Chapter 1

Research: The Meaning, Approaches and Typology

Research in simple terms refers to search for knowledge. It is a scientific and systematic search for information on a particular topic or issue. It is also known as the art of scientific investigation. Several social scientists have defined research in different ways.

In the Encyclopaedia of Social Sciences, D. Slesinger and M. Stephension (1930) defined research as "the manipulation of things, concepts or symbols for the purpose of generalizing to extend, correct or verify knowledge, whether that knowledge aids in the construction of theory or in the practice of an art". According to Redman and Mory (1923), research is a "systematized effort to gain new knowledge". It is an academic activity and therefore the term should be used in a technical sense. According to Clifford Woody (Kothari, 1988), research comprises "defining and redefining problems, formulating hypotheses or suggested solutions; collecting, organizing and evaluating data; making deductions and reaching conclusions; and finally, carefully testing the conclusions to determine whether they fit the formulated hypotheses"

Thus, research is an original addition to the available knowledge, which contributes to its further advancement. It is an attempt to pursue truth through the methods of study, observation, comparison and experiment. In sum, research is the search for knowledge, using objective and systematic methods to find solution to a problem.

1.1.1 Objectives of Research: The objective of research is to find answers to the questions by applying scientific procedures. In other words, the main aim of research is to find out the truth which is hidden and has not yet been discovered. Although every research study has its own specific objectives, the research objectives may be broadly grouped as follows:

1. To gain familiarity with new insights into a phenomenon (i.e., formulate research studies);
2. To accurately portray the characteristics of a particular individual, group, or a situation (i.e., descriptive research studies);
3. To analyze the frequency with which something occurs (i.e., diagnostic research studies);
4. To examine the hypothesis of a causal relationship between two variables (i.e., hypothesis-testing research studies).

1.1.2 Research Methods versus Methodology:

Research methods include all those techniques/methods that are adopted for conducting research. Thus, research techniques or methods are the methods that the researchers adopt for conducting the research studies. on the other hand, research methodology is the way in which research problems are solved systematically. It is a science of studying how research is conducted scientifically. Under it, the researcher acquaints himself/herself with the

various steps generally adopted to study a research problem, along with the underlying logic behind them. Hence, it is not only important for the researcher to know the research techniques/ methods, but also the scientific approach called methodology.

1.1.3 Research Approaches:

There are two main approaches to research, namely quantitative approach and qualitative approach. The quantitative approach involves the collection of quantitative data, which are put to rigorous quantitative analysis in a formal and rigid manner. This approach further includes experimental, inferential, and simulation approaches to research. Meanwhile, the qualitative approach uses the method of subjective assessment of opinions, behaviour and attitudes. Research in such a situation is a function of the researcher's impressions and insights. The results generated by this type of research are either in non-quantitative form or in the form which cannot be put to rigorous quantitative analysis. Usually, this approach uses techniques like in depth interviews, focus group interviews, and projective techniques.

1.1.4 Types of Research:

There are different types of research. The basic ones are as follows.

Descriptive Versus Analytical:

Descriptive research consists of surveys and fact-finding enquiries of different types. The main objective of descriptive research is describing the state of affairs as it prevails at the time of study. The term 'ex post facto research' is quite often used for descriptive research studies in social sciences and business research. The most distinguishing feature of this

method is that the researcher has no control over the variables here. He/she has to only report what is happening or what has happened. Majority of the ex post facto research projects are used for descriptive studies in which the researcher attempts to examine phenomena, such as the consumers' preferences, frequency of purchases, shopping, etc. Despite the inability of the researchers to control the variables, ex post facto studies may also comprise attempts by them to discover the causes of the selected problem. The methods of research adopted in conducting descriptive research are survey methods of all kinds, including correlation and comparative methods. Meanwhile, in the Analytical research, the researcher has to use the already available facts or information, and analyze them to make a critical evaluation of the subject.

Applied Versus Fundamental:

Research can also be applied or fundamental in nature. An attempt to find a solution to an immediate problem encountered by a firm, an industry, a business organization, or the society is known as applied research. Researchers engaged in such researches aim at drawing certain conclusions confronting a concrete social or business problem. On the other hand, fundamental research mainly concerns generalizations and formulation of a theory. In other words, "Gathering knowledge for knowledge's sake is termed 'pure' or 'basic' research" (Young in Kothari, 1988). Researches relating to pure mathematics or concerning some natural phenomenon are instances of Fundamental Research. Likewise, studies focusing on human behaviour also fall under the category of fundamental research. Thus, while the principal objective of applied research is to find a solution to some

pressing practical problem, the objective of basic research is to find information with a broad base of application and add to the already existing organized body of scientific knowledge.

Quantitative Versus Qualitative:

Quantitative research relates to aspects that can be quantified or can be expressed in terms of quantity. It involves the measurement of quantity or amount. Various available statistical and econometric methods are adopted for analysis in such research. Which includes correlation, regressions and time series analysis etc, On the other hand, Qualitative research is concerned with qualitative phenomena, or more specifically, the aspects related to or involving quality or kind. For example, an important type of qualitative research is 'Motivation Research', which investigates into the reasons for certain human behaviour. The main aim of this type of research is discovering the underlying motives and desires of human beings by using in-depth interviews.

The other techniques employed in such research are story completion tests, sentence completion tests, word association tests, and other similar projective methods. Qualitative research is particularly significant in the context of behavioural sciences, which aim at discovering the underlying motives of human behaviour. Such research helps to analyze the various factors that motivate human beings to behave in a certain manner, besides contributing to an understanding of what makes individuals like or dislike a particular thing. However, it is worth noting that conducting qualitative research in practice is considerably a difficult task. Hence, while

undertaking such research, seeking guidance from experienced expert researchers is important

Conceptual Versus Empirical:

The research related to some abstract idea or theory is known as Conceptual Research. Generally, philosophers and thinkers use it for developing new concepts or for reinterpreting the existing ones. Empirical Research, on the other hand, exclusively relies on the observation or experience with hardly any regard for theory and system. Such research is data based, which often comes up with conclusions that can be verified through experiments or observation. Empirical research is also known as experimental type of research, in which it is important to first collect the facts and their sources, and actively take steps to stimulate the production of desired information. In this type of research, the researcher first formulates a working hypothesis, and then gathers sufficient facts to prove or disprove the stated hypothesis. He/she formulates the experimental design, which according to him/her would manipulate the variables, so as to obtain the desired information. This type of research is thus characterized by the researcher's control over the variables under study. In simple term, empirical research is most appropriate when an attempt is made to prove that certain variables influence the other variables in some way. Therefore, the results obtained by using the experimental or empirical studies are considered to be the most powerful evidences for a given hypothesis.

Other Types of Research:

The remaining types of research are variations of one or more of the afore-mentioned type of research. They vary in terms of the purpose of research, or the time required to complete it, or may be based on some 8 other similar factors.

On the basis of time, research may either be in the nature of one-time or longitudinal time series research. While the research is restricted to a single time-period in the former case, it is conducted over several time-periods in the latter case. Depending upon the environment in which the research is to be conducted, it can also be laboratory research or field-setting research, or simulation research, besides being diagnostic or clinical in nature. Under such research, in-depth approaches or case study method may be employed to analyze the basic causal relations. These studies usually undertake a detailed in-depth analysis of the causes of certain events of interest, and use very small samples and sharp data collection methods. The research may also be explanatory in nature. Formalized research studies consist of substantial structure and specific hypotheses to be verified. As regards to historical research, sources like historical documents, remains, etc. Are utilized to study past events or ideas. It also includes philosophy of persons and groups of the past or any remote point of time.

