Chapter 2

Behavioral Variability and Research

Chapter Outline

Variability and the Research Process
Variance: An Index of Variability
Systematic and Error Variance
Effect Size: Assessing the Strength of Relationships
Meta-Analysis: Systematic Variance Across Studies

Key Terms

descriptive statistics
effect size
inferential statistics
mean
meta-analysis
range
statistical notation
systemic variance
total sum of squares
total variance
variability
variance
effect size
Variability as an Organizing Heuristic

I originally wrote *Introduction to Behavioral Research Methods* because none of the textbooks I had used in my course offered students a framework for organizing all of the pieces of information they had learned. I started using variability as an organizing heuristic in my own course when I realized that I thought about measurement, methodological, and statistical problems in my own research from the standpoint of variability. When I ran up against a problem, question, or decision about which of alternative methods to use, I found myself asking "How can I design the study so that it is most likely to help me understand the variability in my data?"

Incorporating variability as an organizing theme into the book required a chapter quite unlike any I had seen in research methods books up to that time—one that introduced students to the concept of variability and set the stage for the rest of the book. In Chapter 2, I present five propositions about the relationship between variability and the research process:

1. Psychology and other behavioral sciences involve the study of behavioral variability.
2. Research questions in all behavioral sciences are questions about behavioral variability.
3. Research should be designed in a manner that best allows the researcher to answer questions about behavioral variability.
4. The measurement of behavior involves the assessment of behavioral variability.
5. Statistical analyses are used to describe and account for the observed variability.
in the behavioral data.

Once they grasp the importance and nature of variability, students are able to think about many of the topics covered in later chapters in sophisticated ways. Instructors can help this process if they also link their lectures to variability when possible. Thus, I encourage you to look for ways to use variability as an integrative theme.

**Meta-Analysis**

Meta-analysis has become an increasingly popular technique in the past decade, and students should have at least an intuitive understanding what it involves. I had difficulty deciding where to discuss meta-analysis in the text, finally settling on Chapter 2 (pp. 44-46). Some instructors may wish to deal with meta-analysis in greater detail than I did in the book and, for them, I recommend the following article:

Test Questions

Multiple Choice Questions

1. Psychologists study behavioral variability
   a. among individuals
   b. across situations
   c. over time
   d. as a function of age
   * e. all of the above

2. Behavioral research should be designed so that
   * a. the researcher can identify factors that are related to behavioral variability
   b. behavioral variability is eliminated
   c. variability among participants is maximized
   d. behavioral variability is due to only one factor
   e. participants’ behavior does not vary across conditions

3. When measuring behavior, researchers want the variability in the numbers they assign to participants’ responses to
   a. be as small as possible
   b. be as large as possible
   * c. correspond to the variability in participants’ responses
   d. be unrelated to variables they are investigating
   e. be affected by their manipulation of the dependent variable

4. Statistics that are used to draw conclusions about the reliability and generalizability of one’s findings are called
a. the range and variance  
b. descriptive statistics  
c. effect sizes  
* d. inferential statistics  
e. meta-analyses

5. The variance
* a. reflects the degree to which participants’ scores differ from the mean of the scores  
b. is a measure of skewness  
c. is inferior to the range as a measure of variability  
d. is the sum of participants’ scores divided by the number of scores  
e. all of the above

6. What is the range of these scores: 2,4,4,7,6,5,3,5,9,4?
   a. 10  
   * b. 7  
   c. 2  
   d. 49  
   e. none of the above

7. What is the mean of the following scores: 2,4,5,6,8?
   a. 6  
   b. 25  
   c. 4  
   *d. 5  
   e. none of the above
8. Which of the following is the statistical formula for the mean?
   a. $y_i - \bar{y}$
   b. $\sum (y_i - \bar{y})^2$
   * c. $\frac{\sum y_i}{n}$
   d. $\frac{\sum (y_i - \bar{y})^2}{n - 1}$
   e. $\frac{\sum y_i}{n}$

9. If we calculate the deviation scores ($y_i - \bar{y}$) for all of the observations in a set of data and add them, what will the sum be?
   a. the mean
   * b. zero
   c. the sum of squares
   d. 1
   e. the variance

10. The sum of the squared deviations of participants’ scores from the mean is called
    a. the standard deviation
    b. the range
    * c. the total sum of squares
    d. zero
    e. the variance

11. In statistical notation, $n$ is the symbol for the
    * a. sample size
    b. mean
    c. variance
    d. range
e. effect size

12. Variance in a behavior that is related to variables that an investigator is investigating is
* a. systematic variance
b. standard variance
c. error variance
d. total variance
e. none of the above

13. Variance in a behavior that is not related to the variables that an investigator is investigating is
   a. systematic variance
   b. standard variance
* c. error variance
d. total variance
e. none of the above

14. In an experiment that examined the effects of room temperature on aggression, systematic variance would be caused by
   a. error variance
   b. participants’ personalities
   c. aggression
* d. differences in temperature e. the dependent variable

15. Which of the following would not contribute to error variance in an experiment?
   a. the personalities of the participants
16. Error variance

* a. obscures the effects of the variables in which the researcher is primarily interested

b. should be maximized

c. is always caused by researchers’ mistakes

d. creates effects that are opposite to those predicted by the researcher

e. always leads researchers to draw incorrect conclusions from their data

17. Statistics that express the strength of relationships are called measures of

* a. variability

b. strong inference

c. error variance

d. statistical notation

* e. strength of association

18. When the relationship between two variables is "perfect,"

a. one variable causes the other

b. the effect size is zero

* c. all of the variability is systematic variance

  d. the hypothesis is confirmed

  e. the ratio of systematic variance to error variance is 50:50

19. According to your book, researchers regard a relationship between two variables as
relatively large if the proportion of systematic variance to total variance is at least

- a. .01
- b. .10
- *c. .15
- d. .50
- e. .85

20. A procedure that is used to analyze and integrate the results across a set of individual studies is called

    * a. meta-analysis
    
- b. effect size
- c. systematic induction
- d. strength of association
- e. inferential statistics

21. An index of the strength of the relationship between variables is often called the

- a. meta-effect
- * b. effect size
- c. systematic variance
- d. proportion of yield
- e. associative index

22. Compared to the effect sizes found in other sciences, including the biomedical sciences, the effect sizes in psychology are

- a. smaller
- b. larger
- *c. about the same size
d. more likely to be due to error variance

e. more variable

**Short Answer Questions**

1. In what sense may it be said that psychology is the study of behavioral variability?

2. Describe the difference between descriptive and inferential statistics.

3. What does the variance tell us about a set of data?

4. Why is the variance preferred over the range as an index of variability?

5. What is the formula for the variance?

6. What is the total sum of squares?

7. Tell what each of the following statistical symbols represents:
   a. $\bar{y}$
   b. $\sum (y_i - \bar{y})^2 / n - 1$
   c. $s^2$
   d. $n$
   e. $\sum$

8. Distinguish between systematic and error variance.

9. Would researchers like their data to contain more systematic variance or more error variance? Explain.

10. What are some factors than can contribute to error variance?

11. Statistics that express the strength of relationships are called _______.

12. What is a perfect relationship?
13. What does it mean if the measure of strength of association is .20? .00? 1.00?

14. What is meta-analysis?

15. In meta-analysis, what does the effect size tell us?

**Calculation Problems**

1. Calculate the variance of the following data: 5, 1, 0, 2, 0, 3, 9, 7, 8, 6, 3
   
   *Answer: 9.61*

2. Calculate the variance of the following scores: 8, 9, 3, 12, 10, 8, 0, 4, 7, 11, 13

   *Answer: 14.59*