Chapter 3

VARIABLES AND HYPOTHESES

Fraenkel & Wallen (2006). *How to design and evaluate research in education (6th ed.).* Boston: McGraw-Hill.

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VARIABLES AND HYPOTHESES

- The importance of studying relationships
- Variables
- What is a variable?
- Hypotheses
- What is hypothesis?

VARIABLES

- Quatitative versus Categorical Variables
- Independent versus Dependent Variables
- Moderator Variables
- Extraneous Variables
- Confounding Variables

HYPOTHESES

- Research Hypothesis
- Null Hypothesis
- Alternative Hypothesis
- Directional Hypothesis
- Nondirectional Hypothesis

The importance of studying relationships

- The relationship between voter gender and party affiliation

Group A		Group B	
Republican		Republican	
M 8	F 8	M 14	F 2
Democrat		Democrat	
M 8	F 8	M 2	F 14

The importance of studying relationships

- The hypothetical data for Group A show that out of 32 voters 16 are Republicans and 16 Democrats. It also shows that half are male and half are female.
- Group B also shows the same breakdown by gender and party affiliation. Republicans 14 M and 2 F Democrats 2 M and 14 F.
- In Group A, there is no relationship between gender and party affiliation.
- In Group B, there is a strong relationship between these two factors.
- We can say that males tend to Republicans and females tend to be Democrats.
- We can also express this relationship in terms of a prediction. If another female joins Group B, we would predict she would be a Democrat.

The importance of studying relationships

- **Many research questions suggest a relationship to be investigated.**
- **Some research questions try to find out how people think or feel or behave in a particular situation through obtaining descriptive information.**
- **In some other cases the purpose of research is to describe a particular program or activity.**
- **Let's have a look at such questions:**

Research questions ...

- **How do parents of the English prep class feel about the counseling program?**
- **What changes would the staff like to see in the ELT program?**
- **Has the number of students graduating from English-medium secondary schools enrolling in the EPS as compared to Turkish-medium secondary schools changed over the last four years?**
- **How does the reading course in the new ELT program differ from the one used in the previous program?**
- **What does a teacher teaching English at intermediate level do?**

Research questions ...

- These questions do not suggest investigating a relationship.
- The researcher only wants to identify characteristics, behaviors, feelings, or thoughts. Such information may be necessary as a preliminary step for designing other research.
- Answers to purely descriptive research questions may help us learn what happened, where, when and even how, BUT NOT WHY. They do not help us understand WHY people feel, or think, or behave in a certain way, why programs possess certain characteristics, etc.
- As a result, our understanding of a situation, group, or phenomenon is limited. Therefore, ...

Research questions ...

- **Scientists highly value research questions that suggest relationships to be investigated, because the answers to them help explain the nature of the world in which we live. We learn to understand the world by learning to explain how parts of it are related. We begin to detect patterns, or connections between the parts.**
- **Understanding is generally enhanced by the demonstration of relationships or connections. Therefore, scientists are in favor of the formation of a hypothesis that predicts the existence of a relationship or in some cases non-existence of a relationship (to show that it is erroneous although a widespread belief).**

What is a variable?

- We need to understand the idea of variables since a relationship is a statement about variables.
- A variable is a concept – a noun that stands for variation within a class of objects such as chair, gender, eye color, achievement, motivation, style etc.
- The individual members in the class of objects must vary to qualify the class as a variable. If all members of a class are identical, we do not have a variable. Such characteristics are called constants, since the individual members of the class are not allowed to vary, but rather are held constant.

What is a variable?

- **Example studying: Effects of reinforcement on student achievement.**
- **The researcher systematically divides a clarge class of ninth-graders into three smaller subgroups. Teachers are trained to reinforce their students in different ways. Teachers reinforce:**

  Group 1 → by giving verbal praise,

  Group 2 → by giving money rewards

  Group 3 → giving extra points
- **In this study reinforcement is a variable (it contains three variations) and the grade level (ninth-graders) is a constant.**
- **Variables must be defined as clearly as possible so that they can be measured or manipulated. (Examples: chair and motivation for definition)**

Classifying variables

- **Quantitative** vs **Categorical Variables**
- **Independent** vs **Dependent Variables**

  - Manipulated Var.
  - Selected Var.
  - Experimental Var.
  - Treatment Var.
  - Orgasmic or Attribute Var.