Research has also been classified into decision-oriented and conclusion-oriented categories. The decision-oriented research is always carried out as per the need of a decision maker and hence, the researcher has no freedom to conduct the research according to his/her own desires. On the other hand, in the case of Conclusion-oriented research, the researcher is free to choose

the problem, redesign the enquiry as it progresses and even change conceptualization as he/she wishes to.

An operation research is a kind of decision-oriented research, where in scientific method is used in providing the departments, a quantitative basis for decision-making with respect to the activities under their purview.

1.1.5 Importance of Knowing How To Conduct Research:

The importance of knowing how to conduct research is listed below:

i. The knowledge of research methodology provides training to new researchers and enables them to do research properly. It helps them to develop disciplined thinking or a 'bent of mind' to objectively observe the field;
ii. The knowledge of doing research inculcates the ability to evaluate and utilize the research findings with confidence;
iii. The knowledge of research methodology equips the researcher with the tools that help him/her to make the observations objectively; and
iv. The knowledge of methodology helps the research consumers to evaluate research and make rational decisions.

1.1.6 Qualities of a Researcher:

It is important for a researcher to possess certain qualities to conduct research. First and foremost, he being a scientist should be firmly committed to the 'articles of faith' of the scientific methods of research. This implies that a researcher should be a social science person in the truest sense. Sir Michael Foster cited by (Wilkinson and Bhandarkar, 1979) identified a few distinct qualities of a scientist. According to him, a true research scientist should possess the following qualities:

(1) First of all, the nature of a researcher must be of the temperament that vibrates in unison with the theme which he is searching. Hence, the seeker of knowledge must be truthful with truthfulness of nature, which is much more important, much more exacting than what is sometimes known as truthfulness. The truthfulness relates to the desire for accuracy of observation and precision of statement. Ensuring facts is the principle rule of science, which is not an easy matter. The difficulty may arise due to untrained eye, which fails to see anything beyond what it has the power of seeing and sometimes even less than that. This may also be due to the lack of discipline in the method of science. An unscientific individual often remains satisfied with the expressions like approximately, almost, or nearly, which is never what nature is. A real research cannot see two things which differ, however minutely, as the same.

(2) A researcher must possess an alert mind. Nature is constantly changing and revealing itself through various ways. A scientific researcher must be keen and watchful to notice such changes, no matter how small or insignificant they may appear. Such receptivity has to be cultivated slowly and patiently over time by the researcher through practice. An individual who is ignorant or not alert and receptive during his research will not make a good researcher. He will fail as a good researcher if he has no keen eyes or mind to observe the unusual changes behind the routine. Research 10 demands a systematic immersion into the subject matter by the researcher grasp even the slightest hint that may culminate into significant research problems. In this context, Cohen

and Negal cited by (Selltiz et al, 1965; Wilkinson and Bhandarkar, 1979) state that "the ability to perceive in some brute experience the occasion of a problem is not a common talent among men… it is a mark of scientific genius to be sensitive to difficulties where less gifted people pass by untroubled by doubt".

(3) Scientific enquiry is pre-eminently an intellectual effort. It requires the moral quality of courage, which reflects the courage of a steadfast endurance. The process of conducting research is not an easy task. There are occasions when a research scientist might feel defeated or completely lost. This is the stage when a researcher would need immense courage and the sense of conviction. The researcher must learn the art of enduring intellectual hardships. In the words of Darwin, "It's dogged that does it". In order to cultivate the afore-mentioned three qualities of a researcher, a fourth one may be added. This is the quality of making statements cautiously. According to Huxley, the assertion that outstrips the evidence is not only a blunder but a crime (Thompson, 1975). A researcher should cultivate the habit of reserving judgment when the required data are insufficient.

1.1.7 Significance of Research:

According to a famous Hudson Maxim, "All progress is born of inquiry. Doubt is often better than overconfidence, for it leads to inquiry, and inquiry leads to invention". It brings out the significance of research, increased amount of which makes the progress possible. Research encourages scientific and inductive thinking, besides promoting the development of logical habits of thinking and organization. The role of

research in applied economics in the context of an economy or business is greatly increasing in modern times. The increasingly complex nature of government and business has raised the use of research in solving operational problems. Research assumes significant role in the formulation of economic policy for both, the government and business. It provides the basis for almost all government policies of an economic system. Government budget formulation, for example, depends particularly on the analysis of needs and desires of people, and the availability of revenues, which requires research.

Research helps to formulate alternative policies, in addition to examining the consequences of these alternatives. Thus, research also facilitates the decision-making of policy-makers, although in itself is not a part of research. In the process, research also helps in the proper allocation of a country's scarce resources. Research is also necessary for collecting information on the social and economic structure of an economy to understand the process of change occurring in the country. Collection of statistical information, though not a routine task, involves various research problems. Therefore, large staff of research technicians or experts is engaged by the government these days to undertake this work.

Thus, research as a tool of government economic policy formulation involves three distinct stages of operation:

Stage 1: Investigation of economic structure through continual compilation of facts;

Stage 2: Diagnosis of events that are taking place and analysis of the forces underlying them; and

Stage 3: The prognosis i.e.,the prediction of future developments (Wilkinson and Bhandarkar, 1979).

Research also assumes significance in solving various operational and planning problems associated with business and industry. In several ways, operations research, market research and motivational research are vital and their results assist in taking business decisions. Market research refers to the investigation of the structure and development of a market for the formulation of efficient policies relating to purchases, production and sales. Operational research relates to the application of logical, mathematical, and analytical techniques to find solution to business problems, such as cost minimization or profit maximization, or the optimization problems. Motivational research helps to determine why people behave in the manner they do with respect to market characteristics. More specifically, it is concerned with the analysis of the motivations underlying consumer behaviour. All these researches are very useful for business and industry, and are responsible for business decision-making. Research is equally important to social scientists for analysing the social relationships and seeking explanations to various social problems. It gives intellectual satisfaction of knowing things for the sake of knowledge. It also possesses the practical utility for the social scientist to gain knowledge so as to be able to do something better or in a more efficient manner. The research in social sciences is concerned with both knowledge for its own sake, and knowledge for what it can contribute to solve practical problems.

1.1.8 Ethical issues in Research:

Research ethics involve requirements on daily work, the protection of dignity of subjects and the publication of the information in the research. Ethical issues, conflicting values, and ambiguity in decision making, are recurrently emerging from literature review on research. The major ethical issues in conducting research are: a) Informed consent, b) Beneficence- Do not harm c) Respect for anonymity and confidentiality d) Respect for privacy. There are a number of key phrases that describe the system of ethical protections that the contemporary social/biological/ medical research establishments have created to try to protect better the rights of their research participants. The principle of ***voluntary participation*** requires that people not be coerced into participating in research. This is especially relevant where researchers had previously relied on 'captive audiences' for their subjects -- prisons, universities, and places like that. Closely related to the notion of voluntary participation is the requirement of ***informed consent***. The prospective research participants must be fully informed about the procedures and risks involved in research and must give their consent to participate. Ethical standards also require that researchers not put participants in a situation where they might be at ***risk of harm*** as a result of their participation. Harm can be defined as both physical and psychological. There are two standards that are applied in order to help protect the privacy of research participants. Almost all research guarantees the participants' ***confidentiality*** -- they are assured that identifying information will not be made available to anyone who is not directly involved in the study. The stricter standard is the principle of ***anonymity*** which essentially means that

the participant will remain anonymous throughout the study-even to the researchers themselves. Clearly, the anonymity standard is a stronger guarantee of privacy, but it is sometimes difficult to accomplish, especially in situations where participants have to be measured at multiple time points (e.g., a pre-post study). Increasingly, researchers have had to deal with the ethical issue of a person's ***right to service***. Good research practice often requires the use of a no-treatment control group -- a group of participants who don't get the treatment or program that is being studied. But when that treatment or program may have beneficial effects, persons assigned to the no-treatment control may feel their rights to equal access to services are being curtailed.

