



PSYCHOLOGICAL RESEARCH

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Indira Gandhi National Open University

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Course Contents

	Pages
Course Introduction	4
<hr/>	
BLOCK 1 : SCIENTIFIC RESEARCH AND EMPIRICAL METHODS IN BEHAVIOURAL RESEARCH	5
<hr/>	
Unit 1 Definition and Goals of Psychological Research	7
Unit 2 Problem and Hypothesis	21
Unit 3 Constructs and Variables	35
<hr/>	
BLOCK 2 : QUANTITATIVE AND QUALITATIVE RESEARCH METHODS	47
<hr/>	
Unit 4 Quantitative Research Method	49
Unit 5 Qualitative Research Method	62
<hr/>	
BLOCK 3 : POPULATION AND SAMPLING	77
<hr/>	
Unit 6 Population and Sampling	79
Unit 7 Sampling Techniques	91
<hr/>	
BLOCK 4 : METHODS OF DATA COLLECTION	103
<hr/>	
Unit 8 Methods of Data Collection: Quantitative and Qualitative	105
Unit 9 Introduction to Test Construction	117
Unit 10 Preparation of Research Proposal and Research Report Writing	128
<hr/>	

COURSE INTRODUCTION

The Course of Psychological Research is one of the courses of Second Semester of BA (Honours) in Psychology. The attempt of this course is to explain to you the meaning, concept, processes, theories and relevance of researches in the field of Psychology. It also explains the various methods of collecting data for analysis and interpretation of human behaviours.

The first block of this course is – **Scientific Research and Empirical Methods in Behavioural Research** which deals with definition, nature and goals of psychological research. It further highlights the concept and types of problems as well as hypotheses. The block also discusses about the different types of constructs and variables.

The second block of this course is – **Quantitative and Qualitative Research Methods** which deal with the different types of research methods (predominantly the quantitative and the qualitative research methods). You will come to know about the various aspects of different research methods and also about when and how to select what kind of method, specifically for a research in this block.

The third block of this course is – **Population and Sampling** which deals with the concepts and processes of population and sample. It also explains the various process and techniques of sampling.

The fourth block of this course is – **Methods of Data Collection** which is the last block of this course. In this block, the first unit will explain about the various ways of collecting data in quantitative as well as qualitative research methods. The following units will introduce the method of constructing test and ways of preparing a research proposal as well as research report.

UNIVERSITY

BLOCK 1
SCIENTIFIC RESEARCH AND EMPIRICAL
METHODS IN BEHAVIOURAL RESEARCH

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BLOCK 1 SCIENTIFIC RESEARCH AND EMPIRICAL METHODS IN BEHAVIOURAL RESEARCH

This block comprises of three units. *The first unit* deals with definition, nature and goals of psychological research. It reflects upon the ethical issues which need to be taken care of while conducting a research. It also explains the concept of inductive and deductive methods of proposing a research.

The *second unit* discusses about the different types of problems and hypotheses. It also explains the required criteria and characteristics of problem. Further, it elaborates upon the concept and types of hypotheses. It also explains the various errors that may occur in the process of hypothesis testing.

The *third unit* describes the concept of constructs and variables. It further mentions about the different types of variables.



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UNIT 1 DEFINITION AND GOALS OF PSYCHOLOGICAL RESEARCH*

Structure

- 1.0 Objectives
- 1.1 Introduction
- 1.2 Definition, Goals, Principles of Psychological Research
 - 1.2.1 Goals of Psychological Research
 - 1.2.2 Characteristics of Psychological Research
 - 1.2.2.1 Steps in Research Process
- 1.3 Ethical Issues in Psychological Research
- 1.4 Deductive and Inductive Methods
- 1.5 Let Us Sum Up
- 1.6 Glossary
- 1.7 Unit End Questions
- 1.8 Answers to Self Assessment Questions
- 1.9 References

1.0 OBJECTIVES

After reading this unit, you will be able to:

- Define psychological research and discuss its goals and principles;
- Describe the ethical issues in psychological research;
- Explain deductive and inductive methods;
- Discuss the statement of problem and formulation of hypotheses;
- Describe descriptive research, hypothesis testing, one tailed, two tailed tests and errors in hypothesis testing; and
- Elucidate constructs, variables and operational definition of variables.

1.1 INTRODUCTION

There are a number of problems and issues in the society that can be directly or indirectly related to human behaviour, be it aggressive behaviour in terms of road rage, bullying or even cyberbullying, overindulgence in social networking, lack of effective communication and interpersonal relationship, suicidal ideation and so on. Such problems and issues need to be researched further in order to develop better understanding about them including factors leading to those problems and issues and to develop suitable intervention strategies to deal with them effectively.

Research is an important aspect of any subject area. A research is carried out in order to further broaden the scope and knowledge of the subject. In the present course, we will mainly focus on psychological research. The very first unit of this course will discuss about behavioural research will lay foundation to the subsequent units in which we will further discuss about various aspects of psychological research.

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In the very first unit of this course, we will define psychological research and discuss its goals and principles. Further, the ethical issues in psychological research will also be described. The deductive and inductive methods will then be dealt with, in detail. Besides, descriptive research, ethical issues in research, inductive and deductive methods of research, will also be explained. Lastly, in this unit we will also discuss constructs, variables and operational definition of variables.

1.2 DEFINITION, GOALS, PRINCIPLES OF PSYCHOLOGICAL RESEARCH

What comes to your mind when we say the term ‘research’. In the course BPCC 104: Statistical methods for Psychological Research-I, you must have come across the concept of research and related concepts. In the present unit, we will revisit the concept of research and will also discuss its goals and principles.

Before we go on to discuss various aspects of psychological research, it is important that we define research.

Research in simple terms can be explained as adding information to the existing fund of knowledge. The term research is derived from the French word ‘recherche’ which means to travel through or survey. Research can be described as an enquiry that is not only critical but complex as well. Research can also be described as an analysis and recording of controlled observation that is objective and systematic in nature. And this analysis and recording can result in generalisations, and also development of theories.

Some of the definition of research are given as follows:

Kerlinger (1995, page 10) defines scientific research as “a systematic, controlled, empirical and critical investigation of natural phenomenon guided by theory and hypotheses about the presumed relations among such phenomena”.

Research, in simple terms, can be defined as “a systematic investigation to find answers to a problem” (Burns, 2000).

Best and Kahn (1999) have defined research as “systematic and objective analysis and recording of controlled observation that may lead to the development of generalisation, principles or theories, resulting in prediction and possibly ultimate control of events”.

Some of the key points in the above given definitions of research are as follows:

- 1) **It is systematic in nature:** Psychological research is systematic as well as scientific in nature and follows a pattern of scientific process. It is important that research is carried out in systematic and scientific manner so as to ensure that the outcome of the research can be relied on and the researcher(s) have confidence in the outcome of the research.
- 2) **It is objective:** Objectivity is a significant characteristics of any research and care needs to be taken that no subjectivity creeps in, so that the internal validity of the research is maintained. Thus, the subjective beliefs of the researcher should not interfere in the research process or the outcome, rather the focus needs to be given to reality which is objective in nature.
- 3) **It seeks answers to certain problem:** Psychological research is carried out with an objective that needs to be clear and specific. There could be certain problems and issues that the researcher(s) may come across and may seek answers to.

- 4.) **With the help of research, generalisations can be made and theory and principles can also be developed:** Based on the research findings generalisations can be made. Further, based on the findings, theory and principles can also be developed.

1.2.1 Goals of Psychological Research

The main goal of psychological research is to comprehend human and animal behaviour. And the more the researchers are able to decipher human behaviour, the more it will benefit the society in general and individuals in specific. For example, developing a better understanding about aggressive behaviour amongst youth, can help develop suitable intervention. Let us now look at certain specific goals of psychological research, that are discussed as follows:

- 1) **Description:** This is one of the prominent goals of research that involves description of behaviour in a systematic manner. Description involves information about what exactly is happening a situation, where and with whom is it happening. In description, a certain phenomenon/ event or issue is identified and reported. For example, safety behaviour of employees can be observed and described.
- 2) **Explanation:** This mainly involves explaining why a certain behaviour/ phenomenon is taking place. For example, if employees in an organisation are not using safety devices, then explanation can be generated as to why they are doing so.
- 3) **Prediction:** Yet another goal of psychological research is prediction. That is, based on even previous research, certain predictions are made about the behaviour under study. In prediction, the factors that may be correlated or related with certain behaviour or phenomenon are identified. For example, predictions are made with regard to why employees are not using safety devices based on previous research and information.
- 4) **Control:** Control is also an objective of research which involves bringing about a change in the behaviour with the help of suitable intervention strategies. For example, suitable intervention strategies can be developed to promote use of safety devices amongst the employees.
- 5) **Application:** Inferences can be drawn based on the results obtained by carrying out the research and these can then be applied for problem solving as well as decision making.

1.2.2 Characteristics of Psychological Research

A good psychological research is systematic and scientific in nature. It also needs to be valid as well as verifiable and replicable. A good psychological research needs to be logical as well and it should be possible to make generalisations or develop theories and principles based on the research outcomes. Thus, a research could be carried to systematically and scientifically test certain hypothesis(es) and theories and this is done by controlling the influence of extraneous or confounding variables.

An adequate psychological research needs to have the following characteristics:

- **The purpose and objective of the research needs to be stated in clear and specific manner:** It is important that the purpose and the objective of the research are stated clearly and specifically as the choice of research design and other aspects of the research will depend on the objective of the research.

- **In order to ensure objectivity, the research procedure needs to be planned adequately:** Any research needs to be adequately planned. Even while building a house, a plan is to be drawn that is followed. In a similar manner while carrying out research as well, a plan is to be drawn. That is the reason why often a research proposal or synopsis is created that provides details about the problem, objectives, hypothesis(es), sample, research design, tools for data collection and data analysis.
- **Research design needs to be appropriately selected based on the purpose and objective of the research:** Research design provides a structure to the research and it is important to adequately select a research design based on the statement of problem stated in the research. Suitable selection of research designs can ensure high internal validity.
- **Appropriate tools needs to be used for data analysis:** Data analysis is an equally important aspect of a psychological research and based on the purpose and objective of the research suitable techniques of data analysis need to be employed.

1.2.2.1 Steps in Research Process

There are various steps that are involved in a research process, these are described as follows:

Step 1: Research idea needs to be developed: The very first step in research process is developing the research idea. Thus, an issue or problem needs to be identified that can be subjected to research. One can obtain research ideas by observing one's surrounding or even through interaction with certain experts in the subject area. Though, it is important to go through existing review or studies that have been carried out on the issue or problem that the researcher is interested in studying. And this can be done by referring to articles, research papers, books etc on the subject area. Reviewing literature is important in order to avoid any duplication of the research. It is possible that the issue or problem has been well researched and need not be subjected to further investigation. Though based on the review obtained, further research on the same problem or issue can be carried out that will provide insight in to new dimension(s) regarding the problem or issue. Review of literature also helps in selecting suitable design for one's research and will also provide latest information and developments in the area that one is interested in researching. For example, a researcher wants to study care givers of chronically ill patients, he/ she may first go through the review of literature, identify relevant variables and then may come up with a topic, for instance, "Resilience, Psychological Wellbeing, and Adjustment amongst Caregivers of Chronically Ill Patients".

