those activities for which there are no apparent rewards except the activity itself. The activities are ends in themselves rather than means to ends.

Self-Actualization

Maslow (1954) has developed a humanistic approach to motivation, which is very popular due to its theoretical and practical value. His humanistic model is known as the "***Theory of self-actualization***".

Maslow attempted to portray a total picture of human behaviour. His approach is unique. He explained human motives or needs by arranging them in a hierarchy. Going from the highest need of self-actualization down the motives in the hierarchy are:

- *Need for self-actualization.*
- *Esteem needs: Such as the needs for prestige, success and self-respect.*
- *Belongingness and love needs: Such as needs for affection, affiliation, and identification.*
- *Safety needs: Such as needs for security, stability and order.*
- *Physiological needs: such as hunger, thirst and sex.*

Maslow's arrangement was made in the order of potency and priority of unsatisfied human needs. The hierarchy has different levels arranged in an ascending order (see Figure 7.3). A person's stand in this hierarchy is determined by either deficiency-oriented or growth-oriented behaviour (**D**-Behaviour or **G**-Behaviour).

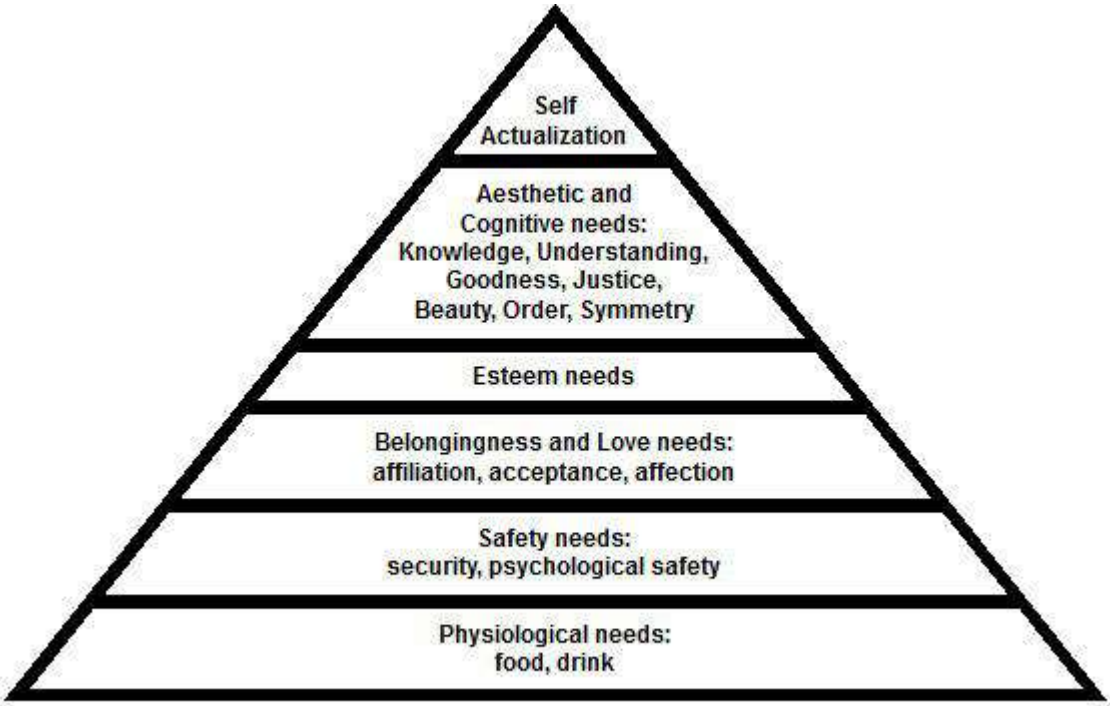


Figure 7. 3 : *Hierarchy of needs*

An individual who is deficiency-oriented is one whose basic needs have not yet been satisfied, and who is oriented towards achieving satisfaction and eliminating deficiency. The individual who is growth-oriented is the person whose basic needs have been satisfied and who is motivated towards self-actualization.

The most basic aspects of human motivation are ***physiological needs***, which remain in the first level in the ladder of motives. These are essential for our survival. Once these needs are satisfied, the second level needs emerge and gain importance. At the highest level is the desire to utilize one's personal capacities, to develop one's potentialities to the fullest and to engage in activities for which one is well suited. This level is called "***self-actualization***".

Maslow explains that every individual does not ascend this hierarchy step-by-step; some exceptions may be there. But it is true that the basic needs like hunger and thirst cease to be powerful motivators of behaviour once they have been satisfied to a certain degree. This approach reveals that every category of need has a limited

Maslow explains that every individual does not ascend this hierarchy step-by-step; some exceptions may be there. But it is true that the basic needs like hunger and thirst cease to be powerful motivators of behaviour once they have been satisfied to a certain degree. This approach reveals that every category of need has a limited capacity to motivate behaviour. Beyond this point of limitation, it is necessary to involve a higher category of need to motivate action.

Maslow's humanistic approach has been criticized for being over-optimistic about mankind in general. He has been accused of looking at only the healthy side of man and totally ignoring the unhealthy side. However, this model insisted that the human being is not a multi-system but a single entity consisting of many part functions. Truly speaking, this approach attempted to view "man as a man and not as an animal or machine''- thus restoring man to himself.

Unconscious Motivation

Very often we do things without knowing why we do them. This aspect of behaviour can be easily analyzed through the concept of "unconscious" developed by **Sigmund Freud**. Freud's concepts of "**instincts**" and "**unconscious**" are very much important to explain human motivation.

According to Freud, the unconscious includes ideas, thoughts and feelings, which cannot be brought to awareness or conscious level by ordinary means. It is just like a great underworld with powerful unseen forces, which influence conscious thoughts and the actions of the individual. In his psychoanalytic theory, Freud has rejected the principles, which limit themselves to the analysis of observable and conscious behaviour because they cannot explain the underlying powerful unconscious motives of human behaviour.

He emphatically viewed that unconscious processes, which guide human behaviour, can be known by special techniques devised by psychoanalysts. These techniques are *free-association, dream analysis, hypnosis* etc.

Another distinguished psychoanalyst, **C.G. Jung** also emphasized the importance of human behaviour in his theory. However, the concept of the unconscious differs notably from Freud. According to Jung, the unconscious is much more complicated and it is made up of two functional divisions- the **personal unconscious** and **collective** or **racial unconscious**. Personal unconscious is somehow similar to Freud's description of unconscious. But the collective unconscious is much more influential. Jung believed that human behaviour is guided by two potential forces – the **unconscious** and **teleology**.

The *unconscious* includes everything about human past; *teleology* includes everything about the future like one's aims, aspirations and intuitions. So the psychic life results from an interaction of the past with the future.

According to Jung, the main agency, which guides the past and future, is the ego. He calls it "**conscious mind**". It is made up of conscious perceptions, memories, thoughts, feeling etc. But beyond this ego, lies a bigger interacting system, which influences human behaviour. Jung calls it "**personality**" of an individual. In his theory, Jung told about a fascinating concept called "**collective unconscious**". It is the most powerful and influential system of the personality and in pathological cases it overshadows the ego and the personal unconscious. The collective unconscious is inherited from man's ancestral past.

Jung also viewed that a person adopts a mask in response to social demands, norms and conventions. He called it

"**persona**". It is the role assigned to him by the society and expected of him. The purpose of mask is to make a definite impression upon others and often to conceal the real nature of the person. The "persona" is the public personality. Very often, this is different from the private personality. According to Jung, man inherits some animal instincts, which indicate the animal side of his nature. This can be inferred from the display of violence, aggression, and injury to oneself.

The concept of unconscious motivation was criticized by many psychologists later on. This approach was stated to be most unscientific by many experts. The concept of collective unconscious is considered to be absurd and lacking in scientific proof.

Homeostasis

Psychologists, in the early part of the twentieth century were fascinated by the concept of homeostasis. They borrowed this concept from physiology. Claude Bernad, a physiologist coined the word "**homeostasis**" to explain the stability of the inner environment or physiological equilibrium. The function of all biological drives is to regulate and maintain the physiological equilibrium of the organism. When the internal state is disturbed, the conditions propel the organism to seek activity. Such activity continues until the equilibrium is restored and this state is called **homeostasis.** Generally homeostatic processes are physiological and automatic in nature. The examples are maintenance of body temperature, adequate supplies of nutrition for growth and maintenances of body and so on.

Psychologists used two terms for homeostasis for animals and human beings separately. For animals, it is known as static equilibrium or *static homeostasis*. This involves a

limited part of the organism, mostly reflexes or chains of reflexes, where the activities are controlled by the spinal cord and the brain. But the human being is more than a biological creature. He is superior to animals. So the psychologists used the concept of '*dynamic homeostasis'* to explain our complex behaviour. This behaviour takes place as a consequence of the functioning of the cerebral cortex.

It is true that an organism strives to restore its balance when there is a physiological deficiency. On the same line, it also strives to maintain equilibrium when there is psychological imbalance. This could be inferred from the processes of adjustment or coping patterns. The organism may use other ways and means to resolve conflicts and reduce the tension arising out of such conflicts for a short span of time. This state is referred to as dynamic equilibrium by **Kurt Lewin**. So it is obvious that static and dynamic homeostases are the key concepts in understanding human motives.

No doubt, the concept of homeostasis has been borrowed from physics and physiology to explain psychological processes. Experts opined that trying to explain psychological processes with this concept is like fixing a square peg in a round hole. They argue that many a time man exhibits such a variety of behaviour that it can be explained neither by static nor dynamic homeostasis. An individual may behave in such a manner that it deliberately upsets its equilibrium and destroys itself. For example, revolting against society or bringing about social reforms often means an increased state of disequilibrium. Very often, every human being chooses death to dishonor, prefers aesthetic experiences to satisfaction of hunger. Here homeostasis does not give the entire picture of human motivation.

Measurement of Human Motives

It is not easy to measure human motives. The attempts made earlier proved to be too complex. Apart from the practical difficulties involved in putting people into an activity wheel, the very idea of measuring human motivation through activity is ridiculous. The main reason is that at the human level, there can be motivated inactivity as well as unmotivated activity.

It is true that in human beings, motivation shows a high degree of complexity. As discussed earlier, Freudian concept of unconscious motivation adds the possibility of different forms of activity springing from the same motive. This has necessitated the development of a variety of tools and techniques for measuring motivation. Taking this problem into consideration, psychologists have developed a variety of tools serving different purposes. The two approaches to the measurement of human motives are: (a) *direct measurement*, and (b) *indirect measurement*.

When motives are measured directly through objective observation, the approach is the “Direct Measurement of Motives”. This approach also includes ***conscious self-reports, administering questionnaires***, and ***inventories*** to assess specific motives as required by the observer. To measure the drives like hunger, thirst, many gadgets have been derived. These gadgets have a precise quantitative measure of the level of deprivation, physiological changes accompanying the drive and some behavioral changes, as a whole. In these types of measures, the tools are basically structured and responses are classified into predetermined categories.

Some psychologists rejected the concept of “direct approach” of measuring motivation. They have opined that motives cannot be measured directly, but can be inferred through certain indirect means. Hence, they use ***projective***

techniques for the measurement of motivation. In these techniques, the stimuli are deliberately made somewhat ambiguous in nature and the organism is free to give the responses he wishes. Popular projective techniques used to assess motives are ink-blots, pictures, incomplete sentences, and ambiguous figures. Chances of faking are less in this case, because the individual does not know what kind of demands are being made of him. In these tests, he is more likely to project his own needs and motives into responses.

The most popular projective technique used by experts in motivational research is the **Thematic Apperception Test (TAT)**. This test was originally introduced by Morgan and Murray in 1935. The TAT test consists of a series of pictures about which the person is asked to write stories. These stories are then analyzed and coded as motives, needs, wishes, and desires etc., which are assumed to have been projected by the respondent into the characters in the pictures.

No doubt, the studies on motivation invited many criticisms later on. Despite their flaws, the plethora of studies in this area has opened avenues for human beings to understand themselves.

EMOTION

Meaning and Definition

The term 'emotion' has been derived from the Latin word "*emovere*" which means 'to move', 'to excite', 'to stirrup', or 'to agitate'. Arousal behaviour is emotion, which is an affect-laden state of the organism. "Affect means experience of pleasantness, unpleasantness, excitation, calmness, tension and relaxation" (E.B. Titchener). It is what we mean when we say that we love, fear, or hate. Some of the other emotions are joy, acceptance, surprise, sadness, anger, and disgust etc.

Emotion is a subjective experience of prolonged feelings. What is feeling? In a general way, feeling refers to “experiencing”, “sensing” or having a “conscious process”. Specific meaning of feeling is, (a) ‘sensory experience’ such as warmth or pain, and (b) ‘affective states’, such as feeling of well-being, a feeling of depression, and a feeling of desire etc. Wilhelm Wundt stated three dimensions of feelings, such as (!) pleasant or unpleasant, (ii) tense or relaxed, and (iii) excited or depressed. Intense feelings when prolonged turn to be emotions.

P.T. Young has operationally defined emotion in the following way: ***Emotion is an acute disturbance of the organism as a whole, psychological in origin involving behaviour, conscious experiences, and visceral functioning*.** In emotion, the total behaviour including the receptors, effectors, nervous systems, and related psychological processes is affected. For example, we have experiences at one time or another the pleasure of seeing a loved one, the enjoyment of a movie, or the feeling of grief for the sad demise of a dear relation etc. All these experiences represent emotions in spite of their subtle differences, and varied characteristics. In other words, emotions are prolonged feelings that generally have both physiological and cognitive elements, which influence behaviour.

Nature of Emotion

Emotional behaviour involves both physiological and psychological activities. Any emotion consists of both mental and cognitive components, and physiological responses. Emotion helps persons in the following ways.

1. ***Emotion prepares the individuals for actions.*** Preparation for action means aiding the development of effective responses. Thus emotion gives motion to the organism

to respond, i.e., either to move towards the goal or to move away from the harmful stimulus environment. **Emotion activates and directs behaviour towards the goal.** It serves as a motive for locomotion towards the desired object. It also serves as a basis for avoidance or flight-behaviour when the situation arises. For example, being emotionally attached towards music, one may go for admission to a music college instead of mainstream of science, arts or commerce etc. The individual gets satisfaction out of such music pursuit, and it serves as reinforcement for seeking out similar course of action in future.

2. Emotion is behaviour-arousal. That means the individual being emotional becomes active for a prolonged period. He or she goes on working tirelessly. This continuous action does not usually happen when one is in a state of calmness and relaxation. For example, political party workers continue to work ceaselessly before their election schedule canvassing for their party-candidates. During festival and wedding ceremonies members of the host become overactive arranging decorations, lightings, music and dinner etc. This is because they become emotional about the event, and the emotion arouses in them a set of behaviors towards a desired goal.

3. Emotion prepares the individual to be insensitive to physical pains and injuries. For example, one forgets his/her hunger, as one has to attend an urgent meeting. During outdoor games such as football or cricket, players hardly become aware of any muscular pain or injury unless it is very severe. They become conscious of their pain only after the event is over. In picnics, parties, and fanfares, participants hardly become aware of their minor bruises.

4. Emotion activates the individual to use his

maximum potential at the time of life-threatening dangers. For example, when an individual is about to be attacked by an enemy or a beast, he/she tries to exert maximum strength to save his/her life and escape into safety. Very often we come across the news that a pouncing leopard was killed by a cowherd boy by means of a small weapon. During emotional state, the motor organs are supplied with more flow of blood and thus become energetic.

5. Emotion helps us to regulate and appropriately modify our social interactions with others. Whether verbal or nonverbal, our emotional behaviour is observed by others; their reactions act as a signal to us. We become aware of our emotional behaviour. In course of time, this awareness leads us to be more effective in our social interaction with our fellowmen. For example, a father who notices frightening responses in his son seeing a stranger may explain, persuade, and finally convince him not to fear this loving stranger, and thus teach him to deal with the world effectively.

The world has been enriched due to some healthy emotions such as parental affection, piety, love, compassion, fellow feeling, patriotism, martyrdom, reverence for genius, love for plants and flowers, tenderness for animals and pets etc. F. L. Ruch states that emotion involves four types of responses: (a) *destructive responses*, (b) *approach responses*, (c) *retreat or flight*, and (d) *stopping of responses*

Destructive **Responses**. Emotional behaviour is manifested through destructive responses, such as attacking, hitting, biting, kicking, spitting, shouting, and abusing. Destruction of self and others are noticed in extreme cases. Each individual expresses his anger and frustrations in unique ways. The civilized society has influenced the modern man not

to be quite obvious in expressing his emotions. Rather the expectation is to inhibit strong emotional reactions from being expressed in physical forms. These inhibited emotional urges sometimes find expressions indirectly through ridicule, parody, or snobbery.

Approach Responses. There are some pleasant emotional situations, which the individual seeks with delight and interest. For example, a lover and a beloved eagerly want a quick meeting of the two. They welcome each other with gusto. The individual shows approach responses where there are possibilities of success. Approach behaviours are manifested in peace, satisfaction, and contentment. A confident football player demonstrates such approach behaviours before entering the field for a scheduled match.

Retreat or Flight Responses. Due to fear emotion, the individual takes a flight and goes away from the goal-object. The flight may be direct or indirect. Running away from a place out of fear of a biting dog is an example of direct flight. But the situation, where direct flight is not possible, psychological retreat is an alternative. There are some individuals who frequently change their jobs or even marital lives. The modern man demonstrates his flight through apology, excuses, reconciliatory approach, and several withdrawal responses. Daydreaming, childish behaviour, and regression are some of the examples of such repressed emotional-retreat responses.

Stopping of Responses. Excessive disappointment and sorrow may create in an individual a state of complete inactivity, a situation where he stops all kinds of responses and remains static. Because of extreme emotional shock, he cases to work, talk, and take food. The individual experiences a state of depression, and loses all interest in pleasurable

activities. The person sometimes may require to be forcibly fed by the doctor. But this does not mean that we will not have our normal shares of frustrations, disappointments or grief. Stopping of response owing to grief etc. point out our limitations as well deficiencies, thereby aiding us to gain insight as to how this can be overcome.

Organic (Physiological) Changes During Emotion

The experience of emotion is associated with a variety of bodily changes, both overt and covert. Overt bodily manifestations of emotions are obvious and observable. But the covert organic changes are detected only by special procedures, and modern recording devices including computers. Following overt and covert changes occur in the body at the time of emotion :

- *Face becomes red with excitement or anger;*
- *Eyes are protruded;*
- *The pupils of the eyes are dilated.*
- *Respiration becomes more rapid;*
- *The electrical resistance of the skin decreases;*
- *The blood clots more quickly at the time of injury;*
- *Blood sugar level increases to make the organism energetic;*
- *Gastrointestinal activities decrease or even stop totally;*
- *Blood is canalized from stomach and intestine to the motor organs and brain;*
- *The hairs stand on their roots.*

All bodily changes during emotions are the result of a number of complex underlying processes originating in and

integrated by the *Autonomic Nervous System, the endocrine glands* and *the cerebrospinal system*. (Activities of the Autonomic Nervous System have been described in detail later in this chapter). These internal reactions are quite complex and difficult to measure.

The outward bodily changes include changes in facial expression, vocal expression, sweating on the surface of the body, and accelerated motor activities, etc. The internal physiological changes include changes in the electrical activities of the skin, respiratory activities, blood pressure, pulse rate, sweat glands, reactions of the endocrine glands, and the chemical activities of blood etc.

The following instruments are used separately or in combination to measure organic changes during emotion: (i) the polygraph, (ii) multichannel amplifier with associated ink writing, (iii) optical oscillographs, (iv) pneumograph, (v) sphygmomanometer, (vi) psychogalvanometer, and (vii) electroencephalogram.

In addition to these instruments, damages in the brain such as paralysis on any lobe of the cerebral cortex due to emotional shock can be diagnosed by modern computerized instruments such as CAT scan, PET scan and MRI (Magnetic Resource Imaging). The electrical activities of the body during emotion such as brain waves, muscle action potentials, galvanic skin responses, electro grams, and eye blinks are studied through these aforesaid instruments.

The following organic or physiological changes occur during emotion.

Electrical Phenomena of the Skin

One of the common measures of autonomic activities associated with affective and emotional state is the

“galvanic skin response” (GSR). It also bears several names, such as ‘psychogalvanic reflex’, ‘skin resistance’, ‘Palmer resistance’, ‘Palmer conductance’, ‘electrodermal response’ and ‘skin potential’. The GSR is measured with an apparatus known as psychogalvanometer. The changes in GSR called the electrodermal changes result from the activity of the sweat glands. The GSR is associated with blood pressure and respiration, and indicates that an emotional reaction is taking place. The GSR is activated during emotion by the sympathetic nervous system and decreases during emotional stimulations. The latency, amplitude, and duration of the GSR provide indications of whether or not an emotional reaction is taking place.

Blood Pressure

Darrow (1936) used blood pressure and galvanic skin reflex as indicators of emotional states. The level of blood pressure and GSR are considered to be the best indications of facilitative, preparatory, and emergency functions during emotion activated by the sympathetic system.

There are two measures of blood pressure, i.e., *systolic* and *diastolic*. The difference between these two measures is known as “pulse pressure”. Systolic pressure is maximal pressure reached during the contraction of the heart; diastolic pressure is the least pressure during expansion. Variations in pressure owing to emotion are recorded continuously. The

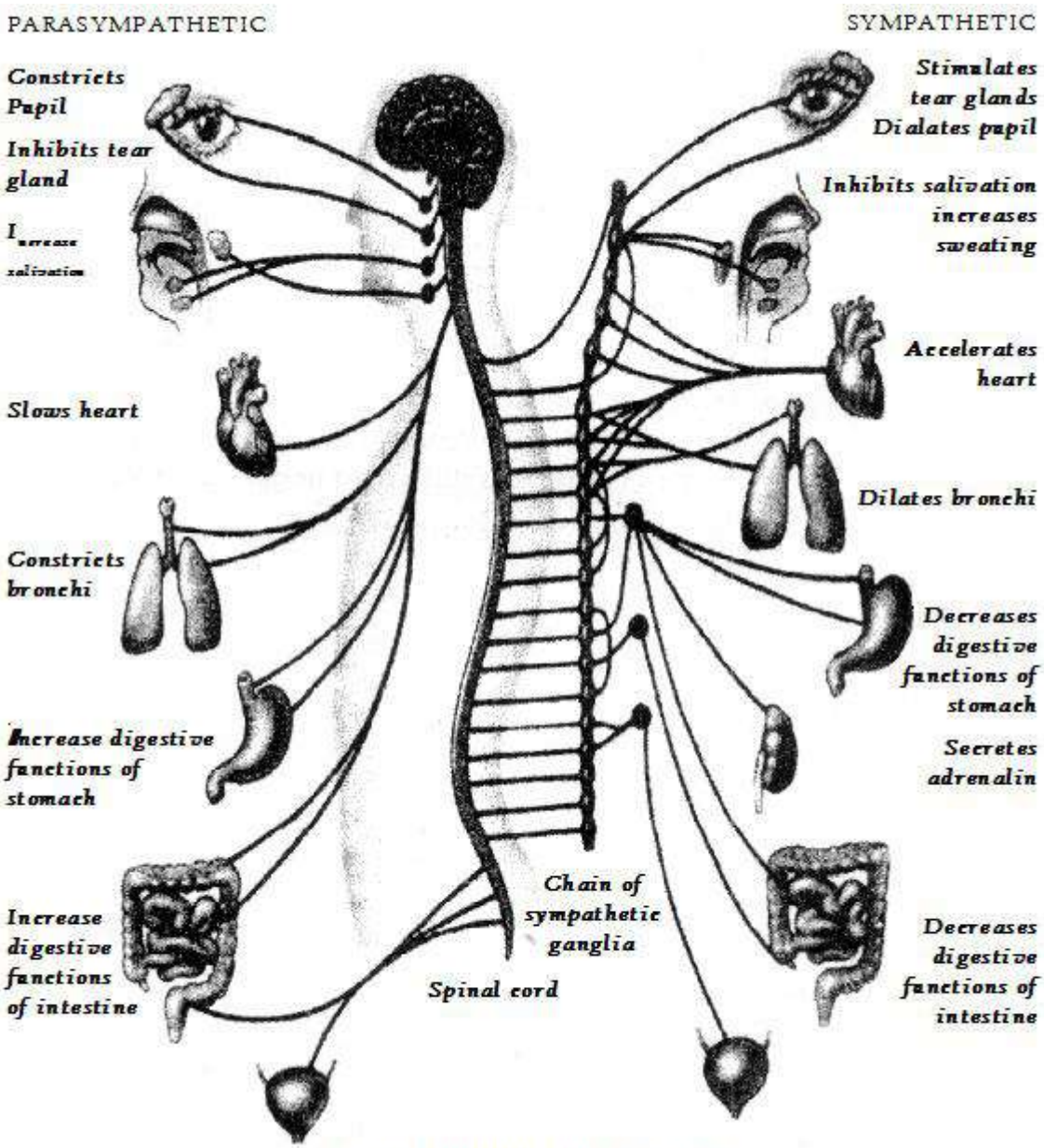


Figure 7.4 Autonomic Nervous System

significance of these changes is correlated with emotional manifestations of the individual.

Heart Rate

The ***electrocardiogram (ECG)*** records the heart rate by means of attachment of electrodes to the two arms or to either of the arms and the left leg. The pattern recorded enables the cardiologist to analyze the performance of the heart during the emotional state. The “cardiotachometer” is a useful device for counting the number of heartbeats. “Cardiochronograph” is also another such device to study the heartbeats during emotion.

Respiration

The respiration pattern is very often disturbed by emotional conditions. The respiratory features, i.e., the rate, depth, pattern, and inspiration and expiration ratio are measured in order to gauge the intensity of the emotional state. Respiration is mainly regulated reflexively through the respiratory center in the medulla. The medulla responds to changes in blood chemistry. Even if the respiration is interrupted by other reflexes, such as, coughing, sneezing, sighing, and yawning, it is a sensitive indicator of emotional responses such as the startle response, the conscious attempts at deception, and conflicts.

Skin Temperature

The common method to measure skin temperature in emotion is to apply a thermocouple to the skin area concerned. Emotional stress produces a fall in the skin temperatures. Conflict and altercations are associated with vasoconstriction and a fall in the skin temperature. On the other hand, uninhibited action and emotional security are said to result in vasodilation and increase in skin temperature.

Pupillary Response

The sympathetic and parasympathetic divisions of the Autonomic Nervous System never act together. Either of the two becomes active at one time depending on the situation. That means the two divisions are in active opposition to each other while in action. Pupil of the eyes is the index of this. During emotion, dilation of the pupil occurs through the sympathetic system. Constriction of the pupil occurs by the parasympathetic system. Pupillary responses to pain and emotion-provoking stimuli have been studied by Bender (1933), Lindsley and Sassaman (1930). They recorded pupillary reaction during emotion, which are recorded through motion pictures. (This is the same as modern video-tape recording).

Salivary Secretion

The secretion of the parotid gland has been studied by Pavlov and others in conditioning experiments. Wenger and Ellington (1943) described a method measuring salivary output as an index of autonomic activity. Others have tried to study the secretion of parotid gland in psychoneurotic patient's response to auditory stimulation. The secretion resulting from parasympathetic stimulation is thin and watery. But owing to sympathetic stimulation the salivary secretion becomes thick and is filled with mucus. This leads to the general observation that emotional excitement, anticipation, fear and anger produce a dryness of the mouth due to predominance of sympathetic activity.

Pilomotor Response

During emotion, especially when one is afraid, hairs stand on their roots. This is due to the activities of the sympathetic nerves. The production of "goose flesh" when one is afraid is an emotional reflex.