1.2 Research Process: Research process consists of a series of steps or actions required for effectively conducting research. The following are the steps that provide useful procedural guidelines regarding the conduct of research: (1) Formulating the research problem; (2) Extensive literature survey; (3) Developing hypothesis; (4) Preparing the research design; (5) Determining sample design; (6) Collecting data; (7) Execution of the project; (8) Analysis of data; (9) Hypothesis testing; (10) Generalization and interpretation, and (11) Preparation of the report or presentation of the results. In other words, it involves the formal write-up of conclusions.

1.3 Research Problem: The first and foremost stage in the research process is to select and properly define the research problem. A researcher should first identify a problem and formulate it, so as to make it amenable or susceptible to research. In general, a research problem refers to an unanswered question that a researcher might encounter in the context of

either a theoretical or practical situation, which he/she would like to answer or find a solution to. A research problem is generally said to exist if the following conditions emerge (Kothari, 1988): i. There should be an individual or an organization, say X, to whom the Problem can be attributed. The individual or the organization is situated in an environment Y, which is governed by certain uncontrolled variables Z; 13 ii. There should be at least two courses of action to be pursued, say A1 and A2. These courses of action are defined by one or more values of the controlled variables. For example, the number of items purchased at a specified time is said to be one course of action. iii. There should be at least two alternative possible outcomes of the said courses of action, say B1 and B2. Of them, one alternative should be preferable to the other. That is, at least one outcome should be what the researcher wants, which becomes an objective. iv. The courses of possible action available must offer a chance to the researcher to achieve the objective, but not the equal chance. Therefore, if P(Bj / X, A, Y) represents the probability of the occurrence of an outcome Bj when X selects Aj in Y, then P(B1 / X, A1,Y) ≠ P (B1 / X, A2, Y). Putting it in simple words, it means that the choices must not have equal efficiencies for the desired outcome. Above all these conditions, the individual or organization may be said to have arrived at the research problem only if X does not know what course of action to be taken is the best. In other words, X should have a doubt about the solution. Thus, an individual or a group of persons can be said to have a problem if they have more than one desired outcome. They should have two or more alternative courses of action, which have some but not equal efficiency. This is

required for probing the desired objectives, such that they have doubts about the best course of action to be taken. Thus, the components of a research problem may be summarized as:

i. There should be an individual or a group who have some difficulty or problem.
ii. There should be some objective(s) to be pursued. A person or an organization who wants nothing cannot have a problem.
iii. There should be alternative ways of pursuing the objective the researcher wants to pursue. This implies that there should be more than one alternative means available to the researcher. This is because if the researcher has no choice of alternative means, he/she would not have a problem.
iv. There should be some doubt in the mind of the researcher about the choice of alternative means. This implies that research should answer the question relating to the relative efficiency or suitability of the possible alternatives. v. There should be a context to which the difficulty relates. Thus, identification of a research problem is the pre-condition to conducting research.

A research problem is said to be the one which requires a researcher to find the best available solution to the given problem. That is, the researcher needs to find out the best course of action through which the research objective may be achieved optimally in the context of a given situation. Several factors may contribute to making the problem complicated. For example, the environment may alter, thus affecting the efficiencies of the alternative courses of action taken or the quality of the outcomes. The

number of alternative courses of action might be very large and the individual not involved in making the decision may be affected by the change in environment and may react to it favourably or unfavourably. Other similar factors are also likely to cause such changes in the context of research, all of which may be considered from the point of view of a research problem.

1.4 Research Design: The most important step after defining the research problem is preparing the design of the research project, which is popularly known as the 'research design'. A research design helps to decide upon issues like what, when, where, how much, by what means etc. with regard to an enquiry or a research study. A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. In fact, research design is the conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data (Selltiz et al, 1962). Thus, research design provides an outline of what the researcher is going to do in terms of framing the hypothesis, its operational implications and the final data analysis. Specifically, the research design highlights decisions which include:

1. The nature of the study 2.The purpose of the study 3. The location where the required data can be collected 4. What time period the study would cover 5. The type of sample design that would be used 6. The techniques of data collection that would be used 7. The methods of data analysis that would be adopted and 8.The manner in which the report would

be prepared. In view of the stated research design decisions, the overall research design may be divided into the following (Kothari 1988):

a. The sampling design that deals with the method of selecting items to be observed for the selected study;
b. The observational design that relates the conditions under which the observations are to be made;
c. The statistical design that concerns with the question of how many items are to be observed, and how the information and data gathered are to be analysed; and,
d. The operational design that deals with the techniques by which the procedures specified in the sampling, statistical and observational designs can be carried out.

1.4.1 Features of Research Design: The important features of Research Design may be outlined as follows: i. It constitutes a plan that identifies the types and sources of information required for the research problem; ii. It constitutes a strategy that specifies the methods of data collection and analysis which would be adopted; and iii. It also specifies the time period of research and monetary budget involved in conducting the study, which comprise the two major constraints of undertaking any research.

Concepts Relating to Research Design

Some of the important concepts relating to Research Design are discussed below:

1. Dependent and Independent Variables:

A magnitude that varies is known as a variable. The concept may assume different quantitative values like height, weight, income etc. Qualitative

variables are not quantifiable in the strictest sense of the term. However, the qualitative phenomena may also be quantified in terms of the presence or absence of the attribute(s) considered. The phenomena that assume different values quantitatively even in decimal points are known as 'continuous variables'. But all variables need not be continuous. Values that can be expressed only in integer values are called 'non-continuous variables'. In statistical terms, they are also known as 'discrete variables'. For example, age is a continuous variable, whereas the number of children is a non-continuous variable.

When changes in one variable depend upon the changes in other variable or variables, it is known as a dependent or endogenous variable, and the variables that cause the changes in the dependent variable are known as the independent or explanatory or exogenous variable**s**. For example, if demand depends upon price, then demand is a dependent variable, while price is the independent variable. And, if more variables determine demand, like income and price of the substitute commodity, then demand also depends upon them in addition to the price of original commodity. In other words, demand is a dependent variable which is determined by the independent variables like price of the original commodity, income and price of substitutes

Extraneous Variables: The independent variables which are not directly related to the purpose of the study but affect the dependent variables, are known as extraneous variables. For instance, assume that a researcher wants to test the hypothesis that there is a relationship between children's school performance and their self-confidence, in which case the latter is an

independent variable and the former, a dependent variable. In this context, intelligence may also influence the school performance. However, since it is not directly related to the purpose of the study undertaken by the 17 researcher, it would be known as an extraneous variable.

2. The influence caused by the extraneous variable(s) on the dependent variable is technically called the 'experimental error'. Therefore, a research study should always be framed in such a manner that the influence of extraneous variables on the dependent variable/s is completely controlled, and the influence of independent variable/s is clearly evident.