Step 2: Stating the problem and formulating the hypothesis(es): Once the research idea is identified and the researcher has fair idea about the existing review of literature, a statement of problem can be stated and hypotheses can be formulated. Based on the example that was discussed under step 1, the statement of problem could be "To study the Resilience, Psychological Wellbeing and Adjustment amongst Caregivers of Chronically Ill Patients". There could also be certain specific objectives based on the problem, for instance, "To study relationship between resilience and psychological wellbeing of caregivers of chronically ill patients" or "To study the effect of gender on resilience, psychological wellbeing and adjustment of caregivers of chronically ill patients". Based on the statement of problem, hypothesis can also be formulated. These are

tentative statements that are tested with the help of scientific research. For instance, “There will be significant correlation between resilience and psychological wellbeing of caregivers of chronically ill patients”. Hypothesis could also be framed as “Gender difference will exist with regard to resilience of the caregivers of chronically ill patients”.

Step 3: Appropriate Research design needs to be selected: Based on the problem, the researcher needs to select suitable research design. Research design denotes structure of the research. As stated by Kerlinger (1995, page 280) “Research designs are invented to enable researcher to answer research questions as validly, objectively, accurately and economically as possible”. Research designs not only help in obtaining answers to the research problem but also helps in variance control, that includes maximisation of true variance (variance in independent variable leads to variance in dependent variable) and minimisation of error variance (variance in dependent variable that can be attributed to extraneous variable). There are various types of research design, for example, factorial design, small n designs and so on that can be selected based on the requirement of the research and research problem. In the example that we discussed under step 1 and 2, the research design could be correlational design where an attempt is made to study the relationship between resilience, psychological wellbeing and adjustment amongst caregivers of chronically ill Patients. Further, research could be qualitative or quantitative in nature or may be a mixed approach.

Step 4: Data Collection: Once the statement of problem is stated, hypothesis(es) formulated and research design is finalised, one can then move to the next step that is data collection. In this step, though, one has to first of all identify the population and sample. In the case of our example, the population that is being studied is ‘caregivers of chronically ill patients’. The researcher will have to select a sample size and also a sampling technique to carry out the study. Sampling techniques have been briefly mentioned in table 1.1.

Table 1.1: Sampling Techniques

Sampling technique	Description	Example
Probability Sampling	Every individual who is part of the population has an equal chance of being included in the sample. Sample is assumed to be representative of the population	If the population for a research is students in class 9 th of a school, each and every student has an equal chance of being selected for the research.
Simple random sampling	Participants are randomly selected from the population using methods like lottery method.	Names or roll numbers of all the students are written on the chits that are then put in a bowl and then, say ten chits are taken out (sample size for research is 10) and these students form the sample of the study.
Systematic random sampling	A list of individuals in the population is created in a random order and sample is selected based on a random integer, keeping in mind the sampling fraction and the interval size.	For 50 students in a class (N), the researcher may want to take a sample of 10 (n) for the research. Sampling fraction (f) = n/ N= 10/50 = 0.2. Interval size (i) = N/n = 50/10= 5. The random integer from 1 to 5 could be 4. Thus, from the 4th student in the list the researcher will select every 5th student (4, 9, 14, 19 and so on) till he/ she gets the sample size of 10.

Stratified random sampling	Population is divided in to homogeneous group and then the sample is selected randomly.	Population is divided in to males and females and for each groups sample is randomly selected.
Cluster sampling	Population is divided in to clusters that are then randomly selected and then all the individuals falling in the selected clusters are taken.	In a school, from all the classes, five classes are randomly selected and then all the students of these classes form the sample for the research.
Multi Stage random sampling	As the name suggests, this is carried out at multiple levels.	Using cluster sampling the classes in a school are selected and then simple random sampling/ stratified random sampling, sample is selected from these classes.
Non-probability Sampling	There is no random selection of the participants to be included in the sample. Hence, the sample may not be representative of the population.	If a study is to be carried out on female victims of domestic violence, then randomisation is not used and based on the availability and consent of the persons, they are included in the sample.
Convenient sampling	Whether an individual will be included in the sample will depend on his/ her availability.	The researcher will approach the female victims of violence and based on their availability, they will be included in the sample.
Voluntary sampling	Participants willing to be part of the research are included in the sample.	Female victims of violence who are willing to participate in the research are included in the sample.
Judgement sampling	Sample selection is carried out by individual who have good idea about the sample.	A teacher may identify students who will participate in the research.
Quota sampling	Based on a fixed quota, the sample is selected.	Quota could be 100 junior managers and 50 senior managers in a company that will form the sample of the study.
Snowball sampling	A researcher approaches an individual with characteristics as per the requirement of the sample and then this individual is asked to further refer individuals with similar characteristics.	A researcher may contact parents having gifted children and then they may be asked to refer other parents having gifted children.

Further, tools for data collection also need to be finalised, which can be done through interview, observation to psychological tests. In the case of the example, discussed by us, a researcher may decide to use standardised psychological tests to measure resilience, psychological wellbeing and adjustment. Once the sample and tools for data collection are finalised, the researcher can then carry out data collection.

Step 5: Data analysis: The data thus obtained in step 4 will be subjected to data analysis. Data analysis also can be qualitative or quantitative. If the researcher employed interview or observation as method of data collection, then the data will be qualitatively analysed. If he/ she used standardised psychological tests, then the obtained raw score can be subjected to statistical analysis (We discussed some of the statistical techniques in BPC-104: Statistical Methods for Psychological Research- I).

Step 6: Deriving conclusions and making generalisations: Based on the data analysis, the researcher can then draw conclusions and make generalisations, that is, the results generated from the sample (representative) can then be generalised to the population.

It is also important at this stage to adequately report the findings of the research for the benefit of other researchers, experts, students and society in general.

A simplified version of research process, can be seen in figure. 1.1 that looks like an hour glass, where the process starts with a general research idea that the researcher may have in mind. For example, a researcher may have an idea to carry out research on caregivers of chronically ill patients. From this general research idea, after referring to review of literature, the researcher will identify specific variables and then follow the other steps of research from stating the problem, formulating hypothesis(es), finalising research design to data collection and data analysis. The results thus obtained can then be used to draw conclusions and make generalisations.

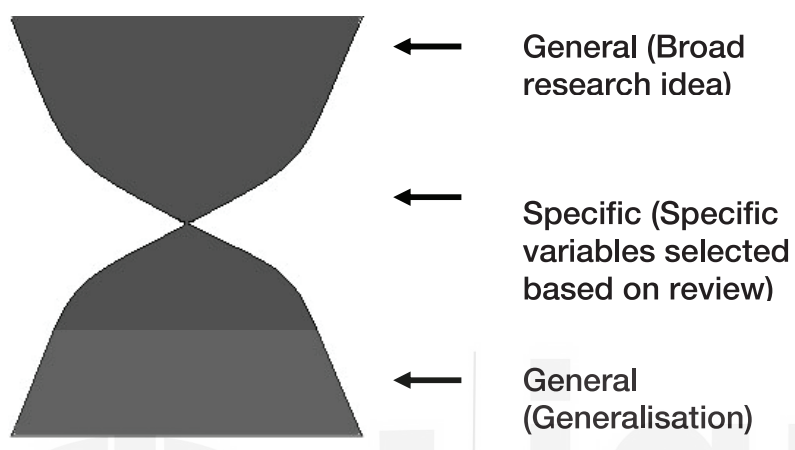


Figure 1.1: Research Process

Self Assessment Questions I

1) Define Research.

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2) List the goals of research.

a)
 b)
 c)
 c)
 d)
 e)

1.3 ETHICAL ISSUES IN PSYCHOLOGICAL RESEARCH

Research in psychology is necessarily carried out on humans and animals and in this regard it is important to follow certain ethical issues while carrying out research, in order to ensure that they are treated in respectful way.

Before we go on to discuss various ethical issues, let us look at some of the experiments that raised questions related to ethics in research.

A research was carried out by John Watson in order to study whether emotional responses are learned. The study was carried out on a young child named Albert. In the study, Albert was repeatedly exposed to a white rat. Initially, he did not show any negative reaction to the white rat. However, when the exposure to the white rat was accompanied repeatedly with a loud noise, Albert displayed negative reaction to the white rat. Further, as the study continued, Albert displayed negative reactions towards stimuli that were similar to white rat like white rabbit and fur coat.

This study raises some serious ethical issues as there is no record whether any informed consent was taken from the guardian (mother) of Albert (Albert being a minor). Further, ethical issues can also be raised with regard to whether it was really fair to subject Albert to such conditions and instilling fear in him, that could have repercussions later in his life.

Yet another study was carried out by Zimbardo and is known as Stanford Prison Experiment. In this research, Zimbardo attempted to study participant's group behaviour, how they adopted the abusive roles in the process of following certain orders. In this study, a simulation of prison was created and the participants were divided in to two groups, prisoners and guard. The participants also signed a contract and received monetary benefits. The guards were give instructions by Zimbardo, who acted as a warden of the prison, to maintain order amongst the prisoners (though any physical aggression was not allowed). The experiment had to be ended within a few days as role was internalised by the participants to such an extent that the guards were displaying aggressive behavior that negatively affected the participants who played the role of prisoners.

These experiments raises certain ethical issues, as the beneficence of the participant was at stake.

Thus, the above two experiments and many more led to more and more focus on ethical issues in research, in order to ensure wellbeing of the participants.

As such, the origin of ethical codes can be found in the Hippocratic oath that was written way back in 400 BC. Though, much attention was received to ethics after certain studies, as discussed above, raised questions regarding safety as well as welfare of the participants in research. The experiments carried out by Nazis during World War II also lead to development of the Nuremberg Code (that mainly focused on informed consent and coercion) that were a result of the Nuremberg war crime trials. Besides, there were other studies as well that raised ethical issues, like the Tuskegee syphilis study that were conducted by the U. S. Public Health Services in 1930s on African Americans, having low income, who suffered from syphilis. The participants were not aware that they were suffering from syphilis and were also not given any treatment (Penicillin) as they participated in the study.

Yet another study on how development of children is affected by social interaction, was carried out by René Spitz in 1940s. The study involved two groups of children whose development were studied from birth onwards. One of these groups were babies in orphanages who were deprived of any human contact and appropriate care. The other group of babies (from prison nursery) belonged to incarcerated mothers, who received care from their mothers. The results of the study indicated that social deprivation had an impact on the development of the children.

Thus, such studies and many more brought ethical issues and concern for safety and welfare of participants in the light. The Belmont Report was presented by U.S. Department of Health, Education and Welfare in 1979, where three ethical principles were highlighted:

- **Respect for persons:** Recognising the autonomy of the participants and protecting those with lower autonomy.
- **Beneficence:** Maximising benefits and minimising any harm and risk to the participants.
- **Justice:** Fairness in terms of who receives the benefits of research and faces risks.