Blood, Saliva and Urine Analysis

Chemical components of the blood have been found to be affected by emotional stimulation. Among them are blood sugar level, adrenaline content, acid balance (pH), red blood cells, and many other constituents. Tests have been made to know which organ of the body is activated when glucose and insulin are injected into the body. It was known that due to glucose and insulin intake, the sympathetic division becomes most active. Urine is analyzed for excess sugar secretion from samples taken at intervals before, during, and after emotional stimulation. The secretion of ketosteroids, a metabolic product resulting from steroid flow from adrenal cortex during stressful emotion, and the acid base balance (pH) have been found to vary with emotional state and stressful mental activities.

Gastro-intestinal Activities

Studies have been made on the activities of the stomach and the intestine in animals under emotional, electrical, and chemical stimulation. Cannon (1929) demonstrated that emotions of fear or anger inhibit activities in the gastro-intestinal tract. X-ray and fluoroscopic examination following barium milk, and by means of inflated stomach-balloon with a recording device are used to measure such gastro-intestinal activities.

Metabolic Rate

The amount of oxygen consumption or the basal metabolic rate (BMR) generally increases during emotions involving excitement and general body mobilizations. A standard BMR machine is used for the purpose.

Muscle Tension

A common symptom of emotional anxiety is bodily tension. These somatic reactions are caused by emotional reactions. Muscular tensions and visceral changes occur in emotion. Muscular tensions are recorded by means of muscle-action potential. Studies by Davis (1938), and Courts (1942) reveal the relation of muscular tension to frustration and performance.

Tremor

The emotional excitements such as fear and anger give rise to tremors. Tremor is witnessed in conditions of tensions. Luria (1932) found that emotional conflict externalized in motor performance led to tremor and disorganization of motor responses. Berrien (1939) has described finger-tremors as indices of emotion.

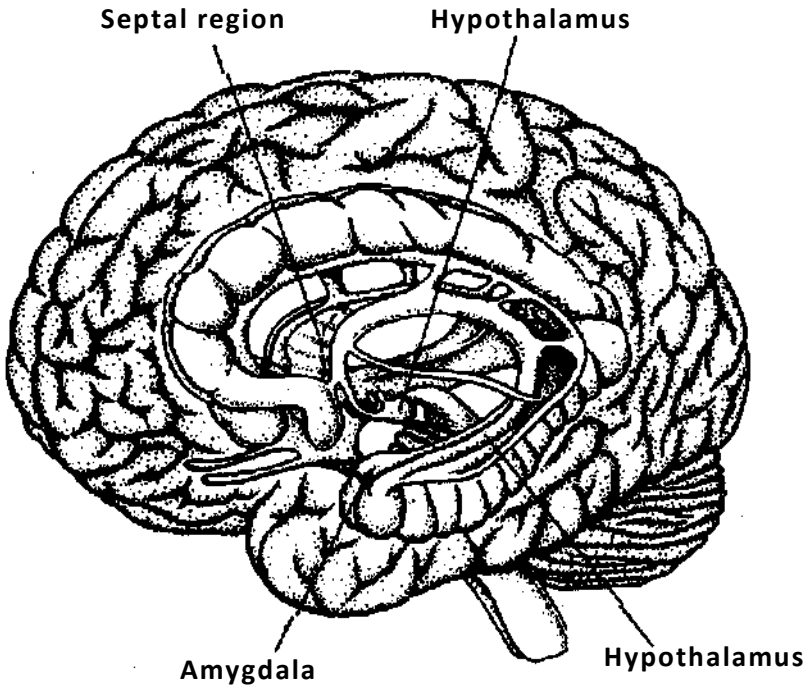


Figure 7.5 : The limbic system

Eye Blinking

The excessive eye blinking is associated with emotional tensions. Too much eye blinking seems to suggest a kind of "nervousness". The rate of eye blinking increases with emotional arousal and excitement. Records of eye blink shows that there are different patterns of blinking in different people; in some there may be continuous blinking; in others sporadic groups of rapid blinks; and in some others blinks may occur singly or doubly at irregular intervals.

Besides the aforesaid organic changes, which are associated with emotional sates, there are neural and hormonal mechanisms underlying emotional behaviour. These can be understood by studying the activities of the Autonomic Nervous System.

Role of the Autonomic Nervous System in Emotion

The visceral system of the Peripheral Nervous System is known as the Autonomic Nervous System. The sensory (afferent) and motor (efferent) nerves connecting the surface of the body with the central nervous system constitute the peripheral nervous system. In other words, rest of the nervous system, other than the brain and spinal cord is the area for Autonomic Nervous system (see Figure 7.4).

The nerve fibers of the Autonomic Nervous System are connected with the function of the blood vessels, endocrine glands, heart, lungs, stomach, intestines, colon and bladders etc. The Autonomic Nervous System is controlled by the old brain, and is not under the functional control of the cortex. The synapse of this system is situated outside of both the spinal column and central nervous system.

Physiologists have discovered two divisions of the

autonomic nervous system, i.e., *sympathetic division* and *parasympathetic division*. These two divisions never function together. Either of the two functions at a time.

The Sympathetic Division

Structure. The spinal nerves emerge from the middle portions of the spinal cord. These spinal nerves emerging on both the sides of the spinal cord run into a series of ganglia. Ganglia are the nerve centers present in both the sides of the spinal cord. These nerve fibers run up and down the body synapse with the effector neurons that go into muscles, glands, skin, and viscera. These fibers coming from thoracic-lumbar segments of the spinal column finally reach organs from the head to toes - all parts of the body. This part of the autonomic system is called sympathetic nervous division because they make the visceral organs function in 'sympathy' during emergency conditions of serious effort or exercise, states of fear and anger.

Functions. The sympathetic division acts in three major events, such as during (a) excitement, emotion of fear, anger and elation, (b) violent exercise and bodily activities and (c) extreme cold when the life is endangered.

Owing to the function of the sympathetic division during emotion such as anger and rage, medulla of the adrenal gland pours excess amount of its "adrenaline" secretion to the blood stream. This secretion in the blood stream is associated with strong emotional experiences. This leads to release of stored sugar from the liver into the blood. There are chemical changes in the blood as a result of which the blood clots easily and quickly. Blood pressure increases, pulse beats become rapid and vigorous. The passages of the lungs enlarge and more air is admitted due to heavy breathing. The pupils of the eyes are

dilated and thus more light enters into the eyes. Heavy sweating occurs throughout the body. Palms and hands are full with sweating. The temperature of the skin sometimes rises and at times falls several degrees.

The adrenal medulla also secretes another hormone called "*noradrenaline*" which constricts the blood vessels at the surface of skin. Bloods are chanelised from stomach and sex organs to the motor organs, such as, muscles of legs and arms. The digestive functions come to stop. There is cessation of digestive juices due to inhibitive function of the sympathetic division. The blood from these is diverted to the muscles. Hairs stand on their roots. The adrenaline secreted from adrenal glands expedites the actions and reinforces the emergency-facing processes. There is evidence that the thyroids and pituitary glands also secrete hormones during emotion. During joy, the stomach has maximum visceral changes, where as in fear and anger, the adrenal functions vigorously. During sorrow, the gall bladder becomes most active. These glandular responses in emotion are adaptive in nature, which means the individual becomes able to cope physically with emergency situation.

The visceral activities as well as the neural activities are involved in emotion. Almost the total nervous system is involved in emotional response. Electrical responses are also closely associated with the visceral and neural activities during emotion. The electrical responses, such as galvanic responses and brain potentials undergo changes during emotion. The autonomic activities energizing sweat glands lead to perspiration, which produces changes in the electrical properties of the skin. The tissues of the skin generate electromotive force and the electrical resistance of the skin is changed.

The Parasympathetic Division

Structure. From the two end segments of the spinal cord, i.e., from the upper and the lower segments, the nerves of the parasympathetic division emerge on both the sides. The upper division of the spinal column is called cranial part and the lower segment is called the sacral part. These nerves then pass the rough series of ganglia and reach the visceral organs and structures having synapses outside the central nervous system. Thus, the parasympathetic division of the autonomic nervous system is situated from the above and below the sympathetic division. This division is thus known 'cranio-sacral division' of the autonomic nervous system. Parasympathetic nerves like the sympathetic division reaches almost all the organs of the body from head to toes. When sympathetic division is active, the parasympathetic division takes rest and vice-versa. Whether a particular division accelerates or inhibits a particular organ or system depends on the welfare of the organism at that moment depending on the situation.

Functions. Parasympathetic division is involved in the ordinary vital functions of life. The parasympathetic division maintains the ordinary processes of life. Protection of the eyes from the bright light is the work of this division. The constriction of the pupils of the eyes is done by this division for protection purpose. It adjusts the lens of the eye for new vision. The conduction of food, its digestion and the excretion are done by parasympathetic division. During sexual union, more blood supply to the sex organs are made by this division. It meets the physiological demands of the body to maintain. It stores up energy in abundance for future use by the sympathetic division during emergency.

But owing to prolonged emotion, if both the divisions of the Autonomic nervous system become overactive that may lead to organic pathology. Parasympathetic over activity may lead

to peptic ulcer, backache, and headache etc. The sympathetic over activity may lead to psychosomatic diseases, such as asthma, tuberculosis, migraine etc. for which psychosomatic medicines are prescribed by the physicians.

Role of Hypothalamus in Emotion

Hypothalamus sits at the midline of the brain just below the thalamus extending to the base of the brain. Its size is not larger than the tip of a little finger and it weighs about less than one percent of the brain's entire weight.

Hypothalamus is very vital to both emotion and motivation, thus it is called "***the brain within the brain***". It is an important brain structure, which through its connections with autonomic nervous system controls glands and smooth muscles, blood vessels and the heart. It influences various kinds of emotional responses accompanied by physiological arousal. The heart rate speeds up, blood

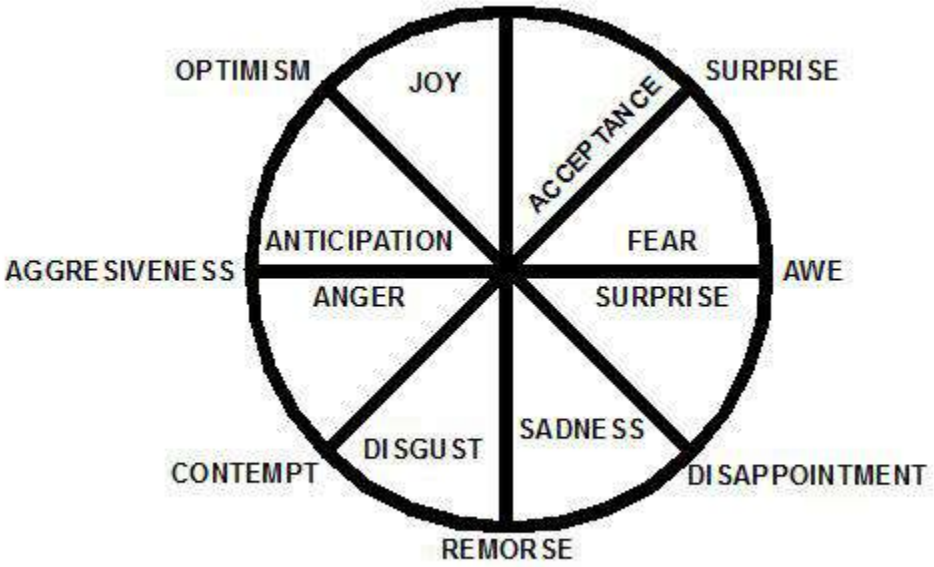


Figure 7.6 : Robert Plutchiks's wheel of emotion

circulations from internal organs carrying increased amount of glucose i.e. blood sugar to the muscles take place. These “fight” or “flight” emergency responses are the preparatory processes of body for appropriate kind of action and are regulated by the autonomic nervous system under the control of hypothalamus.

By stimulating a part of the hypothalamus in cats, Levison and Flynn (1965) have found that they turn into cold, silent killers of its victims. Flynn (1967) by stimulating other part of hypothalamus found that the cats can be violent, aggressive emotionally, and can attack the victim that comes close. Thus aggressive behaviour can be elicited in animals by

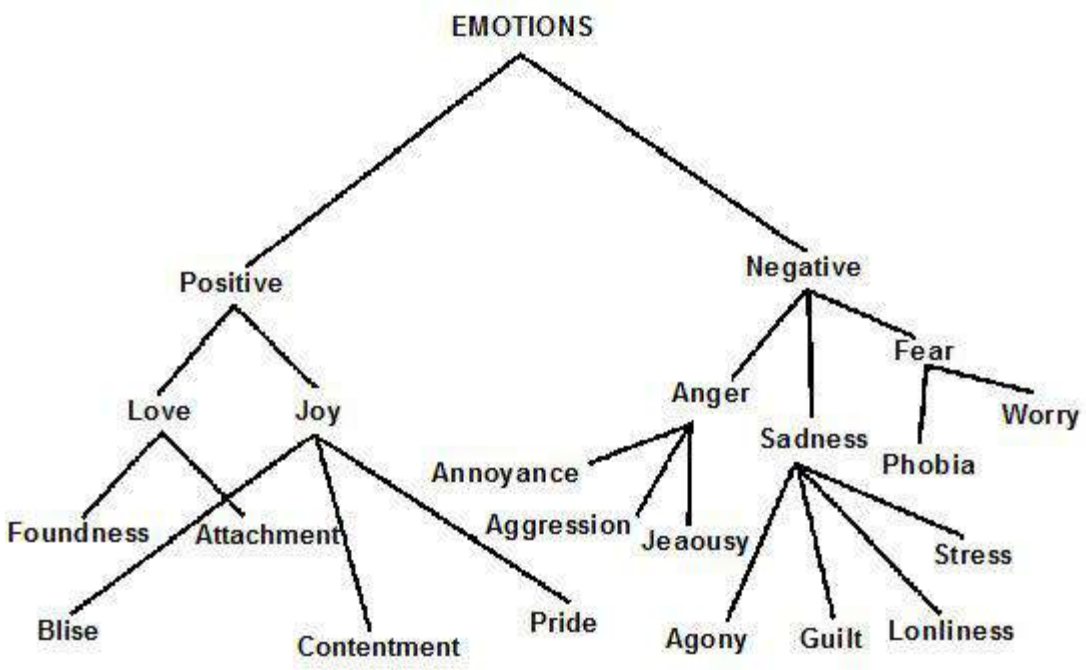


Figure 7.7 : Positive and negative emotions

mild electrical stimulation of a particular part of the hypothalamus. By implanting electrodes when a part of a cat's hypothalamus is stimulated the animal hisses, its hairs stand on its body, its pupils become dilated and it attacks the rat or its victim ferociously in the experimental cage. Injected neurochemical stimulation of a hypothalamic region results in exactly the same violent attack response by the cat. On the other hand inhibitory neurochemical stimulation injected to the same part of hypothalamus produced temporary inhibitory responses. (Smith, King, & Hoebel, 1970). Later studies have shown that **hypothalamus is the important center for the integration of emotional impulses**.

Role of Limbic System in Emotion

The limbic system is a group of structures of the brain lying in an area below the corpus callosum at the innermost edge of the cerebral hemisphere. The particular structures, which are grouped as limbic system, are as follows: the hippocampus, anterior thalamus, amygdala, septum or septal area, hypothalamus and their interconnecting fibers. There are specific structures in the limbic system, which are involved in emotional and motivational reactions. This structure is not well developed in lower organisms below the mammals. Limbic system being interconnected with hypothalamus works in emotional and motivational needs (see Figure 7.5).

When there is a lesion in a precise part of the limbic system in human patients, they fail to carry out sequential activities. They are found to have forgotten the order of activities. Monkeys having lesions in some regions of the limbic system express anger at minor provocations. Moreover, monkeys with lesions on some other regions at the limbic system become

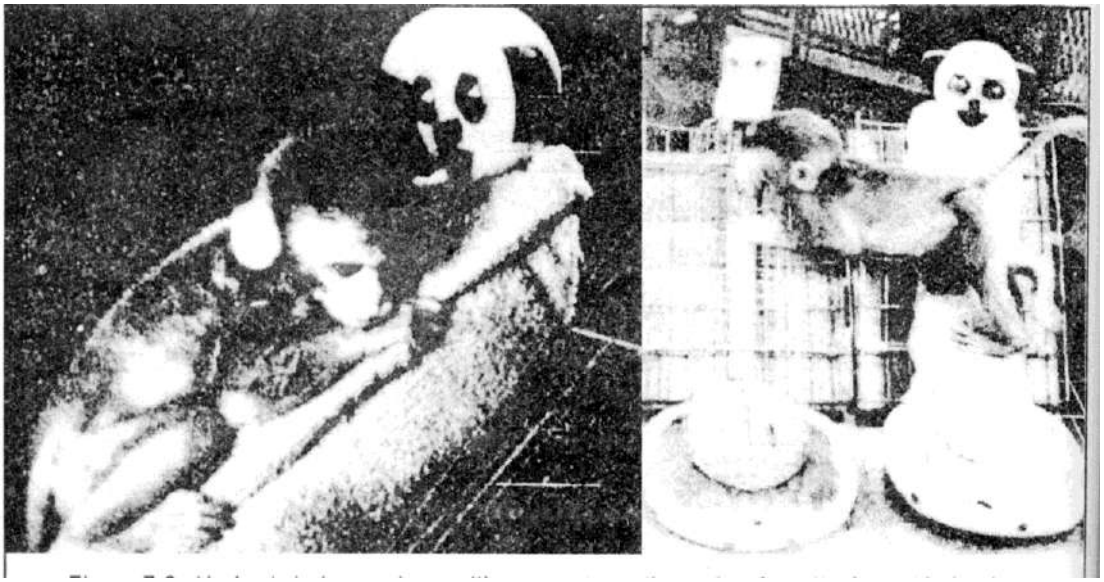


Figure 7. 8 :Harlow's baby monkeys with surrogate mothers showing attachment behavior

docile and calm, and do not show hostility or anger when provoked.

Tumors and lesions in the limbic system lead to impotence and reduction of sexual drive (Blumer & Walker, 1967). Other evidences also suggest that stimulating limbic area may result in sexual arousal. Heath (1964) reports four cases of electrical stimulation of the limbic system of three males and a female, of which three male persons experienced sexual arousal during limbic stimulation and the female experienced orgasm. Thus researchers have evidences in common that this structure is involved in emotional reaction.

Role of Amygdala in Emotion

Amygdala is a part of the cerebellum in general, and limbic system in particular. Findings by G.V. Goddar (1964) revealed that damage to the amygdala could turn a wild animal into a docile creature. In another study, Bard and Mountcastle (1948)

d turn a docile animal into an aggressive beast. Goddard also found that by stimulating parts of the amygdala, mild and intense fears are elicited. In intense fear, the animal flees from the spot in panic. Psychosurgery of amygdala is called "*amygdalectomy*". Malfunction of amygdala may trigger violent emotional reactions. (Mark and Ervin, 1970)

Role of Learning in Emotion

Many of our emotional reactions are innate as well as learnt too. Except the emotion of fear, rage and love, all other emotions are learned through our experiences and interactions with people. Our emotional reactions are learnt through association with new objects and situations. **J.B. Watson,** the founder of the behaviorist school (1930) considered a number of emotions as the product of child's learning experiences. Watson and Rayner have described the way by which one may learn to fear certain stimuli from their famous experiments with a child, named Albert.

Albert was an 11-month-old boy who was never afraid of animals. In the beginning, he was playing with white furry toys, i.e., a rat, a rabbit, a dog, a monkey and Santaclaus mask. But later, when he was happily looking at a white rat, Watson introduced a loud sound, which evoked fear response in him. Albert shrank back. He repeated the procedure many times whenever Albert was with the white rat. Such repetition of loud sound being associated with the presentation of white rat/rabbit elicited fear responses in Albert. The child was frightened by the very sight of the rabbit and tried to avoid it. When other white toys were shown to him, these also provoked fear in him. Thus this experiment led to the

g is a simple type of learning made possible through association. Thus a stimulus being all the time associated with a fear response becomes in the long run a stimulus for fear. This is called “generalization” phenomenon in learning. The fear responses, which Albert learned, was not limited to the CS only but was generalized to similar objects, i.e. to all white furry toys.

Not only fear, love and rage emotions are learned. The escape and avoidance behaviours are learned too. There are many situations, which are emotion producing. We in course of our development learn to fear more and more stimuli, i.e., we develop the ability to distinguish the new stimuli, which are fear provoking from the old ones. Our cognitive abilities help us to be aware of such new emotion-provoking stimuli in the environment.

We also learn many emotional responses including irrational fears through imitations and observations of our sibling and parental behaviour. Similarly many emotional expressions, such as abusive language, temper-tantrum, escape responses etc. are learned behaviours. Facial expressions and gestures in certain emotions are learnt from one’s culture. Many emotional reactions are also modified according to the cultural norm to which the person belongs.

Development of Emotion

The ability to respond emotionally is present in the newborn; it is a part of the developmental process and not learned. Emotion is governed by “*biological clock*” of the brain and its maturation. The environment and its influences at different times can alter the emotional development in children. Children learn to control and regulate their

emotions through socialization process. Emotional development in children involves biological factors too.

As early as the second week after birth, strong stimulus gives rise to the generalized responses of undifferentiated excitement. Thus ***general excitement*** is the original emotional response from which all other emotional patterns develop. During the first month, the general excitement gets divided into ***pleasant*** and **i** emotions, having apparent appearance of undifferentiated form. The child's smile is not focused on any particular stimulus.

During neonate and infancy stage, wet diapers, cold or hot touch, rough holding, sudden change of baby's body position, loud sound, insect biting and stomach trouble etc. are the common stimuli which give rise to unpleasant emotions. According to the research findings of Johnson, Emde, Pannabecker, Stenberg and Davis (1982), the infants display a wide range of emotional expressions at a very early age.

In one study by Malatesta and Haviland, 95% mothers conveyed that their one-month-old infants displayed joy; 85% mothers reported anger, 74% surprise, 58% fear, and 34% sadness, and 99% showed interests. Bridges (1932) has given a developmental timetable for infants' emotional expressions (see Table 7.1).

Table 7.1 :*Developmental Timetable for Infants' Emotional Expression*

Age	***Expressions of Emotions***
At birth	Generalized undifferentiated excitement
2 to 4 weeks	Interest, spontaneous pleasant and unpleasant emotions without any specific

cause.

2 to 4 weeks	Startle response
2 weeks	While responding to sucking, rocking, patting, close hugging and providing warmth pleasant emotion
2 weeks	Spontaneous smiling, getting stroking of the lips, cheeks. It is like a reflex. Girls show more spontaneous smile than boys.
3 weeks	Responding to unfamiliar food, unpleasant taste, smell, disgust
3 to 6 weeks	Social smile while responding to voices, faces, moving from one side to the other, hide and seek of one's face.
1-2 months	Calm or excited fleeting smiles, when they are picked up.
2-4 months	Anger, surprise, sadness corresponding to the nature of stimulation.
3 months	distress, and delight
4 months	Laughter in response to facial, tactile, visual, auditory or social stimulus
5 - 7 months	Fear emotion on account of loud sound, animals, displacement, in darkness being left alone, high places, loss of body support and presence of stranger
7 months	Undifferentiated jealousy; Differentiated emotion

7 months Joy, elation when they succeed in manipulating some toys, in grasping the

feeding bottle, in catching a toy or rattle beyond reach, uncovering mother's face and visual scenes.

11 Months	Love and affection for adults
12-18 months	Jealousy (has elements of both fear and anger) when attention of familiar adult is withdrawn and is shown to another
18 Months	Selective affection behaviour for adults.
15 months to 2 years	Affection for other children (by putting arms around the neck of mother, children, and kissing etc.)
2 years	Shyness, pride, guilt, contempt, self awareness
3 years	Fears of snake, death and ghosts

Pleasure emotion by the child is expressed through general relaxation of the total body. It is followed by smiling, cooing and laughing response. Learning to walk is a pleasant emotion to the child.

Crying is a common way of infant's expression of displeasure. They cry in distress because of physical discomfort and pain. Displeasure is shown not only by crying, but also by sulking, running away, verbalizing his/her displeasure and hiding. Grownup children express their displeasure through language, sometimes using slangs.

Common Emotional Patterns

All of us have experienced emotion when our heart beats fast, our palms sweat, and our stomach churns. When one is in love with another, she/he experiences varieties of emotions.

JAMES-LANGE

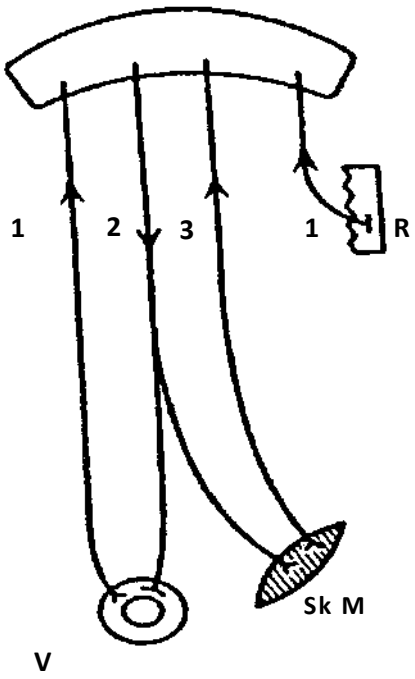


Figure 7.9 : Diagram of the nerve connections in the James-Lange theory of emotion. C : cerebral cortex; R : receptor; V : viscera; SkM : skeletal muscles. Lines

Our body, mind, facial grimace or smile play significant role in understanding and experiencing emotions. Do we not experience love, fear, anger, awe, compassion, happiness and anxiety at times? The English vocabulary consists of as many as 200 words for emotion. However we exercise considerable control over emotional states.

Robert Plutchik (1980) has classified human emotions into four types: (i) emotions are either positive or negative, (2) they are primary or mixed, (3) emotions are quite opposite, and (4) they vary in intensity. Plutchik's classification has been put in a wheel of emotion given in Figure 7.6.

In the Figure 7.6, the primary emotions are given inside the wheel. The emotions arranged outside the wheel are the combined products of primary emotions. It is believed that opposite emotions cannot be experienced simultaneously. For example, happiness, disgust, sadness, anger and fear etc. are considered as primary emotions by Plutchik. Anger and fear are negative emotions. Positive emotions give us pleasure, facilitate our self-esteem and improve our relationships with

others. The negative emotions lower our self-esteem, and lowers quality of relationship with others.

Figure 7.7 provides a profile of positive and negative emotions. Love and remorse, optimism and disappointment are opposite emotions. We have discussed in the beginning of this chapter about Titchener's three-dimensional nature of feelings, i.e., pleasant and unpleasant, tense or relaxed, excited or depressed are polar opposites.

J.B. Watson in his experimental studies of Albert, an eleven-month-old child found that, love, fear and anger are the basic emotions. Other emotions are, Watson said, combinations of these basic emotions. Plutchik too believes that emotions are like colors. All colors can be produced by mixing the primary colors. In a similar way, some primary emotions when mixed together form all other emotions. When any emotion is associated with people, place, objects, and even dates, this leads to conditioned emotion, where a neutral stimulus gives rise to conditioned response of emotion.

Love

Love means fondness, affection and tender feelings. ***It is a warm and kind affective state between persons, especially of opposite sex***. It is a process of interpersonal attraction. Mother's affection toward the child and vice-versa, love towards one's own country, or patriotism, relational attachment and sexual passions are also called love. It is considered to be a positive emotion. We express love through language, and gestures. From the intimate physical contact with the mother's body, the child is able to understand her love and all other emotions through tactual sensation.