3. Control: One of the most important features of a good research design is to minimize the effect of extraneous variable(s). Technically, the term 'control' is used when a researcher designs the study in such a manner that it minimizes the effects of extraneous variables. The term 'control' is used in experimental research to reflect the restrain in experimental conditions

4. Confounded Relationship: The relationship between the dependent and independent variables is said to be confounded by an extraneous variable, when the dependent variable is not free from its effects.

5. Research Hypothesis: When a prediction or a hypothesized relationship is tested by adopting scientific methods, it is known as research hypothesis. The research hypothesis is a predictive statement which relates to a dependent variable and an independent variable. Generally, a research hypothesis must consist of at least one dependent variable and one independent variable. Whereas, the relationships that are assumed but not to be tested are predictive statements that are not to be objectively verified,

thus are not classified as research hypotheses. 6. Experimental and Non-experimentation

6. Hypothesis Testing Research: When the objective of a research is to test a research hypothesis, it is known as hypothesis-testing research. Such research may be in the nature of experimental design or non-experimental design. The research in which the independent variable is manipulated is known as 'experimental hypothesis-testing research', whereas the research in which the independent 18 variable is not manipulated is termed as 'non-experimental hypothesis testing research'. For example, assume that a researcher wants to examine whether family income influences the school attendance of a group of students, by calculating the coefficient of correlation between the two variables. Such an example is known as a non-experimental hypothesis testing research, because the independent variable - family income is not manipulated here. Again assume that the researcher randomly selects 150 students from a group of students who pay their school fees regularly and then classifies them into two sub-groups by randomly including 75 in Group A, whose parents have regular earning, and 75 in Group B, whose parents do not have regular earning. Assume that at the end of the study, the researcher conducts a test on each group in order to examine the effects of regular earnings of the parents on the school attendance of the student. Such a study is an example of experimental hypothesis-testing research, because in this particular study the independent variable regular earnings of the parents have been manipulated.

7. Experimental and Control Groups: When a group is exposed to usual conditions in an experimental hypothesis-testing research, it is known as

'control group'. On the other hand, when the group is exposed to certain new or special condition, it is known as an 'experimental group'. In the afore-mentioned example, Group A can be called as control group and Group B as experimental group. If both the groups, A and B are exposed to some special feature, then both the groups may be called as 'experimental groups'. A research design may include only the experimental group or both the experimental and control groups together.

8. Treatments: Treatments refer to the different conditions to which the experimental and control groups are subject to. In the example considered, the two treatments are the parents with regular earnings and those with no regular earnings. Likewise, if a research study attempts to examine through an experiment the comparative effect of three different types of fertilizers on the yield of rice crop, then the three types of fertilizers would be treated as the three treatments.

9. Experiment: Experiment refers to the process of verifying the truth of a statistical hypothesis relating to a given research problem. For instance, an experiment may be conducted to examine the yield of a certain new variety of rice crop developed. Further, Experiments may be categorized into two types, namely, 'absolute experiment' and 'comparative experiment'. If a researcher wishes to determine the impact of a chemical fertilizer on the yield of a particular variety of rice crop, then it is known as absolute experiment. Meanwhile, if the researcher wishes to determine the impact of chemical fertilizer as compared to the impact of bio-fertilizer, then the experiment is known as a comparative experiment. 10. Experimental Unit(s): Experimental units refer to the pre-determined plots, characteristics

or the blocks, to which different treatments are applied. It is worth mentioning here that such experimental units must be selected with great caution.

1.4.2 Types of Research Design: There are different types of research designs. They may be broadly categorized as:

(1) Exploratory Research Design;

(2) Descriptive and Diagnostic Research Design; and

(3) Hypothesis-Testing Research Design.

(4) Ex-Post-Facto Research Design

1. Exploratory Research Design: The Exploratory Research Design is known as formulate research design. The main objective of using such a research design is to formulate a research problem for an in-depth or more precise investigation, or for developing a working hypothesis from an operational aspect. The major purpose of such studies is the discovery of ideas and insights. Therefore, such a research design suitable for such a study should be flexible enough to provide opportunity for considering different dimensions of the problem under study. The in-built flexibility in research design is required as the 20 initial research problem would be transformed into a more precise one in the exploratory study, which in turn may necessitate changes in the research procedure for collecting relevant data.

Usually, the following three methods are considered in the context of a research design for such studies. They are

(a) Survey of related literature;

(b) Experience survey; and

(c) Analysis of 'insight-stimulating' instances.

2. Descriptive and Diagnostic Research Design: A Descriptive Research Design is concerned with describing the characteristics of a particular individual or a group. Meanwhile, a diagnostic research design determines the frequency with which a variable occurs or its relationship with another variable. In other words, the study analyzing whether a certain variable is associated with another comprises a diagnostic research study. On the other hand, a study that is concerned with specific predictions or with the narration of facts and characteristics related to an individual, group or situation, are instances of descriptive research studies. Generally, most of the social research design falls under this category. As a research design, both the descriptive and diagnostic studies share common requirements, hence they are grouped together. However, the procedure to be used and the research design need to plan carefully. The research design must also make appropriate provision for protection against bias and thus maximize reliability, with due regard to the completion of the research study in an economical manner. The research design in such studies should be rigid and not flexible.

Besides, it must also focus attention on the following:

a) Formulation of the objectives of the study, b) Proper designing of the methods of data collection, c) Sample selection, d) Data collection, e) Processing and analysis of the collected data, and f) Reporting the findings.

3. **Hypothesis-Testing Research Design:** Hypothesis-Testing Research Designs are those in which the researcher tests the hypothesis of causal relationship between two or more variables. These studies require

procedures that would not only decrease bias and enhance reliability, but also facilitate deriving inferences about the causality. Generally, experiments satisfy such requirements. Hence, when research design is discussed in such studies, it often refers to the design of experiments.

4. Ex-Post-Facto Research designs:

An ex post facto research design is a method in which groups with qualities that already exist are compared on some dependent variable. Also known as "after the fact" research, an ex post facto design is considered quasi-experimental because the subjects are not randomly assigned - they are grouped based on a particular characteristic or trait.

Although differing groups are analyzed and compared in regards to independent and dependent variables it is not a true experiment because it lacks random assignment. The assignment of subjects to different groups is based on whichever variable is of interest to the researchers. For example, a researcher is interested in how weight influences self-esteem levels in adults. So the participants would be separated into differing groups (underweight, normal weight, overweight) and their self esteem levels measured. This is an ex post facto design because a pre-existing characteristic (weight) was used to form the groups.

1.4.3 Importance of Research Design: The need for a research design arises out of the fact that it facilitates the smooth conduct of the various stages of research. It contributes to making research as efficient as possible, thus yielding the maximum information with minimum effort, time and expenditure. A research design helps to plan in advance, the methods to be employed for collecting the relevant data and the techniques to be adopted

for their analysis. This would help in pursuing the objectives of the research in the best possible manner, provided the available staff, time and money are given. Hence, the research design should be prepared with utmost care, so as to avoid any error that may disturb the entire project. Thus, research design plays a crucial role in attaining the reliability of the results obtained, which forms the strong foundation of the entire process of the research work.

1.4.4 Characteristics of a good Research Design:

A good research design often possesses the qualities of being flexible, suitable, efficient, and economical and so on. Generally, a research design which minimizes bias and maximizes the reliability of the data collected and analyzed is considered a good design (Kothari 1988). A research design which does not allow even the smallest experimental error is said to be the best design for investigation.

