
UNIT 3 VARIABLES AND CONSTRUCTS

Structure

- 3.0 Introduction
- 3.1 Objectives
- 3.2 Meaning of Variables
- 3.3 Types of Variables
 - 3.3.1 Stimulus, Organism and Response Variables
 - 3.3.2 Independent and Dependent Variables
 - 3.3.3 Extraneous and Confounded Variables
 - 3.3.4 Active and Attribute Variables
 - 3.3.5 Quantitative and Categorical Variables
 - 3.3.6 Continuous Variables and Discrete Variables
- 3.4 Constructs
- 3.5 Types of Constructs
 - 3.5.1 Intervening Variables
 - 3.5.2 Hypothetical Constructs
- 3.6 Let Us Sum Up
- 3.7 Unit End Questions
- 3.8 Glossary
- 3.9 Suggested Readings and References

3.0 INTRODUCTION

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. It 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 are described.

3.1 OBJECTIVES

After reading this unit, you will be able to:

- Define the term variable and construct;

- Discuss the types of variable and constructs;
- Identify different types of variables i.e. independent variable, dependent variable, extraneous variables etc. in a research study;
- Distinguish between variable and constructs; and
- Differentiate hypothetical concept and intervening variable.

3.2 MEANING OF VARIABLES

A variable, as the name implies, is something that varies. This is the simplest way of defining a variable.

Webster says that a variable is “a thing that is changeable” 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 ‘a property that taken as 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.

Self Assessment Questions

- | | |
|--|-------|
| 1) Variable is a property that taken as different values. | T / F |
| 2) Unchangeable physiological and psychological characteristics of organism are called the organism variables. | T / F |
| 3) Variable are tangible. | T / F |
| 4) Variables are not related to theoretical concepts. | T / F |
| 5) Variables can be manipulated, controlled or observed by the experimenter. | T / F |

Answers: (1) T, (2) F, (3) T, (4) F, (5) T

Before discussing the types of variables, it is important to know how the variables of study related to theoretical concepts. Because the variables 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; murders committed; books written. The theoretical concept is intangible: hunger, motivation, anxiety. The variables are related to the theoretical concepts by means of the operational definitions 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 definitions. The theory is an abstract statement. For example, anxiety can be measured by the Anxiety Scale and affiliation by 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 generated the experiment.

3.3 TYPES OF VARIABLES

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

3.3.1 Stimulus, Organism and Response 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 responses 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 resistant of the rat at the time of shock was introduced 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).

3.3.2 Independent and Dependent Variables

An *independent variable* or stimulus variable (as Underwood calls it) is that factor manipulated or selected by the experimenter in his 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 experimental 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. He may manipulate the noise by dividing into three categories — continuous noise, intermittent noise and no noise and 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 is here 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 he can get an appropriate representation from different age groups ranging from say, 16 to 55 years. Subsequently, 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 constitutes 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 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.

Self Assessment Questions

Identify the independent and dependent variables?

- 1) As the number of trials increases error decreases.

.....

.....

.....

.....

.....

.....

2) Intensity of lights affects the task performance.

.....

.....

.....

.....

.....

3) Healthy parent child relationship facilitated emotional adjustment of the children.

.....

.....

.....

.....

.....

4) Teaching methods affects learning.

.....

.....

.....

.....

.....

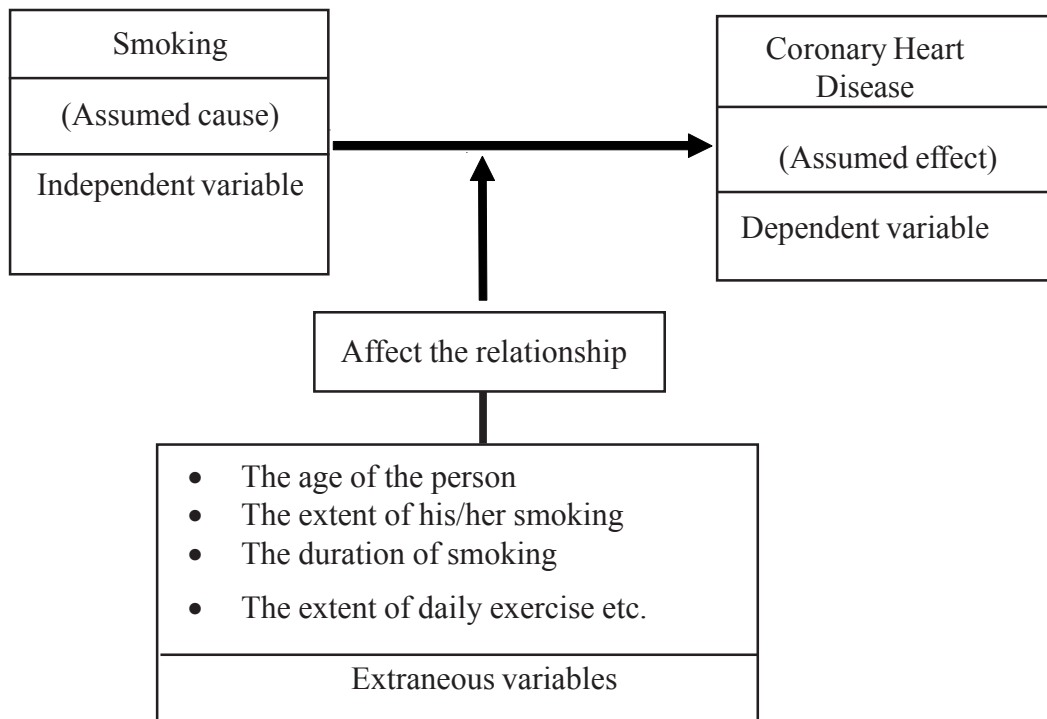
3.3.3 Extraneous and Confounded Variables