These ethical principles were later stated as regulations by Department of Health and Human Services and the Food and Drug Administration. In 1991, they were adopted by the Federal Policy for the Protection of Human Subjects.

American Psychological Association proposed their own ethical standards in 1953 that were revised from time to time. And these are the ethical issues that we mainly follow while we conduct Psychological research.

Ethics as such are relevant at every stage of research. Any research is to be carried out keeping in mind the risk and benefit ratio. If the risk is high and benefit is low, there is no point in carrying out the research. If the benefits are high and risks are low, provided the minimal risk is taken care of, the research can be initiated. If the benefits and risks both are low, then again there is no use of carrying out the research. If the benefits and risks, both are high, then the decision with regard to whether the research should be carried out or not is difficult but by managing risk, in certain situations such research can be carried out. Besides the vulnerability of the population also needs to be kept in mind. For example, children can be considered as vulnerable population.

Further, in few of psychological researches deception is also used. *Deception* can be defined as “efforts by researchers to withhold or conceal information about the purpose of a study from the persons who participate in it” (Baron and Byrne, 1995, page 31). Though deception needs to be avoided, it may not be possible to do so in case of certain researches. Using deception could also raise certain ethical issues as the participants may not be pleased as they come to know about the actual objective of the research and may in fact resent for participating in research and may avoid participating in any research in future. Further, deception may lead to the participants being subjected to stress and anxiety. If deception cannot be totally avoided then it should be ensured that the participants do not face any serious risk during the research and debriefing needs to be provided. In debriefing, where any information about the research is provided to the participants, their doubts are clarified and privacy and confidentiality are assured.

There are certain significant ethical issues that need to be considered before any research is carried out, there are discussed as follows:

- **Beneficence and Non-maleficence:** A research needs to be carried out by keeping in mind its benefits to the participants (beneficence) and it should be ensured that the participants are not subjected to any harm (non-maleficence). Thus any risk to the participants is to be identified and eliminated and if there is any minimal risk, the participants need to be informed about the same and their consent for participation in the research needs to be taken.

- **Privacy and Confidentiality:** In any research, privacy and confidentiality of the participants is to be maintained. The researcher needs to take adequate care to ensure that the identity of the participants is not revealed. The participants may seek privacy and may not want others to know that they participated in the research. For instance, an employee may participate in certain research being carried out in his/ her organisation but may not want other employees to know about the same. Confidentiality is equally important as is privacy, where, information and details regarding the participants are not shared by the researcher with others. One way in which privacy and confidentiality can be assured is by using codes instead of the names of the participants.
- **Anonymity:** Anonymity denotes that even the researcher may not be able to identify the participant. In anonymity, the participants may have objection to others knowing that they participated in the research, but may have no problem with their performance details being shared.
- **Informed Consent:** As discussed earlier, the participants need to be informed about the details of the research, and this is done by taking informed consent from the participants. According to Berg (1998, page 47) informed consent means “the knowing consent of individuals to participate as an exercise of their choice, free from any elements of fraud, deceit, duress, or similar unfair inducement or manipulation”. Though, when ever deception is used in psychological research, obtaining informed consent could be a challenge as it can be when a study is carried out with the help of naturalistic observation. An informed consent needs to provide details about the research including the duration, procedure and benefits of participating (including incentives, if any) in research. It also needs to mention that the participants have a right to decline from participating in research or to leave or withdraw even after the research has started. Any consequences with regard to denying to participate in research or withdrawing from the research also need to be explained in the informed consent. The participants also need to be updated about the risks that they may face during their participation. If there are any limitations with regard to confidentiality, the same also needs to be mentioned in the informed consent. Lastly, the details of contact person whom the participants can contact in case if they have any query also need to be mentioned in the informed consent.

While conducting animals researches also, ethical guidelines need to be followed. An assessment of cost and benefit needs to be carried out before such a research is carried out and due care needs to be taken in acquiring, caring, maintaining as well as disposal of the animals. Care also needs to be taken to ensure minimal discomfort and pain to the animals. Guidelines in this regard as well have been provided by the American Psychological Association.

Ethical issues are significant at every stage of research right from selecting the research problem , finalising the research design, sample to data collection and analysis and reporting of the research. While the research is being written and reported, the researcher needs to ensure that there is no plagiarism and that the sources cited in the research are duly acknowledged.

For detailed information on the Principles of Psychologists and Code of Conduct given by American Psychological Association, refer to the following link

<https://www.apa.org/ethics/code>

Self Assessment Questions II

1) Define deception.

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2) What is informed consent?

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1.4 DEDUCTIVE AND INDUCTIVE METHODS

Deductive and inductive methods are two important methods in research. These are discussed as follows:

Deductive method: Deductive method is also termed as a ‘top-down’ approach or method of explanation/verification. It mainly involves testing of a theory. Based on a theory, hypothesis (es) are formulated, that are then tested in order to validate or invalidate the theory. The focus on this method could be on cause and effect relationship between the variables. Deductive methods mainly rely on the quantitative approach to research, though in certain situations qualitative approach may also be employed. Deductive method is more structured as there is a clear and specific aim that is to be achieved and is less time consuming when compared to inductive method. In deductive method, a larger sample size is taken in order to facilitate generalisation of the results.

Inductive method: Inductive method is also termed as ‘bottom-up’ approach or method of discovery. It mainly involves deriving a new theory. This method usually starts with a research question that is aimed to specify the scope of the research. The method mainly involves exploration of a novel phenomenon/ event or studying the phenomenon/event from a new perspective. In doing so inductive method may make use of qualitative methods of research. Inductive method is less structured and more time consuming when compared with deductive method. Inductive method is less concerned with generalisation and focuses on comprehending the context of the research.

Table 1.2 : Difference between Deductive and Inductive Method	
Deductive Method	Inductive Method
Main focus is on testing a theory	Main focus is on building a new theory
Top-down approach is adopted	Bottom-up approach is adopted
A large sample is taken in order to facilitate generalisation of the findings	Less focus on generalisation
More structured	Less structured
Less time is consumed	Time consuming process

The decision whether to use deductive or inductive method will mainly depend on the purpose of the research, whether, a research problem needs to be answered, a hypothesis is to be tested or a new theory is to be explored. Though, in certain cases, both the methods may be used in a research.

1.5 LET US SUM UP

To summarise, in the present unit , we discussed about psychological research , its definition, goals and principles. Research in simple terms can be explained as adding to the existing fund of knowledge. The term research is derived from the French word ‘recherche’ which means to travel through or survey. Research can be described as an enquiry that is not only critical but complex as well. Research can also be described as an analysis and recording of controlled observation that is objective and systematic in nature. And this analysis and recording can result in generalisations, and also development of theories. The main goals of psychological research are description, explanation, prediction, control and application. Besides covering the characteristics of an adequate psychological research, the steps in research process were also discussed. Another important topic in the context of psychological research, namely, the ethical issues were also discussed in detail with a focus on beneficence and non-maleficence, privacy and confidentiality, autonomy and informed consent. Further, the deductive and inductive methods were also highlighted.

1.6 GLOSSARY

Concept: A concept expresses an abstraction formed by generalisation from particulars

Construct: A construct can be terms as a concept that is adopted for empirical purpose

Deception: Deception can be described as efforts by researchers to withhold or conceal information about the purpose of a study from the persons who participate in it

Hypothesis: Hypothesis is a conjectural or tentative statement of the relation between two or more variables

Informed consent: Informed consent can be explained as the knowing consent of individuals to participate as an exercise of their choice, free from any elements of fraud, deceit, duress, or similar unfair inducement or manipulation

Problem: Problem can be described as a statement that is interrogative in nature and focuses on the objective or purpose of the research.

Research: Research is a systematic, controlled, empirical and critical investigation of natural phenomenon guided by theory and hypotheses about the presumed relations among such phenomena

Variable: Variable can be explained as quantity or a number that will vary or will have different values.

1.7 UNIT END QUESTIONS

1. Discuss the ethical issues of research.
2. Describe the steps involved in research.
3. Explain the goals and principals of Psychological research.

1.8 ANSWERS TO SELF ASSESSMENT QUESTIONS

Self Assessment Questions I

- 1) Best and Kahn (1999) have defined research as “systematic and Objective analysis and recording of controlled observation that may lead to the development of generalisation, principles or theories, resulting in prediction and possibly ultimate control of events”.
- 2) List the goals of research.
 - a) Description
 - b) Explanation
 - c) Prediction
 - d) Control
 - e) Application

Self Assessment Questions II

- 1) Deception can be defined as “efforts by researchers to withhold or conceal information about the purpose of a study from the persons who participate in it” (Baron and Byrne, 1995, page 31)
- 2) According to Berg (1998, page 47) informed consent means “the knowing consent of individuals to participate as an exercise of their choice, free from any elements of fraud, deceit, duress, or similar unfair inducement or manipulation”

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UNIT 2 PROBLEM AND HYPOTHESIS*

Structure

- 2.0 Introduction
- 2.1 Objectives
- 2.2 Problem
 - 2.2.1 Nature and Meaning
 - 2.2.2 Statement of the Problem
 - 2.2.3 Characteristics of a Scientific Problem
 - 2.2.4 Ways in which a Problem is Manifested
 - 2.2.5 Identifying a Research Problem
 - 2.2.6 Considerations in Selecting a Research Problem
 - 2.2.7 Formulating Research Problem
 - 2.2.8 The Importance of Formulating a Research Problem
 - 2.2.9 Types of research Problem
- 2.3 Formulation of Hypotheses
 - 2.3.1 Sources of Hypothesis
- 2.4 Types of Hypotheses
 - 2.4.1 Null Hypothesis
 - 2.4.2 Alternative Hypothesis
 - 2.4.3 Directional Hypotheses
 - 2.4.4 Non-directional Hypotheses
 - 2.4.5 Associative Hypotheses
 - 2.4.6 Complex Hypothesis
- 2.5 Descriptive Research
 - 2.5.1 Features of Descriptive Research
- 2.6 Hypothesis Testing
 - 2.6.1 Steps in Hypothesis Testing
 - 2.6.2 One-tailed and Two-tailed Tests
 - 2.6.3 Errors in Hypothesis Testing
- 2.7 Let Us Sum Up
- 2.8 Unit and Questions
- 2.9 Glossary
- 2.10 Answers to Self Assessment Questions
- 2.11 Suggested Readings and References

2.0 INTRODUCTION

Let us start our journey into the realm of human mind. A scientific quest for understanding will be the foremost in our journey. We want to know why we think, feel and behave as we do. What makes each of us different from all other people? Why do we often behave as alike in some situations? Psychologists try to answer these questions, develop the principles to explain them, and use those

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principles to solve various problems. The range of application of psychology is very wide. A cognitive psychologist may like to know the causes of forgetting. An organisational psychologist may try to find out nature of resistance among the employees to introduction of new performance appraisal system. A health psychologist may like to examine the relationship between smoking behaviour and coronary heart disease. While evaluating major areas of psychological researches, a psychologist uses the principles and practices of scientific methods.