Further, a research design that yields maximum information and provides an opportunity of viewing the various dimensions of a research problem is considered to be the most appropriate and efficient design. Thus, the question of a good design relates to the purpose or objective and nature of the research problem studied. While a research design may be good, it may not be equally suitable to all studies.

In other words, it may be lacking in one aspect or the other in the case of some other research problems. Therefore, no single research design can be applied to all types of research problems. A research design suitable for a specific research problem would usually involve the following considerations:

i. The methods of gathering the information;
ii. The skills and availability of the researcher and his/her staff, if any;
iii. The objectives of the research problem being studied;
iv. The nature of the research problem being studied; and v. The available monetary support and duration of time for the research work.

1.5 Case Study Research:

The method of exploring and analyzing the life or functioning of a social or economic unit, such as a person, a family, a community, an institution, a firm or an industry is called case study method. The objective of case study method is to examine the factors that cause the behavioural patterns of a given unit and its relationship with the environment.

The data for a study are always gathered with the purpose of tracing the natural history of a social or economic unit, and its relationship with the social or economic factors, besides the forces involved in its environment. Thus, a researcher conducting a study using the case study method attempts to understand the complexity of factors that are operative within a social or economic unit as an integrated totality.

Burgess (Kothari, 1988) described the special significance of the case study in understanding the complex behaviour and situations in specific detail. In the context of social research, he called such data as social microscope.

1.5.1 Criteria for Evaluating Adequacy of Case Study:

John Dollard (Dollard, 1935) specified seven criteria for evaluating the adequacy of a case or life history in the context of social research. They are:

i. The subject being studied must be viewed as a specimen in a cultural set up. That is, the case selected from its total context for the purpose of study should be considered a member of the particular cultural group or community. The scrutiny of the life history of the individual must be carried out with a view to identify the community values, standards and shared ways of life.

ii. The organic motors of action should be socially relevant. This is to say that the action of the individual cases should be viewed as a series of reactions to social stimuli or situations. To put in simple words, the social meaning of behaviour should be taken into consideration.

iii. The crucial role of the family-group in transmitting the culture should be recognized. This means, as an individual is the member of a family, the role of the family in shaping his/her behavior should never be ignored.

iv. The specific method of conversion of organic material into social behaviour should be clearly demonstrated. For instance, case-histories that discuss in detail how basically a biological organism, that is man, gradually transforms into a social person are particularly important.

v. The constant transformation of character of experience from childhood to adulthood should be emphasized. That is, the life-history should portray the inter-relationship between the individual's various experiences during his/her life span. Such a study provides a comprehensive understanding of an individual's life as a continuum.

vi. The 'social situation' that contributed to the individual's gradual transformation should carefully and continuously be specified as a

factor. One of the crucial criteria for life-history is that an individual's life should be depicted as evolving itself in the context of a specific social situation and partially caused by it.

vii. The life-history details themselves should be organized according to some conceptual framework, which in turn would facilitate their generalizations at higher levels.

These criteria discussed by Dollard emphasize the specific link of co-ordinated, related, continuous and configured experience in a cultural pattern that motivated the social and personal behavior. Although, the criteria indicated by Dollard are principally perfect, some of them are difficult to put to practice.

Dollard (1935) attempted to express the diverse events depicted in the life-histories of persons during the course of repeated interviews by utilizing psycho-analytical techniques in a given situational context. His criteria of life-history originated directly from this experience. While the life-histories possess independent significance as research documents, the interviews recorded by the investigators can afford, as Dollard observed, "rich insights into the nature of the social situations experienced by them".

It is a well-known fact that an individual's life is very complex. Till date there is hardly any technique that can establish some kind of uniformity, and as a result ensure the cumulative of case-history materials by isolating the complex totality of a human life. Nevertheless, although case history data are difficult to put to rigorous analysis, a skilful handling and interpretation of such data could help in developing insights into cultural conflicts and problems arising out of cultural-change.

Gordon Allport in (Kothari 1988) has recommended the following aspects so as to broaden the perspective of case-study data:

i. If the life-history is written in first person, it should be as comprehensive and coherent as possible.

ii. Life-histories must be written for knowledgeable persons, that is, if the enquiry of study is sociological in nature, the researcher should 25 write it on the assumption that it would be read largely by sociologists only.

iii. It would be advisable to supplement case study data by observational, statistical and historical data, as they provide standards for assessing the reliability and consistency of the case study materials. Further, such data offer a basis for generalizations.

iv. Efforts must be made to verify the reliability of life-history data by examining the internal consistency of the collected material, and by repeating the interviews with the concerned person. Besides this, personal interviews with the persons who are well-acquainted with him/her, belonging to his/her own group should be conducted.

v. A judicious combination of different techniques for data-collection is crucial for collecting data that are culturally meaningful and scientifically significant.

vi. Life-histories or case-histories may be considered as an adequate basis for generalization to the extent that they are typical or representative of a certain group.

vii. The researcher engaged in the collection of case study data should never ignore the unique or typical cases. He/she should include them as exceptional cases.

Case histories are filled with valuable information of a personal or private nature. Such information not only helps the researcher to portray the personality of the individual, but also the social background that contributed to it. Besides, it also helps in the formulation of relevant hypotheses. In general, although Blummer (in Wilkinson and Bhandarkar, 1979) was critical of documentary material, he gave due credit to case histories by acknowledging the fact that the personal documents offer an opportunity to the researcher to develop his/her spirit of enquiry. The analysis of a particular subject would be more effective if the researcher acquires close acquaintance with it through personal documents. However, Blummer also acknowledges the limitations of the personal documents. According to him, such documents do not entirely fulfil the criteria of adequacy, reliability, and representativeness. Despite these shortcomings, avoiding their use in any scientific study of personal life would be wrong, as these documents become necessary and significant for both theory-building and practice. In spite of these formidable limitations, case study data are used by anthropologists, sociologists, economists and industrial psychiatrists. Gordon Allport (Kothari, 1988) strongly recommends the use of case study data for in-depth analysis of a subject. For, it is one's acquaintance with an individual that creates a desire to know his/her nature and understand them. The first stage involves understanding the individual and all the complexity of his/her nature. As a consequence, the important emotional organizations, anchorages and natural identifications characterizing the personal life of the individual might not yield adequate representation. Hence, the researcher should understand the life of the subject. Therefore, the totality of life-

processes reflected in the well-ordered life-history documents become invaluable source of stimulating insights. Such life-history documents provide the basis for comparisons that contribute to statistical generalizations and help to draw inferences regarding the uniformities in human behaviour, which are of great value.