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 affect. 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 others factors operating in a real life situation may affect changes in the dependent variable. These factors, not measured in the study, 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 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 variables 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 that affecting this relationship, such as a 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.

Independent, dependent & extraneous variables in a causal relationship



3.3.4 Active and Attribute Variables

Any variable that is manipulated is called *active variables*. 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 human characteristics like intelligence, Aptitudes, sex, socio economic status, education, field dependence and need for achievement are the example of attributes 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.

3.3.5 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 (Labor, Liberal, Democrat); and attitudes (strongly favorable, favorable, uncertain, unfavorable, strongly unfavorable), it s called a polytomous variable.

Self Assessment Questions

- 1) The event manipulated or altered by the experimenter is termed as
.....
- 2) The is the response that the person or animal makes.
- 3) Any and all other variables that may mask the relationship between independent variable and dependent variables are known as
- 4) Manipulated variables are called and measures variable are called
- 5) is one that varies in amount whereas varies in kind.

Answer: (1) Independent variables (2) Dependent variables (3) Extraneous variables (4) Active variables, Attribute variables (5) Quantitative variables & Categorical variables.

3.3.6 Continuous Variables 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 constitutes the examples of a discrete variable.

Activity -1

Check whether the following are continuous or discrete variables:

	C	D
a) the bar presses that a rat makes in a Skinner box	()	()
b) the height of six-year-old boys and girls in Chicago	()	()
c) the score you make on a true-false exam	()	()
d) the distance various people can travel in 5 hours	()	()

Activity -2**Identity Types of Variables**

A researcher wants to administer an intelligence test to 30 college students. After collecting information on subjects' age, sex, height, weight, political preference, career goals, and socioeconomic status, the researcher administers and attitude survey on current issues to all 30 subjects.

Required:

Identify examples of the following types of variables in the paragraph and the scales by which they would be measured:

- a) discrete
- b) continuous
- c) categorical
- d) quantitative

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 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 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 observations of the intelligence of children by administering X 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.

3.5 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

3.5.1 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 know, 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.

3.5.2 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. 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 variables (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

Which of the following constructs (as used) would be classified as an Intervening Variable(IV) or a Hypothetical Construct (HC)?

	IV	HC
1) Thinking is the mental activity leading to problem solving.	()	()
2) Arousal is the increase in neural activity in the lower brain stem following stimulation.	()	()
3) A reinforcement is something that makes you want to repeat the behaviour that was rewarded.	()	()
4) The id is the deepest part of the psyche and motivates our "base" desires.	()	()

3.6 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 variables is a term which is internal and directly unobservable psychological processes that, in turn, 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.

3.7 UNIT END QUESTIONS

- 1) Defined 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. Giving suitable example elucidate the different types of variables.
- 4) Write short notes on any two:
 - i) Independent & dependent variables.
 - ii) Quantitative & categorical variables.
 - iii) Active & attribute variables.
- 5) Explain the nature of extraneous variable with suitable examples.

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 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

Alberto, P.A. & Troutman, A.C. (2006). *Applied Behaviour Analysis for Teachers* (7th ed). Columbus: OH: Merrill.

D'Amato, M. R. (1970). *Experimental Psychology: Methodology, Psychophysics and Learning*. Tokyo: McGraw-Hill Kogakusha, Ltd.

Hilgard, E., & Bower, G. *Theories of Learning*. New York: Appleton-Century-Crofts.

Kerlinger, F. N. (1986). *Foundations of Behavioural Research*. New York: Holt Rinehart and Winston.

Bourne, L.E., Ekstrand, B., & Dominowski, R. 1971. *The Psychology of Thinking*. Englewood Cliffs, N.J.: Prentice-Hall.

MacCorquodale, K., & Meehl, P.E.(1948). On a distinction between hypothetical constructs and intervening variables. *Psychological Review*, 55, 95-107.

Postman, L. and Egan, J.P. (1949). *Experimental Psychology*. New York; Harper & Row

Townsend, J. C. (1953). *Introduction to Experimental Methods*. New York: McGraw-Hill.