Loving involves attachment, i.e. "being close to". Love

also means possessiveness. **Harlow** (1959) studied attachment behaviour of baby-monkeys in experimental laboratory conditions (see Figure 7.8). Infant monkeys were separated from their mothers at birth. There were two one-way-see-through glass rooms for experimental observation. These baby-monkeys were put with artificial mothers in these rooms where surrogate mothers were made of iron wires having wooden heads and heating arrangements for warmth. There were two wire-mothers in each room; one mother was covered with soft cloth; the other mother was left bare - the wire nets only. A feeding bottle with milk was inserted in the wire-mother's breast part of the body. In the other room, there were the same surrogate mother-monkeys, but of the two mothers the cloth mothers were fitted with the feeding bottle and the wire mother was left without the milk. There were four

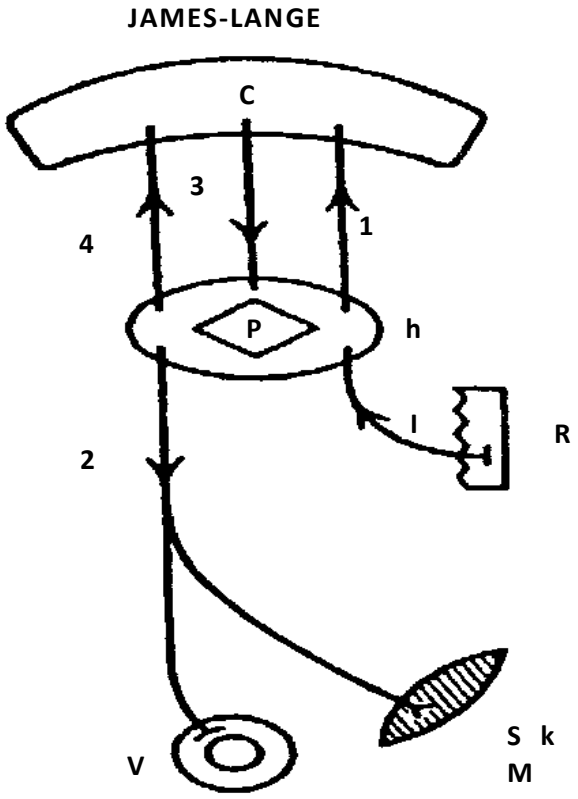


Figure 7.10 : Diagram of the nerve connections in the James-Lange theory of emotion. C : cerebral cortex; R : receptor; V : viscera; SkM : skeletal muscles. Lines

infant monkeys in each of these situations.

Harlow took two measures of attachment, i.e. the amount of time spent by the baby monkeys on each of the surrogate monkeys; and the reaction to a fear-inducing stimulus. It is found from the experiment that irrespective of the surrogate mother-monkeys' breast feeding conditions, they were deeply attached to the one who was soft cloth mother.

The baby monkeys were frequently running to the cloth mother and clung to it closely when frightened. Most interesting was the scene that when the two mothers were kept side by side, the baby would typically suck milk from the wire-mother's breast while holding tightly the cloth mother. From these experimental observations it is obvious that love and attachment emotions are different from the satisfaction of basic drives.

Love is also interpersonal attraction in case of human beings. Self-love, and love for others are the functions of the "***libido***"- the life energy- a hypothetical concept contributed by Freud. Loving means the ability to feel empathy (awareness and understanding of emotions and feelings of another person) for and loyalty to another person. Caring, attachment, belongingness, and intimacy are the components of love.

Fear

Fear is an emotional state in the presence, or anticipation of a dangerous stimulus. Often it becomes intense like anger. Fear means being afraid of or panic. Fear for loud sound, strangers, unknown objects, new places, dark shadows and darkness, seclusion, imaginary objects and

withdrawal of love etc. are common with children. Children are afraid of various animals including frogs, rats, insects, snakes, cockroaches, etc. Tiger and elephant bring out emotion of awe and surprise. Children are afraid of demons, thieves, villains in operas and movies. J.B. Watson in course of studying the emotional behaviour of a boy named Albert found that he was conditioned to fear a previously neutral object- a white rat. When this eleven-month-old Albert was shown a white rat he reached for it, showing no fear response. But every time he touched the rat he was hearing a loud sound, which made him frightened of rat. He soon developed fear for rat. Thus rat became a “conditioned stimulus” to fear. Albert also was conditioned by Watson to fear white furry objects, furry coats etc. (Watson and Rayner, 1920).

Some fears are acquired through conditioning process. The child comes to fear both lightning and thunder as one follows the other. But thunder is the primary reason for fear. Fear also is learned through contact with punitive objects (for example, electric shock while exploring an open switch board). Some are learnt through imitation of parental and sibling fears. Watson also added that the loss of body support evokes fear. In families parental physical punishments, verbal reprimand, forced toilet training, doctors with injection syringe are the causes of emotion.

In adult life, the loss of security on account of unemployment, retirement, demise of companions, natural calamities like super cyclone or plague, political unrest and old age etc. causes fear response. Due to fear, the behaviours affected are: pounding of heart, and rapid pulse rate, tense muscles, dryness of the throat, churning in the stomach, frequent nature-call for urinating, trembling, confusion, fainting, inability to concentrate, wetting and soling one’s

dress and crying aloud etc. Responses to the fear emotion are usually expressed through anxiety, flight and feeling miserable.

Fear to the objects or events, when becomes irrational, is called "***phobia***". Phobic reactions of fear are persistent and intense, and not based on sound judgment. For example, fear of public speaking, fear of public toilet, fear of eating in public are the examples of social phobia.

It is known from experimental studies that phobias can develop through classical conditioning. These irrational fears can be eliminated and cured through classical conditioning methods. Fear emotions can be rectified by the following techniques: (i) *counter-conditioning process*, (ii) *desensitization process*, and (iii) *exposure to fearless models*.

Anger

Intense emotion like anger involves a great deal of bodily changes that occur as a result of activation of the sympathetic divisions of the autonomic nervous system. At one time or another every one feels angry. J.B. Watson mentioned that when goal-directed behaviour of a child is obstructed and is interfered with, anger is manifested. ***Thus anger is the outcome of restrictions imposed against desires***. In other words, frustrating situation on the way for a goal results in anger. The need for catharsis and role of learning also play significant role in anger. ***Catharsis*** refers to the release of anxiety and tension, pent-up feelings and dissatisfaction and emotions resulting from daily life struggle verbally and through actions. These are directed towards any one or anything that causes anger in the adult person. Children learn to show attack and aggressive behaviours by observing cartoons, movies, and T.V. serials, and aggressive models.

Observation of live scenes of anger and aggressive behaviour produces more imitation of specific anger action. In one of the experiments by Bandura (1973), nursery school children observed a movie where adults were showing varieties of aggressive behaviour toward an inflated baby doll. After observing the film both boys and girls demonstrated the same kind of aggressive behaviour toward the inflated doll. These aggressive responses include punching, throwing, striking with a hammer, kicking and pounding number of blows to the doll.

Freud inferred from his observational studies of numerous patients and children that aggression is an inborn instinct. Lorenz too believed that anger and aggression are innate instincts with animals and human beings. This basic anger behaviour should have some outlets, such as competitive sports, hard labor such as gardening, walking, recognizing the stimuli that provokes anger and aggression, a persuasive leader, and not rewarding any aggressive behaviour etc.

Studies indicated in the past that rage- an extreme form of anger, relatively uncontrollable - can be at times real and at times partial which are termed as "*sham rage*". Sham rage was demonstrated in cats, dogs, primates and other animals by stimulating particular areas of brain, especially the hypothalamus.

Joy

Joy means pleasure, happiness and delight. ***The stimuli that make a child feel satisfied, and contented give rise to the feelings of joy.*** Joys are expressed by smile, laughter, shouting, dancing with glee and hugging mother or peers. But smiling does not appear till the boy is two months old. Joy or pleasure is an emotional reaction to the satisfaction of a motive. It is also as the result of reaching a goal. Unhindered

exploration, patting, stroking, and touching evoke the feeling of joy.

Child shows joy when he/she is having close physical contact with the mother. In the beginning, joy is a generalized and undifferentiated reaction. It comes from physical comfort. Joy is associated with baby's new activities such as cooing, babbling, creeping, standing up, walking and running. The child becomes joyous being active on his own accord (Jersild, 1960). When he overcomes an obstacle to reach the goal the joy increases. Babies get pleasure when they learn a new skill (reaching out, shaking a rattle, opening a box, and when some body plays hide and seek with newspaper in between). Smiling and laughter are the expressions of joy in different situations at different ages (Washburn, 1929). Children laugh when there are odd behaviours, funny sight, and funny stories. Teasing others, playing pranks, putting animals or other children in difficulties give him/her pleasure too. Cartoon scenes in T.V. and movies also give joy to children. They transfer joy to pet animals, toys, dolls or pillows. Older children experience joy emotion when they feel superior. Plutchik's wheel (see Figure 7.6) of human emotion reveals that of the eight pairs of primary emotions joy and sadness is one pair.

Jealousy

Jealousy is a special form of emotional anxiety, which occurs due to the lack of a sense of security in relation to the one who is loved. The jealousy is directed to a third party, i.e., the competitor who is perceived as the rival for the affection of the person who is loved. Jealousy is an emotion having components of both anger and fear commonly found in children. It originates from the lack of a sense of security for the affections of one who is loved and more attended to.

There is subtle difference between “*envy*” and “*jealousy*”. In envy, there need not be any loved one. It is a desire for things, which belong to the competitor. McDougall has defined envy as “a grudging contemplation of more fortunate persons”.

Jealousy arises apprehending loss of affection. Apprehension of losing affection leads to the attitude of resentment directed towards the rival. In relation to a loved one, the child feels insecure and never wishes to lose that person’s affection.

Children compete with one another in their attention-drawing behaviour from near and dear ones and members who dominate the family as leaders. Anticipatory or actual loss of affection on the part of the child in comparison to another who is about to get much attention evokes jealousy. It may be expressed directly through shouting, temper tantrum, i.e., hitting, biting, kicking, misbehaving, and being immodest. It may also be expressed in inhibitory manners where jealousy-responses are found through generalized passivity, apathy, melancholy, loss of interest in the events in the surroundings, loss of appetite, sleeplessness, anxiety, refusal to play and loss of exchange of ideas found in adults.

The jealous child feels insecure in his/her relationship with a loved one, and is afraid of losing the love and affection, which he/she was accustomed to getting. Thus among siblings in the joint family, jealousy is found to be common. Parental preferences and extra care to one child and neutral behaviour to another child also aggravate jealousy emotion.

Sigmund Freud in his theory of psychoanalysis put forth the topic of psychosexual development. In his elaborate analysis, he mentioned how sons are jealous of their fathers, and daughters are jealous of their mothers during late phallic

stage of psychosexual development. The unconscious wishes, feelings, and ideas focus the desire to "possess" the opposite-sexed parent and "eliminate" the same-sexed parent. This is termed as "***oedipus complex***" roughly between the ages of 3 to 5. This complex is gradually resolved when people become matured.

In school students, who are academically poor possess jealousy toward good students and rank holders because the latter get more attention from the teachers. Jealous students do not make good adjustments in schools. Jealousy in adults is characterized by being fatalistic, having low work-morale and lack of enthusiasm.

Theories of Emotion

The field of emotion has received some theoretical approaches from researchers. These theories are based on experiments. They all involve both physiological and cognitive elements. For introductory knowledge, we have discussed two important theories of emotion, i.e., James-Lange theory and Cannon-Bard theory. There are also other theories of emotion, such as (a) Activation Theory, (b) Behaviorist theory and (c) Cognitive-appraisal theory (d) MacLean's theory of emotion (e) Papez's theory of emotion and (f) Singer's two factor theory of emotion.

James-Lange Theory

C.G. Lange was a Danish physiologist. He outlined a theory of emotion. This theory was very similar to **William James** (1890). Thus both are given credit for the theory. James wrote in his book entitled, "*Principles of Psychology*",

"*Our natural way of thinking about these coarser emotions, e.g., grief, fear, rage, love is that the mental perception of some facts excites the mental affection called*

the emotion, and that this latter state of mind gives rise to the bodily expression. My theory on the contrary is that the bodily changes follow directly the perception of the existing fact, and that our feeling of the same changes as they occur is the emotion".

James again stated, "common sense says we loose our fortune, are sorry and weep; we meet a bear, get frightened and run; we are insulted by rival, are angry and strike. The hypothesis here to be defended says that this order of sequence is incorrect, that the one mental state is not immediately induced by the other; that the bodily manifestations must first be interposed between, and that the most rational statement is that we feel sorry because we cry, angry because we strike, afraid because we tremble, and not that we cry, strike, or tremble because we are sorry, angry, or fearful, as the case may be. Without the bodily states following as the perception, the latter would be purely cognitive in form, pale, colorless, devoid of emotional warmth. We might then see the bear and judge it best to run, receive the insult and deem it right to strike, but we should not actually feel afraid or angry" (1892).

Lange proposed a similar view and concluded that ***the vasomotor (bodily) changes were the emotion***. Lange's theory held that a stimulus object or situation gives rise immediately to vasomotor changes wherever blood vessels are found. The secondary changes occurring in the tissues were believed to give rise to the sensations that constitute the emotion.

Cannon schematized the above neural basis for the James-Lange theory of emotion (see Figure 7.9). The diagram may be described as follows: an object stimulates one or more receptors (R). Afferent impulses proceed to the cortex

through path No.1 and the object is perceived. Then efferent impulses immediately activate muscles, i.e., motor organs and viscera through path No. 2. The activities of these organs cause the afferent impulses to reach the cortex via path Nos. 3 and 4. The perception of these changes in muscles and viscera, which follow the original perception of the external stimulus object, transforms the object simply apprehended into the object emotionally-felt. According to James, "***the feeling of the bodily changes as they occur is the emotion***". Thus James-Lange theory identifies the emotions with the perception of the organic changes. This can be stated as follows:

Perception of the stimulus object **Motor Reaction** **Visceral Arousal** **Emotion**

This theory was criticized by Cannon showing its limitations. James and Lange did not portray the several mechanisms of emotion as advance knowledge about neuroanatomy and neurophysiology were largely unknown during those years.

Cannon-Bard Theory

This theory of emotion is the contribution of American physiologist **Walter B. Cannon.** It is often referred to as the "***Thalamic theory of emotion***" This theory proposes that the integration of emotional expression is controlled by the ***thalamus*** sending relevant excitation pattern to the

cortex, and at the same time the hypothalamus controls the behaviour. Much of the support for the theory came later from the work of Bard. His theory is otherwise known as thalamic theory of emotion.

This theory states that strong emotions make the individual alert and ready for emergency reactions. Thus, this theory is called "***Emergency Theory of Emotion.***" In essence, the theory postulates that the sympathetic division of the autonomic nervous system is dominant during emotion. Owing to the activities of the sympathetic division, the heart is palpitated, digestion is inhibited, respiration is deeper and more rapid, blood is chanelised to motor organ from viscera, and adrenal is poured in to the blood stream.

Cannon and Bard identified ***the hypothalamus as the main integrating center in the brain for the control of behavioral reactions in emotion***. It was experimentally observed that when the hypothalamus of the animal is removed, emotional responses become fragmentary and disintegrated. They also demonstrated that electrical stimulation of the hypothalamus leads to the full rage and attack reaction. This rage pattern is called the "sham rage". Removal of the cerebral cortex lowers the threshold for rage responses in animals. This shows that cortex normally exercises inhibiting responses over hypothalamus. It is also experimentally found that rage responses in decorticated animals are short lived and disappear when the stimulus is withdrawn. Cannon-Bard's thalamic theory can be best understood from the Figure 7.10.

When the emotion-provoking stimulus excites the receptor, the afferent impulses move towards the thalamus through path No.1. After reaching thalamus, they may activate thalamic processes or may go to the cortex through path 1. Here they invoke the conditioned response in the cortex after which,

cortical excitation may excite thalamic process through release of inhibition in path No. 3. Because of thin afferent impulses flow in path No. 2, either through direct activation of the thalamus over path 1 or impulses passing on to the cortex on path 1, they inactivate inhibition over path 3. This leads to patterned motor responses in the thalamus to be expressed in motor organs and gland via path No. 2. At the same time an upward discharge in path 4 go the cortex carrying the pattern just released. Thus the original sensory experience along with perceptual cortical activities through path No. 4 transform the object simply apprehended to the object emotionally felt. When the thalamic processes are aroused, emotion is materialized from a simple sensation. Bard's experiments supported Cannon's view that emotion involves the reactivation of the cortex via path 4.

Cannon and Bard held that emotional experiences and the expressive responses both occur at the same time because of thalamic and hypothalamic activities, which can be stated as follows:

Visceral Arousal

Perception of the Stimulus **Thalamic & Hypothalamic**

Arousal **Visceral Arousal**

KEY TERMS

Motivation	*Emotion*	*Need*
Drive	*Incentive*	*Instrumental behaviour*

Motive	*Biological Motive*	*Psychological Motive*
Social Motive	*Hypovolemia*	*Homeostasis*
Affiliation need	*Curiosity*	*Exploration*
Achievement Motivation	*Self-actualization*	*Unconscious Motivation*
Self-esteem	*Projective test*	*Flight response*
Galvanic skin response	*Blood pressure*	*Heart rate*
Pupillary response	*Pilomotor response*	*Metabolism*
Tremor	*Eye-blinking system*	*Autonomic Nervous*
Sympathetic System	*Parasympathetic System*	*Hypothalamus*
Thalamus	*Limbic System*	*Amygdala*
Undifferentiated excitement	*Fear*	*Love*
Anger	*Jealousy*	*Joy*
James-Lange Theory	*Cannon-Bard Theory*	

SUMMARY

MOTIVATION

1. *Motivation refers to states within the organism that drive behaviour towards some goals*. It has three aspects: (a) the *driving state*, (b) the *behaviour aroused* and directed by the driving state, and (c) the *goal* towards

which the behaviour is directed.

2. Motives are very powerful tools to explain our behaviour. They are never observed directly; *they are inferred from behaviours*. Motives enable us to make predictions about an individual's future actions.

3. Very often, motivation is considered to be *cyclical*. Drive state is the first stage of the motivational cycle. The second stage is the behaviour triggered by the drive state. This instrumental behaviour may lead to a goal, which is the third stage of the motivational cycle. Reaching the goal completes the cycle.

4. There are subtle differences between needs, drives, and incentives. *Needs* are physiological and environmental imbalances that give rise to drives. *Drives* are the tendencies to act in specific ways to reach a goal. *Incentive* means the value or effectiveness of the goal as a motive for behavior.

5. There are several types of motives, such as *biological* (physiological) motives, *social* motives, and *psychological* (personal) motives. The biological motives consist of physiological needs such as hunger, sex, thirst, sleep, and need for sensory stimulation, and need for postural changes.

6. *The hypothalamus plays a vital role in controlling hunger drive*. Different studies revealed that thirst and drinking result from dehydration of cells called osmoreceptors in the hypothalamus. The sex drive in human beings as well as in higher species is generally triggered by sensory stimuli. Further, the expression of

sex motive in higher species depends on learning.

7. *Social motives are acquired or learned*. Most of these motives stem from the organized social life. Since social motives depend upon learning, their strength varies from person to person. These motives can give us some insight into an individual's social behaviour and make up an important part of the description of personality. The *need for affiliation* is a motive to be with other people.

Chapter 8

PROCESSES OF THINKING

This chapter covers :

a) Nature of Thinking and its relation to Language

b) Stages of Cognitive Development by Piaget

c) Problem solving and Decision Making

d) Creative Thinking: Nature and Stages of Creative Thinking

After you go through this chapter, you would be able to:

- *Understand the nature of thinking and its relationship with language.*
- *Know how cognitive development takes place and describe the stages of cognitive development according to Piaget.*
- *Understand how people solve problems and take decisions.*
- *Describe the nature of creative thinking.*
- *Explain the stages through which creative thinking proceeds.*

CONTENTS

Processes of Thinking

Introduction

Thinking abstractly and using language are uniquely human skills. It is true that animals communicate, but there is no conclusive proof that animals use true language, because their communications cannot produce new and unique meanings following formal grammar.

The study of thinking has traversed a long way from Wundt's study of consciousness (using introspection) to the modern perspectives on information-processing. All inventions, discoveries and creations are the products of human thinking and this is the domain that distinguishes human beings from other animals.

Nature of Thinking

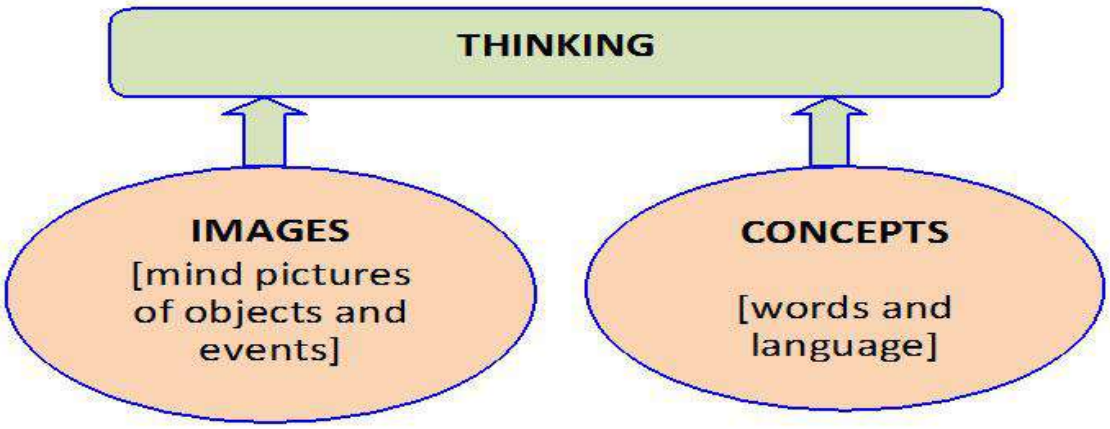
Thinking is very basic to all cognitive activities. What do we do when we think? We mentally process information to reach a goal. Some information is acquired from the environment and some information lie in a symbolic form in our long-term memory.

According to Morgan, **thinking is manipulation of mental representations of both information from the environment and the symbols stored in long-term memory**. The mental representation may be a word, a concept or a mental image. Thinking transforms this representation into a new form for the purpose of reaching a goal – to answer questions, to make judgments, to solve problems, or to take decisions. Thus, thinking is information processing that goes on during the period between a stimulus event and the response to it. Suppose you visit a market place to buy a good television. The salespersons present several items in your range of choice (stimulus event) and eventually you purchase one of them (response). Before making the response, you must have weighed the advantages and disadvantages of different varieties of television. Before purchasing, you were cognitively processing information (thinking) which started with a stimulus event and concluded with a response.

The basic features of formal thinking, according to Mayer (1983) are:

1. Thinking is cognitive – it occurs internally in the mind and is inferred from observable behavior.
2. Thinking consists of manipulation of both information from the environment and symbols stored in long-term memory.
3. Thinking is mostly organized and directed towards a goal/problem-solution.

   Thinking makes use of symbols. The symbols may be images or concepts. Thus, *mental images* and *concepts* are the building blocks of thought.



Building blocks of thought

Images are mind pictures. In thinking, we use mental images instead of actual objects, experiences or activities. *An image is a mental representation of objects and events*. If you are excited about going to Konark on a picnic, you bring into mind the visual images of the Konark temple and also the images of what you are going to do there on the picnic day. When you give directions to someone who wants to reach your house, you do that with the help of the visual images of the roadway that leads to your house.

Concepts constitute the second type of symbol we use in thinking. *Concepts are mental categories for objects, events and situations that share some common features*. (e.g., bus, car, truck and tractor are all vehicles). Concepts are embedded in words and language. Therefore, thinking and language are closely related.

Relationship between Thought and Language

According to Feldman (1999), *language is systematic and meaningful arrangement of symbols.* It is not just used for communication; it is also closely linked to the way we think about and understand the world. Psychologists cannot deny the influence of language on human cognitive process such as perception, learning and problem solving. Information is stored in memory in the form of language. Verbal labels such as 'good', 'polite', 'rational', and 'aggressive' influence our perception of people. Sometimes a problem may be worded differently so that the solution becomes easy. There is thus an intimate connection between language and thinking. Some psychologists such as Whorf view that language shapes our thoughts, while others such as Jean Piaget view that thoughts influence the development of language.

Whorf (1956) was of the view that language determines the content of thought. He proposed what is known as **linguistic relativity hypothesis** *which says that language shapes and determines our thought.* According to this view, people who speak different languages may perceive the world in different ways because their thinking is shaped by the words and linguistic categories available to them.

The Eskimos in Alaska have many words for snow (about 23 words or more) which help them perceive this aspect of the physical world differently from English-speaking people. In Odia or Hindi, we have different words for describing kinship relationships: mother's brother, father's elder-brother, father's younger-brother, mother's sister's husband, father's sister's husband and so on. In English, a single word, '*uncle*' describes all these kinship relationships. With so many categories, an Indian child, compared to an English-speaking child, may find it easier to differentiate between various kinship relationships and relate to them accordingly. On the other hand, there are many words

for colors in English language, whereas in some Indian tribal languages, there may be about two to four words for colors. Accordingly, an English-speaking child would find it easy to distinguish among colors while it may not be so for an Indian tribal child. Do language differences matter for how we think and process information about the world? Whorf says that such language differences influence our thought.

Jean Piaget, a Swiss psychologist viewed that *thought precedes language and determines the development of language.* Language does not determine thought; it only expresses thoughts. A child thinks before he can translate his thinking into language. A child forms an internal representation of the world even when he has not acquired language. For example, children observe and imitate the actions of others. They engage in symbolic or make-believe play in which they make an object stand for others. In animistic thinking, children think that inanimate objects have life. These are all examples where children think without using language. As the child grows, and the world is represented internally, language may affect children's range of symbolic thinking, but language is not necessarily the origin of thought. Piaget believed that the acquisition of language depends on the level of thinking i.e., how the world is mentally represented. Thus thought is necessary for language to be understood.

Which position is more accurate? The issue is far from resolved. A modified version of linguistic relativity hypothesis suggests that the structural features in a language may in fact lead people to think about their physical world in certain way, as in case of Eskimos. Furthermore, studies reveal that bilingualism (proficiency in communicating in two languages) and multilingualism (proficiency in more than two languages) facilitates cognitive, linguistic and academic competence of

children. In short, language seems to play an important role in shaping certain important aspects of human thinking.

Jean Piaget

A third view was given by Lev Vygotsky, a Russian psychologist. He argued that thought and language develop separately in a child until about two years of age and thereafter they become interdependent. Before two years (during Piaget's sensori-motor stage), thought is pre-verbal and action-based. At about two years, when children learn to use language, they can manipulate their thoughts with the help of language. Both become interdependent in that the quality of thinking depends on inner speech and vice versa. Though both become interdependent, thought can be used without language as in case of forming visual images or repeating a procedural movement and language can be used without thought as in case of engaging in routine communications such as "Good morning! How are you?" When the two functions are brought close together, they can produce verbal thought and thoughtful speech.

In summary, one can say that both language and thought are intimately connected but it is difficult to speak of one as the origin of the other. To determine whether language influences thought or thought influences language may be like determining which came first, the chicken or the egg.

Stages of Cognitive Development by Piaget

The Swiss Psychologist, **Jean Piaget** (1970, 1972) took cognitive-developmental approach which is different from that of the psychometricians to understand human cognition. The psychometricians were interested in studying individual differences in cognition, but Piaget was interested in understanding the nature of intellectual development in normal

children. For nearly 50 years, Piaget observed children's intellectual development, and suggested that all children proceed through a series of four stages in a fixed order. He said that these stages differ not only in the *quantity* of information acquired at each stage, but also in the *quality* of knowledge and understanding as well.

In order to examine how children think, Piaget asked children some interesting questions, such as "Where do dreams come from"? Or "Has the rock life?" He was interested not with correct answers but with the way children answer a question, even if their answers were wrong. This gave him tremendous insight about the nature of children's thought processes, which is very different from that of the adults.