  - Outcome variable (quantative)

- **Moderator Variables (Mediating Variables)**
- **Control Variables (Constant)**
- **Confounding Variables (Uncontrolled)**
  - Intervening Variables
  - Extraneous Variables

Classifying variables

- **Variables can be classified in several ways:**
- **Quantitative vs Categorical Variables**
- **Quantitative variables are those that exist in some degree along a continuum from less to more to which we can assign numbers. Examples: height, weight, price, aptitude etc.**
- **Categorical variables are those that do not change in degree, amount or quantity, but are qualitatively different. (Examples: categories of different types of trees, different teaching methods, different animals)**

Classifying variables

- **Variables can be classified in several ways:**
- **Independent vs Dependent Variables**
- **Independent variables are those that the researcher chooses to study in order to assess their possible effect(s) on one or more other variables.**
- **An independent variable is presumed to affect or influence at least one other variable.**
- **The variable that the independent variable is presumed to affect is called a dependent variable.**
- **Independent variables may be either manipulated (created by the researcher) or selected (from an existing one)**
- **Under experimental conditions more variables are created. They are called manipulated variables, experimental variables, or treatment variables.**
- **The dependent variable which is quantitative is referred to as an outcome variable.**

Classifying variables

- **Moderator Variables (Mediating Variables)**
- **A moderator variable is a special type of independent variable. It is a secondary independent variable that has been selected for study in order to determine if it affects or modifies the basic relationship between the primary independent variable and the dependent variable. (See the example in your book, p. 44)**

Classifying variables

- **Control Variables (Constant)**
- **In the experiment of reinforcement methods in three groups, reinforcement is an independent variable, achievement is a dependent variable, the class level, the ninth-graders is a constant (See the example in your book, p. 40).**

Classifying variables

- **Confounding Variables (Uncontrolled)**
  - **Intervening Variables**
  - **Extraneous Variables**

    These variables are independent variables that have not been controlled by the researcher. The principal comparing the final examination scores of two groups taught by teachers using different methods cannot control differences in:

    - **class size**
    - **gender of students**
    - **age of teachers**
    - **time of the day class meets etc.**

    One way to control extraneous variables is to hold them constant.

Classifying variables

- **Confounding Variables (Uncontrolled)**
  - **History:** The longer times between pretest and posttest measurements, for example, weight, height or other environmental factors.
  - **Testing:** Subjects may gain proficiency through repeated practice on measuring instruments
  - **Selection:** Two groups compared should be equivalent before the manipulation begins.
  - **Attrition:** Some subjects may be lost, become ill, go on vacation, forget their appointments, lose their interest, etc.
  - **Instrumentation:** Change of the measuring instrument, change of the observer etc.
  - And many other factors that cannot be controlled during experimentation or treatment and can be **threats to internal validity**.

Hypotheses

- Research Hypothesis
- Null Hypothesis
- Alternative Hypotheses
- Directional vs Nondirectional Hypotheses

Hypotheses

- **Research Hypothesis**
- **A research hypothesis is a prediction of the possible outcomes of a study.**
- **Students taught history by a teacher of the same gender like the subject more than students taught by a teacher of a different gender.**
- **The dependent variable: liking for the history.**
- **The independent variable: gender of the teacher.**
- **Possible extraneous variables: age, ability, personality & the like of both teachers and students.**

Hypotheses

- **Null Hypothesis**
- **A null hypothesis states that differences are due to chance or that there are no differences between treatments used in statistical analysis.**
- **For example: The new form of psychoteraphy is no better than either no teraphy or conventional teraphies.**

Hypotheses

- **Alternative Hypotheses**
- **Alternative hypotheses suggest that results are due to factors other than the independent variable. These factors, rather than the independent variable, may cause the result. Alternative hypotheses develop due to confounding/extraneous variables.**

Hypotheses

- **Directional vs Nondirectional Hypotheses**
- **A directional hypothesis shows the specific direction (higher, lower, more, less) that a researcher expects to emerge in a relationship.**
- **Ex. Second-graders like school less than they like watching television.**
- **A nondirectional does not make a specific prediction about what direction the outcome of a study will take. When the researcher suspects that there is relationship but has no basis for predicting the direction of the relationship, s/he formulates a nondirectional hypothesis.**
- **Ex. First-, second, and third-graders will feel differently toward school.**

Thanks for your patience!