This unit attempts to acquaint you with statement of the problem and formulation of hypotheses of psychological research.

Finally, the unit deals with indispensable stages of psychological research, i.e. statement of problem, formulation of hypothesis and the types of hypotheses. All the three stages are considered as foundation pillars of psychological research in terms of research design. Precisely, without traveling through these stages the journey for achieving goal via psychological research can not be concluded.

2.1 OBJECTIVES

After reading this unit, you will be able to:

- Identify some of the problems that one encounters while trying to do reliable and valid research;
- Discuss how to identify and formulate a problem and know the ways in which problem is manifested;
- Define and describe hypothesis and its characteristics;
- Explain formulation of hypothesis;
- Enumerate the possible difficulties in formulating hypothesis;
- Explain types of hypotheses;
- Discuss descriptive research;
- Explain one tailed; two tailed tests; and
- Discuss errors in hypothesis testing.

2.2 PROBLEM

2.2.1 Nature and Meaning

A scientific inquiry starts when a researcher has already collected some information/ knowledge and that knowledge indicates that there is something we do not know. It may be that we simply do not have enough information to answer a question, or it may be that the knowledge that we have is in such state of distorted form that it cannot be adequately be related to the question. Here a problem arises. The formulation of a problem is especially important, as it guides us in our inquiry. According to Townsend (1953) 'a problem is a question proposed for solution'. According to Kerlinger (1964) 'A problem is an interrogative sentence of statement that asks: What relation exists between two or more variables'. According to McGuigan (1964) 'A solvable problem is one that poses a question that can be answered with the use of man's normal capacities'.

2.2.2 Statement of the Problem

In order to be able to seek answers to questions, it is important to know what exactly the questions are. Thus, a researcher seeks answers to certain problem

or issue, having a statement of problem that is clear and specific. Problem can be described as a statement that is interrogative in nature and focuses on the objective or purpose of the research. A problem necessarily manifests when a researcher finds a gap in knowledge related to the subject area, when the results obtained after several research on a certain issue or problem are contradictory, thus, indicating needs for further research in order to rest the contradictions and also when a fact needs to be scientifically explained. The problem is always stated in a question form e.g. “what is the relationship between work environment and employee performance?”

Three main criteria have been stated by Kerlinger (1995) that determine a good statement of problem:

- 1) It focuses on relationship between two or more variables in the research
- 2) It needs to be stated clearly and should lack any ambiguity.
- 3) It should be possible to subject it to scientific testing.

2.2.3 Characteristics of a Scientific Problem

After analysing the mentioned definition of a problem statement, it can be said there are certain characteristics of a problem statement:

- i) A problem statement is written clearly and unambiguously, usually in question form. A few examples of problem statement are given below:
 - What is the relationship between IQ and class-room achievement?
 - What is the relationship between anxiety and adjustment among school going children?
 - Do students learn more from a lecture method than from discussion method?
- ii) A problem expresses the relationship between two or more than two variables. This kind of problem permits the investigator to manipulate two or more than two variables in order to examine the effects upon the other variables. For example: Do teacher’s reinforcement cause improvement in student’s performance? In this example, one variable is teacher reinforcement and the other variable is student performance. It illustrates the problem found in a scientific study because the problem statement explores the effect of teacher’s reinforcements on student performance. The conditions for a problem statement are:

The problem should be testable by empirical methods

- A problem statement should be solvable.
- The data of a scientific problem should be quantitative.
- The variable relating to the problem should be clear and definite.

2.2.4 Ways in which a Problem is Manifested

A problem is said to exist when we know enough that there is something we do not know really. There are atleast three ways in which a problem is said to be manifested: *Gap in knowledge*: A problem is manifested when there is a noticeable gap or absence of information. Suppose a community or group intends to provide psychotherapeutic services, two questions arise, viz., (i) What kind of psychotherapy they should offer and (ii) Which one of the different forms of therapeutic methods is most effective for a given type of mental disease. In this

example, there exists a noticeable gap in the knowledge, and hence the collection of necessary data and their explanation are needed for filling the gap in knowledge. *Contradictory results*: When several investigations done in the same field are not consistent and therefore, at times, contradictory, a problem is to find out a new answer and settle the controversy. *Explaining a Fact*: Another way in which we become aware of a problem is when we are in possession of a 'fact', and we ask ourselves, "Why is this so?" When the facts in any field are found in terms of unexplained information, a problem is said to exist.

2.2.5 Identifying a Research Problem

Ideas may come from a variety of sources, such as professional or personal experience, existing theory, media (Electronic, Print and Social) and other earlier / recent research studies, for research problems/ issues or topics. Few of the ways of identifying a research problem can be as follows:

- **Professional or Personal experience**

Professional or Personal experience every day will lead us to consider a problem to which we want a solution. Alternatively, it might be possible to answer a question or issues that we need to try to resolve.

- **Existing theory**

Research is a method of theoretical growth and theoretical testing. In their practices, psychologist use several ideas from other fields. If a current theory is used to establish researchable issues/problem or question, it is important to separate a particular statement from the theory. In general, a section or sections of the theory are subjected to clinical research. In psychology, the testing of an established theory is certainly necessary; hence, they serve as a good source of problem.

- **Review of Related Literature and Media**

Literature sources, such as Foreign and Indian books/ periodicals and journals, encyclopedias, dictionaries, handbooks and Manorama yearbooks, specialized sources like NCERT's Survey of Education Studies, psycinfo database etc. are numerous. Gaps in information, expertise, and issues for which there is currently no solution can be found by searching and reading related literature. These can provide a strong research base. We are also saturated with all media-provided material, such as Facebook, WhatsApp and twitter, which could again give rise to ideas for study.

2.2.6 Considerations in Selecting a Research Problem

When selecting a research problem/topic there are a number of considerations to be taken care and these considerations can be the interest, magnitude, measurement and clarity about the concept, level of expertise, relevance, availability of data as well as ethical issues. If you select a problem without considering these issues it could become extremely difficult to sustain the required motivation and interest, and hence its completion as well as the amount of time taken could be affected.

2.2.7 Formulating Research Problem

If the topic, problem or issue has been defined, this can then be reported as a particular research problem, that is, taken from just a statement about a difficult situation to a clearly described researchable problem that describes the issues you are trying to solve.

To formulate the research problem simply and explicitly is not always simple. The researcher may spend years investigating, thinking, and researching in certain fields of social science research before they are clear about what research questions they are trying to address.

To provide a researchable problem, many subjects can prove too wide-ranging. Choosing to study, for example, a psychological issue such as learning disability, does not include a researchable problem in itself. The topic is too wide-ranging for one investigator to answer. Time and energy would render this unlikely and the conclusions from such a study would also lack depth and concentration.

2.2.8 The Importance of Formulating a Research Problem

The formulation of a research problem is the first and most important step of the research process. It is like the identification of a destination before undertaking a journey. As in the absence of a destination, it is impossible to identify the shortest route, so also in the absence of a clear research problem, a clear and economical research plan is impossible. A research problem is like the foundation of a building. The type and design of the building is dependent upon the foundation. If the foundation is well designed and strong you can expect the building to be also strong and well designed. In the case of research, the research problem serves as the foundation of a research study. If it is well formulated, you can expect a good study to follow. According to Kerlinger (1986), if one wants to solve a problem, one must generally know what the problem is. It can be said that a large part of the problem lies in knowing what one is trying to do. You as a researcher must have a clear idea with regard to what it is that you want to find out about and not what you think you must find. A research problem may take a number of forms, from the very simple to the very complex. The way you formulate a problem determines almost every step that follows, that is (i) the type of study design that can be used, (ii) the type of sampling strategy that can be employed, (iii) the research instrument that can be used or developed (iv) and the type of analysis that can be undertaken. The formulation of a research a problem is like the ‘input’ into a study, and the ‘output’ – the quality of the contents of the research report and the validity of the associations or causation established – is entirely dependent upon it. Hence the famous saying about computers – ‘garbage in, garbage out’ – is equally applicable to a research problem.

2.2.9 Types of Research Problem

There are FOUR general conceptualizations of a research problem in the Psychology:

- **Uni-variable Problem** : When the problems are formulated to deal with a single independent variable after certain assumptions are followed. The researcher focuses her/ his work only on that independent variable, not on any other variable. After undergoing analysis, the formulated hypothesis is either accepted or rejected.
- **Bi-variables Problem** : Where the hypothesis implies inference, two distinct independent variables responsible for the existence of the problem, are called the Bi-variable problem. At the same time, on these two variables, the researcher has to focus his/her attention.
- **Multi-variables Problem** : Where more than two variables are seen in hypothesis accountable for, then the problem is called Multivariables, Problem. Researchers must pay careful attention to all factors equally.

- **Opponent variables Problem:** Where there is a question between two or more independent and dependent variables, then the problem is called as opponent variables, problem for example : “to find out whether schizophrenia is the cause of heredity or environment”.

Self Assessment Questions I

- 1) A problem is a question proposed for
- 2) According to ‘A solvable problem is one that posses a question that can be answered with the use of man’s normal capacities’
- 3) A problem expresses thebetween two or more than two variables.
- 4) The variable relating to the problem should be clear and
- 5) Ais like the foundation of a building.

2.3 FORMULATION OF HYPOTHESIS

Science proceeds with observation, hypothesis formulation and hypothesis testing. Hypothesis refers to a tentative solution to a problem. It refers to assumptions that are made in advance, before starting the process of research. After testing the hypothesis, through various statistical tests, researcher can accept or reject the hypothesis. If the hypothesis is accepted then researcher can replicate the results, if hypothesis is rejected then researcher can refine or modify the results. By stating a specific hypothesis, the researcher narrows the focus of the data collection effort and is able to design a data collection procedure which is aimed at testing the plausibility of the hypothesis as a possible statement of the relationship between the terms of the research problem. It is, therefore, always useful to have a clear idea and vision about the hypothesis. It is essential for the research question as the researcher intents to verify, as it will direct and greatly help in the interpretation of the results.

2.3.1 Sources of Hypothesis/es

The major sources of hypothesises are as follows:

- *Culture:* Culture in a particular place and time is the collection of ways of behaving and adopting the norms of society. While formulating a hypothesis for an issue, culture should be examined. If we want to examine trends in schizophrenia within a particular country, for this purpose, we will research the traditions, family structure, norms , values, region and education system of the country.
- *Researcher’s personal experience :* Researcher uses her/his mind on the basis of her/ his own knowledge, experience and proposes those points for the eradication of a social problem by creating a strong hypothesis. Increased study experience contributes to higher levels of preparation.
- *Thinking and Imagination:* A researcher's imaginative thinking and creativity often aid in the formulation of a hypothesis. A researcher 's personal ideas and reasoning abilities will contribute to a greater amount of hypothesis formulation as well as control over the problem.
- *Scientific Theory :* All the details relating to the problem can be clarified by theory. A main source of hypothesis formulation is a scientific theory. The theory used by a researcher can satisfy the requirements of making it, since the theory explains the facts that are known.