Piaget received his early training in biology and philosophy. During his teenage years, his grandfather introduced him into an area of philosophy called *epistemology,* which is concerned with analysis of various forms of knowledge. It is only natural that his theory of cognitive development reflects a distinctively biological flavor. He believed that human beings are active organisms having a network of mental structures and constantly trying to make sense of their experiences. He consistently observed his own three children, two daughters Jaculine, and Lucine and the son Laurent. His observations were found to be almost same in cases of all his children. His meticulous studies were put into a systematic theory, which continued to be updated until his death in 1980. His careful work inspired a great deal of research on children's cognition and intelligence. *Even today, Piaget's theory of intelligence provides the most dominant framework in developmental psychology.*

According to Piaget (1952), **"Intelligence is a particular instance of biological adaptation."** For Piaget, intelligence refers to a general mental adaptability. Piaget was basically

concerned with three questions: (a) *What is it that changes with development*? (b) *How do cognitive changes take place*? (c) *What is the most systematic way of ordering the stages of cognitive development?*

What is it that changes with development? According to Piaget, the specific *cognitive structures or* **schemes** change as a function of age. For the infant, the schemes are motor action patterns. The newborns are equipped with only primitive schemes such as sucking, looking, and grasping etc., which guide elementary forms of behavior. These sensory motor action patterns are activated when certain objects are present. For example, when a feeding bottle is present, the child can look, grasp, or suck. Therefore there is a looking scheme, a sucking scheme, or a grasping scheme, and so on. As the infant grows, the schemes become more complex.

As the child advances in age, the "schemes move from an *action-based level* to a *mental level,* and become symbolic - that is, actions can be carried even when the object is not present. At this stage, the child not just acts on objects, but shows evidence of thinking before he acts. As will be discussed later, this change marks the transition from the sensorimotor stage to the preoperational stage.

Piaget believed that all schemes are spontaneously exercised as children have a natural tendency to use them repeatedly. As the schemes are exercised, they come in contact with new situations. Gradually, children notice the gap between their existing schemes, and the reality requirements, and try to reduce this discrepancy. Hence, the schemes are continuously modified and adapted to the environmental demands. As a result of this modification and adaptation, cognitive changes take place as the child's age increases. Thus, **what change with development are the schemes or the cognitive structures**

of the child.

How cognitive changes take place? To explain how cognitive structures or schemes change, Piaget identified two important intellectual functions: **adaptation** and **organization.** The basic characteristics of these two intellectual functions remain the same throughout life. Their nature and functions do not change. That is why they are known as ***functional invariants***. These functions work together and produce a variety of schemes.

Adaptation *is an intellectual process of building mental representations of the world by interacting with the external world*. Adaptation is made up of two complementary processes: **assimilation** and **accommodation.** Piaget borrowed these terms directly from the field of biological growth. Let us see how these concepts are used in the biological sphere. When we eat to support our body, we assimilate food and transform it to make it look like ourselves. When we cannot fully assimilate the new objects, we accommodate to them. For example, when we take a new food, we must accommodate to its new demands, by adjusting our stomach and digestion to the special properties of this novel food.

Cognitive adaptation works in much the same way. **During *assimilation*, we interpret the external world in terms of our existing cognitive structures**. For example, when an infant sucks an artificial nipple, he assimilates the nipple to the scheme of sucking. **In *accommodation*, we modify the existing mental structures to take account of new information**. The baby who sucks the edge of the blanket is modifying the sucking scheme to fit a new object. Both assimilation and accommodation work together in every interaction with the environment. But the balance between these two processes varies

from one situation to another. When children assimilate more than they accommodate, cognitive changes do not take place. They remain in a state of cognitive equilibrium. When more accommodation is necessary, children are in a state of disequilibrium or cognitive discomfort. They modify their cognitive structures to fit to the new environmental requirements. **This back-and-forth movement between equilibrium and disequilibrium is called *equilibration.*** Each equilibration produces more complex and more effective schemes as children advance in age. This is how cognitive changes take place.

Organization is another process, which helps cognitive development. It takes place internally. Once children form new cognitive structures, they rearrange them and link each other in a network of cognitive system. **Thus *organization* refers to internal arrangement of schemes or cognitive structures to form a strong interconnected cognitive system**. According to Piaget, the schemes reach a true state of equilibrium, when they become a part of a broad network of structures. **Thus, cognitive changes take place through processes of adaptation and organization.**

How cognitive development can be ordered? Piaget believed that the cognitive changes take place in an orderly manner, and follow a sequence. Children proceed through four qualitatively distinct stages of development: (a) *the sensorimotor stage* (birth to 2 years); (b) *the pre-operational stage (2* years to 7 years); (c) *the concrete operational stage (7* years to 11 years); and (d) *the formal operational stage* (11 years and older). These stages differ not only in the *quantity* of information, but also in the *quality* of knowledge and understanding. This sequence of development is *invariant* (the stages always emerge in a fixed order), and *universal* (all children

everywhere proceed through these stages). The four successive stages of cognitive development are described below.

Sensorimotor Stage (Birth to 2 years)

This is the first stage of cognitive development, which begins at birth and continues until the child is 2-years-old. **It is called so, because child's understanding of the world is limited to his sensory and motor organs**. He must act on the environment to understand what it is like. He has little competence in representing the environment through images, language, and symbols. Through his motor actions, the child gradually learns that his actions produce effects on the environment. The cognitive development proceeds at such a rapid rate during these two years that Piaget has divided the sensorimotor stage into six sub-stages. This is the most complex and most important period of development in which a great deal of accommodation is required to meet the environmental demands.

The child masters three important capacities during this period: (a) ***cause-and-effect relationship****,* (b) ***object permanence****,* and (c) ***deferred imitation****. First,* he acquires a basic understanding of the concept of **cause-and-effect**. He understands that he can manipulate his environment to produce interesting effects. *Second,* he develops the concept of **object permanence** that is the ability to understand that objects exist even when they are not visible. At about one year of age, the child understands that even when a doll is not right there in front of him, it is somewhere in the home. If he wants, he can find and play with it. *Third,* he develops the capacity for **deferred imitation**- the ability to remember and copy behaviors of others who are not immediately present. **By the end of the sensorimotor period,**

he develops mental representations of the external world that is, he can think with mental images of absent objects and past events.

Pre-operational Stage (2 Years to 7 Years)

This stage is characterized by ***emergence of symbolic activity****.* During this stage, there is an extraordinary increase in child's ***representational ability*** *- the ability to think using mental images of people and objects*. The child learns to carry out symbolic thinking. Symbolic thinking is the ability to make one thing represent, or act as a symbol for another thing. When the child points to his fingers as guns, or uses a matchbox as a telephone receiver, he is demonstrating symbolic thinking. In the preoperational stage, the child learns not only through his motor actions, but more so by thinking symbolically and reflecting on his actions.

Child's symbolic thinking is reflected in several of his activities such as (a) acquiring and using language, (b) symbolic or make-believe play, and (c) drawings. ***Language*** is symbolic in nature, because words act as symbols for objects, events, and persons. The language helps the child to separate thought from action. As a result, thinking becomes more efficient as language helps the child to deal with the past, present, and future all at once. Through language, children form a stable, larger, and interconnected image of reality. The second manifestation of symbolic thinking is witnessed in ***make-believe play.*** In the make-believe play, children make an object stand for another object. They enact familiar activities such as pretending to eat or go to sleep. The little children wipe out the tears from doll's eyes, and make her sleep by singing rhymes. These are examples, where children's sensory-motor actions are turned into internal mental representations of reality. Third, children's ***drawings*** are

another important mode of symbolic thinking. They represent animals, objects, persons, and events pictorially through drawings. The drawings reflect child's mental representations.

While children's thinking during this stage is more advanced than that of the sensorimotor stage, Piaget believes that preoperational children are still immature in several important aspects. Their thinking is qualitatively inferior to that of the adults. Piaget described preoperational children in terms of what they *cannot,* rather than *can* understand. The interesting features of children's thinking during this period are: (a) *egocentric thought,* (b) *animistic thinking,* (c) *centration,* (d) *irreversibility,* and (e) *lack of classificatory ability.*

Because of **egocentric thinking,** children cannot take another person's perspective. They see the world only in terms of their perspectives. For example, a 3-year old frequently hides himself with his face against the wall and hands covering his eyes. Though he is in plain view of the other persons, he believes that he cannot be seen as he cannot see others. Egocentric thinking is responsible for **animistic thinking** - the belief that inanimate objects have lifelike qualities. Children at this stage imagine that objects like tables, chairs, clouds, moon, etc. have thoughts, wishes, feelings, and intentions. A 3-year old who bangs his head against a tabletop complains about the 'bad table'.

Centration is the focusing of attention on one single aspect of a situation, while ignoring other important features. Because of centration, preoperational children fail to understand the **principle of conservation.** Though there are equal amount of juice in a narrower glass, and a wider glass, the child prefers to drink the juice from the narrower glass as juice in the narrower glass fills to a greater height. Here the child makes a judgment about the quantity by centering his attention on the dimension of height only, ignoring the dimension of width.

Centration is a weakness of preoperational thinking.

Another important illogical feature of preoperational thinking is **irreversibility.** The preoperational children cannot reverse their thinking or trace their thought processes in a backward manner. They may think through a series of steps in solving a problem, but they cannot go backward mentally returning to the starting point. Because their thinking is centered, and irreversible, they cannot understand the principle of conservation.

Lastly, preoperational children **lack classificatory ability.** They have difficulties in grouping objects into classes and subclasses. Piaget illustrated this with his famous class-inclusion problem. Children are shown. 15 flowers, most of which are yellow, and only a few are blue. When asked, "Whether there are more yellow flowers or more flowers?" the preoperational children confidently respond, "There are more yellow flowers!" This shows their inability to classify objects hierarchically. They fail to understand that a subclass contains lesser (or at best equal) number of elements than that of a class.

The children overcome the above limitations, when they pass to the next stage, i.e., the concrete operational stage, which begins at about 7 years of age. Recent research suggests that preoperational children are intellectually more competent than what Piaget believed. **Piaget appears to have underestimated the intellectual competence of preoperational children**.

Concrete Operational Stage (7 Years to 11 Years)

The concrete operational stage which spans the years from 7 to 11 is a major turning point in cognitive development, as children at this stage think more like adults than like younger children at earlier ages. This stage is characterized by logical thought and a loss of egocentric thinking. **The concrete**

operational child is far more logical, flexible, and organized in his cognition. But his logical mental operations are only applied to concrete objects and events, not to propositions, which are abstract and hypothetical in nature. During this stage, children acquire a number of important skills such as (a) *conservation,* (b) *decentration,* (c) *reversibility,* (d) *seriation,* and (e) *hierarchical classification.*

Piaget regarded conservation as the most important achievement of the concrete operational stage. **Conservation refers to an understanding of the fact that physical characteristics of objects remain the same even when their outward appearance changes.** When a ball of clay is flattened to the shape of a cake, the mass of clay remains the same, even if the shape of clay changes. This is called conservation of mass. The number of beads in a string remains the same, whether the string is stretched in the form of a line or rolled into a circle. The ability to achieve conservation is dependent on two other concepts: **decentration and reversibility.** The child can achieve conservation if he **decenters** his attention from only one feature of the stimulus situation to take into account a number of features at the same time. In other words, like a preoperational child, a concrete operational child does not focus his attention on only one single aspect of the stimulus situation; he takes into account several important aspects in making a judgment.

Reversibility refers to understanding that as we can think through several steps in a problem, we can also go backward in our steps to finally return to the starting point. In the conservation of mass, the child understands that the cake of clay can be again brought back to form the original ball of clay.

The concrete operational children demonstrate **seriation,** that is the ability to arrange a set of objects on the basis of physical characteristics such as height, shape etc. Given 10 sticks

of varying length, they can arrange the sticks in an order from the shortest stick to the longest one.

Hierarchical classification means grouping and regrouping objects into classes or subclasses using more than one attribute. The children at this stage can understand that a subclass contains lesser or at the most equal number of elements as that of a class to which it belongs. Thus, given 15 flowers most of which are yellow, and a few are blue, and asked the question, “Are there more yellow flowers or more flowers?” the child will unhesitatingly answer that there are more flowers. **He can understand that yellow flowers constitute a subclass of the class of flowers.**

Although, concrete operational children demonstrate logical thinking, there is still one major limitation in their thinking. Their logical thinking is mostly bound by the concrete physical reality of the world. Their mental operations have not yet attained a formal status in that they cannot apply their thinking to questions that are abstract and hypothetical in nature.

Formal Operational Stage (11 Years and Older)

In this final stage of cognitive development, children’s thinking becomes formal, hypothetical, and abstract like that of adults. They can deal with possibilities and predict future events. Their thinking is no longer confined to the concrete physical realities. Suppose children are asked a question of the form, “Cycles are faster than cars, and cars are faster than aeroplanes; which between the two, aeroplane and cycle, is slower?” A concrete operational child may answer “Cycle” or may reject the question, or refuse to apply his mental operations to answer the question, because the information is contrary to his

real-world knowledge. On the other hand, a formal operational child will evaluate the logic of the statements to answer the question. This shows the abstract and hypothetical nature of formal operational child's through processes.

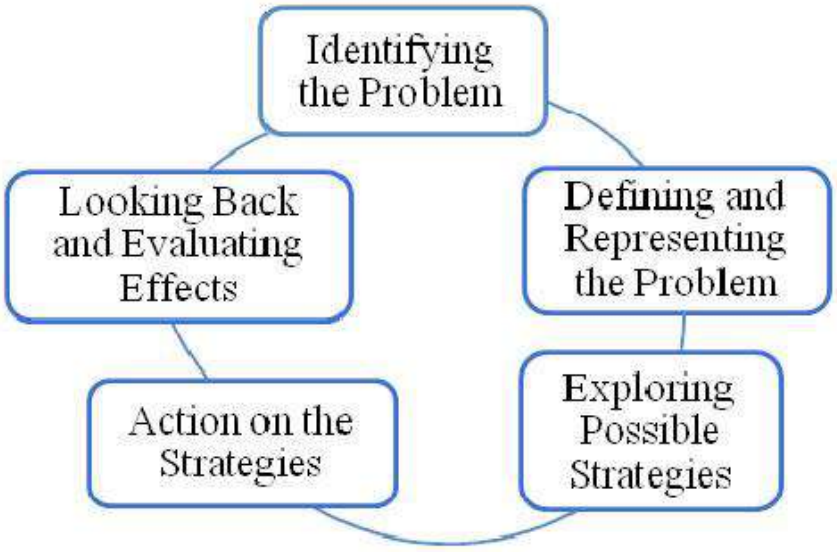
The two important characteristics of child's thinking during the formal operational stage are: (a) *hypothetico-deductive reasoning* and (b) *propositional thinking.* **Hypothetico-deductive** reasoning is a formal operational problem solving strategy. That is, when faced with a problem, a formal operational thinker can formulate a general theory based on all possible factors and then deduce specific hypotheses from the general theory for further testing. He can test hypotheses in an orderly fashion to examine which ones work in the real world. This form of reasoning begins with possibilities and proceeds to reality. On the other hand, concrete operational children start with examining reality, and when their examination is not confirmed, they cannot think of alternatives to solve the problem.

Piaget and Inhelder (1958) have demonstrated how children solve the '*pendulum problem'*. The problem-solver is asked to figure out what determines how fast a pendulum swings. Is it the length of the string, the weight of the pendulum, or the force with which the pendulum is pushed? (*The correct answer is the length of the string*). Concrete operational children approach the problem in an unsystematic manner. They may simultaneously change *two* or *more* variables (e.g., the length of the string and weight of the pendulum) to examine what happens. Since, they vary more than one factor at once, they cannot tell which factor is the critical one. In contrast, formal operational children approach the problem systematically. They behave as scientists carry out investigations. They vary one factor at a time and observe its effect on the movement of the pendulum. As a result,

they are likely to identity that the critical factor is the length of the string. Thus, they carry simple experiments to rule out competing possibilities. Such kind of thinking is based on **hypothetico-deductive reasoning**. This is an important characteristic of formal operational thought.

A second important characteristic of this stage is **propositional thinking**. Children can evaluate the logic of propositions or verbal statements without referring to real-world circumstances. The statements are evaluated on their own merit even if they are contrary to the real-world knowledge. Consider the question, “If aeroplanes are called elephants, can elephants fly?” A concrete operational thinker will answer, “No, elephants cannot fly”, while a formal operational thinker will answer, “Yes” to the question. A formal operational thinker can say so, because he is evaluating the logical validity of verbal statements without being influenced by the concrete real-world knowledge.

Though thinking during the formal operational stage closely approaches adult thinking, yet it falls short of adult level. While the reasoning of older children may be quite logical, their theories are not **very practical**, because they simply do not know enough about life and its possibilities. Furthermore, there is no guarantee that child after attaining 11 years of age



Stages in Problem Solving

will demonstrate hypothetico-deductive reasoning and prepositional thinking as claimed by Piaget. Even adults sometimes deviate from formal operational thinking. In some cultures, particularly in less technologically advanced societies, adults do not reach the stage of formal operational thinking.

Evaluation of Piaget's theory

Piaget's theory provides the most important and powerful perspective on children's cognitive development. It is a grand theory in developmental psychology, which has inspired many researchers all over the world. Tests have been developed, and educational programs for children have been planned on the basis of Piaget's theoretical framework. A number of researchers have confirmed Piagetian concepts and stages of cognitive development. The impact of his theory has been so great that any textbook or research reports on cognition cannot overlook Piaget's theory of cognitive development; if they do, their work will be considered incomplete. All said and done, Piaget's theory has not been free from criticisms. Several of his ideas are now regarded as either incorrect or only partially correct.

The first criticism is against Piaget's belief that ***development proceeds in a stage-like manner***. Some developmental psychologists believe that *development is a continuous process, and cannot be broken down into different stages as Piaget's theory suggests.* They believe that development is more quantitative than qualitative in nature, and that the basic nature of the underlying cognitive processes changes very little with age.

Another major criticism leveled at Piaget is that ***he has seriously underestimated the cognitive capacities of infants and young children***. In fact, they show more advanced cognitive capacities than what Piaget believed. It has been shown that children demonstrate many concrete operational skills such as conservation, seriation, and decentration before 7 years of age. The concept of object permanence is attained much earlier than what Piaget postulated.

The third major drawback in Piaget's theory is that ***many older children, adolescents, college students, and adults do not show formal operational thinking***. *The universal nature of Piagetian stages is thus called into question.* The development is

a lifetime process. All the skills do not emerge at once when the child reaches formal operational stage at the age of 11 years. In some cultures, almost no one reaches the formal operational stage.

Fourth, Piaget's belief that children must act on their environment to revise their cognitive structures is too narrow a notion of how learning takes place. Cognitive development is not always self-generating activity. As noted by Vygotsky, cognitive development is shaped to a large extent by the socio-cultural practices and experiences. The external social environment plays a significant role in shaping up and modifying cognitive structures of children. ***Piaget has undermined the role of societal context in the development of children's cognitions***.

Finally, Piaget has overemphasized the aspects of cognition in developing his theory. ***There are several other important dimensions of development such as social, emotional, and moral development, which have not been given due attention by Piaget.*** The course of human cognition cannot be completely understood without taking into account other dimensions of development, which have close linkages with human cognition.

Problem Solving

Almost on a daily basis, we come across situations that require our ability to solve problems. Our needs and motives are to be satisfied; satisfaction occurs when our goals are met. But meeting one's goals is not easy as many obstacles and interferences come on the way. Thus the situation is perceived as a problem situation and serious efforts have to be made to overcome these obstacles in order to attain the goal. **Problem solving is a process in which efforts are to be made to**

develop or choose among various responses in order to attain the desired goal.

Take the example of a student who regularly takes a bus to cover a distance of 10 kms. from his residence to the examination center. In the event of a bus strike on the day of examination, there arises a problem to be solved. To solve the problem, the student has to generate a set of responses and finally choose the best among them. Some of the possible responses may be: hiring a motor-cycle from a friend, covering the distance by own bi-cycle, taking a lift with someone else, walking out the distance etc. The goal state is 'to be present at

the examination center in time' and the initial state is 'the student being at his residence'. Problem is thus a conflict or a difference between the initial state and the goal state. The problem solving process generates solutions to overcome the difficulties and bridge the gap between the initial state and the goal state.

According to Skinner, **problem solving is a process of overcoming difficulties that appear to interfere with the attainment of a goal**.

According to Woodworth and Marquis, **problem solving behavior occurs in novel or difficult situations which cannot be solved by habitual methods drawn from past knowledge and experiences**.

Nature of Problem Solving Behavior

1. Problem solving behavior arises when the goal is purposeful

and important for the individual. (It would not take place in the absence of goal.)

2. There must be serious difficulties, obstacles or interferences in the attainment of the goal. This means that obstacles to goal cannot be overcome by habitual methods and past knowledge.

3. Problem solving behavior requires deliberate and conscious efforts from the problem-solver. The problem-solver needs to engage in serious mental work and systematically follows a set of well-organized steps.

4. Problem solving behavior removes the obstacles and helps the individual reach his goal and satisfy his needs. Thus problem solving helps the individual grow and develop.

Stages in Problem Solving

What is the sequence of mental operations involved in solving a problem? Bransford and Stein spoke of five steps associated with the task of problem solving. They referred to these steps as '**IDEAL**' thinking.

I = Identifying the problem

D = Defining and representing the problem

E = Exploring possible strategies

A = Acting on the strategies

L = Looking back and evaluating the effects

1. **Identifying the problem** – We must first recognize that a problem exists which needs a solution. At this stage, we need to be aware of the goal, the difficulties and the issues involved. If we do not perceive that a problem exits, obviously no attempt would be made to find a solution. (e.g., two groups of students in your class are in a conflicting relationship. They occasionally indulge in fighting which disturbs the academic climate. You perceive that there is a problem which needs

and tried out. (e.g., you evaluate the possible solutions on the basis of difficulties in execution, cost, duration, suitability and such other factors you think are important. From among the four alternatives given in the previous step, you may decide that taking expert help for counseling students may be the best option.)

5. **Looking back and evaluating the effects** – Finally we evaluate the effects of our actions in solving the problem. We examine if the solution arrived at would work in similar other situations. Then only the solution would be considered acceptable. Such a verified solution may then become a useful product to be used for solving other future problems of similar nature. (e.g., if your solution strategy works well, think about the steps you have followed for your future reference as well as that of your friends. You as well as others can use this tried-out procedure to deal with problems of similar nature.)

Methods for Solving Problems

What methods people use to solve problems? The following are the methods people often use.

a. Trial-and-Error: This is the simplest problem-solving method. Trial and error refers to trying one solution after another until we find one that works. We use trial and error because we do not have enough information to adopt a more systematic approach. But such an approach is not very efficient as it does not offer a guarantee that the correct solution will be found. Thomas Edison invented the light bulb by trial and error that is by trying out different kinds of materials for a filament until he found one that worked.

b. Algorithms: Algorithms are rules (step-by-step procedures) for solving certain kinds of problems. Algorithms will always result in a correct solution, if followed meticulously.

Mathematical formulas are algorithms. When librarians organize books on bookshelves, they use an algorithm. For example, they may place books in alphabetical order within each discipline. If you are supposed to meet your friend in a hotel in your city and you have forgotten the name of the hotel, you may get a list of hotels from the yellow pages and try calling all the hotels in the city to find if you friend has checked into any of the hotels. The method will eventually work but would be time-consuming and inefficient. A more effective approach would be to use heuristics.

c. Heuristics: A heuristic is a 'rule of thumb' that we use in many problem-solving situations. Algorithm is a specific rule that will always lead to a solution, but heuristic is a shortcut method based on previous experiences because it helps us narrow down the possible solutions to a problem. Heuristics lead to faster solutions compared to algorithms but may not always lead to correct solution. What we gain in speed is lost in accuracy. Referring to the previous example, if you want to locate the hotel where your friend might be found, you might use your past knowledge of where your friend preferred to stay earlier or the level of cost your friend might be willing to afford. Using such information, you could narrow down you options to only a few hotels in the city. This would simplify your task of meeting your friend.

One kind of heuristic is called **means-end-analysis** in which a person determines the difference between the current situation and the goal and then tries to reduce that difference by various means. In finding the road to a city from your town, you may choose various connecting roadways, and each time you choose a roadway, you analyze the option by examining how much that choice brings you closer to the destination. Through this, you close the gap between your town and the destination city. We use means-end-analysis to find train and bus routes. Another commonly used heuristic is to divide a problem into many intermediate steps or **sub-goals** and then to solve each of the intermediate steps to arrive at the goal.

d. Insight: We do not always follow a step-by-step procedure to solve a problem. Sometimes the solution comes all on a sudden, which is termed as 'insight'. As you may recall, Kohler's chimpanzee named Sultan solved the stick-and-banana problem by insight. The insightful solution comes in a flash.

Here is a problem that can be solved with insight: *Preeti and Pinky were born on the same day of the same month of the same year to the same father and same mother, yet they are not twins. How is that possible*? Think about it before reading the next sentence. The answer is that both are two of a set of triplets (three children born at the same time). Let us try another problem: *Put a coin in the bottle and then a cork in the opening. How can you get the coin out of the bottle without pulling out the cork or breaking the bottle*? The answer is very simple: Push the coin into the bottle and then shake out the coin. Insight is not a magical process. What usually happens is that the problem gets consistently shaped and reorganized in the mind even when the person is thinking about something else. Most inventions and discoveries are matters of insightful problem solving.

Factors Interfering with Effective Problem Solving

The difficulty level of the problem or our lack of necessary information and experience do affect our problem solving behavior. Sometimes, in spite of our best efforts, we fail to solve problems because of very subtle reasons – we get stuck in certain ways of thinking that act as barriers to solving problems. Let us consider some of these.

(a) ***Functional fixedness***: *It is the tendency to think of an object only in terms of its typical use*. The person's mind remains fixed on the functions of a particular object so that he cannot think of using it in another way. We continue searching for a screwdriver to tighten a screw even when many objects close at hand such as a knife, a key or a coin can very well be used for the purpose. There is tendency to think that these objects are respectively meant for cutting, unlocking and spending.

Consider the following string problem. *Two strings are hanging from a ceiling but are too far apart to allow a person to hold one and walk to another. On the floor are a book of matches, a screwdriver and a few pieces of cotton. How could the strings be tied together*? Try to find the solution on your own.

(b) ***Mental set***: *Mental set is the tendency of a person to use a problem solving method that has been tried out earlier*. Solutions that have worked in the past tend to be used and the person overlooks other, more efficient approaches. The mental set obstructs the problem solver to think of any new rules or strategies. Look at the pattern of dots given below.

Can you draw four straight lines so that they pass through all the nine dots without lifting your pencil from the page?

If you face difficulty with the problem, it is probably because you feel that you have to stay within the lines. The solution involves drawing the lines beyond the boundaries of dots.

(c) ***Confirmation Bias***: Another barrier to logical thinking is confirmation bias. *This is the tendency to search for evidence that fits one's beliefs while ignoring any evidence to the contrary.* It is similar to mental set except that here the mental set is a 'belief' rather than a method of solving problems. A person who holds a view against death penalty probably comes across many articles in newspapers and magazines – some provide arguments against death penalty and some others argue in favor of death penalty. The person will remember more information that support his view against death penalty and much less information that go against his view. This happens because of confirmation bias which he will also demonstrate in his arguments against death penalty.

Decision Making

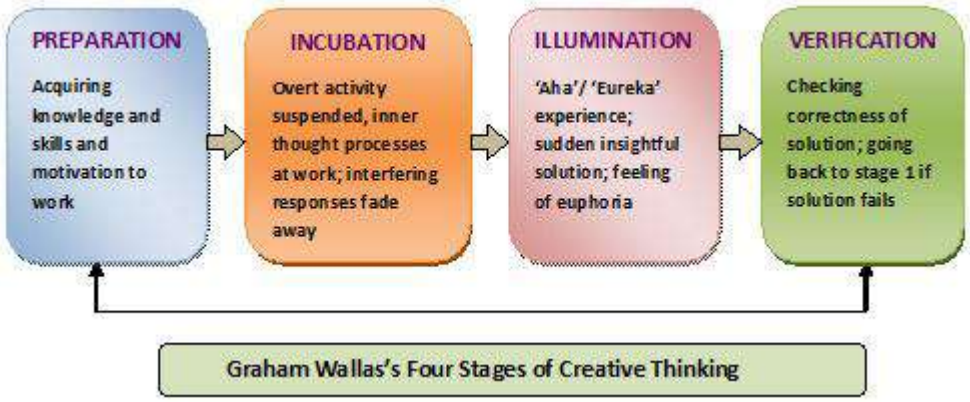
Decision making is the process of choosing among available options by evaluating

the pros and cons of each option. *Decision-making refers to the process of choosing among various courses of action or alternatives*. It is a part of our everyday life experiences. We have to take decisions in many occasions – what to eat, what to wear, where to go, whether to go to college or not and so on.

