dCHAPTER 2
THE SCIENTIFIC METHOD

CHAPTER OUTLINE AND OBJECTIVES

I. Scientific and Everyday Approaches to Knowledge

The scientific method is empirical and requires systematic, controlled observation.

Scientists gain the greatest control when they conduct an experiment; in an experiment, researchers manipulate independent variables to determine their effect on behavior.

Dependent variables are measures of behavior used to assess the effects of independent variables.

Scientific reporting is unbiased and objective; clear communication of constructs occurs when operational definitions are used.

Scientific instruments are accurate and precise; physical and psychological measurement should be valid and reliable.

A hypothesis is a tentative explanation for a phenomenon; testable hypotheses have clearly defined concepts (operational definitions), are not circular, and refer to concepts that can be observed.

A. General Approach and Attitude
B. Observation
C. Concepts
D. Reporting
E. Instruments
F. Measurement
G. Hypotheses

II. Goals of the Scientific Method

The scientific method is intended to meet four goals: description, prediction, explanation, and application.

A. Description

Psychologists seek to describe events and relationships between variables; most often, researchers use the nomothetic approach and quantitative analysis.

B. Prediction

Correlational relationships allow psychologists to predict behavior or events, but do not allow psychologists to infer what causes these relationships.

C. Explanation

Psychologists understand the cause of a phenomenon when the three conditions for causal

inference are met: covariation, time-order relationship, and elimination of plausible alternative causes.

The experimental method, in which researchers manipulate independent variables to determine their effect on dependent variables, establishes time order and allows a clearer determination of covariation.

Plausible alternative causes for a relationship are eliminated if there are no confoundings in a study.

Researchers seek to generalize a study's findings to describe different populations, settings, and conditions.

D. Application

In applied research, psychologists apply their knowledge and research methods to improve people's lives.

Psychologists conduct basic research to gain knowledge about behavior and mental processes and to test theories.

III. Scientific Theory Construction and Testing

Theories are proposed explanations for the causes of phenomena, and they vary in scope and level of explanation.

A scientific theory is a logically organized set of propositions that defines events, describes relationships among events, and explains the occurrence of events.

Intervening variables are concepts used in theories to explain why independent and dependent variables are related.

Successful scientific theories organize empirical knowledge, guide research by offering testable hypotheses, and survive rigorous testing.

Researchers evaluate theories by judging the theory's internal consistency, observing whether hypothesized outcomes occur when the theory is tested, and noting whether the theory makes precise predictions based on parsimonious explanations.

IV. Summary

REVIEW QUESTIONS AND ANSWERS

These review questions appear in the textbook (without answers) at the end of Chapter 2, and can be used for a homework assignment or exam preparation. Answers to these questions appear in italic.

1. For each of the following characteristics, distinguish between the scientific approach and everyday approaches to knowledge: general approach and attitude, observation, concepts, reporting, instruments, measurement, and hypotheses.

As summarized in Table 2.1, the scientific approach differs from nonscientific (everyday) approaches to knowledge in the following ways. For each characteristic a description of the scientific approach appears first followed by a description of the nonscientific approach in parentheses. General Approach: empirical (intuitive); Observation: systematic and controlled (casual and uncontrolled); Concepts: clear definitions and operational specificity (ambiguous and with surplus meaning); Reporting: unbiased and objective (biased and subjective); Instruments: accurate and precise (inaccurate and imprecise); Measurement: valid and reliable (not valid or reliable); Hypotheses: testable (not testable). (p. 28)

2. Differentiate between an independent variable and a dependent variable, and provide an example of each that could be used in an experiment.

   An independent variable is the factor a researcher manipulates with at least two levels in order to determine its effect on behavior; a dependent variable is the measure of behavior used by the researcher to determine the effect of the independent variable (if any). An example of an independent variable is when some type of treatment is assessed, such as the effects of alcohol on people's performance on complex tasks. Participants in an experimental condition would receive the treatment (alcohol present); participants in the control would not receive the treatment (alcohol absent). The dependent variable would be some measure of performance on a complex task, such as errors on a video game. (Note: Students' examples of independent and dependent variables may vary.) (pp. 32-33)

3. What is the major advantage of using operational definitions in psychology? In what two ways has the use of operational definitions been criticized?