1.6 Hypothesis:

"Hypothesis may be defined as a proposition or a set of propositions set forth as an explanation for the occurrence of some specified group of phenomena either asserted merely as a provisional conjecture to guide some investigation in the light of established facts" (Kothari, 1988). A research hypothesis is quite often a predictive statement, which is capable of being tested using scientific methods that involve an independent and some dependent variables. For instance, the following statements may be considered:

i. "Students who take tuitions perform better than the others who do not receive tuitions" or,
ii. "The female students perform as well as the male student

These two statements are hypotheses that can be objectively verified and tested. Thus, they indicate that a hypothesis states what one is looking for. Besides, it is a proposition that can be put to test in order to examine its validity. A hypothesis should have the following characteristic features.

i. A hypothesis must be precise and clear. If it is not precise and clear, then the inferences drawn on its basis would not be reliable.

ii. A hypothesis must be capable of being put to test. Quite often, the research programmes fail owing to its incapability of being subject to testing for validity. Therefore, some prior study may be conducted by the researcher in order to make a hypothesis testable. A hypothesis "is tested if other deductions can be made from it, which in turn can be confirmed or disproved by observation" (Kothari, 1988).

iii. A hypothesis must state relationship between two variables, in the case of relational hypotheses.

iv. A hypothesis must be specific and limited in scope. This is because a simpler hypothesis generally would be easier to test for the researcher. And therefore, he/she must formulate such hypotheses.

v. As far as possible, a hypothesis must be stated in the simplest language, so as to make it understood by all concerned. However, it should be noted that simplicity of a hypothesis is not related to its significance.

vi. A hypothesis must be consistent and derived from the most known facts. In other words, it should be consistent with a substantial body of established facts. That is, it must be in the form of a statement which is most likely to occur.

vii. A hypothesis must be amenable to testing within a stipulated or reasonable period of time. No matter how excellent a hypothesis, a researcher should not use it if it cannot be tested within a given period of time, as no one can afford to spend a life-time on collecting data to test it.

viii. A hypothesis should state the facts that give rise to the necessity of looking for an explanation. This is to say that by using the hypothesis, and other known and accepted generalizations, a researcher must be able to derive the original problem condition. Therefore, a hypothesis should explain what it actually wants to explain, and for this it should also have an empirical reference.

1.6.1 Concepts Relating to Testing of Hypotheses:

Testing of hypotheses requires a researcher to be familiar with various concepts concerned with it such as:

1) Null Hypothesis and Alternative Hypothesis:

In the context of statistical analysis, hypotheses are of two types viz., null hypothesis and alternative hypothesis. When two methods A and B are compared on their relative superiority, and it is assumed that both the methods are equally good, then such a statement is called as the null hypothesis. On the other hand, if method A is considered relatively superior to method B, or vice-versa, then such a statement is known as an alternative hypothesis. The null hypothesis is expressed as $\mathbf{H}_0$, while the alternative hypothesis is expressed as H_a. For example, if a researcher wants to test the hypothesis that the population mean (μ) is equal to the hypothesized mean (H_0) = 100, then the null hypothesis should be stated as the population mean is equal to the hypothesized mean 100. Symbolically it may be written as:-

H_0: = μ = μ H_0 = 100

If sample results do not support this null hypothesis, then it should be concluded that something else is true. The conclusion of rejecting the null

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hypothesis is called as alternative hypothesis H_1. To put it in simple words, the set of alternatives to the null hypothesis is termed as the alternative hypothesis. If H_0 is accepted, then it implies that H_a is being rejected. On the other hand, if H_0 is rejected, it means that H_a is being accepted. For H_0: $\mu = \mu$ $H_0 = 100$, the following three possible alternative hypotheses may be considered:

Alternative hypothesis	To be read as follows
H1: $\mu \neq \mu$ H0	The alternative hypothesis is that the population mean is not equal to 100, i.e., it could be greater than or less than 100
H1 : $\mu > \mu$ H0	The alternative hypothesis is that the population mean is greater than 100
H1 : $\mu < \mu$ H0	The alternative hypothesis is that the population mean is less than 100

2) Test of Hypothesis or Decision Rule:

Suppose the given hypothesis is H_0 and the alternative hypothesis H_1, then the researcher has to make a rule known as the decision rule. According to the decision rule, the researcher accepts or rejects H_0. For example, if the H_0 is that certain students are good against the H_1 that all the students are good, then the researcher should decide the number of items to be tested and the criteria on the basis of which to accept or reject the hypothesis.

3) Type I and Type II Errors:

As regards the testing of hypotheses, a researcher can make basically two types of errors. He/she may reject H_0 when it is true, or accept H_0 when it is not true. The former is called as Type I error and the latter is known as Type II error. In other words, Type I error implies the rejection of a hypothesis when it must have been accepted, while Type II error implies the

acceptance of a hypothesis which must have been rejected. Type I error is denoted by α (alpha) and is known as α error, while Type II error is usually denoted by β (beta) and is known as β error.

4) One-Tailed and Two-Tailed Tests:

These two types of tests are very important in the context of hypothesis testing. A two-tailed test rejects the null hypothesis, when the sample mean is significantly greater or lower than the hypothesized value of the mean of the population. Such a test is suitable when the null hypothesis is some specified value; the alternative hypothesis is a value that is not equal to the specified value of the null hypothesis.

1.6.2 Procedure of Hypothesis Testing:

Testing a hypothesis refers to verifying whether the hypothesis is valid or not. Hypothesis testing attempts to check whether to accept or not to accept the null hypothesis. The procedure of hypothesis testing includes all the steps that a researcher undertakes for making a choice between the two alternative actions of rejecting or accepting a null hypothesis. The various steps involved in hypothesis testing are as follows:

1) Making a formal statement:

This step involves making a formal statement of the null hypothesis (H_0) and the alternative hypothesis (H_a). This implies that the hypotheses should be clearly stated within the purview of the research problem. For example, suppose a school teacher wants to test the understanding capacity of the students which must be rated more than 90 per cent in terms of marks, the hypotheses may be stated as follows:

Null Hypothesis H_0 : = 100 Alternative Hypothesis H_1 : > 100

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2) Selecting a Significance Level:

The hypotheses should be tested on a pre-determined level of significance, which should be specified. Usually, either 5% level or 1% level is considered for the purpose. The factors that determine the levels of significance are: (a) the magnitude of difference between the sample means; (b) the sample size: (c) the variability of measurements within samples; and (d) whether the hypothesis is directional or non-directional (Kothari, 1988). In sum, the level of significance should be sufficient in the context of the nature and purpose of enquiry.

3) Deciding the distribution to use:

After making decision on the level of significance for hypothesis testing, the researcher has to next determine the appropriate sampling distribution. The choice to be made generally relates to normal distribution and the t-distribution. The rules governing the selection of the correct distribution are similar to the ones already discussed with respect to estimation.

4) Selection of a random Sample and computing an appropriate Value:

5) Calculation of the probability:

The next step for the researcher is to calculate the probability that the sample result would diverge as far as it can from expectations, under the situation when the null hypothesis is actually true.

6) Comparing the Probability:

Another step involved consists of making a comparison of the probability calculated with the specified value of α, i.e. the significance level. If the calculated probability works out to be equal to or smaller than the value in

case of one-tailed test, then the null hypothesis is to be rejected. On the other hand, if the calculated probability is greater, then the null hypothesis is to be accepted. In case the null hypothesis H_0 is rejected, the researcher runs the risk of committing the Type I error. But, if the null hypothesis H_0 is accepted, then it involves some risk (which cannot be specified in size as long as H_0 is vague and not specific) of committing the Type II error.

1.7 Levels of Measurement: Before we can conduct a statistical analysis, we need to measure our dependent variable. Exactly how the measurement is carried out depends on the type of variable involved in the analysis. Different types are measured differently. To measure the time taken to respond to a stimulus, you might use a stop watch. Stop watches are of no use, of course, when it comes to measuring someone's attitude towards a political candidate. A rating scale is more appropriate in this case (with labels like "very favorable," "somewhat favorable," etc.). For a dependent variable such as "favorite color," you can simply note the color-word (like "red") that the subject offers. Although procedures for measurement differ in many ways, they can be classified using a few fundamental categories. In a given category, all of the procedures share some properties that are important for you to know about. The categories are called "scale types," or just "scales," and are described in this section. A higher level of measurement provides a better opportunity for statistical analysis and interpretation of data.