On the basis of our evaluations, we take decision which means exercising choices. Judgment about people, ideas and events comes before decision making. Judgment is guided by motives, values and the emotional and motivational state of the individual. Using our judgment, we create choices and using our decision making we select the best choice. We take decisions favoring our judgment.

Decision making operates usually under three situations :

- *Decisions under conditions of certainty* – They are easy to make as it is known that a particular choice would lead to a particular outcome.
- *Decision making under conditions of uncertainty* – The probability of outcomes associated with each choice is not known. We need to subjectively estimate the probabilities associated with each choice. The decision maker remains uncertain. Most of real life decisions involve conditions of uncertainty.
- *Decision making under conditions of risk* – the decision maker has the knowledge of the risks associated with each choice. He would not like to make decisions that



Graham Wallas's Four Stages of Creative Thinking

are risky.

Rational decision-making is based on good reasoning. It depends on expected utility, which is a product of the value of an outcome and the probability of its occurrence.

Throughout our waking state, life presents a continuous series of choices. In decision making we try to maximize gains. People's choice for an alternative is a function of (i) the utility of the event and (ii) the subjective estimate of the probability that a certain result would occur. In mathematical terms it can be written as

Choosing the alternative = f (EU X SEP)

Where EU = Expected Utility (Psychological value we attach to an alternative), and SEP = Subjective Estimate of probability (Probability that a certain result would occur)

The model can be used for predicting decision making behaviors. But in real life situations, the decision making process is far more complex and people do not reason in a systematic manner. A rational decision making process requires more cognitive effort which people usually are not willing to invest. Therefore they make decisions informally on the basis of opinions and subjective considerations. Therefore they employ a few rules of thumb which are known as heuristics which are mental short cuts requiring less cognitive effort.

Algorithm is a rule which, if followed guarantees solution to a problem. This is true of physical sciences and is involved in formal decision-making. For many real life decisions, no formal rules are available. Then we use heuristics to help us. *A heuristic is a rule of thumb or mental short cut that may lead to a solution*. But the quality and the accuracy of the decisions reached through heuristics may not be very satisfactory. What kind of heuristics we use? Generally, the following five heuristics are used most frequently.

Heuristics in Decision Making

1. ***Availability heuristics*** (What can be recalled is more likely): *We judge the probability of an event by how easily the event can be recalled from memory.* The more readily we can bring events to mind, the frequent they generally are. The shortcut tends to work fairly

well, but may lead to errors in decisions making. Tversky and Kahneman (1974) presented participants a list with equal number of names of males and females. Then they asked them whether the list contained more men's or women's names. Nearly 80% of the participants reported that women's names appeared more frequently because women named in the list were more famous. Because of availability heuristics, many people overestimate their chances of being a victim to a violent crime, facing a plane crash, or winning the lottery. Because these events are given extensive coverage in the media, people can quickly bring these examples to mind. They conclude that such outcomes are much more frequent than they actually are.

2. Representativeness heuristics (What is typical is more likely): *The more closely an item (person, idea, event) resembles the most typical examples of some category/concept, the more likely it is to belong to that category*. We carry in mind typical examples of events. When we come across a new event, we compare it with the most representative example of a class of concepts/events – the more the resemblance; we judge that it belongs to that class of concepts or events. If we find our next-door neighbor showing certain personality and behavioral characteristics, we compare it with the most typical examples of professionals we have in mind and conclude that he is in such and such kind of profession – may be teacher, a businessman, a lawyer etc. It is a stereotypical judgment about a person. If we find some typical lawyers to be dishonest, we would probably reach the same conclusion about another lawyer. This rule of thumb also leads to error because we may ignore important information such as the base rate (relative frequency) of various items/ events.

3. Anchoring and Adjustment heuristics (We decide using a reference point as the anchor) – *It is a rule of thumb in which*

decision is taken by making adjustments against an anchor (information that is already available) in the light of various factors. For example, in buying a used car, we start our negotiation against an anchoring point (the cost quoted by the seller) and make adjustments to reach the point of decision making. The error is that the initial anchoring point would influence our adjustments and finally the decision making.

4. Diversification heuristics (We choose more when making simultaneous choices) – *When people have to make simultaneous choices* (choose which of the snacks to consume in the next month), *they tend to show more variety* (pick more kinds of snacks) than when they make sequential choices. When asked to make several choices at once, people tend to diversify more than when making the same type of choice sequentially.

5. Escalation of commitment (We stick to bad decisions taken in the past): *People tend to get increasingly committed to bad decisions taken in the past even when they bring losses.* The initial decision making is primarily based on rational factors. When things go wrong and negative results occur, psychological factors come into play. Persons taking the initial discussion are less likely to admit that they made a mistake; instead they justify the decision and also the losses associated with it. They get trapped in bad decisions to which their commitment increases, and they may experience a growing need for self-justification to protect their self-image. Escalation of commitment is reduced if there is decentralized planning or people making bad decisions are personally held accountable for the decision.

Factors Influencing Judgment and Decision Making

- *Information base* – The larger the information base, the more correct the decision is likely to be.

- *Intelligence* – Higher the intelligence of the individual, the better is the information processing capacity and therefore greater is the likelihood that the correct decision would be made.
- *Personality characteristics* – Several personality and social characteristics such as individual's motivational and emotional state, feeling of security, self-concept, positive attitude and openness to experience influence the correctness of decisions.
- *Cognitive style* – Cognitive style refers to the consistent manner in which the individual observes and thinks about the world around him. The person may be field-independent or field-dependent; he may be of impulsive or reflective type. Persons with field-independent and reflective cognitive style are more likely to make correct judgment and reach correct decisions.
- *Heuristics* – Several heuristics have been discussed beforehand. They are mental shortcuts requiring less cognitive effort but often lead to errors in judgment and decision making. Reliance on a particular heuristics all the time would lead to more errors. But people use heuristics most often to take real life decisions.
- *Framing* – Framing is the presentation of information regarding the potential outcomes in terms of gains or losses. The way the information is presented alters the way the information is processed and thereby influences the judgment process. When the information is presented emphasizing potential gains, most people do not want to take risks. When the emphasis is on potential losses, they are more likely to take risks – they prefer to take risks and accept probable losses.

Nature of Creative Thinking

Creativity is the ability to use ones' intellect to generate novel and productive ideas. It is a unique talent in a particular field of endeavor. All our inventions and discoveries are the products of creativity. Guilford views that *creative process is any process by which something new is produced – an idea or an object including a new form of arrangement of old elements. The new creation must contribute to the solution of some problems*.

Guilford proposed two types of thinking: *convergent* and *divergent*. Creativity is

closely aligned to **divergent thinking**. Divergent thinking is the ability to use limited amount of information to derive many correct solutions to the problem. The person starts up with one point and comes up with many different ideas based on that point. It is different from **convergent thinking** which refers to the ability to synchronize large amount of information to reach one correct solution to the problem**.** Convergent thinking primarily produces responses based on knowledge and logic. Creative thinkers make use of convergent thinking in the beginning stages but gradually shift to a mode of divergent thinking. Ability to solve problems is a matter of convergent thinking. IQ tests primarily measure convergent thinking. There are separate tests for measuring creativity. Certain level of intelligence is necessary to be creative but beyond a threshold level, creativity does not correlate with intelligence. All highly intelligent people may not necessarily be creative.

Creativity is defined in many different ways. According to Drevdahl, **creativity is the capacity of a person to produce compositions, products, ideas which are essentially new or novel and previously unknown to the producer.**

For Mednick, *creativity is forming new combinations of associative elements in place of their more common varieties.* Papapalia and Olds view *creativity as the ability to see things in new and unusual light, to see problems that no one else may even realize exist, and then to come up with new, unusual and effective solutions.*

For a process or product to be judged creative it must have the following features: (i) it should be unique and novel, (ii) it should contribute towards the solution of a problem, (iii) it should have been previously unknown to the producer, (iv) at some point in time it should be acceptable to the society, and (v) it

must have been a conscious attempt, not an accidental occurrence.

Guilford has identified five important dimensions/ aspects of creativity.

Fluency – It is the ability to produce a large number of ideas/ responses to the problem within a time span. The more the ideas a person produces, the higher is his fluency. (Suppose, in response to a question, "In how many ways can we use a piece of brick?" a person gives 20 correct responses. His fluency score is 20.)

Flexibility – It is the ability to produce different categories of ideas/ responses within a time span. It indicates variety in thinking. (If the preceding 20 responses fall into 3 different categories such as for construction purposes, preparing colors and using as a tool, the person's flexibility score is 3.)

Originality – It is the ability to produce rarely novel ideas which are different from others. Fluency and flexibility are necessary conditions for originality. (If 1 of the preceding 20 responses are given by less than 5% of people, the response is original. His originality score is 1.)

Elaboration – It is the ability to add more details to given information by examining the question at greater depth. (Given a proverb 'a stitch in time saves nine', if a person can write a paragraph explaining the meaning and importance of the message, he shows certain degree of creativity.)

Redefinition – It is the ability to understand concepts and problems and define those in new ways. (If on the basis of his understanding of the concept of 'intelligence', a person comes up with two equally competing definitions, then he shows certain degree of creativity.)

Characteristics of Creative People

On an overall basis, most researchers have pointed out the following characteristics of creative people.

- They have broad range of knowledge and are good at using mental imagery.
- They like to toy with new concepts and ideas.
- They are flexible and more open to new experiences.
- They are independent in their judgment and decisions.
- They have internal locus of control; their thought processes and behaviors are less affected by external agents.
- Most often, they are unconventional in their work and styles of behavior.
- Usually they are self-assertive.
- They are more realistic and less dogmatic.
- They usually carry a good sense of humor.
- In most cases, they are emotionally more stable.
- They prefer certain degree of complexity and challenging situations.
- They can take greater risks.

Stages in Creative Thinking

Though there are individual differences in the way creative people think, there is more or less a definite pattern followed for creative solutions. Long time back in 1926 Graham Wallas observed that creative solution involves the following four stages.

- ***Preparation*** – Thomas Edison remarked, “Success is 98% perspiration and only

two percent inspiration." The process of creative thinking begins with the preparation stage in which a creative thinker spends long hours thinking about the problem and putting together all the materials needed to solve the problem. He looks at the problem from different angles and perspectives. A plan of action is formulated and if required, modified from time to time taking cognizance of new facts and methods. When he finds that the problem cannot be solved, he puts it aside for some time. This leads him to the second stage called 'Incubation'.

- ***Incubation*** – Here the creative thinker stops thinking consciously on the problem but his inner thought processes are at work. There is no overt activity. The person can take rest, relax, sleep or engage in other interesting activities. By doing so, the ideas that were interfering with the solution of the problem fade away. His experiences during this period may provide him clues towards the solution of the problem. (Archimedes found the solution of the problem while he was talking bath). Then comes the stage of illumination or inspiration.
- ***Illumination*** – The thinker gets the 'Aha' experience or 'Eureka'. There is sudden appearance of the problem solution which emerges from sudden insight or illumination. In this stage, the individuals report that they see the first glimpse of a solution. It is difficult to know what exactly happens during this stage. The insightful solution may or may not be correct and therefore require further evaluation which takes the thinker to the next stage.
- ***Verification*** – In the final stage, the thinker checks whether the solution he has reached is correct. When it is tested and verified with evidence gathered in support of the idea, a creative solution is said to occur. After verification, if the problem is not solved, ideas are refined and fresh attempts are made to solve the problem. The thinker goes back to stage 1 and the process continues.

KEY TERMS

Thinking	*Make-believe play*	*Means-end-analysis*
Language	*Conservation*	*Insight*

Images	*Decentration*	*Functional fixedness*
Concepts	*Hypothetico-deductive reasoning*	*Mental set*
Adaptation	*Psychometric approach*	*Confirmation bias*
Equilibration	*Schemes*	*Divergent thinking*
Egocentric thinking	*Assimilation*	*Convergent thinking*
Irreversibility	*Organization*	*Creativity*
Seriation	*Animistic thinking*	*Fluency*
Class inclusion	*Centration*	*Flexibility*
Object permanence	*Propositional thinking*	*Originality*
Accommodation	*Problem solving*	*Elaboration*
Decision making	*'IDEAL' thinking*	*Redefinition*
Trial-and error	*Trial-and-error*	*Incubation*
Algorithms	*Heuristics*	*Illumination*

SUMMARY

1. Thinking is very basic to all cognitive activities. It is the manipulation of mental representations of both information from the environment and the symbols stored in long-term memory. The *mental images* and *concepts* are the building blocks of thought.

2. Language is closely linked to the way we think about and understand the world. Whorf says that people who speak different languages may perceive the world in different ways because their thinking is shaped by the words and linguistic categories available to them.

3. Jean Piaget views that thoughts precede language and determine the development of language. Vygotsky argued

that thought and language develop separately in a child until about two years of age and thereafter they become interdependent. In summary, one can say that both language and thought are intimately connected but it is difficult to speak of one as the origin of the other.

4. Piaget's cognitive-developmental approach focuses more on the *quali-tative* rather than *quantitative* aspects of development, and specifies that children's thought processes change with age. Children's *cognitive structure* (scheme) changes with age through processes of *adaptation* and *organization.* Adaptation involves two complementary processes such as *assimilation* and *accommodation.*

5. According to Piaget, children proceed through four successive stages of development to think like adults. In the *sensorimotor stage,* infants acquire the basic concepts of cause and effect. In the *preoperational stage,* children engage in symbolic thinking, but their thought processes are limited by egocentric and animistic thinking. In the stage of *con-crete operations,* children are capable of logical thought and show un-derstanding of conservation and reversibility. But their logical thinking is confined only to concrete physical reality. Finally, in the *formal opera-tional stage,* older children can show formal logical thinking, manipulate abstract concepts, and engage in prepositional thinking.

6. Piaget's theory has been challenged on several grounds. Piaget has seriously underestimated the intellectual competence of infants and young children. Cognitive development does not take place in a stage-like manner as Piaget had postulated. He has overlooked not only other important dimensions of development, but also the significant influence of language and social interaction on cognitive development.

7. Problem solving is a process in which efforts are to be made to develop or choose among various responses in order to attain the desired goal. Problem solving behavior

proceeds through five stages known as 'IDEAL' thinking: (i) identifying the problem, (ii) defining and representing the problem, (iii) exploring possible strategies, (iv) acting on the strategies, and (v) looking back and evaluating the effects.

8. The methods used to solve problems are: *trial-and-error* (trying one solution after another to reach goal), *algorithms* (using a set of rules for problem solution), *heuristics* (using a 'rule of thumb' or short-cut for problem solution) and *insight* (hitting upon an innovative solution all on a sudden).

9. Sometimes, in spite of our best efforts, we fail to solve problems because we get stuck in certain ways of thinking that act as barriers to solving problems. The factors interfering with effective problem solving are: *functional fixedness* (using an object only in terms of its typical use), *mental set* (getting stuck to a problem solving method used in the past), and *confirmation bias* (using evidence that fits one's beliefs).

10. Decision making is the process of choosing among available options by evaluating the pros and cons of each option. Judgment about people, ideas and events comes before decision making. Using our judgment, we create choices and using our decision making we select the best choice.

11. In decision making we try to maximize gains. People's choice for an alternative is a function of (i) the utility of the event and (ii) the subjective estimate of the probability that a certain result would occur. In mathematical terms - Choosing the alternative = f (EU X SEP), Where EU = Expected Utility (Psychological value we attach to an alternative), and SEP = Subjective Estimate of probability (Probability that a certain result would occur)

12. A rational decision making process requires more cognitive effort which people usually are not willing to invest. Therefore they employ a few rules of thumb which are known as heuristics which are mental short cuts requiring less cognitive effort.

13. Generally people use a*vailability heuristics* (what can be recalled is more likely), representativeness *heuristics* (what is typical is more likely), *anchoring and adjustment heuristics* (we decide using a reference point as the anchor), diversification *heuristics* (we choose more when making simultaneous choices) and *escalation of commitment* (we stick bad decisions taken in the past).

14. The factors influencing judgment and decision making are: information base, intelligence, personality and cognitive style of the individual, heuristics and framing of the problem.

15. Creativity is the capacity of a person to produce compositions, products, ideas which are essentially new or novel and previously unknown to the producer. For a process or product to be judged creative, it must have the following features: (i) it should be unique and novel,

(ii) it should contribute towards the solution of a problem, (iii) it should have been previously unknown to the producer, (iv) at some point in time, it should be acceptable to the society, and (v) it must have been a conscious attempt, not an accidental occurrence. Certain level of intelligence is necessary to be creative but beyond a threshold level, creativity does not correlate with intelligence.

16. The dimensions of creativity are: *fluency* (producing large number of ideas), *flexibility* (producing different categories of ideas), *originality* (producing rarely novel ideas), *elaboration* (adding details to given information) and *redefinition* (defining problems in new ways).

17. Creative people are unconventional, curious, open-minded, flexible, realistic, self-assertive and emotionally stable. They usually carry a good sense of humor, prefer complexity and challenging situations and have internal locus of control and a broad range of knowledge.

18. Creative thinking involves four stages: *preparation* (spending long hours in collecting information and thinking about the problem in depth), *incubation* (resting in which inner processes are at work and overt activity is rare), *illumination* ('Aha'/ 'Eureka' experience, sudden insightful solution and feeling of euphoria), and *verification* (checking correctness of solution and going back to preparation stage, if solution fails).

QUESTIONS

A. True-False Items

(State whether each of the following statements is True (T) or False (F))

1. Thinking uses contents from memory.
2. Whorf said that language shapes our thought.
3. Piaget said that children can think without language.
4. Insightful solution is guided by heuristics.
5. Mental set facilitates problem solution.
6. Thinking is a cognitive activity.
7. Concepts are symbols.
8. Means-end-analysis is an algorithm.
9. Thinking uses mental image.
10. Heuristics is a short-cut problem solving method.
11. Adaptation involves the process of organization.
12. Cognitive structures are known as schemes, according to Piaget.
13. Assimilation refers to adjustment to the environmental demands.
14. Piaget primarily emphasizes the quantitative characteristics of development.
15. Infants show sensory motor schemes.

Chapter 9

INTELLIGENCE

This chapter covers :

a) Meaning and Nature of Intelligence

b) Approaches to Understanding Intelligence:

i) Gardner

ii) Sternberg

iii) J.P.Das

c) Factors affecting Intelligence

After you go through this chapter, you would be able to:

- *Understand the nature of intelligence and history of intelligence testing.*
- *Explain the concept of IQ and procedures of intellectual assessment.*
- *Understand the different approaches theoreticians have taken in examining the critical components of intelligence.*
- *Know the limitations of IQ tests and the need for developing culture fair tests.*
- *Describe the characteristics of children who occupy the two extremes in the continuum of intelligence.*
- *Acquaint yourself with new concepts in*

CONTENTS

Chapter 9

Intelligence

Introduction

Man is distinctively different from the lower species of animals because of his ability to control the environment he lives in. The distinction between man and other animals also springs from his successful adaptation to his environmental demands. The animals can at best escape to safety, protect their lives, may build nests as their shelter, can migrate to a distant land, but cannot conquer nature. The animals hardly can ingeniously adapt to any unfavorable chaotic environment. On the contrary, man can recreate the world, create comforts for him with the help of scientific gadgets, climb the high ranges of mountains, invade the depth of the seas and air, travel with enormous speed, and can extend the life-span of its species by inventing remedies for several fatal diseases. His intellectual skills place him as the most superior species in the animal kingdom. Thus, **underlying all human abilities lie the essential attributes of intelligence.**

Intelligence is a popular term referring to all forms of man's complex mental abilities. Intelligence as a term refers to the ability to understand, act, interpret, and predict the future, and to achieve and handle relationships, information, concepts, and abstract symbols. Intelligence is thus a commonly used word to express universal capacity required for survival and progress beyond the present.

Intelligence is a process of cognition. "***Cognition refers to how we acquire, store, retrieve, and use knowledge***"

(Matlin, 1996). All the basic psychological processes such as learning, perception, memory, concept formation, thinking, reasoning, problem solving, decision-making, and creativity are related to intelligence. Therefore, intelligent behavior includes all forms of cognitive behavior such as attending, perceiving, learning, memorizing, thinking and predicting. Intelligence is an abstract concept. It cannot be observed directly; it can be estimated only through individual's performance on tests and real life situations. Recently, the concept of intelligence has been broadened to include such terms as "emotional intelligence", "spiritual intelligence", "practical intelligence", "social intelligence", "vocational intelligence" and "musical intelligence".

This chapter discusses the meaning, definitions, concepts, and practical uses of intelligence in both the western and Indian cultural context.

Meaning of Intelligence

Individuals differ from one another in both physical and psychological characteristics. Each man is unique. Men differ from one another in their color, height, weight, size, strength, hairstyle, and even in their mode of social interaction. Varied are also their mental abilities and behavior, i.e., some men are found to be very alert, witty, sensitive, and quick to react, whereas others are average and even are found to be dull. There are outgoing extroverts as well as quiet, shy, withdrawn, and very passive individuals. Many are social and friendly, whereas others are exclusively self-centered and inhibited. All these are reflections of their differences in mental abilities. In a classroom set up, a teacher comes across very bright, intelligent, and creative students as well as students who are just average or dull or even very dull. The term intelligence

is synonymous with several other concepts such as talent, brilliance, sharpness, clear-sightedness, smartness, reasoning, judiciousness, rationality, adeptness, prodigy and man of mark etc.

In our Indian culture, the term intelligence has been conceived and expressed in various terms such as "*Budhi*", "*Manisha*", "*Dhi*", "*Mati*", "*Sambit*", "*Medha*", "*Chetana*", "*Chaitanya*", "*Upalabdhi*", "*Pranidhana*", "*Prekhya*", "*Jnapti*", and "*Prajna*". These terms denote various mental functions associated with the manifold demonstrations of intelligent understanding and behavior.

What then is intelligence? In one survey, made by **Robert J. Sternberg** (1981), a group of people was asked to define what they meant by intelligence. Their answers indicated three major components of intelligence. First was the ***problem-solving ability.*** People who reason logically and identify more solutions to problems were seen as intelligent. Second, ***verbal abilities were*** thought to exemplify intelligence. And finally ***social competence,*** that is the ability to show interest in others and interact effectively with people, was viewed as indication of intelligence.

Intelligence has been explained in various ways. It is conceived as a complex universal ability to understand the world, to profit from past experience and training, to imagine various possibilities, to surmount difficulties, to protect oneself when life is physically and psychologically endangered, to be engaged in abstract and innovative thinking using concepts, symbols, and logical reasoning. Intelligence is an abstract concept. Individual's intelligence is expressed through his intellectual activities, which can be measured formally or informally. Informal assessment of one's

intellectual activities can be made through some acts, such as simple puzzle solution, filling up of a gap, answering correctly short but problem-questions, simple numerical abilities, explaining a concept, and adaptation to a novel situation.

Defining Intelligence

Intelligence has been defined in several ways. There is not just one definition of intelligence; there are several of them. A few definitions are given below for your reference. In all the definitions given below you may notice the following important characteristics of intelligence. First intelligence is ***a cognitive process involving rational and abstract thinking***. Second, it is ***goal-directed and purposeful***, which means that all intelligent activities are planned ***to reach a self-determined goal***. Finally, it involves ***social competence*** to help individuals adjust to their environmental surroundings.

1. **Intelligence is the innate general cognitive capacity** (Francis Galton, 1884).
2. **Intelligence is the ability to think abstractly** (Lewis Terman, 1921).
3. **Intelligence is what the intelligence tests test** (E.G. Boring, 1923).
4. **Intelligence is a particular instance of biological adaptation** (Jean Piaget, 1952).
5. **Intelligence is a person's capacity for goal-directed adaptive behavior** (Robert Steinberg, and William Salter, 1982).

   David Wechsler gave a commonly accepted definition of

intelligence as follows:

6. **Intelligence is the global and aggregate capacity of the individual to think rationally, to act purposefully, and to deal effectively with the environment** (David Wechsler, 1972).

Sir Francis

Assessment of Intelligence

The intelligence of an individual is assessed through measuring instruments called tests. Psychologists depend on intelligence tests, as these are very helpful to assess a person's intellectual processes. A test must possess certain characteristics in order to yield meaningful information. A test has three basic requirements: *reliability, validity,* and *standardization.* If the test does not possess any of these requirements, the assessment does not yield meaningful information.

J. McKeen

Reliability. If a test measures something consistently, then it is considered as reliable. Reliability means how consistently the person performs on a test. If a person's performance on a test shows wide variations from one occasion to another, the test is not considered to be reliable. For example, a thermometer is said to be reliable if it records a value of 98.4 degrees Fahrenheit for the normal body temperature and a figure above 98.4 degrees for a person suffering from fever, and does so consistently. If

Alfred Binet

a thermometer records 98.4 degrees the first time, and 100.5 degrees the second time for the same body temperature, it is said to be unreliable. A ruler (scale) is a good physical measuring instrument for length, because it provides the same or consistent measurement index repeatedly. Similarly ***an intelligence test would be considered reliable, if it records relatively the same performance level every time it is administered***.

Validity. A test is said to be valid if it measures what it intends to measure. An intelligence test will be valid if it measures intelligence. If a test is valid, it will always be reliable. We should use valid tests of intelligence in order to make meaningful inferences about the intelligence status of an individual.

Standardization. Standardization refers to the processes and procedures of establishing a set of norms for a test. In testing including intelligence, the investigator has to establish for a particular test a set of uniform procedure for its administration, the scoring techniques to be used, and the methods of evaluation and interpretation of the obtained score. Standardization involves *norms.* A standardized test is a test that has been subjected to a sufficiently thorough empirical analysis so that an adequate set of *norms* has been developed, and a reasonable assessment of its reliability and validity has been obtained.

Early Studies on Intelligence

The development of formal tests of intelligence assessment is quite modern. The formal intelligence tests were developed in the early 1900s. **Sir Francis Galton** (1885)

is considered as the father of the mental tests. In 1884, in an International Health Exhibition at London's South Kensington Museum, he tested more than 9000 men and women visitors without their knowledge. The term "test" was not known until then. Galton measured such characteristics as head size, visual acuity, strength of handgrip, breathing capacity, reaction time, visual acuity, and memory for visual form. He was a naturalist and mathematician. He attempted to discover individual differences. He was keen to know how and why people differ in their abilities, and why some are gifted and others are below average.

Galton believed that intelligence could be measured by objective tests. Galton raised many important issues concerning intelligence - the degree to which it is inherited, how it can be measured, and what are its components. Intelligence theorists are still studying these issues today.