   The major advantage of operational definitions is clarity of communication. The two major criticisms are that: (1) there is no specified limit to the number of operational definitions of a concept; and (2) operational definitions are not always meaningful or valid. (pp. 34-35)

4. Distinguish between the accuracy and the precision of a measuring instrument.

   Accuracy of a measuring instrument refers to the differences between the reading taken from the instrument and the value that is known to be true. A scale that registers a value of 200 when a 200-pound weight is placed on it is accurate. Precision of a measuring instrument refers to the level at which an event is measured. Timing an event in milliseconds is more precise than timing the event in whole seconds. (p. 36)

5. What is the difference between the validity of a measure and the reliability of a measure?

   The validity of a measure refers to its "truthfulness," that is, a valid measure is one that measures what it claims to measure. The reliability of a measure refers to the consistency of the measure. That is, a reliable measure consistently indicates the same value. (p. 38)

6. Which three types of hypotheses lack the critical characteristic of being testable?

   Hypotheses are not testable if they: (1) refer to concepts that are not adequately defined or measured (i.e., operational definitions); (2) are circular; and (3) do appeal to forces or ideas not recognized by science. (p. 40)

7. Identify the four goals of the scientific method and briefly describe what each goal is intended to accomplish.

   The goals of the scientific method are description, prediction, explanation, and application. Psychologists seek to describe events and relationships between variables, predict behavior and events, understand and explain the causes of phenomena, and apply their knowledge and research methods to improve people's lives. (pp. 40-41)

8. Distinguish between the nomothetic approach and the idiographic approach in terms of who is studied and the nature of the generalizations that are sought.

   The nomothetic approach is used in science with the goal of establishing broad generalizations and universal "laws" that apply to a diverse population. Research studies following this approach are frequently characterized by large numbers of participants with an interest in the "average" performance of a group of individuals. The idiographic approach emphasizes the uniqueness of the individual and the necessity of studying individuals in depth, for example, by using single-case research. (pp. 42-43)

9. Identify two differences between quantitative and qualitative research.

   In quantitative research, a study's findings are summarized using statistical summaries and analyses. Qualitative research, in contrast, produces verbal summaries of research findings with no statistical analyses. A second difference is that in qualitative research, investigators ask participants to describe their experiences in ways that are meaningful to the participants, whereas in quantitative research, participants frequently are asked to record their experiences using categories and dimensions determined by the researchers. (p. 44)

10. What are researchers able to do when they know that two variables are correlated?

    Researchers are able to form predictions when two variables are correlated. A correlation exists when two different measures of the same people, events, or things vary together—that is, particular scores on one variable tend to be associated with particular scores on another variable. Correlations provide the basis for scientific prediction. When two variables are correlated, if we know values for one variable we can predict values for the second variable. (p. 45)

11. Give an example from a research study described in the text that illustrates each of the three conditions for a causal inference. [You may use the same example for more than one condition.]

    The three conditions for a causal inference are: covariation of events; a time-order relationship, that is, a cause precedes an effect; and elimination of plausible alternative causes. In the text example, an instructor examines whether using personal response systems ("clickers") in the classroom helps students learn. She compares two different teaching approaches, clicker and no-clicker. A finding that students' subsequent performance in the clicker classroom is better than that of the other group would demonstrate that teaching approach and performance covary. Because changes in the independent variable (teaching approach) precede subsequent performance differences, the time-order condition for a causal inference is met. Finally, by avoiding all confoundings (e.g., clickers tested in the morning, and no-clicker in the afternoon), plausible alternative explanations for the findings are eliminated. (pp. 47-49)

12. What is the difference between basic and applied research?

Applied research comprises research that seeks knowledge that will improve a situation; basic research is research that seeks knowledge to increase understanding of behavior and mental processes, and to test theories. Applied research is often conducted in "real-world" settings; basic research is often conducted in laboratory settings. (p. 49)

13. What is an intervening variable? Propose a psychological construct that could serve as an intervening variable between "insult" (present/absent) and "aggressive responses." Explain how these variables might be related by proposing a hypothesis that includes your intervening variable.

    An intervening variable is a concept used in theories to explain why independent and dependent variables are related. The intervening variable is used to explain the process that links or "goes between" the independent and dependent variables—that is, the process that explains why the independent variable affects the dependent variable. As an example, suppose a researcher manipulated the presence or absence of an insult given to research participants, and subsequently measured their aggressive responses. One possible intervening variable might be "anger." If participants who are insulted respond in a more aggressive manner than participants who are not insulted, the researcher could propose that the insulted participants became angry, which could explain their aggressive responses. (pp. 51-52)

14. Describe the roles of logical consistency and empirical testing in evaluating a scientific theory.

    The first step in evaluating a theory is to consider whether it is logical–does the theory make sense and are its propositions free of contradictions. This involves discussions among the scientific community regarding a theory's definitions and explanations for the occurrence of events described by the theory. The second critical step when evaluating a theory is to test its hypotheses using controlled, empirical observation and testing. Successful tests of a hypothesis increase the acceptability of a theory; unsuccessful tests decrease a theory's acceptability. (p. 53)

15. Explain why rigorous tests of a theory that seek to falsify a theory's propositions can be more informative than tests that seek to confirm a theory's propositions.

    Although tests that confirm a theory's propositions provide support for the theory, alternative theories of the same phenomenon are not ruled out. Tests that falsify a theory help to eliminate or rule out alternative explanations of phenomena. (pp. 53-54)

CHALLENGE QUESTIONS AND ANSWERS

These questions appear in the textbook at the end of Chapter 2, and can be used for a homework assignment, in-class discussion, or exam preparation. Answers to these questions appear in italic below.