- *Previous researches* : Earlier research study is a basis for the establishment of a concrete hypothesis. If for a particular field a researcher uses previous knowledge of a phenomenon, then another researcher applies her/ his approach and formulates her/ his own.
- *Observation* : Observation is important in the consideration and undertaking of a research issue. A good hypothesis is developed through the compilation of previous facts and current facts relevant to the problem.

2.4 TYPES OF HYPOTHESES

As explained earlier, any assumption that you seek to validate through investigation is called hypotheses. Hence theoretically, there should be one type of hypotheses on the basis of the investigation that is, research hypothesis. However, because of the conventions in scientific enquiries and wording used in the constructions of the hypothesis, hypotheses can be classified into several types, like; universal hypotheses, existential hypotheses, conceptual hypotheses etc. Broadly, there are six categories of the hypothesis

2.4.1 Null Hypothesis

Null hypothesis is symbolised as H_0 . Null hypothesis is useful tool in testing the significance of difference. In its simplest form, this hypothesis asserts that there is no true difference between two population means, and the difference found between sample means is, accidental and unimportant, that is arising out of fluctuation of sampling and by chance. Traditionally null hypothesis states that there is zero relationship between terms of the hypothesis. For example, (a) schizophrenics and normal do not differ with respect to digit span memory, (b) there is no relationship between intelligence and height, (c) Adrenaline hormone has no effect on ability to coping with stress. The null hypothesis is an important component of the decision making methods of inferential statistics. If the difference between the samples of means is found significant the researcher can reject the null hypothesis. It indicates that the differences have statistically significant and acceptance of null hypothesis indicates that the differences are due to chance. Null hypothesis should always be specific hypothesis i.e. it should not state about or approximately a certain value. The null hypothesis is often stated in the following way: $H_0 : \mu_HV$

2.4.2 Alternative Hypothesis

Alternative hypothesis is symbolised as H_1 or H_a , is the hypothesis that specifies those values that the researcher believes to hold true, and the researcher hopes that sample data will lead to acceptance of this hypothesis as true. Alternative hypothesis represents all other possibilities and it indicates the nature of relationship. The alternative hypothesis is stated as follows: $H_1 : \mu_HV > \mu_LV$ The alternative hypothesis is like the mean of population of those who have the vocabulary, is greater than the mean of those to lack the vocabulary. In this example the alternative hypothesis is that, the experimental population had higher mean than the controls. This is called directional hypothesis because researcher predicted that the high vocabulary children would significantly differ in one particular direction from the low vocabulary children. Sometimes researcher predicts only that the two groups will differ from each other but the researcher doesn't know which group will be higher. This is non directional hypothesis. The null and alternative hypothesis in this case would be stated as follows: $H_0 : \mu_1 = \mu_2$, $H_1 : \mu_1 \neq \mu_2$ Thus, the null hypothesis is that mean of group 1 equals the

mean of group 2, and the alternative hypothesis is that the mean of group 1 does not equal the mean of group 2.

2.4.3 Directional Hypotheses

Typically, these are taken from theory. They can mean that a specific result is intellectually dedicated by the researcher. They specify the expected direction of the relationship between variables, i.e. not only the presence of a relationship, but also its nature is predicted by the researcher.

2.4.4 Non-directional Hypotheses

It is used when there is little or no theory, or when findings of previous studies are contradictory. They may imply impartiality. Do not stipulate the direction of the relationship.

2.4.5 Associative Hypotheses

In this types the research proposes relationships between variables – once one variable changes, the opposite variable also changes. But these hypotheses do not explain cause and effect.

2.4.6 Complex Hypothesis

A complex hypothesis is a hypothesis that describes the relation between more than two variables.

2.5 DESCRIPTIVE RESEARCH

When a school in Hyderabad decides to assess teachers' attitudes towards the use of information communication technology (ICT) in the classroom setup, then at such an instance descriptive research can be used with the help of conducting survey and observing their interest using ICT by observational methods. This result will help in recognizing the impact of learning.

Descriptive research describes and interprets what it is. It is concerned with conditions or relationships that exist, the practices that prevail, the beliefs or attitudes that are held, the processes that are going on; effects that are being felt or trends that are developing. The approach is directed towards identifying various characteristics of research problems and to create observation conducive to further research. Descriptive research describes characteristics of an existing phenomenon. Descriptive research provides a broad picture of a phenomenon you might be interested in exploring. Current employment rates, census of any country, number of working single parents are examples of descriptive research.

Gephart and Ingle, 1969 have defined the aim of descriptive research as “to classify events so that subsequent research can use an unambiguous vocabulary and reduce the ambiguity that arises from adhoc definitions. But the object of descriptive analysis is to provide a clear description of the materials and phenomena under study.”

Best, 1983 defines descriptive research as “It is concerned with the conditions or relationships that exist, opinions that are held, processes that are going on, effects that are evident or trends that are developing. It is primarily concerned with the present, although it often consider past events and influences, as they relate to current conditions”.

As Lovell and Lawson , 1970 stated, “Descriptive research refers to research which does not involve the experiments. It seeks to discover the nature of the

factors involved in a given situation, it seeks to determine the degree to which they exist and it tries to discover the links or relationship between the factors”.

Definition by International Encyclopedia of Psychology, 1996 states, “Descriptive research is almost self-explanatory; it occurs when the researcher merely wants to describe an individual's or a group's behaviors”.

Another definition by APA dictionary of Psychology, 2015 define, “it as an empirical analysis intended to test predetermined theories or sum up existing conditions, and sometimes relationships, without manipulating variables or trying to determine cause and effect”.

Thus, analyzing all the above definitions, We may conclude that the relationship between variables that currently exist in their natural setting is descriptive research. It also tests the hypotheses, establish generalizations and results in some estimate.

2.5.1 Features of Descriptive Research

- *Quantitative research*: Descriptive research is a quantitative method of study that aims to gather quantifiable information and data to be used for statistical analysis of the sample. It is a common tool for social sciences research that enables the demographic segment to gather and describe its nature.
- *Uncontrolled variables*: It is the variable, that has the ability to adversely affect the relationship between the independent and dependent variables. This can lead to false interpretations, inadequate outcome interpretation. It is a characteristic factor that is not measured or analysed by the investigator during an experiment or analysis.
- *Cross-sectional studies*: It is typically a cross-sectional study analyzing various parts that belong to the same group.

Self Assessment Questions (State True and False) II

- 1) Null hypothesis is denoted by H₁. T/F
- 2) If the hypothesis is accepted then researcher can replicate the results. T/F
- 3) Rejection of a null hypothesis when it is true is called type II error. T / F
- 4) Hypothesis can be stated directional and non directional. T / F
- 5) Alternative hypothesis specifies values that researcher believes to hold true. T / F

2.6 HYPOTHESIS TESTING

One of the significant aspects of research is hypothesis testing. Hypothesis is a tentative statement that is investigated during the process of research. Hypothesis pertains to certain phenomenon and is based on a theory. Data is then collected by the researcher in order to validate the hypothesis. Thus, the hypothesis is rejected or accepted by a researcher based on the results obtained. Hypothesis testing is also referred to as a process involving statistical decision making with regard to population value that is based on the sample value (Veeraraghavan and Shetgovekar, 2016, p. 9). Though, while drawing inference one needs to ensure that hypothesis is not incorrectly accepted or rejected due to results that are influenced by chance factor or confounding factors. Do the facts support hypotheses, or they happen to be contrary? This is the usual question which should be answered while testing hypotheses. Various parametric and non-parametric tests have been developed for this purpose. The hypothesis may be tested through

the use of one or more of such tests, depending upon the nature and object of research inquiry. Hypothesis testing will result in either accepting or in rejecting it.

For instance, Ram had worked in a multinational company as a senior manager. He is accused of corruption in the labour court. The judge has to decide if Ram is innocent (H_0), or shameful (H_1). We usually consider Ram to be innocent unless the judge can find sufficient proof that he is ashamed. Likewise, we predict that H_0H_0 is correct unless we can find proof that it is incorrect. H_1H_1 is correct, in this case we reject H_0H_0 and accept H_1H_1 .

2.6.1 Steps in Hypothesis Testing

The steps involved in hypothesis testing are as follows:

Step 1: Null hypothesis(es)/ alternative hypothesis(es) are specified.

Step 2: A level of significance is selected. This level of significance could be at 0.05 level or 0.01 level. The term significance in the context of statistics implies 'probably true' that indicates that results are free from chance factor at the specified level of significance. For example, if there exists a significant difference in job satisfaction of government and private bank employees then the researcher could either be 95% (0.05 level of significance, $P < 0.05$) confident or 99% (0.01 level of significance, $P < 0.01$) confident about the results obtained. This is because when carrying out research with human participants, 100% accuracy cannot be achieved. Thus, there could be 5% or 1% chance that the results are due to chance or confounding factors. Whether the null hypothesis is accepted or rejected will depend on whether the statistical value obtained after data analysis is more or less than the table value (tables for various statistical techniques are provided at the end of any book on Statistics) specified at 0.05 or 0.01 level of significance. If the obtained value is higher than the table value, then the null hypothesis is rejected, and if the obtained value is less than the table value then the null hypothesis is accepted.

Step 3: Based on the parameter specified in the null hypothesis (es), the statistic is calculated. A sample is selected by the researcher and the data is collected. Statistics is thus obtained from the sample (representative) and is then used in order to make an estimation about the population parameters.

Step 4: Decision is made whether to accept or reject the null hypothesis (es). In this regard, the P value or probability level is computed as has been discussed under step 2 and accordingly decision is taken by the researcher.