The American psychologist, **J. McKeen Cattell** also studied the nature of individual differences. Like Galton, Cattell believed that sensory, perceptual, and motor processes constitute the core of intelligence. He developed the label ***mental test.***

Being requested by the French Ministry of Education in 1904, Alfred Binet devised a method to identify the mentally disabled children from the normal school children. The Ministry asked him to determine why a number of children were not profiting from the standard school curriculum, and to develop means to teach these weak children in public schools. Binet and his disciple Theophil Simon developed an intelligence test as requested. The test was called 1905

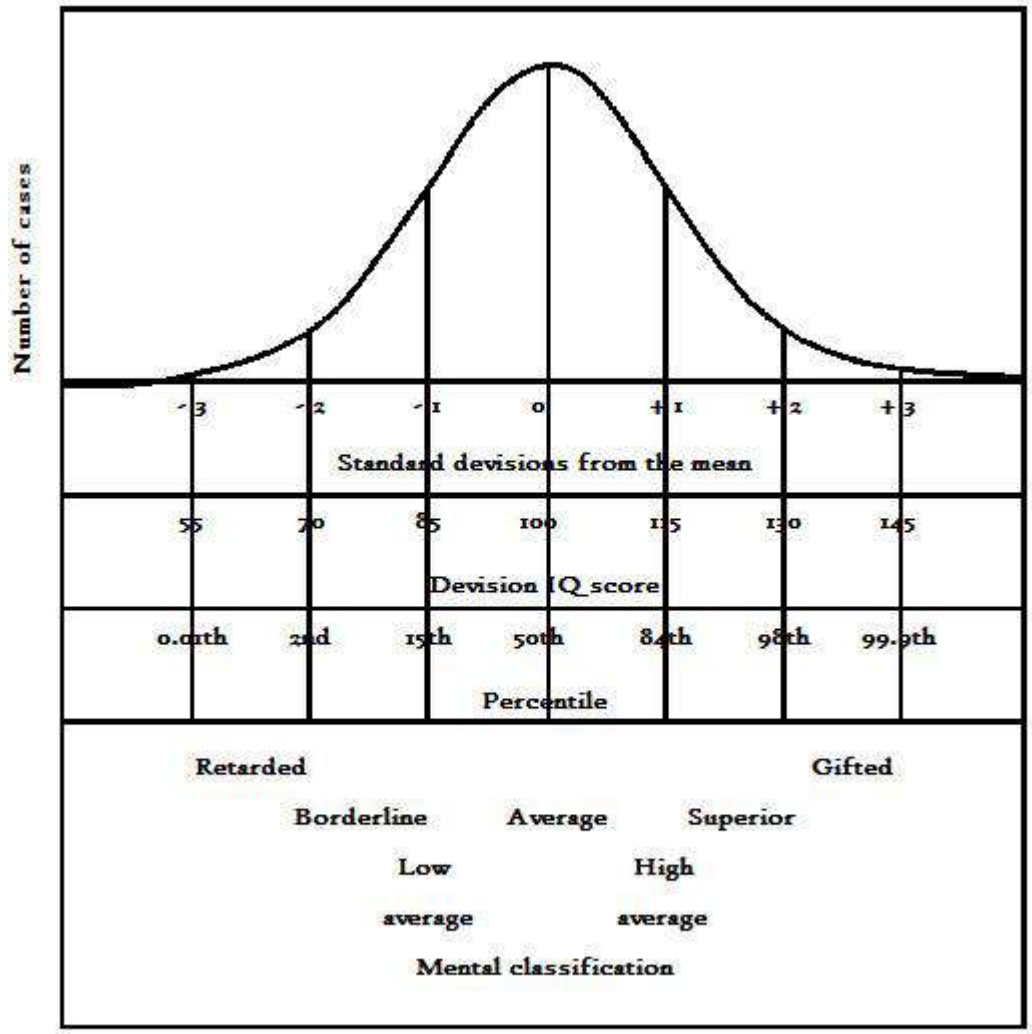


Figure 8.1 : Distribution of Intelligence Quotients

scale having 30 different kinds of items. The items ranged from the simple ability of touching one's nose or ear to the more complex abilities of defining abstract concepts.

The concept of ***Mental Age*** **(M.A.)** was first developed by Binet. ***Mental age is the average age at which normal individuals achieve a particular score on a measure of***

intelligence. Mental age is separate from the ***Chronological Age*** **(C.A.),** which is the number of years or months since the child is born. Binet is credited with devising age-appropriate test items so that a number of children's responses could be compared. The items were chosen objectively without being influenced by differences in their varied environment, impulsive judgment, and rote memory. The items were based on rational judgment and reasoning.

Normal children of different ages were tested, and then the average score for each age was determined. Then each child's performance was compared to the average of all other children of the same age.

Test findings were interpreted in terms of the average age at which the normal children achieved a particular score. This measure was called the *Mental Age* (M.A.). For example, when a child's scores on various items of a test add to the average score of a group of 5-year olds, the child is said to have a mental age of 5 irrespective of his/her actual *chronological age* (C.A.). Binet defined retardation as being two mental age years below the chronological age. A bright child's M.A. will be more than his/her C.A. A dull child's M.A. will fall below his/her C.A.

David Wechsler

Intelligence Quotient (IQ)

Intelligence quotient is just a number. It was devised in 1912 by a German Psychologist, **William Stern** (1871-1938). It is an age-related measure of intelligence level. I.Q. is determined by child's mental age divided by chronological age multiplied by

100.

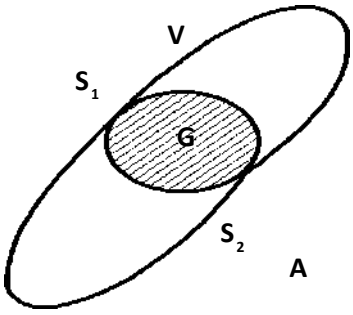
I.Q. (Intelligence Quotient) = (MA / CA) x 100

The number 100 is used as a multiplier to avoid the decimal point. When the M.A. equals the C.A., the I.Q. is equal to 100. When the M.A. is less than the C.A., the I.Q. is less than 100. If the M.A. is above the C.A., the I.Q. becomes more than 100.

The test of intelligence developed by Binet had the following four characteristics. First, the score on his newly developed test was ***an assessment of the current performance, and not a measure of the inherited attributes***. Second, his test scores were to be used ***to identify weak children, who needed special help***, and there should be no stigma attached to them for their weakness. Third, he believed that intelligence can be ***influenced by training and opportunity,*** and he tried to identify the areas in which special education can benefit the performance of these children. And fourth, he did not develop a theory of intelligence; he ***developed his test empirically*** on the basis of how children's performances can be observed.

The test originally developed by Binet was revised several times in his country and in England. **Terman**, a Professor at the Stanford University, revised Binet's test, in 1916, which was known as the **Stanford-Binet Test of Intelligence**. This test underwent further revisions in 1937, 1960, and 1972. The present Stanford-Binet Test has a wide variety of verbal and nonverbal items. For example, for a six-year-old child, the verbal task in the test is to define at least six words, such as "envelope", "orange" etc. His/her nonverbal tasks consist of tracing a path through a maze. An adult would be required to define such

Charles Spearman



Fiture 8.2 : A diagram representing Spearman's 'g' and 's' factors in

words as "regard", "disproportionate", and to explain several proverbs. The test also consists of subtle thinking to differentiate between "laziness" and "idleness". The Stanford-Binet's latest test for adults have four components such as *Verbal reasoning, Quantitative reasoning, Abstract reasoning,* and *Short-Term memory.*

Binet's measurement of intelligence is found to approximate a ***normal distribution***. This type of distribution is symmetrical with a majority of cases falling in the middle of the range of scores and a few scores falling at the end of the curve. The distribution of intelligence quotients is given in Figure 8.1.

The Stanford-Binet test is a popular and most widely used test of intelligence. It is considered to be advantageous compared to that developed by Galton or Cattell. This is because, contrary to sensory, perceptual, and motor processes only, the

Raymond B. Cattell

Stanford-Binet test captures complex mental processes such as memory, imagery, comprehension, and judgment. The following table shows the classification of people on the basis of their IQs.

Table 8.1 :*The classification of people on the basis of their IQ*

(Interpretation of I.Q. on the Stanford-Binet test)

IQ	***Description of IQ level***	***Percentage in each group***
Above 139	Very superior	1
120-139	Superior	11
110-119	High average	18
90-109	Average	46
80-89	Low average	15
70-79	Borderline	6
Below 70	Mentally retarded	3
		100

Louis L.Thurstone

The Wechsler Scales. In addition to the Stanford-Binet test, the

Wechsler Scales are most widely used intelligence tests. These scales were developed by David Wechsler of the Bellevue Hospital in New York. There are three scales: the *Wechsler Adult Intelligence Scale-Revised* (WAIS-R), *the Wechsler Intelligence Scale for Children-Revised* (WISC-R), and the *Wechsler Preschool and Primary Scale of Intelligence* (WPPSI). These scales have gone through successive revisions. Recently, some of these scales were revised in 1981. The Wechsler scales provide an overall IQ score, and also verbal IQ and non-verbal IQ scores. The separate verbal and non-verbal scores help the tester to see quickly the areas of mental performance in which the individual is below average, average, and above average.

The WAIS-R consists of six verbal and five non-verbal subtests. The verbal subtests are *Vocabulary, Comprehension, Arithmetic, Similarities,* and *Digit Span.* As an example, in *Similarities,* the person is required to state how two things are alike. In the subtest of *Digit Span,* the person is asked to repeat a series of digits in the same order as presented by the examiner. The non-verbal or the performance subtests of the WAIS-R include the subtests of *Block Design, Digit Symbol, Picture Arrangement, Picture Completion* and *Object Assembly.* The WAIS-R is designed for adults over 18 years. The Wechsler Scales are highly reliable and valid.

Approaches to Understanding the Nature of Intelligence

Psychologists have devoted considerable attention to the understanding of the nature of intelligence. Is intelligence a single ability or does it consist of multiple abilities? Is it fully inherited or is it shaped by environmental factors? Should intelligence be conceptualized as abilities or processes? Are there

qualitatively different stages of intellectual development? Is there one type of intelligence or several types of intelligences? These and similar issues have been studied by psychologists for developing different theories of intelligence. There are mainly three groups of theories or three major approaches to the study of intelligence: (a) *psychometric approach,* (b) *information-processing approach,* and (c) *cognitive-developmental approach*.

The psychometric approach studies intelligence as an ability, or as an aggregate of multiple abilities, assesses intelligence in quantitative terms, and expresses individual's performance on a test in the form of scores. The theories of Charles Spearman, Louis Thurstone, Raymond Cattell, J. P. Guilford, Arthur Jensen, and Howard Gardner are examples of the psychometric approach to the study of intelligence.

The information-processing approach describes the processes people use in intellectual reasoning and problem solving. The major emphasis of this approach lies in studying the underlying processes of intelligent behavior. Included in this approach are the theories of Robert Sternberg, and J. P. Das.

The cognitive-developmental approach emphasizes the functional significance and development of intelligence. It argues that intellectual development proceeds in the form of qualitatively distinct developmental stages. Jean Piaget's theory of intelligence is the most dominant cognitive-developmental approach to the study of intelligence. The views of different theorists are discussed below.

Psychometric Approach

Charles Spearman. He advanced Two-factor theory of intelligence in 1927. It was a theory of trait organization based on the statistical analysis of test scores. Spearman pointed out that all intellectual activities have a single common factor called the general factor or “g” factor. Again he advanced a number of specific or “s” factors. Each of the s-factors refers to a specific single activity. He explored statistically the interrelations among scores obtained by many persons on various tests. Positive correlation between any two mental functions was attributed to “g” factor. But the specific factors have low correlations among them.

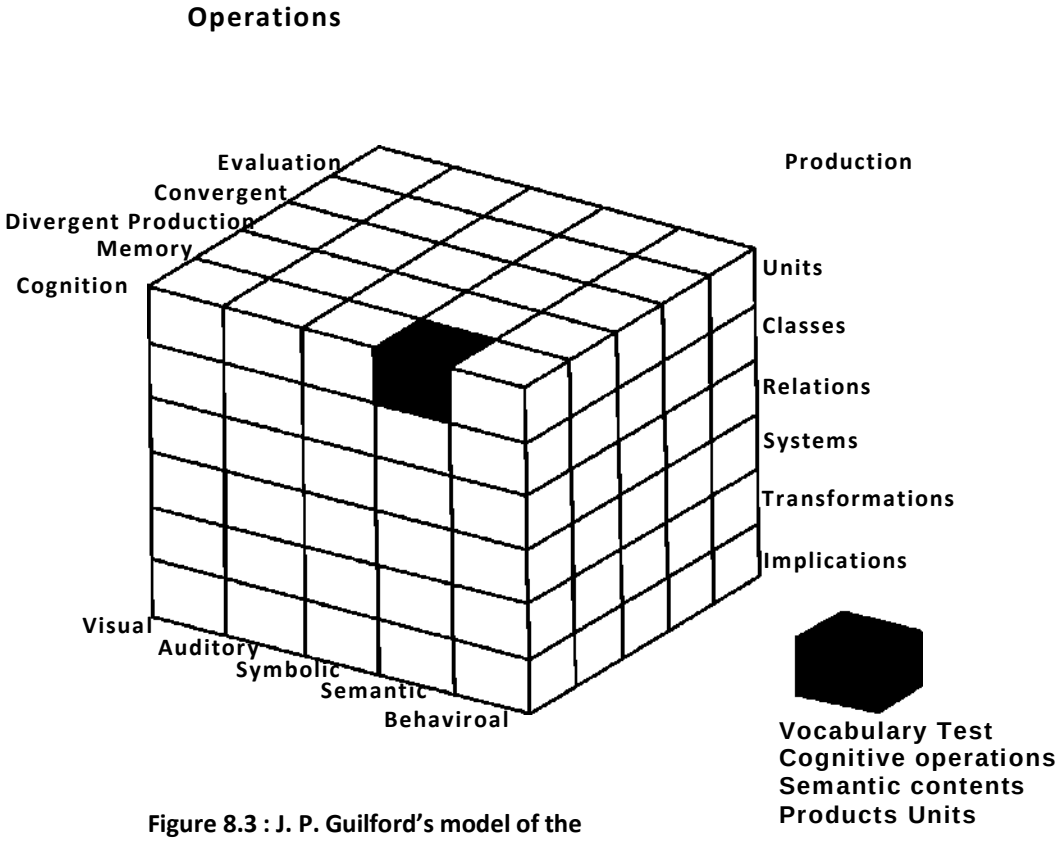


Figure 8.3 : J. P. Guilford’s model of the Structure of Intellect

Spearman's model implies that the objectives of psychological testing should be to measure the amount of each individual's '***g***'. The ***g***-factor runs through all abilities, and forms the basis for prediction of the individual's performance. It would be futile to measure specific factor, as each operates in only a single activity.

Howard Gardener

In the Figure 8.2, tests 1 and 2 are correlated with each other, which is shown by the overlapping shadow area. The shaded area represents the *'g'* factor, while the white areas shown separately for each test represent *'s'* factors. Spearman advocated that the *'g'* factor provides a correct picture of intelligence. His model of two-factor theory paved the way for application of *factor analysis* in psychology. Later, factor analysis was used for discovering cluster of traits, which produced amazing multiple factors.

Raymond B. Cattell. He suggested that general intelligence can be broken down into two relatively independent components called *fluid intelligence* and *crystallized intelligence.* ***Fluid intelligence denotes reasoning, memory and information-processing capabilities. It is the ability to see complex relationships and solve problems.*** It is measured by the tests of block designs and spatial

visualization. ***Crystallized intelligence is the knowledge that the person has already acquired and the ability to access that knowledge***. It is measured by tests of vocabulary, arithmetic, and general information. Research has indicated that fluid intelligence grows rapidly in early adulthood, while crystallized intelligence increases across the life span. Both fluid and crystallized intelligence are partly inherited and partly learned.

Louis L.Thurstone. Thurstone (1938) suggested that ***intelligence is a composite of seven distinct primary mental abilities (PMA).*** He analyzed the intercorrelations of a set of 56 mental tests, and identified seven factors, each of which he called as a primary mental ability. Table 8.2 lists out the seven primary mental abilities listed out by Thurstone.

Table 8.2 :*The Seven Primary Mental Abilities according to L.L. Thurstone.*

	Ability	***Brief Description***
V.	**Verbal comprehension**	*The ability of reading comprehension; grasping meaning of words, concepts, and ideas; verbal reasoning*
N.	**Numerical abilities**	*The ability to use numbers with speed and accuracy, to compute answers to problems. It is the ability to measure the speed of computational skills.*
S.	**Spatial Relations**	*The ability to visualize and manipulate patterns and forms. Visualization of geometric*

relations in space.

P.	**Perceptual Speed**	*Speed of perceiving details, i.e., the ability to grasp perceptual details quickly and accurately, and to determine similarities and differences between stimuli.*
W.	**Word Fluency**	*Speed of manipulation of single words, i.e., the ability to use words quickly and fluently in performing tasks, such as rhyming, solving anagrams, and doing crossword puzzles, and naming words.*
M.	**Memory**	*The ability to recall simple material, such as lists of words, mathematical formulas, and definitions etc.*
I.	**Inductive Reasoning**	*Logical reasoning ability, i.e., the ability to derive general rules and principles from the presented information.*

Thurstone considered each of the mental abilities to be independent of the other, and that each can be assessed separately. He believed that there is no single score of an aggregate intelligence. His ***Primary Mental Abilities Test (PMA)*** is widely used.

Arthur Jensen. Jensen (1969) proposed two level-theory of mental abilities, which sparked a debate on the association

of heredity versus environment with intelligence after his studies got published in the "Harvard Educational Review" in 1969. He demonstrated clear-cut genetic differences in the average intelligence of races and social classes. Jensen suggested that two genetically based levels of intelligence exist. In other words, intelligence consists of two levels of abilities. The **Level I ability** is ***associative learning,*** which consists of Short-Term Memory (STM), rote learning, attention, and simple associative skills. **The Level II** is called ***cognitive***

Robert Sternberg

learning, which consists of abstract thinking, symbolic thought, conceptual learning, and the use of language in problem solving. He argued that Level I ability, i.e., associative learning is equally distributed across all racial and national groups, but on the contrary, Level II, i.e., cognitive learning is concentrated more in the middle class Anglo-American populations than in the lower class

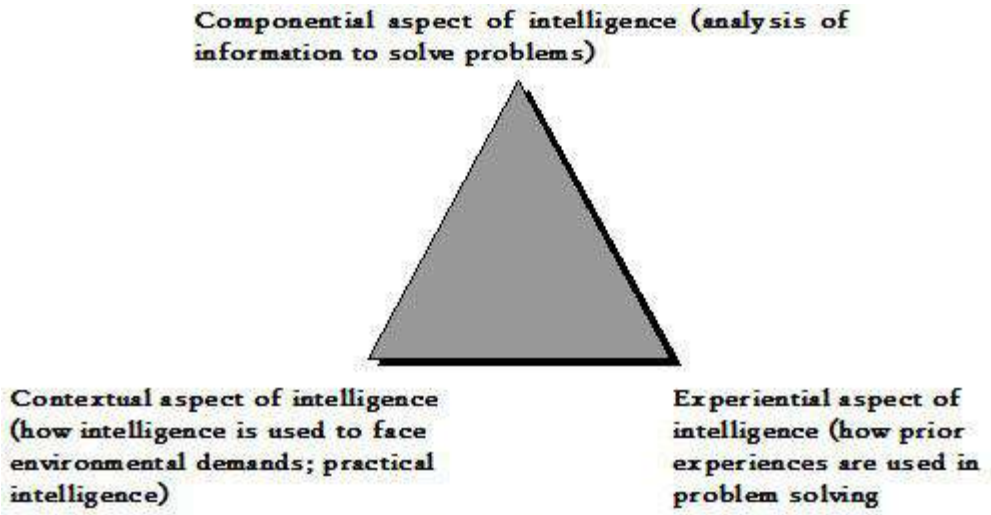


Figure 8.4 : Stenberg's triarchic theory of intelligence

black populations. According to him, genetic differences in intelligence exist among people coming from different races, nationalities, and social classes.

Jensen conducted studies of intelligence comparing identical and fraternal twins. Identical twins have identical genetic dispositions for which their IQs are assumed to be similar. Fraternal twins like ordinary siblings are genetically less similar, which results in the assumption that their IQs are less similar. Jensen found support for his views in these findings. Studies with identical twins produced an average correlation of .86, whereas studies of ordinary siblings produced an average correlation of .47. Jensen on the basis of his studies believed that **genetic factors are more important than environmental factors for one's intelligence.**

J. P. Guilford. J.P. Guilford (1967) advanced a model of intelligence based on factor analysis. He tried to make logical explanations of the factors involved in mental functions. In his "***Structure of Intellect Model***", all mental abilities are conceptualized within a three-dimensional framework. In other words, there are three features of intellectual tasks: the ***content,*** or the type of information; the ***product,*** or the form in which the information is represented; and the ***operation,*** or type of mental activity performed. The Structure of Intellect Model shown in Figure 8.3 indicates five types of contents (visual, auditory, symbolic, semantic, behavioral); five kinds of operations (cognition, memory, divergent production, convergent production, evaluation); and six varieties of operations (units, classes, relations, systems, transformations, implications). Each task performed by an individual can be identified according to a particular type of content, product, and operation involved. Since there are

five types of contents, five different operations, and six different kinds of products, there are altogether 150 (5X5X6) separate kinds of mental abilities. For example, a test of vocabulary assesses one's ability for cognition of units with semantic content, while learning a form of dance requires memory for behavioral contents.

In Guilford's model, the convergent and divergent thinking are considered to be centrally involved in creativity and intelligence. In addition to other operations, creative abilities involve divergent operations. On the contrary, in convergent thinking, the production of single correct response is related to estimate intelligence

Gardner's Theory of Multiple Intelligences

Howard Gardener (1983) proposed a somewhat different theory of intelligence. For him, intelligence consists of numerous abilities, each of which is equally important. In other words, Gardner believes that we have **multiple intelligences,** each relatively independent of the others. After studying many talented persons, who have shown exceptional abilities in their respective areas, Gardner came to the conclusion that we possess *eight types of intelligence,* each relatively independent of the others. The utility and values of each type of intelligence is culturally determined in the sense that individual's intelligent performances are determined according to high desirability, usefulness, and demands of the society. One type of intelligence may be valued in a particular culture, whereas it may be of little consequence in another culture. Gardner identifies the following eight intelligences:

1. Linguistic Intelligence *(skills involved in the production and use of language).* This refers to one's language fluency, and flexibility. A person who is articulate, and can create linguistic images would be regarded as having more of

J. P. Das

linguistic intelligence. The persons strong in this component of intelligence are Rabindranath Tagore, William Shakespeare, T.S. Eliot, and poets and writers. At the age of 10, T.S. Eliot created a magazine called 'Fireside' to which he was the sole contributor. It is only during three days in a winter vacation, he could create eight complete issues of the magazine.

2. Logical-mathematical Intelligence *(skills in scientific thinking and problem solving).* This refers to one's ability to think logically and critically, which is necessary for scientific inventions and discoveries. It is very much required for academic achievement and success in school. The scientists, scholars, and Nobel-prize winners have more of logical-mathematical intelligence. The persons who are strong in this area are Albert Einstein, Archimedes, Madam Curie, C. V. Raman, Hargobind Khuranna, and Amartya Sen.

3. Spatial Intelligence *(skills involved in spatial configurations such as those used by artists and architects).* This skill involves navigation in space and seas without instruments, use of mental images, spatial configuration, architecture and art creation, and piloting aero planes. Leonard da Vinci, Michael Angelo, painters, architects, and interior decorators are strong in this component of intelligence.

4. **Musical Intelligence** *(skills in tasks involving music).* It is related to the production and creation of music, and music sensibilities. Beethoven, Yehudi_Menhuin, Indian violinist Jubin

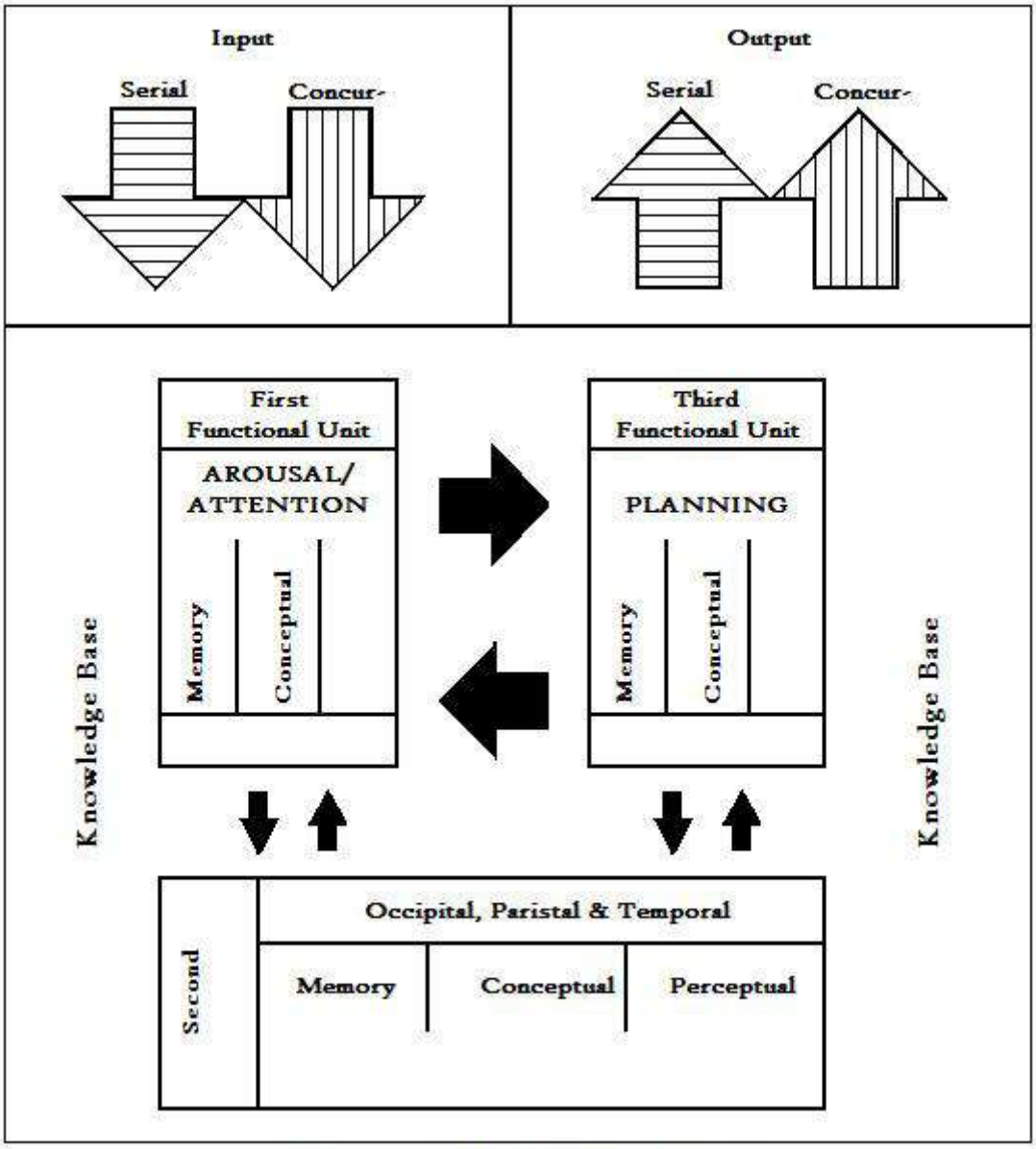


Figure 8.5 : The PASS model of intelligence

Mehta, singers M.Subhalaxmi, and Lata Mangeshkar, sitarist Rabishankar, and tabla player Zakir Hussain are some of the examples.

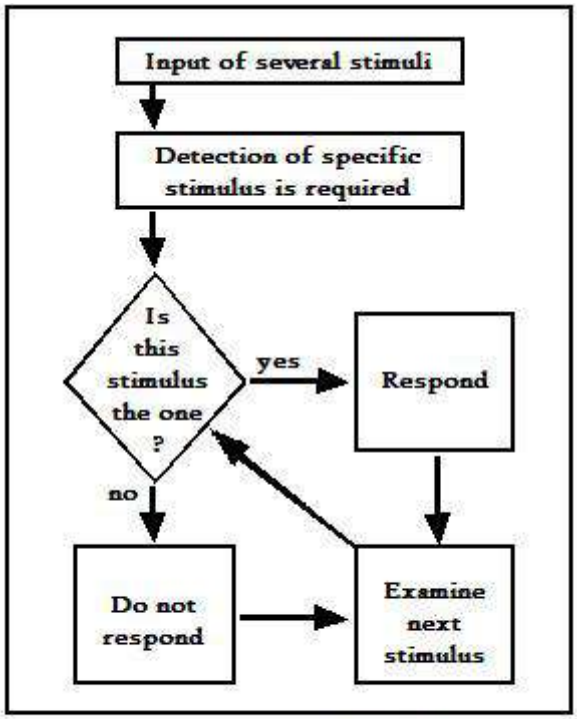
5. Bodily-Kinesthetic Intelligence *(skills used in the construction of products or displays using the whole body or portions of it).* This intelligence consists of the use of whole body or various portions of it for display or in the construction of products, or in problem solving. Athletes, dancers, actors, sportsmen showing acrobatics and surgeons demonstrate such abilities. The Olympic gold medallist, Jesse Owen's (1936), the football players like Pele and Maradona, Cricketers like Bradman and Tendulkar, dancers like Birju Maharaj, and Sanyukta Panigrahi demonstrate high bodily-kinesthetic intelligence.

