Research problems and variables

Abstract: The research process starts with a question regarding the relationship between two or more variables. These variables are usually classified as independent variables, which can either be active or attribute; dependent variables; or extraneous variables. Considerations about variables are discussed, including the levels of an independent variable and groups or sets of variables.

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RESEARCH PROBLEMS

The research process begins with a problem. What is a research problem? Kerlinger (1986) describes a problem as "… an interrogative sentence or statement that asks: 'What relation exists between two or more variables?'" (p. 16). Kerlinger suggests that prior to the problem statement, "… the scientist usually experiences an obstacle to understanding, a vague unrest about observed and unobserved phenomena, a curiosity as to 'why something is as it is'" (p. 11). For example, Harmon et al. (1984) investigated the problem of whether the motivation to master new skills or challenging tasks could be measured in infants and, if so, what factors seemed to influence the amount of such mastery motivation. The general problem might have been stated as, What variables are related to an infant's mastery motivation?

VARIABLES

A variable must be able to vary or have different values. For example, gender is a variable because it has 2 values, female or male. Age is a variable that has a large number of values. Type of treatment/intervention is a variable if there is more than one treatment or a treatment and a control group. Mastery motivation is a variable like age that can have many ordered levels. However, if we are studying only girls, gender is not a variable; it is a constant. Thus, we can define the term variable as a characteristic of the participants or situation that has different values in a study.

Operational Definitions of Variables

An operational definition describes or defines a variable in terms of the operations used to produce it or techniques used to measure it. Demographic variables like age or ethnic group are usually measured by checking official records or simply by asking the participant to choose the appropriate category from among those listed. Treatments are described so the reader knows what the researcher meant by, for example, cognitive therapy. Likewise, abstract concepts like mastery motivation need to be defined operationally by spelling out in some detail how they were measured. To do this, the investigator may provide sample questions, append the instrument, or provide a reference where more information can be found.

Independent Variables

Active Independent Variables. An active independent variable (Kerlinger, 1986) is also called a manipulated variable. A frequent goal of research is to investigate the effect of a particular intervention. When studying an active independent variable, an intervention/treatment is given to a group of participants (experimental) but not to another (control group), within a specified period of time during the study. Thus, a pretest and posttest should be possible. Active independent variables are given or administered to the participants but are not necessarily manipulated by the experimenter. They may be given by a clinic or some person other than the investigator.

Attribute Independent Variables. Unlike some researchers, we do not restrict the term independent variable to those variables that are manipulated or active. We define an independent variable more broadly to include any predictors, antecedents, or presumed causes or influences under investigation in the study. Attributes of the participants would fit within this definition. Type of disability (or level of disability) may be the major focus of a study and qualify as an independent variable because it is a presumed influence on behavior and can have different values. For example, cerebral palsy is different from Down syndrome, which is different from spina bifida, yet all are types of disability. However, disabilities are usually present when we begin a study, and a pretest is not possible, so disability is not an active variable. Research with attribute independent variables is sometimes called ex post facto; experiments are studies with an active independent variable.

A variable that is not manipulated is called an attribute independent variable because it is an attribute of the person (e.g., gender, age, and ethnic group) or the person's usual environment (e.g., child abuse). For ethical and practical reasons, many aspects of the environment (e.g., child abuse) cannot be manipulated or given and are thus attribute variables. This distinction between active and attribute independent variables is important for deter-

mining what can be said about cause and effect.

Dependent Variables

The dependent variable is the outcome or criterion. It is assumed to measure or assess the effect of the independent variable. Dependent variables are scores from a test, ratings on questionnaires, or readings from instruments (e.g., electrocardiogram). It is common for a study to have several dependent variables (e.g., performance and satisfaction).

Extraneous Variables

These are variables that are not of interest in a particular study but could influence the dependent variable. Environmental factors (e.g., temperature or distractions), time of day, other attributes of the participants, and characteristics of the investigator or therapist are some possible extraneous variables that need to be controlled by methods such as holding them constant, randomization, statistics, or matching.

Levels of a Variable

The word level is commonly used to describe the values of an independent variable. This does not necessarily imply that the values are ordered from low to high. Suppose an investigator was interested primarily in comparing 2 different treatments and a third no-treatment control group. The study could be conceptualized as having 1 independent variable, treatment type, with 3 levels, the 2 treatment conditions and the control condition.

Other Considerations About Variables

Many studies have independent variables that have a few levels and dependent variables that have many ordered levels. However, in the associational/correlational approach, both independent and dependent variables usually have many ordered levels. In later articles we will discuss different combinations of independent and dependent variables and how they are analyzed.

Some variables (e.g., mastery motivation or self-concept) could be either the independent variable or dependent variable (or even an extraneous variable), depending on the study. Such variables are usually a changeable characteristic of the participant (such as an attitude or personality characteristic); if used as independent variables, they are attribute independent variables.

Individual participants do not have to vary on a characteristic or variable—it is the group that must have more than one value (e.g., some men and some women). However, in some studies participants may change over time. In these studies, there are repeated measures of the same variable (e.g., a pretest and a posttest on math knowledge).

Groups or Sets of Variables

In analyzing research articles, it is sometimes difficult to distinguish between variables and the levels of variables. In complex studies researchers have many variables, so they often group them into what might be called sets of similar variables. For example, the variables age, gender, education, and marital status could be grouped together and be referred to collectively as demographics. Similarly, SAT verbal and quantitative scores could be called scholastic aptitude scores. Confusion arises if one mistakenly assumes that the sets or groups of variables (demographics and SAT scores) are the variables and the actual variables (age, gender, SAT verbal, etc.) are the levels.

How can one avoid this confusion? Thoughtful reading is the key, but remember that a variable has to have at least 2 levels. Thus, if something varies from low to high (e.g., age or SAT verbal) in this study or has 2 or more nominal values, it has to be a variable, not a level. If treated as a single value (e.g., female), it is either a level or a constant (i.e., not a variable in this study). This distinction is critical for deciding what statistics to use.

The Mastery Motivation Problem Revisited

Let us now identify the variables used in the studies on mastery motivation reported by Harmon et al. (1984). The article discussed a comparison of 3 groups of infants: abused, neglected, and low risk. This attribute independent variable, perhaps called risk type, had 3 levels. Another attribute independent variable, gestational status, had 2 levels, preterm and full term, that were compared. Intervention and nonintervention groups were also compared; they formed an active independent variable called intervention type. The dependent variables were several aspects of mastery motivation (task persistence and causality pleasure). Note that mastery motivation is not a single variable but rather a set of 2 variables, each varying from low to high. Age would not be a variable if all the infants were 12 months gestational age. Thus, the problem might be stated more specifically as, What is the relationship of risk type, gestational status, and intervention type to mastery motivation?

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