2.6.2 One-tailed and Two-tailed Tests

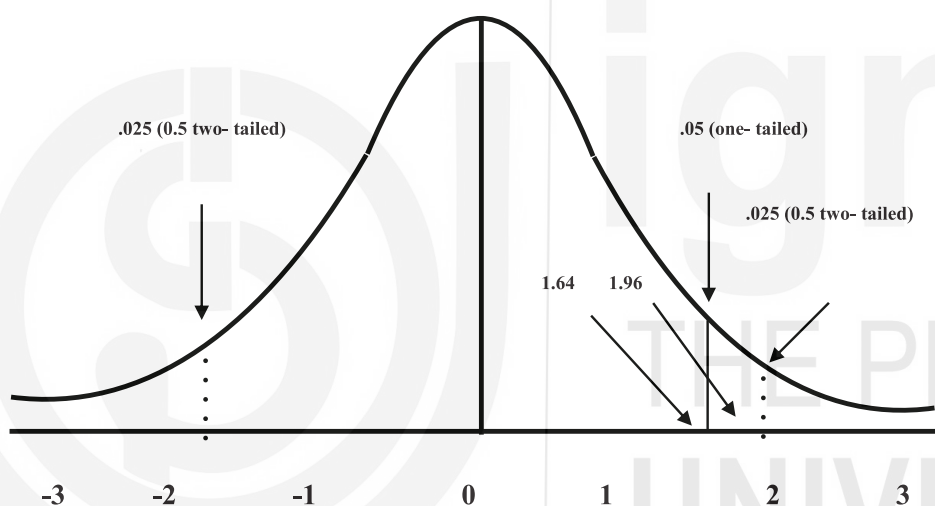
Any hypothesis can also be one tailed or two tailed. We need to understand hypothesis whether it is for a one-tailed or two-tailed test so that we can find the critical values in standard tables i.e. Standard Normal z distribution Table and T distribution table. How can we say if it is a one tailed or two-tailed test? It focuses on the question's argument. A one-tailed test looks for an "increase" or "decrease" in the parameter while a two-tailed test looks for a "change" (increased and decreased) in the parameter. A one tailed test checks only one of the tails (Upper or lower tail) of normal distribution curve. It is used in a collection of data to carry out a test of significance when the investigator is sure that the results will go in one direction. While, a two tailed test checks both upper and lower tails of the normal distribution curve. In a statistical significance test, a two tailed statistical test is used when there is a possibility that results may occur in either predicted direction. It is used for statistical significance in null-hypothesis testing.

It is termed as one- tailed when certain direction is given to the hypothesis or the hypothesis is directional. For example, if the researcher is study if gender difference exists with regard to emotional intelligence, a one-tailed hypothesis would be “Females have higher emotional intelligence than males” or “Males have higher emotional intelligence than females”. Refer to figure no. 1.2 that provides the figure for both 0.05 and 0.01 levels of significance. In one-tailed test, in order to reject a null hypothesis, the score needs to fall in the upper tail, that is in the top 5% of the distribution. A one-tailed test can be tested in either of the direction.

In case of two- tailed hypothesis, the hypothesis is nondirectional and will be stated as “Gender difference will exist with regard to emotional intelligence”. In case of two-tailed test, a null hypothesis can be rejected when the score falls in the either of the top 2.5% of the distribution. Thus the level of significance is maintained at 0.05 level (refer to figure 2.1).

As the level of significance is taken as 0.05 level, it can be taken at 0.01 level as well, in which case the prediction will be based on the lower tail.

a) **0.05 level of significance**



b) **0.01 level of significance**

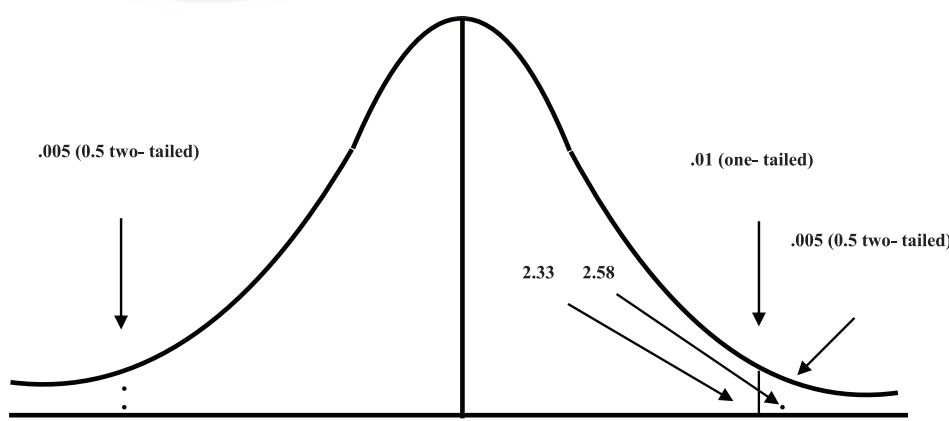


Figure 2.1: One Tailed and two Tailed Tests

2.6.3 Errors in Hypothesis Testing

You have already learned that hypotheses are assumptions that may be prove to be either correct or incorrect. It is possible to arrive at an incorrect conclusion about a hypothesis for the various reasons if –

- Sampling procedure adopted is faulty;
- Data collection method is inaccurate;
- Study design selected is faulty;
- Inappropriate statistical methods used;
- Conclusions drawn are incorrect.

The common errors that might occur when testing a hypothesis are as follows:

- **Type I and Type II Errors:** These will be more clear from table no. 2.1.

Table 2.1: Type I and Type II Errors		
	Null Hypothesis is true	Null Hypothesis is false
Null Hypothesis is Rejected	Type I error	Decision is correct
Null Hypothesis is Accepted	Decision is correct	Type II

As can be seen in table 2.1 a researcher will be making a correct decision when a false null hypothesis is rejected and when a null hypothesis that is true is accepted. However, it may so happen that a null hypothesis is rejected even when it is true and this is termed as type I error. On the other hand when a false null hypothesis is accepted then it is termed as type II error.

As mentioned, Type I error – Rejection of a null hypothesis when it is true. Type II error – Acceptance of a null hypothesis when it is false. Type I error is denoted by α (alpha) and Type II error is denoted by β (beta).

Let’s use the popular moral story about Panchtantra, for example, Lion and Boy. Let’s say that Null Hypothesis is that there is no lion present in village. Type I error will be roar of lion when there is no lion present. That is the actual condition was that there was no Lion present though the Boy wrongly indicated there was a lion present by shouting. This is Type I error.

Likewise, our Null hypothesis is assuming that Lion is not present. A Type II error would be to do nothing (not roaring Lion) when Lion is actually present. But is the real condition is that a Lion was present. However, the boy wrongly thought no lion was present and proceeded to play with his classmate. That is an error in type II.

- **Random and Constant Errors**

They are also a kind of measurement or observational error which takes place either due to some defect or by chance. An error in measurement is called as Random error when the observational values are inconsistent in repeated measurements of a constant attribute or quantity. It occurs due to the chance factor. Systematic or constant errors are the errors that occur due to an inaccuracy (involving either the observation or measurement process) that may be due to defected apparatus or inaccurate observation. They are not a result of chance factor.

2.7 LET US SUM UP

In this unit you have learnt about problem and hypothesis formulation. The formulation of research problem is the most important step in the research process. It is the foundation, in terms of design on which you build the whole study. Any

defects in it will adversely affect the validity and reliability of the study.

In formulating a hypothesis it is important to ensure that it is simple, specific and conceptually clear; is able to be verified; is rooted in an existing body of knowledge; and is capable to be operational used. There are two broad types of hypothesis: null hypothesis and alternate hypothesis. Important concepts involved in the process of hypothesis testing e.g., One tailed; two tailed tests, type I error, type II error of a test were also explained.

2.8 UNIT AND QUESTIONS

- 1) What are the characteristic features of a research problem?
- 2) What is Descriptive research?
- 3) Write short notes on:
 - a) Formulation of hypothesis
 - b) Null hypothesis
 - c) Alternative hypothesis
 - d) Descriptive research
- 4) With the help of examples, contrast between:
 - a. Null and Alternative Hypotheses
 - b. Type I and Type II error
 - c. One tailed and two tailed test
- 5) What are various sources of problem identification?

2.9 GLOSSARY

Problem : An interrogative statement that asks: What relation exists between two or more variables.

Null hypothesis : The hypothesis that is of no scientific interest; sometimes the hypothesis of no difference.

Alternative hypothesis : Statistical term for research hypothesis that specifies values that researcher believes to hold true.

one-tailed test : A one-tailed test looks for an "increase" or "decrease" in the parameter two-tailed test: A two-tailed test looks for a "change" (increased or decreased) in the parameter.

Type I error – Rejection of a null hypothesis when it is true.

Type II error - Acceptance of a null hypothesis when it is false.

2.10 ANSWERS TO SELF-ASSESSMENT QUESTIONS

Self Assessment Questions I

- 1) Solution
- 2) McGuigan
- 3) Relationship

- 4) Definite
- 5) Research Problem

Self Assessment Questions II

- 1) False
- 2) True
- 3) False
- 4) True
- 5) True

2.11 SUGGESTED READINGS AND REFERENCES

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UNIT 3 CONSTRUCTS AND VARIABLES*

Structure

- 3.1 Objectives
- 3.2 Introduction
- 3.3 Variables
 - 3.3.1 Operational Definition of Variables
 - 3.3.2 Types of Variables
- 3.4 Constructs
 - 3.4.1 Types of Constructs
- 3.5 Let Us Sum Up
- 3.6 Unit End Questions
- 3.7 Answers to Self -Assessment Questions
- 3.8 Glossary
- 3.9 Suggested Readings and References

3.1 OBJECTIVES

With the help of this unit, you will be able to:

- Explain the concept and meaning of constructs and variables;
- Describe the various types of variables;
- Identify different types of variables in a research study;
- Distinguish between variable and constructs; and
- Differentiate between hypothetical concept and intervening variable.

3.2 INTRODUCTION

In the previous units of the block, you were introduced about the meaning and process of research. The present unit deals with the different constructs and variables, which are important for research process. In the process of formulating a research problem there are two important considerations; the use of constructs/ concepts and the construction of hypotheses. Constructs/concepts are highly subjective as their understanding varies from person to person and therefore, as such, may not be measurable. In a research study, it is important that the concepts used should be operationalised in measurable terms so that the extent of variation in respondents understanding is reduced if not eliminated. Knowledge about constructs and variables are very important to understand, conceptual clarity and quantitative accuracy as they provide the 'fine tuning' to research. This unit attempts to acquaint you with the term-variables and constructs which are used by the psychologists in gaining knowledge about the behaviour and mental processes. The unit begins with definition of variables then you will find the details about the types of variables along with the examples. Further, you will be exposed to the nature of the scientific concept or construct and the way in which behavioural scientist travel from the construct level to observation level. Finally, types of constructs will be discussed.

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3.3 VARIABLES

Variable means something or a condition that varies. It can also be explained as quantity or a number that will vary or will have different values. For example, in a study on emotional intelligence and self esteem of adolescents in India emotional intelligence and self esteem can be termed as variables. Emotional intelligence can be high or low as can self esteem be. Both these variables can possess varied values. Even gender can be termed as a variable because it will vary in terms of males or females.

As mentioned earlier that variable is “any thing that can change” or “a quantity that may have a number of different values”. True, a variable is something that has at least two values: however, it is also important that the values of the variable be observable. Thus, if what is being studied is a variable, it has more than one value and each value can be observed. For example, the outcome of throwing a dice is a variable. That variable has six possible values (each side of the dice having one to six dots on it), each of which can be observed. However, a behavioural scientist attempts to define a variable more precisely and specifically. Kerlinger (1986) defined variable as ‘a property that has different values’. According to D’Amato (1970) variables may be defined as those attributes of objects, events, things and beings, which can be measured. ‘According to Postman and Egan (1949) ‘a variable is a characteristic or attribute that can take on a number of values’, for example, number of items that an individual solves on a particular test, the speed with which we respond to a signal, IQ, sex, level of anxiety, and different degree of illumination are the examples of variables that are commonly employed in psychological research.