6. Interpersonal Intelligence *(skills in interacting with people by being sensitive to their moods, temperaments, and motives).* This is the skill of understanding oneself and others, and placing oneself in a comfortable relationship with others. Persons having strong interpersonal intelligence can understand the perspectives of others easily, can establish good relationship with people, and help others develop insight into their problems. The psychologists, counselors, social workers, and reformers possess high interpersonal intelligence. Freud, Anne Sullivan, Mother Theresa, Vinoba Bhave are some of the examples.

7. Intrapersonal Intelligence *(skills involved in knowing and understanding oneself, one's feelings, and emotions).* This refers to one's knowledge of the internal aspects of oneself and sensitiveness to one's strengths and weaknesses. Persons strong in this component have high degree of self-awareness, and have finer sensibilities regarding their identity, human

existence, and the meaning of life. They are less disturbed by external events. The religious leaders and philosophers are strong in this component of intelligence. Ramakrishna Paramhansa, Vivekananda, Aurobindo, and Victor Frankle are some of the examples.

8. Naturalistic Intelligence *(sensitivity to aspects of the natural world).* This refers to one's awareness of his/her relationship with the natural world including flora and fauna. Persons high on this tend to appreciate the beauty of nature and discover themselves with reference to the subtle aspects of nature. They can discriminate among the subtle features of the natural world. Bird watchers, hunters, farmers, botanists, zoologists and tourists are high on this aspect of intelligence.



Attention Processes Path Diagram

Figure 8.6 : Simultaneous processing path diagram

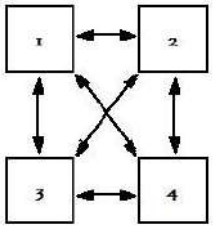


Figure 8.7 : Successive processing path diagram

Gardner believes that these eight human attributes are necessary for successful adaptation and survival. Of these seven abilities, the first two

abilities are promoted more by the western society, and the other attributes are nurtured more by other societies. For example, people living on small island society avoid quarrel among themselves and try to cultivate interpersonal relationship for healthy adaptation. Gardner also suggests that these separate intelligences do not operate in isolation. Normally, any activity encompasses several kinds of intelligence working together.

His model has led to a number of advances in our understanding of the nature of intelligence. First of all, subjects must be observed in a variety of situations for making an inference about their intelligence status. Second, test makers should develop intelligence test items in which more than one answer can be correct, proving opportunities for the subjects to demonstrate their creative thinking. According to Gardner's model, different kinds of intelligence may produce different but equally valid responses to the same question.

Information-Processing Approach

The most recent contribution to the understanding of intelligence comes from the work of cognitive psychologists. The cognitive psychologists apply information-processing approach to understand many aspects of human behavior including intelligence. They believe that the way people receive information, store them in memory, and use strategies to solve problems provides a more accurate measure of intelligence. Thus, cognitive psychologists do not focus on the structure of intelligence, but on the processes underlying intelligent behavior. In other words, they examine processes involved in an intelligent activity. The theories of Robert Sternberg, and J. P. Das are the two information-processing approaches that are discussed in this chapter.

Sternberg's Triarchic Theory of Intelligence

Robert Sternberg of the Yale University, USA is one of the most prominent among the new generation of cognitive psychologists. Sternberg (1982) asked people to identify the characteristics of an *intelligent* person. The most frequently given answers indicated the following: (a) He reasons logically and well; (b) He reads widely; (c) He keeps an open mind; (d) He reads with high comprehension. On the basis of his observation, and experimental research, Sternberg (1986) formulated the triarchic theory of intelligence.

Jean Piaget

He theorized that intelligent behavior consists of three major components. Each component is a basic unit of information processing. According to him, such components consist of activities to acquire or store information, to develop problem-solving strategies, and to use strategies according to a plan to solve problems, and monitor one's progress. The three basic and major components of intelligence are: (1) **Componential intelligence** *(analysis of information to solve problems);* (2) **Experiential intelligence** *(using prior knowledge and information in problem solving and creating new ideas);* and (3) **Contextual intelligence** *(using intelligence to adapt to environmental demands: practical intelligence).*

Componential Intelligence. This is the ***knowledge-acquisition component for learning new facts***. This is reflected in the I.Q scores obtained through test administration, and grades obtained by school students. Intelligent behavior of a person consists of three information-processing components, such as (a) *learning how to do things,*

(b) *planning what things to do and how to do them,* and (c) *actually doing things.* This is the performance component of intelligent behavior. People of such intelligence perform excellently in standard tests and in displaying rational behavior.

Experiential Intelligence. This component of intelligence focuses on experience. ***It is involved in using the past experience creatively to solve novel problems.*** Thus, experiential intelligence is reflected in creative performance. For example, scientists use their experiences to develop novel scientific theories. Artists draw mass attention by drawing commonplace things in extraordinary ways. It focuses on how a person's past experience affects intelligence and how those experiences are utilized in problem-solving behavior. It consists of the ability to integrate different experiences in a unique and original way. Persons who are high in this component quickly find out what information is crucial in a given situation, and how the information is to be used to reach the target. This is the kind of intelligence shown by many scientific genius and inventors such as Einstein, Newton, Freud, C.V. Raman, and J. C. Bose.

Contextual Intelligence. This component of intelligence as put forth by Sternberg involves ***practical intelligence, i.e., the practical management of day-to-day life affairs like how to get rid of trouble, how to face the environmental demands, and how to get along with the society***. The contextual aspect is composed of (a) *adaptation to present environment (b) selection of a relatively favorable environment instead of the existing one, and (c) modifying the present environment to fit to one's skills, needs, and values.* Contextual intelligence is what people sometimes

call ***street smartness*** or ***business sense***. Persons high in this component exercise greater influence in controlling their environment, and therefore, turn out to be successful. **The standard IQ tests do not tap contextual and experiential intelligences.**

Evaluation of Sternberg's Theory. Sternberg believes that this kind of practical intelligence is the tacit knowledge. It consists of all of the important information about practical reality of the world about which one is taught neither in schools nor in colleges. According to him, ***tacit knowledge*** is more important for success than the obvious "bookish" knowledge. The test developed by Sternberg measures tacit knowledge of the individual - how he/she responds to dilemmas and problem-solving circumstances in areas like business, science, and politics. The test also measures sensitivity to the non-verbal cues. Sternberg's test tries to evaluate person's ability to decode nonverbal cues such as the looking behavior in personal interaction, facial expressions, the body postures, body awareness, physical proximity, and appearance.

Recent researchers have focused more on Sternberg's contextual aspect of intelligence. They have put emphasis on practical intelligence, which is related to overall success in living rather than intellectual and academic performance. Sternberg believes that such intelligence is generally predictive of success in a chosen field no matter whether it is tailoring, business or medicine etc. Career success requires a type of intelligence, which is very different from that which is required in academic success. But practical intelligence is learned mainly through observation and modeling.

Sternberg has also expanded his theory to the field of

personality. He speaks of ***mental self-government*** in describing personality dispositions of individuals. The three types of intelligence must be considered along with the intellectual styles i.e., the ways these intelligences are used in solving the problems of everyday life. It is yet to be seen that Sternberg's views regarding intelligence are confirmed by future research. Yet it must be admitted that Sternberg provides a clearly promising perspective in the field of cognition to understand the varied nature of intelligent behavior.

Das's PASS Model of Intelligence

The PASS model is a model of cognitive processing known as ***Planning, Attention, Simultaneous*** and Successive processing. Based on Luria's analyses (Luria, 1973, 1980) of human brain structures and cognitive psychological research (Broadbent, 1958, Simon, 1981), Das and Naglieri (1994) proposed the PASS cognitive processing model as a modern theory of intelligence. According to Das, ***intelligence is information processing that is dynamic in nature***. It is not a static structure like ability.

According to **Luria**, human cognitive processes involve three functional systems or units that work in harmony. The participation of all the three functional units is "necessary for any type of mental activity" (Luria, 1973). The PASS model of intelligence has a strong neurological foundation. At the same time, it focuses on the cognitive processing components rather than their specific neurological locations. The three functional units are as follows:

First Functional Unit. It is responsible for ***cortical arousal and attention***. It is associated with the activities of the **brain stem** and the **lower part of the cerebral cortex.**

Second Functional Unit. It analyzes, codes, and stores information using simultaneous and successive processes. Simultaneous processing is associated with the **parietal and occipital lobes**, whereas successive processing is associated with the **frontal-temporal lobes.**

Third Functional Unit. It is important for ***planning, self-monitoring, and structuring of cognitive activities.*** It is broadly located in the **frontal lobes**, the front portion of our brain.

We receive information through our sensory organs such as eyes, ears, nose, skin, tongue, and internal organs. When the information is analyzed, the central processing becomes active. The four components of the central processing mechanisms are: *Planning* (P), *Attention* (A), *Simultaneous processing* (S), and *Successive Processing* (S). All these four constitute the PASS processes. The PASS model of intelligence is presented in Figure 8.5. These four processes operate on the existing knowledge base, which is the result of past learning, emotions, and motivations. In other words, the four processes become active within the context of an individual's knowledge base. Das says, "*It is as if the PASS processes are floating on a sea of knowledge."* It is like a boat floating on water; without water, the boat will sink. The three units together are responsible for attention, simultaneous and successive processing, and planning. These processes are discussed in detail below.

Attention. According to the first functional system, human cognitive processing starts from the proper wakefulness condition which prepares the individual to receive and process information. This involves maintaining an appropriate level of arousal, which is followed by effective performance, i.e., *attention.* ***Attention is focusing one's consciousness on a stimulus***. It is a complex cognitive activity.

We attend to information through any of our eight receptors (ears, eyes, skin, muscle and joints, internal organs, tongue, nasal buds and cochlea of the inner ear). We attend to sensory stimuli one after another over time or several stimuli occurring together at the same time. For example, auditory information comes simultaneously.

This leads to information processing. Attention is voluntarily controlled. Following an appropriate state of cortical arousal and wakefulness, there may be either ***selective attention*** or ***divided attention***. In selective attention, the subject focuses or acts on a single relevant stimulus, and ignores the irrelevant stimuli; attention on one stimulus takes place. However voluntary discrimination of stimuli or selective attention is an important activity of the first unit of the PASS system of intelligence.

Simultaneous and Successive Processes. The second functional unit is related to processing and retaining information received from the external world. In the second functional system, two types of information processing take place: *simultaneous processing* and *successive processing.*

Simultaneous processing involves integration of stimuli into harmonious groups. It is quasi-spatial in nature and organizes information into a meaningful composite pattern. Through simultaneous processing, the person recognizes that a number of stimuli share a common characteristic. Here elements are interrelated in various ways. Each element is perceived as having a relationship with others in a network system as exemplified in the simultaneous processing path diagram given in Figure 8.6. Successive processing refers to the processing of information in a serial order. It integrates the stimuli into a particular series forming a chain-like progression. The important distinction between the two coding processes lies in whether or not the system is totally surveyable at a given point in time. The successive processing path diagram is given in Figure 8.7.

Planning. The third unit described by the PASS model deals with *planning.* ***It allows the person to form plans of***

action, implement the plans to reach a target, and verify the effectiveness of plans. The PASS model provides a special space for *planning* in the execution of intellectual activities. Planning is required when a person makes decisions about how to solve a problem (e.g., how to write an essay, how to solve an arithmetic problem, how to carry out a business, how to renew contact with a lost friend etc.)

Planning functions are carried out in association with attention, and simultaneous and successive processes. Planning is required when a person decides what to attend to, and what to ignore; and to use either of the simultaneous or successive processes as and when required. Planning defines the very essence of intelligence. **In fact intelligence may be viewed as carrying out strategic planning with an end in view**.

Planning as well as other PASS processes operates on a knowledge base. When the individual makes a systematic approach to solve a problem, he searches his base of knowledge. None of the cognitive processes would help us if we did not have the knowledge base. In other words, **the knowledge base is the foundation of information on which all cognitive processes operate**. The stored up knowledge is nothing but person's stock of experiences, which is acquired formally (e.g., by reading, writing, and experimenting) or informally from his environment. With the feedback from the past knowledge base, the individual develops an initial plan of action and then examines the plan if it is appropriate and reasonable. If the initial plan is acceptable, the plan is implemented. In case it is rejected because of its weaknesses, a new and better plan is made. Finally, when the plan is put into action, decisions are made to modify it as per requirements in order to achieve effectiveness in problem solving.

All the PASS processes are dynamic and interactive in nature. Yet, each has its own distinctive functions. All processes are not equally involved in the performance on a task. One process may be more related to some but not to others. For example, there is close relationship between the first and third functional units, because planning requires proper state of arousal leading to their focusing of attention. Similarly planning is related to coding because it can operate only when the information is coded simultaneously or successively.

On the basis of the PASS theory, **Das and Naglieri** (1994) have developed a battery of tests known as the ***Cognitive Assessment System (CAS)*** to measure the four PASS processes. The PASS tests consist of verbal and nonverbal tests presented visually and /or orally using varieties of modalities.

The PASS theory of intelligence has demonstrated how Luria's conceptualization of human brain structures and functions can be used to operationalize intelligence. The model has been empirically validated across various subgroups and cultures. Wills (1989) evaluates the PASS model as providing a strong theoretical basis for psycho-educational assessment in cognitive literature.

Cognitive-Developmental Approach

The Swiss Psychologist, **Jean Piaget** (1970, 1972) took a different approach from that of the psychometricians to understand human cognition. The psychometricians were interested in studying individual differences in cognition, but Piaget was interested in understanding the nature of intellectual development in normal children. For nearly 50 years, Piaget observed children's intellectual development, and suggested that all children proceed through a series of four stages in a fixed order. He said that these stages differ not only

in the *quantity* of information acquired at each stage, but also in the *quality* of knowledge and understanding as well.

Cognition refers to all psychological processes used in acquiring knowledge from one's environment. It includes learning, memory, perception, thinking, reasoning, decision-making, and problem solving. Piaget's work provides insight into the age-related cognitive activities from early childhood to adolescence. Piaget who initially in 1920s worked in Alfred Binet's laboratory to help standardize the early IQ tests came to believe that **the standardized intelligence tests ignore the development of important qualitative aspects of children's thought processes**.

Piaget's theory of intelligence provides the most dominant framework in developmental psychology. According to Piaget (1952), ***"Intelligence is a particular instance of biological adaptation."*** For Piaget, intelligence refers to a general mental adaptability. Piaget was basically concerned with three questions: (a) What is it that changes with development? (b) How do cognitive changes take place? and (c) What is the most systematic way of ordering the stages of cognitive development?

> Please refer to Piaget's theory which has been described in detail in Chapter 8 under the head " Stages of Cognitive Development by Piaget"

Factors Affecting Intelligence

We notice a wide variety of individual differences in people's intellectual abilities. Some are more intelligent than others. The differences are so much so that while some change the course of human civilization through their intellectual innovations, a few others even find it difficult to master a problem on simple addition. Why are there individual differences? What are the factors influencing people's

intelligence? The individual differences that exist among all of us are the products of two general and broad factors: *hereditary, and environmental.*

Hereditary factors are based on the genetic make up of the individual that influences growth and development throughout life. The offspring inherits the genetic characteristics from his parents. The environmental factors consist of the influence of parents, family, friends, schooling, society, culture, and all other experiences to which the child is exposed right from the moment of conception. The question of whether heredity or environment is important in determining intellectual capacities is known as the ***nature-nurture debate***. In this context, nature refers to hereditary factors, and nurture to environmental influences.

The nature-nurture controversy has philosophical roots. In the 1600s, John Locke, English philosopher, argued that the mind of a newborn is a blank slate, a *tabula rasa* on which the environment writes his life history. Locke believed that environment acts as the sole determinant of development. On the contrary, the French philosopher, J. J. Rousseau suggested in the 1700s that people's natural characteristics (i.e., genetic factors) mostly influence the developmental process subject to the corrupting influences of the environment.

The *nature-nurture question* has been vehemently debated for decades. At present, psychologists agree that both nature and nurture interact to produce specific developmental patterns and competence. The question has now changed from which (heredity or environment) influences behavior to *how* and to *what extent* heredity and environment shape the developmental process. **No body is born without a genetic make up, or no one grows up free from environmental**

influences. Both heredity and environment are important, and it is unwise to determine their relative influence. Even then, the debate concerning their relative influence remains still active with different theorists emphasizing either the role of heredity or the role of environment (Scarr, 1996). These factors are discussed below in detail.

Hereditary Factors

Heredity refers to genetically transmitted characteristics from one generation to the next. We inherit genetic code from parents. Because of genetic code, a fertilized human egg never grows into a dog or a mouse or any other animal. Person's genetic heritage is called **genotype.** The genotype expresses itself in observable appearance and behavior, which is called **phenotype.** The phenotype includes height, weight, eye color, and psychological characteristics such as intelligence, personality and creativity. The genetic code provides the base on which phenotype grows and manifests. How can we know that human intelligence has a genetic basis? To do so, we have to infer the underlying genotypes from the observable phenotypic behavior.

A strategy to differentiate genotypes from phenotypes is to examine the similarities between the intelligence level of children, and their parents and relatives. Francis Galton (1885) was of the view that intelligence is largely inherited, and it runs in families. Researchers have found that parents with high IQs tend to have children with high IQs, and parents with low IQs have children with relatively low IQs (Crooks and Stein, 1995). Correlations between IQs of brothers, sisters, children and their parents, and their distant relatives indicate that intelligence has a strong hereditary component (Kagan and Havemann, 1976). The correlation between the IQs of one

child and another person selected at random would tend to be zero, while among the related individuals, the correlations would be relatively high. Correlation coefficient provides a measure of the strength of relationship between two variables, and is bound by limits from -1.00 to +1.00. The higher is the correlation coefficient, the higher is the strength of relationship.

In more recent times, Arthur Jensen (1969) raised a hostile controversy when he argued that intelligence is primarily inherited. He examined several studies on intelligence, many of which involved comparisons of identical and fraternal twins. Jensen found support in these studies for his argument in favor of the genetic influence on intelligence. **He claimed that clear-cut genetic differences are present in the average intelligence of races, nationalities, and social classes**. He stated that blacks have lower genetic intelligence than whites, and that is why they do not perform as well as whites on intelligence tests. He and others have placed the importance of heredity's influence on intelligence at about 80 percent, leaving only 20 percent to be manipulated by the environment. He believed that environmental manipulations can at best reduce group differences in intelligence, but cannot abolish it altogether. But Jensen's views have been severely criticized, and he has been labeled as a racist.

Psychologists have drawn evidence from a number of studies to examine the relative influence of hereditary and environmental factors on intelligence. The two kinds of studies discussed below are: (a) *studies of twin children,* and (b) *studies involving adopted Children.*

Twin studies. Twins are of two types: identical twins and fraternal twins. Identical twins originate from a single

fertilized egg and ‘share the same genetic code. The fraternal twins arise from two different eggs fertilized by two different sperm cells. **While identical twins show a 100 percent genetic overlap, the fraternal twins have 50 percent genetic similarity, which is no greater than that between ordinary siblings**. If identical twins turn out to be more similar in their intelligence as compared to fraternal twins, the evidence for the hereditary factors would be strong. Table 8.3 reports the average correlation coefficients between the IQs of children having different degrees of genetic similarity. An insightful analysis of the correlations presented in Table 8.3 will clarify several points regarding the relative role of heredity and environment in shaping individual’s intelligence.

Table 8. 3 : ***Correlation coefficients between IQ scores of individuals with different genetic and environmental similarities***

Relationship	**Median Correlation**
Identical twins reared together	.86
Identical twins reared apart	.72
Fraternal twins reared together	.60
Siblings reared together	.47
Siblings reared apart	.24
Relationship	**Median Correlation**
Parent and child living together	.42
Parent and child separated by adoption	.31
Genetically unrelated children reared together	.25
Genetically unrelated foster parents and foster child	.15

The correlation between the IQs of identical twins reared together is .86, which is substantially higher than the correlation of fraternal twins reared together (.60). Furthermore, identical twins reared apart in different environments show a high degree of similarity (.72) in their intelligence as compared to the fraternal twins reared together (.60). The finding that identical twins raised in different environments are similar in their intellectual abilities than fraternal twins reared in the same environment suggests a strong genetic influence on intelligence. However, the role of the environment cannot be ruled out, because the correlation drops from .86 to .72 as the environment changes for the identical twins.

Adoption studies. Another line of evidence comes from the studies on adopted children. In one study (Horn, 1983), the correlation between the IQs of children and their biological mothers (whom they had never seen) was .28, which was much higher than a correlation of .15 between their IQs and their adoptive mothers. Other studies have also shown that children's intelligence is more similar to their biological parents than to their adoptive parents (Scarr and Carter-Saltzman, 1983). This pattern of similarity persists into adolescence. Those favoring an environmental position argue that children of poor and under-educated parents, when adopted into family of high socio-economic status, exhibit very large increase in their IQ scores. But the findings showed that when the socioeconomic status of both biological and adoptive parents is equal, the IQs of adopted children do not rise; instead, it is found to be more similar to their biological parents. All these findings lend support to the hereditary influence on intelligence.

Environmental Factors

Heredity alone cannot account for all the individual differences in intelligence. Environment also has a role to play. Environment consists of a wide range of stimulations that the child is subjected to. He lives and grows in his environment. It provides him the necessary input and experiential base for intellectual development. Enrichment or deficiency of the environment would obviously produce differences in his abilities.

The data in Table 8.3 can be used to support environment's role. Though fraternal twins and siblings share the same genetic similarity (the genetic overlap in both cases is 50 percent), the correlation between the IQs of fraternal twins is a bit higher than

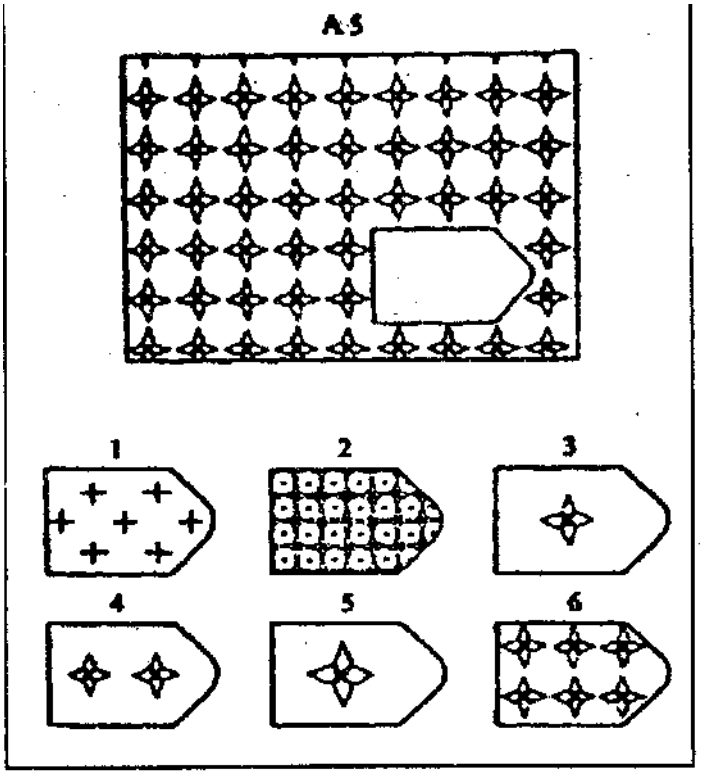


Figure 8.8 : A sample item from the Raven's Progressive Matrices Test

that for ordinary siblings (.60 versus .47). This is because environmental opportunities and experiences are more similar for fraternal twins than for ordinary siblings. When researchers have manipulated child's environment by providing him extra intellectual input, they have observed a remarkable improvement (up to 30 IQ points) in the IQ scores of children. Hence, the role of environment cannot be underestimated. Furthermore, we can change the environment of the child, not his genetic make up. Thus, irrespective of genetic make up, adults should carefully monitor child's environment to help him perform at the optimal efficiency level.

Environment starts showing its actions right from the moment of child's conception. Both the ***prenatal environment*** *(when* the baby/fetus is in mother's womb), and the ***postnatal environment*** (after the child is born) influence the intellectual capabilities of the child.

Prenatal Environment

The prenatal stage is extremely important as a fertilized egg is shaped to the form of a human being during this period. Rapid development takes place in major organs and brain cells. If things go wrong during this period, the effects are nearly irreversible or are very difficult to correct. The major prenatal environmental influences are: (a) mother's nutrition, (b) mother's emotional state, (c) illness of the mother, (d) mother's use of drugs, and (e) birth complications.

An undernourished mother cannot provide adequate nutrition to the growing baby. As a result, the baby is likely to be underweight, and more susceptible to diseases. Lack of nutrition would have an adverse impact on the mental development of the child. Mothers who are anxious and tense are also likely to deliver infants who would be irritable and

show problems in sleeping and eating.

Maternal diseases like rubella, syphilis, AIDS, diabetes, and high blood pressure may produce permanent adverse effects on the baby. The brain cells of the baby would either be damaged or not grow properly. The intellectual development may be arrested. The consequences may be devastating to such an extent that later environmental enrichment programs for the child may be totally ineffective.

Drugs taken by mothers can have tragic effects on the unborn child. Alcohol and nicotine are very dangerous for pregnant mothers. The unborn baby may develop ***fetal alcohol syndrome,*** which is a condition of retarded physical and mental growth. The children of such mothers may show permanent physical and mental impairment. If the baby suffers from birth complications such as lack of oxygen at the time of birth, he may suffer permanent brain damage. He would be born, as a mentally retarded child about whom very little can be done. Due attention to ensuring a healthy prenatal environment is necessary for any child to have a fuller development of his intellectual capabilities.

Postnatal Environment

When we speak of environmental determinants of intelligence, we ordinarily mean the environment the child faces after he is born. Environment consists of a heterogeneous array of stimulations ranging from home experiences to the ecology of the natural habitat. Enriched environment accelerates cognitive development, while impoverished environment produces just the opposite effect.

Home environment

Home is the first learning institution for the child during his early years of development. Needless to mention

that it exercises tremendous influence on child's understanding of the external world, and his conceptions of success and failure. The home provides an identity for the child, builds his self-concept, and prepares him to face the world. The home environment consists of all the mental and behavioral transactions taking place among the family members. The environment can be stressful or supportive for the child. A supportive and warm home environment that encourages exploration, curiosity, and self-reliance leads to higher intellectual competence in children (Kelly & Worell, 1977). In unsupportive home environments, where the family members punish or reject the child, or parents are extremely authoritarian and impose a set of rigid rules and regulations on the child, child's intellectual competence becomes low. A restrictive home atmosphere inhibits early exploration and curiosity in children, and creates high anxiety in the child as a result of which his natural potentials fail to grow to the optimal level. The home environment also influences child's emotions, motivations and beliefs, which are closely linked with intellectual competence.