Nominal scales

In nominal level numbers are assigned to objects or events which can be placed into mutually exclusive and exhaustive categories. When measuring

using a nominal scale, one simply names or categorizes responses. Gender, handedness, favorite color, and religion are examples of variables measured on a nominal scale. The essential point about nominal scales is that they do not imply any ordering among the responses. For example, when classifying people according to their favorite color, there is no sense in which green is placed "ahead of" blue. Responses are merely categorized. Nominal scales embody the lowest level of measurement.

Ordinal scales

In ordinal level numbers are assigned to objects or events which can be placed into mutually exclusive and exhaustive categories and be ordered into a greater or less than scale. A researcher wishing to measure consumers' satisfaction with their microwave ovens might ask them to specify their feelings as either "very dissatisfied," "somewhat dissatisfied," "somewhat satisfied," or "very satisfied." The items in this scale are ordered, ranging from least to most satishfied. This is what distinguishes ordinal from nominal scales. Unlike nominal scales, ordinal scales allow comparisons of the degree to which two subjects possess the dependent variable. For example, our satisfaction ordering makes it meaningful to assert that one person is more satisfied than another with their microwave ovens. Such an assertion reflects the first person's use of a verbal label that comes later in the list than the label chosen by the second person.

On the other hand, ordinal scales fail to capture important information that will be present in the other scales we examine. In particular, the difference between two levels of an ordinal scale cannot be assumed to be the same as the difference between two other levels. In our satisfaction

scale, for example, the difference between the responses "very dissatisfied" and "somewhat dissatisfied" is probably not equivalent to the difference between "somewhat dissatisfied" and "somewhat satisfied." Nothing in our measurement procedure allows us to determine whether the two differences reflect the same difference in psychological satisfaction. Statisticians express this point by saying that the differences between adjacent scale values do not necessarily represent equal intervals on the underlying scale giving rise to the measurements. (In our case, the underlying scale is the true feeling of satisfaction, which we are trying to measure.)

What if the researcher had measured satisfaction by asking consumers to indicate their level of satisfaction by choosing a number from one to four? Would the difference between the responses of one and two necessarily reflect the same difference in satisfaction as the difference between the responses two and three? The answer is No. Changing the response format to numbers does not change the meaning of the scale. We still are in no position to assert that the mental step from 1 to 2 (for example) is the same as the mental step from 3 to 4.

Interval scales

In interval level numbers are assigned to objects or events which can be categorized, ordered and assumed to have an equal distance between scale values. Interval scales are numerical scales in which intervals have the same interpretation throughout. As an example, consider the Fahrenheit scale of temperature. The difference between 30 degrees and 40 degrees represents the same temperature difference as the difference between 80 degrees and

90 degrees. This is because each 10-degree interval has the same physical meaning (in terms of the kinetic energy of molecules).

Interval scales are not perfect, however. In particular, they do not have a true zero point even if one of the scaled values happens to carry the name "zero." The Fahrenheit scale illustrates the issue. Zero degrees Fahrenheit does not represent the complete absence of temperature (the absence of any molecular kinetic energy). In reality, the label "zero" is applied to its temperature for quite accidental reasons connected to the history of temperature measurement. Since an interval scale has no true zero point, it does not make sense to compute ratios of temperatures. For example, there is no sense in which the ratio of 40 to 20 degrees Fahrenheit is the same as the ratio of 100 to 50 degrees; no interesting physical property is preserved across the two ratios. After all, if the "zero" label were applied at the temperature that Fahrenheit happens to label as 10 degrees, the two ratios would instead be 30 to 10 and 90 to 40, no longer the same! For this reason, it does not make sense to say that 80 degrees is "twice as hot" as 40 degrees. Such a claim would depend on an arbitrary decision about where to "start" the temperature scale, namely, what temperature to call zero (whereas the claim is intended to make a more fundamental assertion about the underlying physical reality).

Ratio scales

In interval level numbers are assigned to objects or events which can be categorized, ordered and assumed to have an equal distance between scale values and have a real zero point. The ratio scale of measurement is the most informative scale and it is the highest level of measurement as it has

all the properties of nominal, ordinal, interval scales, plus an absolute zero point. It is an interval scale with the additional property that its zero position indicates the absence of the quantity being measured. You can think of a ratio scale as the three earlier scales rolled up in one. Like a nominal scale, it provides a name or category for each object (the numbers serve as labels). Like an ordinal scale, the objects are ordered (in terms of the ordering of the numbers). Like an interval scale, the same difference at two places on the scale has the same meaning. And in addition, the same ratio at two places on the scale also carries the same meaning.

The Fahrenheit scale for temperature has an arbitrary zero point and is therefore not a ratio scale. However, zero on the Kelvin scale is absolute zero. This makes the Kelvin scale a ratio scale. For example, if one temperature is twice as high as another as measured on the Kelvin scale, then it has twice the kinetic energy of the other temperature.

Level/Scale	Central Tendency
Nominal	Mode
Ordinal	Median
Interval	Mean deviation
Ratio	Geometric mean, Coefficient of Variation

1.8 Assessment of Reliability and Validity:

Assessing the reliability of study findings requires researchers to make judgments about the 'soundness' of the research in relation to the application and appropriateness of the methods undertaken and the integrity of the final conclusions. Reliability refers to the consistency of a measure.

Researchers consider three types of consistency: over time (test-retest reliability), across items (internal consistency), and across different researchers (inter-rater reliability).

1. Test-Retest Reliability: When researchers measure a construct that they assume to be consistent across time, then the scores they obtain should also be consistent across time. Test-retest reliability is the extent to which this is actually the case. For example, intelligence is generally thought to be consistent across time. A person who is highly intelligent today will be highly intelligent next week. This means that any good measure of intelligence should produce roughly the same scores for this individual next week as it does today. Clearly, a measure that produces highly inconsistent scores over time cannot be a very good measure of a construct that is supposed to be consistent. Assessing test-retest reliability requires using the measure on a group of people at one time, using it again on the *same* group of people at a later time, and then looking at test-retest correlation between the two sets of scores. This is typically done by graphing the data in a scatter plot and computing Pearson's *r*. In general, a test-retest correlation of +0.80 or greater is considered to indicate good reliability. Again, high test-retest correlations make sense when the construct being measured is assumed to be consistent over time, which is the case for intelligence, self-esteem, and the Big Five personality dimensions. But other constructs are not assumed to be stable over time. The very nature of mood, for example, is that it changes. So a measure of mood that produced a low test-retest correlation over a period of a month would not be a cause for concern.

2. Internal Consistency: A second kind of reliability is internal consistency, which is the consistency of people's responses across the items on a multiple-item measure. In general, all the items on such measures are supposed to reflect the same underlying construct, so people's scores on those items should be correlated with each other. On the Rosenberg Self-Esteem Scale, people who agree that they are a person of worth should tend to agree that that they have a number of good qualities. If people's responses to the different items are not correlated with each other, then it would no longer make sense to claim that they are all measuring the same underlying construct. This is as true for behavioural and physiological measures as for self-report measures. For example, people might make a series of bets in a simulated game of roulette as a measure of their level of risk seeking. This measure would be internally consistent to the extent that individual participants' bets were consistently high or low across trials. Like test-retest reliability, internal consistency can only be assessed by collecting and analyzing data. One approach is to look at a split-half correlation. This involves splitting the items into two sets, such as the first and second halves of the items or the even- and odd-numbered items. Then a score is computed for each set of items, and the relationship between the two sets of scores is examined. A split-half correlation of +0.80 or greater is generally considered good internal consistency. Perhaps the most common measure of internal consistency used by researchers in psychology is a statistic called Cronbach's α (the Greek letter alpha). Conceptually, α is the mean of all possible split-half correlations for a set of items. For example, there are 252 ways to split a set of 10 items into two sets of five. Cronbach's α would be

the mean of the 252 split-half correlations. Note that this is not how α is actually computed, but it is a correct way of interpreting the meaning of this statistic. Again, a value of 0+.80 or greater is generally taken to indicate good internal consistency.