Before discussing the types of variables, it is important to know how the variables of study are related to theoretical concepts. Because the variables actually exist in the world but the theory is an idea, researcher makes certain assumption to relate the two. These assumptions are guide ropes that tie a theory to the real world. The variables are tangible: duration, frequency, rate, or intensity of bar presses; items checked on a questionnaire; committed crimes; books written. The theoretical concept is intangible: hunger, motivation, anxiety. The variables are related to the theoretical concepts by means of the operational definition used to measure the concepts.

Suppose a theory reveals that increasing anxiety will increase the affiliation motive. To test out this theory, you may take the theoretical concepts of anxiety and affiliation motive and relate them to variables by means of operational definition. The theory is an abstract statement. For example, anxiety can be measured by the Anxiety Scale and affiliation can be measured in terms of how close people sit to each other in the experiment. These two measures constitute the variables of the study. The scores on the variables of anxiety and distance apart are related to one another as test of the hypothesis. The relationship between the variable is taken as providing support for or against the particular theory that generates the experiment.

3.3.1 Operational Definition of Variables

As stated by Kerlinger (1995), constructs can be defined with the help of words or by describing the behaviours that are implied by the construct. In this context, one can discuss about the constitutive definition and operational definition of construct. In constitutive definition, a construct is defined in terms of other constructs (Kerlinger, 1995, page 25). For example, phobia can be defined as

irrational fear. In operational definition, meaning is assigned to the construct by clearly identifying the activities on the basis of which it can be measured (Kerlinger, 1995). For example, Organizational Citizenship Behavior can be defined as “a set of individual behaviour that is discretionary, not directly or explicitly recognized by the formal reward system and that promotes the effective functioning of the organization. By discretionary we mean the behaviour is not an enforceable requirement of the role, or the job description, that is, the clearly specifiable in terms of the person’s employment contract with the organization; the behavior is rather a matter of personal choice, such that its omission is not generally understood as punishable (Organ, 1988, page 4).

It is to be noted here that though operational definition is an important aspect of any research, it may not be possible for a researcher to define a construct in such a way that the whole construct or variable is covered. Thus, the constructs as used in a research can be termed as “specific as well as limited in their meaning” (Kerlinger, 1995, page 29).

Operational definition can be categorised in to following two categories:

- 1) **Measured operational definition:** This definition focuses on how a construct can be measured. For instance, organisational citizenship behaviour can be measured with the help of a standardised scale for organisational citizenship behaviour.
- 2) **Experimental operational definition:** This definition describes how a construct is manipulated by the researcher. For instance, employees can be categorised in two groups, one with high organisational citizenship behaviour and the other with low organisational citizenship behaviour.

Self Assessment Questions I

1) What is concept?

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2) What are the two categories of operational definition?

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3.3.2 Types of Variables

To understand how variables are used and discussed in psychological researches, you need to understand several distinctions that are made among the type of variables. The descriptions of different types of variables are given below:

- **Stimulus, Organism and Response (S-O-R) Variables**

Psychologists are interested in studying the behaviour or causes of behaviour as variables. Many psychologists have adopted a theoretical viewpoint or model called the S-O-R model to explain all behaviour. The symbols S, O, and R represent different categories of variables. S is the symbol of stimuli, and the category may be referred to in general as stimulus variables. A stimulus variable is some form of energy in the environment, such as light, to which the organism is sensitive. O is the symbol for organism variables, that is the changeable physiological and psychological characteristics of the organisms being observed. Examples of such variables are anxiety level, age and heart rate etc. Finally, R is the symbol for response and, in general, response variables, which refer to some behaviour or action of the organism like pressing a lever, and reaction to any stimulus, are the examples of response variables. You can understand an application of S-O-R model through the following example. Suppose that an experiment is conducted in which a rat is placed on a metal grid floor, the grid is electrified, and the length of time it takes the rat to jump from the grid to a platform is measured. Using the S-O-R model, the electrical shock would be called a stimulus variable. The intensity of shock would be the value of the variable. The particular state of the organisms would be measured by the organismic variables. For example, the skin resistance of the rat at the time of shock would be an organismic variables. A response variable would be the latency (i.e. the elapsed time between the onsets of the shock and when the rat reaches the platform).

- **Independent and Dependent Variables**

An independent variable or stimulus variable (as Underwood calls it) is a factor manipulated or selected by the experimenter in his/her attempt to ascertain its relationship to an observed phenomenon. Dependent upon the mode of manipulation, some experts have tried to divide the independent variable into 'Type E' independent variable and 'Type S' independent variable (D'Amato, 1970). Type E independent variable is one of which is directly or experimentally manipulated by the experimenter or and type S independent variable is one which is manipulated through the process of selection only. For example the experimenter wants to study the effect of noise upon the task performance in an industry. Here the IV (Independent Variable) is the noise and the DV (Dependent Variable) is the task performance. S/he may manipulate the noise by dividing it into three categories — continuous noise, intermittent noise and no noise and then examine its effect upon the task performance. Here the noise is being directly manipulated by the experimenter and hence, it constitutes the example of Type-E independent variable. Suppose, for the time being, that the experimenter is interested in answering the question: Is the rate of production dependent upon the age of the workers? Age here is the independent variable. For investigating this problem, the experimenter will have to select groups of workers on the basis of their age in a way by which S/he can get an appropriate representation from different age groups ranging from say, 16 to 55 years. Subsequently, S/he will compare the rate of production obtained by each age group and finally, conclude whether or not age is a factor in enhancement of the performance. Hence, this constitute the examples of S-independent variables. A dependent variable is the

factor that appears, disappears, or varies as the experimenter introduces, removes or varies the independent variable (Townsend, 1953). The dependent variable is a measure of the behaviour of the subject. The dependent variable is the response that the person or animal makes. This response is generally measured using at least one of the several different dimensions (Alberto & Troutman, 2006). The dimensions are – (a) frequency – number of times that a particular behaviour occurs, (b) duration - the amount of time that a behaviour lasts. (c) latency –the amount of time between and when the behaviour is actually performed (d) force – the intensity or strength of a behaviour. Here, you can examine the relationship between independent and dependent variables. The relationship is that of dependence. One variable depends upon the other. Suppose you find a relationship between meaningfulness of the learning material and speed of learning. Speed of learning then depends upon meaningfulness; the greater the meaningfulness, the faster the learning. The speed of learning is, therefore, called dependent variable; meaningfulness is independent variable. Similarly, rest between work periods is independent variables; output of work is dependent variable. Sudden noise is independent variable; change in breathing is dependent variable. In an experiment one discovers and confirms a relationship between an independent variable and a dependent variable.

- **Extraneous and Confounded Variables**

Any and all other variables that may ‘mask’ the relationship between independent variable and dependent variable are known as extraneous variables. Extraneous variables may directly affect the dependent variable or may combine with the independent variable to produce an effect. Therefore, extraneous variables must be controlled so that the experimenter can determine whether the dependent variable changes in relation to variation in the independent variable. Several other factors operating in a real life situation may affect changes in the dependent variable. These factors though are not included to be measured in the study yet they may increase or decrease the magnitude or strength of the relationship between independent and dependent variables. Extraneous variables are relevant in nature, and in experimental studies, they belong to three major types i.e., organismic or subject related variables, situational variables and sequential variables. The subject related variables include age, sex, intelligence, personality etc. are organismic variables. The situational variables include environmental variables operating in the experimental setting (e.g. noise, temperature, humidity) and variables related to the experimental task. The sequence related variables deal with sequence effects. They arise when participants in experiments are required to be tested in several conditions. Exposure to many conditions may result in adaptation, fatigue or practice effects which, if allowed to operate, may make the results difficult to interpret.

Confounding variable is one that varies with the independent variable. While doing a study if we are not careful then two variables may get combined so that the effect of one cannot be separated from the effect of other. This is known as confounding. For instance, if you conducted a study of the effect of television viewing on perception of violence and the experimental group contained only adolescents, whereas the control group only adults, the age of participants would be confounded with the independent variable under study. Confounding makes the conclusions of the study doubtful. It is therefore, necessary that effort should be made to unconfound the variables.

To explain these variables let us take one example. Suppose you want to study the relationship between smoking and coronary heart disease. You assume the

factors affecting this relationship, such as number of cigarettes or the amount of tobacco smoked every day; the duration of smoking; the age of the smoker; dietary habits; and the amount of exercise undertaken by the individuals. All of these factors may affect the extent to which smoking might cause coronary heart disease. These variables may either increase or decrease the magnitude of the relationship. In this example, the extent of smoking is the independent variable, coronary heart disease is the dependent variable and all the variables that might affect this relationship, either positively or negatively, are extraneous variables.

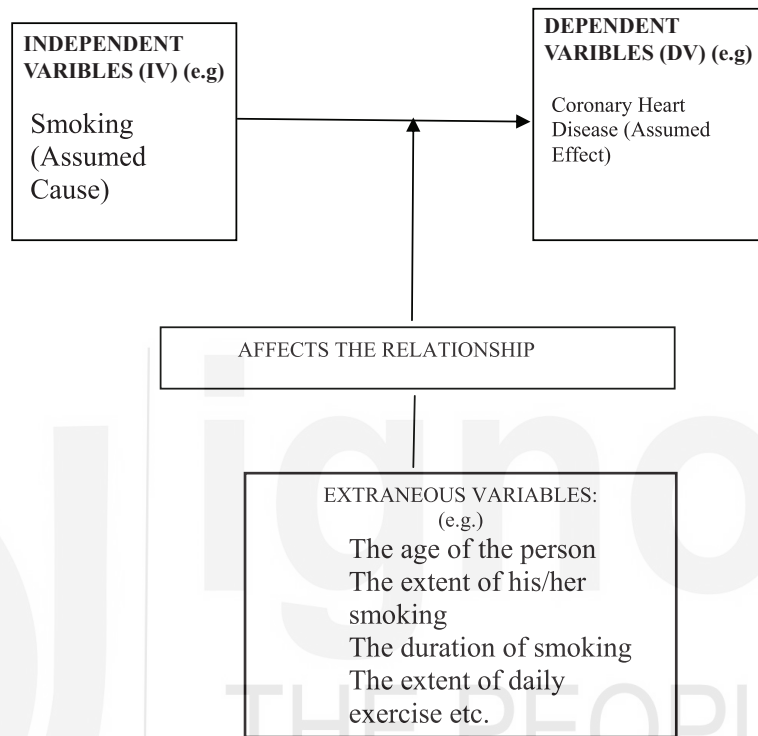


Figure 3.1 : Examples of IV; DV and Extraneous Variables

- **Active and Attribute Variables**

Any variable that is manipulated is called active variable. Examples of active variables are reward, punishment, methods of teaching, creating anxiety through instructions and so on. Attribute variable is that variable which is not manipulated but measured by the experimenter. Variables that are the human characteristics like intelligence, Aptitudes, sex, socio economic status, education, field dependence and need for achievement are the example of attribute variables. The word ‘attribute’ is more accurate enough when used within animated objects or references. Organisations, institutions, groups, population and geographical areas have attributes. Organisations are variably productive; groups differ in cohesiveness; geographical areas vary widely in resources.