Parent-Child interaction

Parents are the first teachers for the child. The nature of mental and behavioral transactions between the parents and the child has a critical influence on his intellectual competence. Children's intellectual development is faster when parents provide emotional security, make the family environment more supportive, praise the child's achievement, allow independence, and support the intellectual achievement of children. On the contrary, with stressful family conditions and protective parents encouraging dependence in children, the

Table 8.4: ***Levels of mentally retarded and their characteristics***

Types	***Mild***	***Moderate***	***Severe / Profound***
Range of IQ	***55-69***	***40-54***	***25-39 / below 25***
Self-care	Can feed and dress; can go to toilet independently	Erratic self-care. But can learn toilet training, how to wear dresses has adaptation difficulties.	Unable to take care of himself/herself. Others' help needed to feed and dress, and toilet activities. Failure to understand and express oneself, makes defective sound.
Speech and way of communication	Simple way of communication, knows rudimentary language, can understand and express need.	Talking problem. Language is poor, imperfect communication.	Neither understands nor can express. Makes defective sound.
Learning	Can be taught with special care maximum up to Classes 3 to 6.	With special care learning of maximum up to Class 1 or 2.	Unable to learn.
Social Activities	Mild and docile, can communicate socially with friends and no adjustment problem.	Is friendly; depends for get-together.	Incapable social life. full others. Is a misfit
Vocation	Can learn to do unskilled job, manual labour.	With continuous assistance can do a few simple errand.	Cannot do any work.
Marital condition	Marries and get parenthood wedding at all	Do not go for	Does not marry

child's intellectual development suffers.

Both cultural and sex differences in intellectual abilities result from parental values and expectations for children's achievement. A study by Harold Stevenson revealed that Chinese and Japanese children in the United States show exceptional ability in mathematics, because their parents emphasize achievement orientation in children during their early formative periods of development. Parental expectations for boys and girls differ and are reflected in their achievements. Parents consider mathematics more important for boys than girls. There are many studies to suggest that girls outshine boys in language skills, whereas boys show superior performance in mathematical and spatial tests.

The mother is more important than the father in determining the intellectual level of the home environment, because she spends more time with children. When the mother is the better-educated parent, the intellectual competence of the college going and university students is higher than those having father as the better-educated parent. In a study (Kagan & Moss, 1962), it was shown that high achievement in boys was associated with high maternal reinforcement and encouragement during the first three years of life. It should, however, be kept in mind that although parent-child interaction is an important determinant of achievement in children, other factors such as social class, education and social opportunities set important limits on children's attainment.

Social and environmental deprivation

If the environmental opportunities and stimulations are low, children show poor cognitive performance. The most

frequently noted study was the one conducted by Skeels (1966) involving 25 children reared up in orphanages with very little stimulation. At about 18 months of age, 13 of these children were transferred to another setting, where older retarded women took care of them. After about 2 years, these children gained 28 IQ points. The other 12 children, who stayed back in the unstimulating orphanage, exhibited a 26-point drop in their IQs. The two groups of children also showed different patterns of adjustment and personality characteristics as adults. A follow-up study after 20 years revealed that the 13 children removed from the orphanage had normal intellectual functioning and social adjustment. The intellectual condition of those 12 children who were in the orphanages was very poor. Studies show that longer the children remain in impoverished environment, the more depressed their IQs would be (Asher, 1935). For example, with the introduction of schools, roads and radios in a community in the USA in 1930s, the average IQ of individuals increased by 10 points (Wheeler, 1942).

In another study J. Hunt (1982) investigated the effects of enrichment on 11 children in Iranian orphanage, who were developmentally and emotionally retarded. They were rescued, and put into special enriched environmental program by Hunt

who arranged specially trained caretakers for them. They provided these infants special attention, played verbal games with them, and responded to their difficulties, problems, and wants. The effect was striking in that all displayed large improvement in their language skill, and social interactions with people and events, and began behaving intelligently. The Project Head Start in the year 1965 in USA provided compensatory education on social skill, and special intellectual training. The program was initially effective in raising the IQs of children coming from the disadvantaged homes in slum areas.

Studies conducted by Dash and Das (1984, 1989) reveal that opportunities for education such as schooling significantly influences children's cognitive capacities. In a study in rural India, they have shown that schooled children show superior performance on a variety of intellectual tasks compared to their unschooled age-mates. Schooling improves children's abilities to memorize, reason, and classify using a variety of principles. Many of the intellectual processes either develop slowly or do not develop at all in children, who do not attend schools. School provides an enriched social environment for children, and allows their thought processes to grow free from the concrete physical and social contexts. Similar findings have been obtained in African countries by Scribner and Cole (1979).

Are the adverse effects of impoverished environments reversible? Can children suffering the ill effects of social deprivation increase their IQs, when raised later in stimulating

environmental conditions? Some argue that the adverse effects operate on a relatively permanent basis. But other researchers have shown that early intellectual retardation can be overcome by providing adequate enriched environmental experiences (Kagan, 1972).

Socioeconomic status *(SES)*

Children of the upper socioeconomic strata of the society are exposed to more intellectual stimulation, get better social opportunities, and are nurtured with better nutrition. All these are believed to influence their intellectual development in a positive direction. The index of socioeconomic status (SES) is based on parental education, occupation, and income. The higher the socioeconomic status of the parents, the higher is the average IQ of children. The children of low socioeconomic status score approximately 10 to 15 IQ points below the middle-class and higher-class children (Hall and Kaye, 1980). These differences are present by the first grade and are sustained throughout the school years. Parental occupation is closely related to the IQ level of children (Harrell and Harrell, 1945). The intellective support provided to children at home differs from one SES to another. Moreover, children from varying SES levels bring different attitudes and cognitive styles to the problem-solving situation, which affect their performance (Yando, Seitz and Zigler, 1979).

In Odisha, Jachuck and Mohanty (1974) found that children of high SES performed significantly better than children from low SES on a variety of intellectual tasks. Even older children from the low SES performed poorly than the younger children of high SES. For low SES children, they observed progressive retardation in intellectual skills. Rath, Dash and Dash (1979) reported the adverse effects of social class on intellectual

reasoning. These findings have been supported by a number of studies conducted in the Indian subcontinent.

Race and culture

Many studies have noted racial and cultural differences in performance on standard intelligence tests (Jensen, 1969; Kennedy, 1966). Jensen (1969) observed clear differences in the cognitive competence of whites and blacks. The study conducted by Lesser, Fifer, and Clark (1965) investigated the verbal ability, reasoning, number facility, and space conceptualization of children from ethnic groups: *Jewish, Chinese, Puerto Rican and black.* They found that racial membership significantly influenced both the pattern and level of intellectual competence. In fact, racial differences were more prominent than the SES differences. **Culture refers to a system of beliefs, attitudes, and values that are passed from one generation to the next.**

In Indian context, there are prominent subcultures defined by caste groups, and traditional parental occupations. The socialization practices in these subcultures are different. Studies have been conducted in rural Odisha comparing children of different caste groups. Rath, Dash, and Dash (1979) compared *Brahmin* (high caste), *Harijan* (low caste), and *Adivasi* (tribal children having different ethnicity) children in Odisha on cognitive test performance. The *Harijan* children scored the lowest among the three groups and the *Brahmins* scored the highest. The *Brahmins* have a highly verbal articulate culture compared to the other groups. Other studies conducted in this region (Das and Singha, 1974; Jachuck and Mohanty, 1974) have reported significant differences in the cognitive level of children differing by caste, culture, and SES.

It may be unfair to compare the performance level of

children from different cultures, as the skills required for successful adaptation in different cultures vary a great deal. The skills tapped by the standard cognitive tests are those that are demanded in more technologically advanced cultures and higher SES groups. As a result, the tests are biased in favor of their competence, and it is no wonder that we find inferior performance of lower caste children on these tests. The appropriateness of the test items has to be considered in any investigation comparing the performance of children from various cultural and social groups.

Sex differences

The overall IQ scores of boys and girls are very similar. There is some evidence that sex differences exist for particular kinds of cognitive abilities. Review of a number of studies has shown that females are superior in language skills, verbal fluency, and reading, while males are superior in mathematical reasoning and spatial abilities (Oetzel, 1966). While neither sex is superior, the two sexes show different patterns of intellectual abilities. These findings have been supported by several researchers. Some argue that intellectual differences between sexes reflect different child-rearing practices and socio-cultural training. The parents and the society train boys and girls differently in terms of what to expect from them. It is known that intelligence is related to personality characteristics. Boys are socialized in a way so as to promote self-reliance and competence, which are positively correlated with intelligence. On the other hand, the traits are discouraged in girls so much so that high intelligence is often considered a masculine quality.

The sex differences also partly result from the fact that many items in standardized intelligence tests are biased in favor of the male population. Hence sex differences are the

products of the test itself. Researchers differ in their convictions regarding sex differences. A group of researchers argue that sex differences are reflections of constitutional and genetic differences between males and females. The most reasonable conclusion is that the differential abilities are the products of some combination of genetic and environmental factors.

Personality dispositions

There is some evidence to suggest that changes in IQ are related to child's general pattern of adjustment and personality. In a longitudinal study (Sontag, Baker, and Nelson, 1958), 140 children were tested at intervals between 2 and 12 years of age. The 35 children, whose IQs increased remarkably, were found to have personality traits of assertiveness, independence, self-initiation, and competitiveness. On the contrary, the 35 children who showed a declining trend were found to lack these traits. If the personality traits were not socially acceptable, the advantages would be minimized. For example, children who show temper tantrums have been found to display drops in their IQs (Peskin, 1964). Good intellectual functioning requires the ability to harness one's emotions and utilize them in a constructive manner.

Physiological conditions

The physiological conditions such as nutrition, health, drugs, disease, and physical injury affect the cognitive competence of the child. Healthy body gives a healthy mind. The mental development is associated with biochemical processes and hormones within the body. The biological processes within the body provide a necessary but not sufficient condition for intellectual development. Poor health and susceptibility to diseases would retard the growth of brain

cells, and consequently the intellectual skills. Physical injury to the brain during early childhood years is likely to result in minimal brain damage thus seriously restricting the development of intellectual faculty. Similarly, intoxicating drugs and alcohol consumption would adversely affect the biological processes and the development of brain cells. Thus, the internal physiological conditions are critical for the expression of intelligent behavior.

Limitations of I.Q. Tests

Psychological tests, especially intelligence tests are widely used tools. The effectiveness of a tool depends on the skill, scientific knowledge, and competence of its users. A long stick can be used to help a disabled person walk across the street or for assault on fellowmen. Similarly, psychological tests can either be used or misused. Ability tests can help a teacher divide children into groups sharing almost equal level of ability, or can be used to label some children as dull and incompetent. ***Poor performance on an intelligence test may attach a stigma to the child, inviting teacher and parental discrimination***. Discriminatory practices initiated on the basis of intelligence test performance are unethical and should be abandoned. On the other hand, tests should be used to know the strengths and weaknesses of the child, and to draw up his cognitive profile with an intention to help him through appropriate remedial programs.

The IQ tests tap only a part of human's overall competence. There are many more skills to be assessed, such as competence in social situations, creativity, and close positive relationship. Intelligence or high IQ is not necessarily the ultimate human value. It only predicts school-related success, not the life success. Therefore, it is impossible to

separate intelligence from scholastic achievement. As a schoolboy, Robert Sternberg, who is known for his triarchic theory of intelligence, did very poorly on intelligence tests. Sternberg, now a Professor of Psychology at the Yale University believes that intelligence is more than what IQ tests measure (Sternberg, 1985, 1987). Sternberg's three-part theory of intelligence suggests that the traditional intelligence tests have three major limitations: (a) *the IQ tests fail to measure creative insight,* (b) *they ignore the practical side of intelligence, and* (c) *since IQ tests are limited to a fixed time schedule, they wrongly equate intelligence with speed.*

The intelligence tests are biased in favor of the middle-class and higher-class populations. They underestimate the intellectual potentialities of children belonging to minority groups and other cultures. That is why, African-Americans tend to score about 15 points lower on IQ tests than the white Americans (Brody & Brody, 1976). Language and the nature of the test items create problems in estimating intelligence. The test-developers have failed to separate what children have already learnt from what their abilities are to acquire new knowledge (Sternberg, 1985).

Miller-Jones (1989) pointed out ***that answers to some intelligence test items seems to have been arbitrarily decided***. For example, a 4-6 year old child taking 1973 edition of the Stanford-Binet Intelligence scale was asked, "What a house is made of?" His answer was "A house is built of walls." But according to the test developer, the correct answer was "The house is made of wood, bricks and stone". The child's answer was relatively correct, but he failed to earn a score on the test. When scores obtained in IQ tests are thought to give a fixed

and unchanging indicator of an individual's intelligence, it brings misjudgment. Similar difficulties occur when an intelligence test is used as the sole indicator of whether a child is placed in a special education program or in a class meant for gifted children.

Psychologists have pointed out that intelligence tests are less predictive of creative abilities that lead to scientific discoveries and inventions. ***It provides less meaningful information for the actual planning of educational instruction***. At best, the IQ tests provide an AQ or Academic Quotient predictive of academic achievement (Kagan, Havemann, and Ernest, 1976).

In spite of its limitations, IQ tests provide important information about the individuals, when used judiciously by trained and expert investigators. The alternatives to intelligence testing are not yet promising. The test should be done repeatedly and its results should be used along with information collected from other sources.

Culture-free and Culture-fair Tests

Most intelligence tests, particularly those having language elements, have a cultural component in them. Some tests are language-free tests. The test administrator uses gestures, demonstrations, or signs to elicit subjects' responses. For example, items requiring subjects to trace mazes, find the missing portion in the picture or pattern, choose the right shapes for the right holes etc. have less language elements. Anastasi (1988) provides an example: a group of Asian immigrant children in Israel were asked to name the missing part of a face. The face was having no mouth. The Asian children instead told that the face was without a body. They were not accustomed to consider a picture of a face without a

mouth. **Therefore it is almost an impossibility to design a culture-free test devoid of all culture-related content**. Instead, psychologists have tried to develop tests that can be considered *culture-fair, or culture-reduced,* where the influence of cultural elements is reduced.

Culture-fair tests were developed to reduce cultural bias. There are two types of culture-fair tests. The first type contains the items that are assumed to be known to individuals from all socio-economic and ethnic backgrounds. For instance, a child might be asked, “How a bird and a dog are different?” Here the experimenter assumes that all children have the knowledge of dogs and birds. The second kind of *culture-fair tests* do not have any verbal items. A sample of Raven’s Progressive Matrices (RPM) test is an example. It is regarded as a culture-fair test of intelligence. But it is noticed that educated individuals obtain higher scores on the RPM than the less educated people.

Another test, which is considered to be culture-fair, is **SOMPA,** i.e., *System of Multicultural Pluralistic Assessment.* (Mercer and Lewis, 1978). It is meant for 5 to 11 year-old children belonging to low-income families. It covers information on four different areas of child’s environment, such as (a) verbal and non-verbal intelligence in the traditional mould of WISC-R, (b) parent’s interview about social and economic background, (c) evaluation of an adaptive behavior-inventory on social adjustment to school to be completed by parents, and (d) physical health examined by medical tests.

The **Kaufman Assessment Battery for Children (K-ABC)** developed by Kaufman (1983) is another culture-fair test meant for children from two to twelve and half years of age. This test has taken into account representative samples of minority, and handicapped children. It focuses less on language

than the Stanford-Binet, and its achievement portion includes problems on arithmetic and reading. But like other culture-fair tests, it has its limitations also.

Constructing a truly culture-fair intelligence test has been difficult. There are a number of reasons. For example, people of Papua New Guinea have the ability to remember names of about 10,000 to 20,000 clans. On the other hand, people of Carolina Islands can sail in the sea by the stars without any instruments of navigation. Thus, a culture-fair test is difficult to construct taking in to account all possible cultural and ethnic variations across the world.

Intelligence Testing in India

Das (1998) in his book "*Working Mind*" has reviewed the short history of intelligence testing in India. S. M. Mohsin is one of the pioneers of intelligence testing in India. He constructed an intelligence test in Hindi in the 1930s. In 1966, Long and Mehta prepared a mental measurement handbook listing out 103 tests of intelligence developed in various Indian languages. The handbook was critical of most of the Indian tests because they did not confirm to the standard procedures of test preparation. The Bhatia test is more popular in India. Kurian (1986) and Kurian and Sharma (1988) have laid down theoretical views on intelligence in terms of cognitive processes. Their theoretical review suggests that intellectual development may show considerable flexibility and modifiability. Pershad (1987) has mentioned about the relationship between general intelligence and school achievement. He used WAIS-R, and remarked that the arithmetic subtest should not be timed for the Indian population, particularly for the aged. He emphasized that power, instead of speed of mental operations, should be the major criterion for judging intelligent behavior.

Intellectually Gifted Children

Giftedness is characterized by an extraordinary ability not evident in the majority of people. It is a term used to refer to an individual with special talents. Gifted are those individuals who are well above average intelligence. ***The traditional definition consists of children having an IQ score of 130 or higher*** (Horowitz & O'Biriess, 1986). The definition of "giftedness" includes superior general intellect, and superiority in a particular area such as mathematics, music, chess, painting, writing, creating etc. Experts view the gifted as occupying the top end of the continuum of intelligence (Humphreys, Zigler, and Farber, 1985).

Sternberg and Davidson (1984) pointed out that gifted children process information efficiently especially in tasks which need insight. Gardener (1983) believed that people can be gifted in one or more of the eight separate intelligences, such as music, dance, intrapersonal, interpersonal, linguistic, logical-mathematical, and spatial. Studies revealed that the gifted are found to be more mature and have fewer emotional problems than others (Janos, and Robinson, 1985). In another investigation, researchers asked adult individuals with exceptional talents about the cause of their giftedness (Bloom, 1983). The individuals who excelled in Olympics, concert music, research on mathematics and neurology answered that their exceptional accomplishments were nourished by special environmental support, excellent teaching by noted teachers, motivational encouragement, and extensive support and encouragement from their parents.

Mentally Retarded Children

Mental retardation lies at the bottom extreme of intelligence. It is currently termed as *"**mentally challenged**"*.

Mental retardation refers to a sub-average level of intelligence which is manifested in about two or more areas of performance such as self-care, home living, social skills, learning safety and health, self-direction and work. About one to three percent of the population is found to be mentally retarded. The current conceptualization of mental retardation is *"**the intelligence test performance two or more standard deviations below the mean having limitations in adaptive functioning such as failure to cope with the common tasks of daily living appropriate to one's age and situation**".* People categorized as mentally retarded can range from those who can be taught to work and do simple errands with little special attention to those who cannot dress themselves, and cannot be trained. The later category must receive institutional treatment for their lifetime.

Mentally retarded with minor deficits are classified as ***mild retarded***. Their IQ scores range from 55 to 69 and they constitute 80 percent of total retarded population. They can take simple jobs involving gross manual labor. Other levels of retardation are termed as ***moderately retarded*** (IQs from 40 to 54), ***severely retarded*** (IQs from 25 to 39), and ***profoundly retarded*** (IQs below 25).

Below is given the table of classification of mental retardation along with their abilities of adaptation which includes capacity for self-care, speech and communication, learning, social interaction, vocational abilities and possibilities of marriage.

New Directions in Intelligence

Emotional Intelligence

In the nineties (1990), the concept of ***emotional intelligence*** came to the fore by **Salovey and Mayer**. According to Salovey, our current mood influences our self-consciousness. They found that persons experiencing either pleasure or sorrow are prone to be inward looking than persons in a neutral mood. The person's mood induces him/her to be desirous of understanding his/her own emotions and feelings.

People who are in a good mood report fewer symptoms and consider themselves as psychologically healthier than people who are in a bad mood. (Salovey and Birnbaun, 1989). The emotional arousal and the cognitive states go together. The researchers have attempted to study emotion with accompanying cognitive states in guiding one's social intelligence expressed in thinking and attention. The following characteristics of emotional intelligence have been identified by Salovey and Birnbaun: (a) reinforcement of one's cognitive activities by his emotional condition, (b) arousal, attention,

perception, and emotional expression, (c) self analysis of emotional input and its utilization in cognitive action, and (d) control of one's emotion intellectually.

Practical Intelligence

A high IQ score does not always guarantee success in life if it is without any practical intelligence. Mentions have been made about Sternberg's contextual intelligence, which consists of practical knowledge applied to solving day-to-day life problems. For example, practical intelligence is involved in getting along with people, in replacing a fuse wire, repairing a constantly flowing tap and so on. Sternberg calls such practical knowledge *"**tacit knowledge**"*. Tacit knowledge includes all the useful and need-based information about getting along in the real world that are not taught in schools or colleges.

Sternberg cites the example of Celia, who was a graduate student. Celia was street-smart. She knew how to manipulate the environment. Her score in traditional tests were not very high, but she could succeed in almost every social context. The use of practical intelligence is seen in the fields of politics, business, social communication, and science. Sternberg has devised tests, which are designed to overcome the limitations of traditional IQ tests. Successful persons whose IQ scores are rather low perform competently on these tests.

Spiritual Intelligence

Spiritual Intelligence is a recent concept in the area of intelligence. After Dandh Zoharand lan Marshall's book "*Spiritual Intelligence*" got published in 2000, the concept of spiritual intelligence came to the fore. It is also called spiritual quotient. It is related to higher values, and meaningful existence in larger holistic context. Possibly, Budha, Christ, Shankaracharya, Vivekandnda, Gandhi, Sivananda, Sri Aurobindo, Mother Theresa, The Mother, Raman Maharshi, Acharya Rajanish, Maharshi Mahesh Jogi, Swamai Satyananda, Sri Sai Baba, Amritanadmayee Maa and Sri Asharam Bapu have high spiritual intelligence. Meditation helps in achieving spiritual intelligence.

Zohar and Marshall have identified the following characteristics with people having spiritual intelligence. **Spiritual intelligence is associated with a greater degree of self-awareness.** It enables one to bear with tenacity and overcome suffering and pain. Spiritual intelligence expands one's ever-growing vision and sense of value. Persons having high **spiritual quotient (SQ)** often encourage and energize others and become a source of constant inspiration. They always delve deep into the matters and actions in order to find the real reason behind the events. They develop the capacity to regulate their own consciousness by overcoming their own stress and physical ailments such as tension, high blood pressure etc. without medical assistance.

Key Terms

Abstract thinking
Intelligence test
Intelligence
Mental age
Intelligence Quotient
Chronological age
Reliability
Standardization
Validity
Stanford-Binet Test
Information-processing approach
Psychometric approach
'g' factor
Fluid intelligence
's' factor
Crystallized intelligence
Associative learning
Primary Mental Abilities
Cognitive learning
Multiple intelligences
Structure of Intellect model
Linguistic intelligence
Spatial intelligence
Logical-mathematical intelligence
Musical intelligence
Interpersonal intelligence
Bodily-kinesthetic intelligence
Intrapersonal intelligence
Componential intelligence
Triarchic theory
Experiential intelligence
Practical intelligence
Contextual intelligence
Mental self-government
Planning
PASS model
Attention
Successive processing
Simultaneous processing
Cognitive Assessment System
Object permanence
Schemes
Adaptation
Accommodation
Assimilation
Equilibration
Make-believe play
Organization
Egocentric thinking
Conservation
Animistic thinking
Irreversibility
Decentration
Centration
Seriation
Hypothetico-deductive reasoning
Prepositional thinking
Class inclusion
Tabula rasa
Nature-nurture debate
Genotype
Prenatal development
Phenotype
Postnatal development
Culture-fair tests
Raven's Progressive Matrices
Gifted children
Mentally retarded children
Emotional intelligence
Spiritual intelligence

SUMMARY

1. *Intelligence is a complex capacity to profit from experiences and training, to adapt successfully to new situations, and to think abstractly using symbols and concepts*. The operational definition of intelligence is that intelligence is what intelligence tests test.

2. Intelligence is not directly observable; it is assessed through tests. In order to be useful, a test must be *reliable, valid,* and *standardized*.

3. Alfred Binet began objective intelligence testing in France in the 1900s. He proposed the concept of *Mental Age.* Stern proposed the concept of IQ. One's intelligence is indicated by IQ, which is determined by child's mental age divided by the chronological age multiplied by 100.

4. The important tests of intelligence are *Stanford-Binet*, and the *Wechsler Scales* (WISC-R, WAIS-R, WPPSI). IQ is normally distributed in the population with a mean of 100.

5. Three major approaches to the study of intelligence are: (a) *psychometric approach,* (b) *information-processing approach*, and (c) *cognitive-developmental approach.*

6. The psychometric approach studies intelligence as an ability measured by standard tests. The theories of Spearman, Cattell, Thurstone, Jensen, Guildford, and Gardner exemplify psychometric approach to the study of intelligence. Spearman viewed intelligence as consisting of a general factor or *'g'* factor, and several specific factors or 's' factors. Thurstone proposed that human intelligence is an integration of seven *primary mental abilities* (PMA). Cattell broke down intelligence into two relatively independent components: *fluid intelligence* (reasoning) and *crystallized intelligence* (knowledge).

7. Jensen thought of intelligence as consisting of two levels of abilities: *Level I ability* (associative learning), and *Level II ability* (cognitive learning). The *Structure of Intellect model* by Guilford holds the view that intelligence has three dimensions: *content* (type of information), *product* (form of representation), and *operation*

(type of mental activity). According to Guilford, there are 150 separate activities involved in intelligence.

8. Gardner developed a theory of multiple intelligences. On the basis of his observation, he concluded that there are eight types of intelligence such *as linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, interpersonal, intrapersonal, and natural.*

9. The information processing approach focuses on the processes underlying intelligent behavior. Sternberg's *triarchic theory* postulates that intelligence has three major components: *componential intelligence* (analysis of information), *experiential intelligence* (using previous knowledge), and *contextual intelligence* (adapting to practical life situation).

10. The *PASS model*, another information-processing approach developed by Das, understands intelligence in terms of *planning, attention,* and *simultaneous* and *successive processes.* The intellectual activity begins with attention, and passes through stages of coding to the process of planning. Planning defines the essence of intelligence. Das's theory has resulted in the *Cognitive Assessment System*, now used for measuring the PASS processes.

11. Piaget's cognitive-developmental approach focuses more on the *qualitative* rather than *quantitative* aspects of development, and specifies that children's thought processes change with age. Children's *cognitive structure* (scheme) changes with age through processes of *adaptation* and *organization.* Adaptation involves two complementary processes such as *assimilation* and *accommodation.*

12. According to Piaget, children proceed through four successive stages of development to think like adults. In the *sensorimotor stage,* infants acquire the basic concepts of cause and effect. In the *preoperational stage,* children engage in symbolic thinking, but their thought processes are limited by egocentric and animistic thinking. In the stage of *concrete operations,* children are capable of logical thought and show understanding of conservation and reversibility. But their logical thinking is confined only to concrete physical reality. Finally, in the *formal*

operational stage, older children can show formal logical thinking, manipulate abstract concepts, and engage in prepositional thinking.

13. Piaget's theory has been challenged on several grounds. Piaget has seriously underestimated the intellectual competence of infants and young children. Cognitive development does not take place in a stage-like manner as Piaget had postulated. He has overlooked not only other important dimensions of development, but also the significant influence of language and social interaction on cognitive development.

14. The wide variety of individual differences in intelligence is brought about by *hereditary* and *environmental* factors. The genetic heritage is called *genotype,* and its expression in behavioral terms is called *phenotype.*

15. Those favoring a hereditary position draw their evidence from studies of twins and adopted children. Jensen believes that genetic influence accounts for 80 percent of variations in intelligence leaving only 20 percent to be manipulated by the environment.

16. Both prenatal and postnatal environmental variations contribute to intellectual development. The major prenatal influences are *mother's nutrition, emotional state, illness,* and *use of drugs,* and *birth complications.*

17. The postnatal environment includes factors related to *home environment, parent-child interaction, social and environmental deprivation, SES, race and culture, sex, personality dispositions, and physiological conditions* of the child.

18. The IQ testing should be done by trained experts with the help of established tests. In spite of their usefulness, IQ tests have several limitations. They provide an index of intellectual product, not the underlying processes. Unless used properly, IQ tests may encourage labeling and discrimination. The stigma attached to a low-IQ child may lower his self-concept, inhibiting further developmental processes. IQ tests at best predict school-related success but fail to measure creative insight and life success. They produce a fixed and static measure of behavior.