3. Interrater Reliability: Many behavioural measures involve significant judgment on the part of an observer or a rater. Inter-rater reliability is the extent to which different observers are consistent in their judgments. For example, if you were interested in measuring university students' social skills, you could make video recordings of them as they interacted with another student whom they are meeting for the first time. Then you could have two or more observers watch the videos and rate each student's level of social skills. To the extent that each participant does in fact have some level of social skills that can be detected by an attentive observer, different observers' ratings should be highly correlated with each other. Inter-rater reliability would also have been measured in Bandura's Bobo doll study. In this case, the observers' ratings of how many acts of aggression a particular child committed while playing with the Bobo doll should have been highly positively correlated. Interrater reliability is often assessed using **Cronbach's α** when the judgments are quantitative or an analogous statistic called Cohen's κ (the Greek letter kappa) when they are categorical.

Validity is the extent to which the scores from a measure represent the variable they are intended to. But how do researchers make this judgment? We have already considered one factor that they take into account—reliability. When a measure has good test-retest reliability and internal consistency, researchers should be more confident that the scores represent

what they are supposed to. There has to be more to it, however, because a measure can be extremely reliable but have no validity whatsoever. As an absurd example, imagine someone who believes that people's index finger length reflects their self-esteem and therefore tries to measure self-esteem by holding a ruler up to people's index fingers. Although this measure would have extremely good test-retest reliability, it would have absolutely no validity. The fact that one person's index finger is a centimetre longer than another's would indicate nothing about which one had higher self-esteem. Discussions of validity usually divide it into several distinct "types." But a good way to interpret these types is that they are other kinds of evidence—in addition to reliability—that should be taken into account when judging the validity of a measure. Here we consider three basic kinds: face validity, content validity, and criterion validity.

1. Face validity is the extent to which a measurement method appears "on its face" to measure the construct of interest. Most people would expect a self-esteem questionnaire to include items about whether they see themselves as a person of worth and whether they think they have good qualities. So a questionnaire that included these kinds of items would have good face validity. The finger-length method of measuring self-esteem, on the other hand, seems to have nothing to do with self-esteem and therefore has poor face validity. Although face validity can be assessed quantitatively—for example, by having a large sample of people rate a measure in terms of whether it appears to measure what it is intended to—it is usually assessed informally. Face validity is at best a very weak kind of evidence that a measurement method is measuring what it is supposed to.

One reason is that it is based on people's intuitions about human behaviour, which are frequently wrong. It is also the case that many established measures in psychology work quite well despite lacking face validity. The Minnesota Multiphasic Personality Inventory-2 (MMPI-2) measures many personality characteristics and disorders by having people decide whether each of over 567 different statements applies to them—where many of the statements do not have any obvious relationship to the construct that they measure. For example, the items "I enjoy detective or mystery stories" and "The sight of blood doesn't frighten me or make me sick" both measure the suppression of aggression. In this case, it is not the participants' literal answers to these questions that are of interest, but rather whether the pattern of the participants' responses to a series of questions matches those of individuals who tend to suppress their aggression.

2. Content validity is the extent to which a measure "covers" the construct of interest. For example, if a researcher conceptually defines test anxiety as involving both sympathetic nervous system activation (leading to nervous feelings) and negative thoughts, then his measure of test anxiety should include items about both nervous feelings and negative thoughts. Or consider that attitudes are usually defined as involving thoughts, feelings, and actions toward something. By this conceptual definition, a person has a positive attitude toward exercise to the extent that he or she thinks positive thoughts about exercising, feels good about exercising, and actually exercises. So to have good content validity, a measure of people's attitudes toward exercise would have to reflect all three of these aspects. Like face validity, content validity is not usually assessed quantitatively. Instead, it is

assessed by carefully checking the measurement method against the conceptual definition of the construct.

3. Criterion validity is the extent to which people's scores on a measure are correlated with other variables (known as criteria) that one would expect them to be correlated with. For example, people's scores on a new measure of test anxiety should be negatively correlated with their performance on an important school exam. If it were found that people's scores were in fact negatively correlated with their exam performance, then this would be a piece of evidence that these scores really represent people's test anxiety. But if it were found that people scored equally well on the exam regardless of their test anxiety scores, then this would cast doubt on the validity of the measure. A criterion can be any variable that one has reason to think should be correlated with the construct being measured, and there will usually be many of them. For example, one would expect test anxiety scores to be negatively correlated with exam performance and course grades and positively correlated with general anxiety and with blood pressure during an exam or imagine that a researcher develops a new measure of physical risk taking. People's scores on this measure should be correlated with their participation in "extreme" activities such as snowboarding and rock climbing, the number of speeding tickets they have received, and even the number of broken bones they have had over the years. When the criterion is measured at the same time as the construct, criterion validity is referred to as concurrent validity; however, when the criterion is measured at some point in the future (after the construct has been measured), it is referred to as predictive validity (because scores on the measure have "predicted" a

future outcome). Criteria can also include other measures of the same construct. For example, one would expect new measures of test anxiety or physical risk taking to be positively correlated with existing measures of the same constructs. This is known as convergent validity. Assessing convergent validity requires collecting data using the measure. Researchers John Cacioppo and Richard Petty did this when they created their self-report Need for Cognition Scale to measure how much people value and engage in thinking (Cacioppo & Petty, 1982). In a series of studies, they showed that people's scores were positively correlated with their scores on a standardized academic achievement test, and that their scores were negatively correlated with their scores on a measure of dogmatism (which represents a tendency toward obedience). In the years since it was created, the Need for Cognition Scale has been used in literally hundreds of studies and has been shown to be correlated with a wide variety of other variables, including the effectiveness of an advertisement, interest in politics, and juror decisions (Petty, Briñol, Loersch, & McCaslin, 2009).

4. Discriminant validity, on the other hand, is the extent to which scores on a measure are not correlated with measures of variables that are conceptually distinct. For example, self-esteem is a general attitude toward the self that is fairly stable over time. It is not the same as mood, which is how good or bad one happens to be feeling right now. So people's scores on a new measure of self-esteem should not be very highly correlated with their moods. If the new measure of self-esteem were highly correlated with a measure of mood, it could be argued that the new measure is not really measuring self-esteem; it is measuring mood instead. When they created the

Need for Cognition Scale, Cacioppo and Petty also provided evidence of discriminant validity by showing that people's scores were not correlated with certain other variables. For example, they found only a weak correlation between people's need for cognition and a measure of their cognitive style—the extent to which they tend to think analytically by breaking ideas into smaller parts or holistically in terms of "the big picture." They also found no correlation between people's need for cognition and measures of their test anxiety and their tendency to respond in socially desirable ways. All these low correlations provide evidence that the measure is reflecting a conceptually distinct construct.

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