- **Quantitative and Categorical Variables**

Quantitative variables is one that varies in amount whereas categorical variables varies in kind. Speed of response, intensity of sound, level of Illumination, intelligence etc. are the example of quantitative variables and gender, race, religion are the example of categorical variables. Precise and accurate measurement are possible with the quantitative variables because they can be easily ordered in terms of increasing and decreasing magnitude. Categorical variables can be of three types: Constant, dichotomous and polytomous. When a variable can have only one value or category, for example taxi, tree and water, it is known as a

constant variables. When a variable can have only two categories as in yes/no, good/bad and rich/poor, it is known as dichotomous variables. When variables can be divided into more than two categories, for example: religion (Christian, Muslim, Hindu); political parties (Labour or, Liberal, Democrat); and attitudes (strongly favorable, favorable, uncertain, unfavorable, strongly unfavorable), it is called a polytomous variable.

- **Continuous and Discrete Variables**

Quantitative variables are further divided into two categories, namely, continuous variables and discrete variables. A distinction between continuous and discrete variables is especially useful in planning of research and analysis of data. A continuous variable is one which is capable of being measured in any arbitrary degree of fineness or exactness. Age, height, intelligence, reaction time, etc., are some of the examples of a continuous variable. The age of the person can be measured in years, month and days. Thus, all such variables which can be measured in the smallest degree of fineness are called continuous variable. The discrete variables are those variables which are not capable of being measured in any arbitrary degree of fineness or exactness because the variables contain a clear gap. For example, the number of members in a family, no. of females in particular group, no of books in library and so on constitute the examples of a discrete variable.

Different types of variables have been discussed in table 3.1.

Type	Description	Example
Independent Variable (IV)	Variable that is manipulated by the researcher is independent variable	In a study on effect of light on performance of individuals, a researcher can manipulate light to bright, dim or normal. Light can be an example of Independent Variable
Dependent Variable (DV)	In a research, variable that is measured for any changes when independent variable is manipulated, is dependent variable.	In the above example, performance is an example of dependent variable.
Extraneous Variables (EV)	Variables that may impede or interfere in the relationship between independent variable and dependent variable are called extraneous variables.	In the above example, noise can interfere in relationship between IV and DV and it is possible that changes in DV, that is performance is due to EV, that is, noise rather than IV, that is, light.
Quantitative Variables	These are variables that are numerically represented.	Intelligence Quotient (IQ), weight, height.
Qualitative Variables	These are measurable characteristics, are not numerical but categorical.	Gender (Male and Female), Socio Economic Status (High and Low), Religion (Christian Hindu, Muslim).
Continuous Variables	Such variables have any value and are continuous in nature.	Weight: 56.98 kg, Age: 2 years 5 months.
Discontinuous or discrete Variables	These are set of integers that are distinct.	Number of children, number of two wheelers.

3.4 CONSTRUCTS

The terms 'concept' and 'construct' have similar meanings. Yet, there is an important distinction. A concept may be defined as any describable regularity of real or imagined events or objects (Bourne, Ekstrand, & Dominowski, 1971). A concept is a set of features connected by some rule (Hulse, Egeth, Deese 1980). Concepts are building block of thinking. They allow us to organise knowledge in systematic ways. Concept represents objectives of activities, ideas or living organism. Concept also represents properties, abstraction and relations between the features. For example – 'achievement'. It is an abstraction formed from the observation of certain behaviours of children. These behaviours are associated with the mastery or "learning" of school tasks – reading words, doing arithmetic problems, drawing pictures, and so on. The various observed behaviours are put together and expressed in a word – 'achievement', 'intelligence', 'aggressiveness,' 'conformity', and 'honesty' are all concepts used to express varieties of human behaviour of interest to behavioural scientists. Researcher often invents or constructs new concepts derived for special scientific purposes; such concepts are called constructs. Thus, you may well explain construct as concept. It has the added meaning i.e invented or adopted for a special scientific purpose. For example, "Intelligence" is a concept, an abstraction from intelligent and nonintelligent behaviours. But, as a scientific construct, "intelligence" means both more and less than a concept. It means that scientists consciously and systematically use it in two ways. One, it enters into theoretical schemes and is related in various ways to other constructs. In this sense, school achievement may also be, in part, a function of intelligence and motivation. Two, "intelligence" is so defined and specified that it can be observed and measured. We can make observation of the intelligence of children by administering any intelligence test to them, or we can ask teachers to tell us the relative degrees of intelligence of their pupils. Constructs are created and used for a wide variety of reasons, but generally have two common characteristics. First, the construct is a part of a theoretical framework and is related in various ways to other constructs. Second, a construct usually operationally defined so as to allow its observation and measurement. An example of a commonly employed psychological construct would be reinforcement. On a theoretical level, reinforcement can be, and is, related to other constructs such as drive, motivation, association, and habit strength. Further reinforcement may be operationally defined as any stimulus or event which increases the probability of the occurrence of a (desired) response.

When we discuss about concept, it is also important to understand what is concept in the context of psychological research. As defined by Kerlinger (1995, page 26), a concept "expresses an abstraction formed by generalisation from particulars". Thus, height can be a concept, that can be expressed in terms of observation of objects that are long or short or to take a psychological variable, adjustment. Abstraction can be formed for adjustment based on observation of individual's behaviour. In a similar manner, various psychological variables can be abstracted based on certain behaviours that can be categorised together.

A construct can be termed as a concept that is adopted for empirical purpose (Kerlinger, 1995). Thus, when adjustment is adopted in a research for empirical purpose, it will be termed as a construct. When a concept is adopted as a construct in a research, it is entered in to the theoretical framework and thus can be related to other constructs in numerous ways. Further, constructs can be subjected to

observation and measurement (Kerlinger, 1995). For instance, a standardised scale on adjustment can be used to measure the construct of adjustment.

3.4.1 Types of Constructs

As Mac-Corquodale & Meehl, (1948) indicated that there are two types of constructs which are often employed by psychologist and behavioural scientist:

Intervening variables;

Hypothetical construct.

- ***Intervening Variables***

An intervening variable is construct which is utilised as a summary term for a group of other construct; it has no meaning apart from context in which it is utilised. As you might know that, Clark Hull, a behaviourist who proposed hypothetical deductive method of learning, utilised intervening variables in the formation of the learning theory. Hull defined reaction potential as the combination of habit strength and drive (Hilgard & Bower, 1966). Reaction potential is an intervening variable, since it only summarizes other constructs (habits strength and drive) and has meaning only in relation to them. An example of intervening variable is, hostility which is inferred from hostile and aggressive acts.

- ***Hypothetical Constructs***

In contrast, a hypothetical construct is a theoretical term which is employed to describe something “real.” That is, it is an intermediary which has tangible characteristics. Habit strength, defined by Hull as the number of reinforced trials, is a hypothetical construct. As another example, the word “reflex” refers to certain readily observable characteristics. The patellar reflex or “knee jerk” occurs when a small force is sharply applied at the appropriate point on the knee. The term “reflex” refers to the chain of events that occurs within the organism after the application of the stimulus and before the response shown. Hence, reflex is a hypothetical construct. As a further example, suppose an equation could be developed which would tell us how much a person knows:

$$K = AC \times IQ$$

Where,

K = knowledge;

AC = amount of conditioning;

IQ = intelligence.

AC could be defined as the number of reinforced trials a person receives and IQ as that person’s score on a standard intelligence test. K could be defined as being a function of AC and IQ. Therefore, AC and IQ are hypothetical constructs (they describe something real and are defined directly by the operations that established them or by which they were measured). On the other hand, K is an intervening variable (it has no meaning of its own, but only summarizes or stands for other constructs). However, if K were defined as the number of correct solutions a person achieved on the “knowledge test,” then K would also be a hypothetical construct.

Self Assessment Questions II

- 1) are building block of thinking.
- 2) An is the factor that can be manipulated by the experiment.
- 3) The symbols S, O, and R represent different categories of
- 4) The variable is the response that the person or animal makes.

3.5 LET US SUM UP

Knowledge of different types of variables and constructs play a crucial role in research. Variables and constructs are important in bringing clarity and specificity to the conceptualising of a research problem, to formulation of hypothesis and to the development of a research instrument. They affect how the data can be analysed, what statistical test can be applied to the data, what interpretation can be made and what conclusion can be drawn. A variable is some property of an event that takes on different values. There are different kinds of variables such as independent variables, dependent variables, quantitative variables and categorical variables, active and attribute variables, continuous and discrete variables, extraneous and intervening variables and so on. A construct is a concept. It has an added meaning and it is adopted for a special scientific purpose. Constructs are of two types: intervening and hypothetical constructs. Intervening variable is a term which is internal and directly unobservable psychological process that, in turn, are inferred from behaviour. A hypothetical construct is a theoretical term which is employed to describe something “real.” That is, it is an intermediary which has tangible characteristics. A construct can be termed as a concept that is adopted for empirical purpose and variable means something that varies. It can also be explained as quantity or a number that will vary or will have different values. In operational definition, meaning is assigned to the construct by clearly identifying the activities on the basis of which it can be measured. Operational definition can be categorised in to measured operational definition and experimental operational definition.

In the next block we will mainly focus on the qualitative and quantitative approaches to research.

3.6 UNIT AND QUESTIONS

- 1) Define variable and discuss the various kinds of variable.
- 2) Explain Intervening variables and Hypothetical constructs in your own words.
- 3) Differentiate between variables and constructs. Give suitable example.
- 4) Explain the nature of extraneous variable with suitable examples.

3.7 ANSWERS TO SELF ASSESSMENT QUESTIONS

Self Assessment Questions I

- 1) As defined by Kerlinger (1995, page 26), a concept “expresses an abstraction formed by generalisation from particulars”.

- 2) Operational definition can be categorised in to two:
 1. Measured operational definition
 2. Experimental operational definition

Self Assessment Questions II

- 1) Concepts
- 2) independent variable or stimulus variable
- 3) variables
- 4) dependent

3.8 GLOSSARY

Variable : A variable is a property that taken as different values.

Independent variables : The condition manipulated or selected by the experimenter to determine its effect on behaviour.

Dependent variables : A measure of the subject's behaviour that reflects that independent variable's effects.

Quantitative variable : One that varies in amount. **Categorical variable :** One that varies in kind.

Continuous variable : One that falls along a continuum and is not lifted to a certain number of values.

Discrete variable : One that that falls into separate bins with no intermediate values possible. **Active variables :** Manipulated variables are active variables. **Attribute variables :** Measured variables are attribute variables.

Constructs : Is a concept, used for scientific purpose, is a part of theoretical framework. **Intervening variables :** Is a construct which is utilised as a summary term for a group of other constructs.

Hypothetical constructs : Is a theoretical term which is employed to describe something real.

3.9 SUGGESTED READINGS AND REFERENCES

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