NOTE: The focus of the first question is the identification of independent and dependent variables, and also provides an opportunity to discuss operational definitions.
[*Answer to Challenge Question 1 also appears in the text.*]

1. In each of the following descriptions of research studies, you are to identify the independent variable(s). You should also be able to identify at least one dependent variable in each study.

    A. A psychologist was interested in the effect of food deprivation on motor activity. She assigned

each of 60 rats to one of four conditions differing in the length of time for which the animals were deprived of food: 0 hours, 8 hours, 16 hours, 24 hours. She then measured the amount of time the animals spent in the activity wheel in their cages.

IV: hours of food deprivation with four levels (0,8,16,24)
DV: time (e.g., in minutes) animals spent in activity wheel

B. A physical education instructor was interested in specifying the changes in motor coordination that occur as children gain experience with large playground equipment (e.g., slides, swings, climbing walls). For a span of 8 weeks, preschool children were assigned to 4, 6, or 8 hours per week for time allowed on the equipment. She then tested their motor coordination by asking them to skip, jump, and stand on one foot.

IV: time on playground equipment with three levels: 4, 6, or 8 hours per week
DV: scores on test of motor coordination

C. A developmental psychologist was interested in the amount of verbal behavior very young children displayed depending on who else was present. The children in the study were 3 years old. These children were observed in a laboratory setting for a 30-minute period. Half of the children were assigned to a condition in which an adult was present with the child during the session. The other half of the children were assigned to a condition in which another young child was present during the session with the child being observed. The psychologist measured the number, duration, and complexity of the verbal utterances of each observed child.

IV: additional person present with two levels (adult, child)
DV: number, duration, and complexity of child's verbal utterances

2. A psychologist conducted an experiment to test the hypothesis that individuals embedded in their in-group culture would be less likely to help a stranger. College students were recruited to respond to Aa brief survey about their campus experience@ near the entrance to the student activity center. The first testing session took place early in the semester. To activate identification with their university (embeddedness), these participants were given a clipboard and asked to write down three things they like about their university. Twenty students were tested. The second testing session took place on two afternoons during the last week of classes at the same location. In this control condition (low-embedded situation), twenty new students were asked to write down three things they plan to do during break.

In each condition, immediately after each participant returned the clipboard to the psychologist, a student research assistant, wearing a sweatshirt with the name of a rival school, walked by the pair and Aaccidentally@ dropped a file containing papers near the participant. The psychologist recorded whether the participant helped pick up the papers. Results indicated that, as predicted, participants in the embedded condition were less likely to help than participants in the control condition. The psychologist concluded that identification with an in-group (embeddedness) causes people to offer less help to a stranger.

A. Identify the independent variable of interest to the psychologist (and its levels) and the dependent variable.

The independent variable of interest is embeddedness (or identification) with an in-group with two levels, embedded and control. The dependent variable is helping, measured by whether each participant helped to pick up papers.

B. What potentially relevant independent variable is confounded with the psychologist=s independent variable? Explain clearly how the confounding occurred and describe the conclusions that can be made about the effects of embeddedness on helping.

Another potentially relevant variable is time of the semester participants were tested. The confounding occurred because all the participants in the embedded condition were tested early in the semester and all the participants in the control condition were tested during the last week. The psychologist concluded that being embedded in an in-group causes people to be less helpful. Because of the confounding, however, it is also possible to conclude that participants are more helpful at the end of an academic term than at the beginning of the term.

C. Suggest ways in which the experiment could be done so the psychologist could make a clear conclusion about the effect of identification with an in-group (embeddedness) and helping a stranger.

To break the confounding, the psychologist should conduct the experiment during one time period, such as the end of the semester. To manipulate embeddedness, half of the participants could write about what they like at their university (embedded condition), and half could write about their plans for break (control). The psychologist could alternate which condition is tested, or flip a coin to determine which condition each participant would receive.

3. In a widely distributed news report in March 2013, researchers linked 180,000 obesity-related deaths worldwide (including about 25,000 in America) to the consumption of sugary beverages such as soda, energy and sports drinks. Using 2010 data from the Global Burden of Diseases Study collected by the World Health Organization, the researchers investigated obesity-related deaths due to diabetes, cardiovascular disease, and cancer. They also obtained data for the per-capita consumption of sugary beverages for the countries in the health study. As sugary-beverage consumption increased, the risk of obesity-related deaths increased. The researchers claimed that overall, 1 in 100 deaths of obese people globally is caused by drinking too many sweetened beverages. Prominent nutritionists have claimed that sugary beverages are a major contributor to the obesity epidemic in the United States. These data have been used by some government officials to call for limits on the size of soft drinks (e.g., New York's Bloomberg law).

A. The researchers claim that consumption of sugary beverages leads to an increased risk of obesity-related death, and argue that limiting sugary-beverage consumption is an important step in reducing obesity-related deaths. What evidence from this summary can be used to meet the conditions necessary for drawing this causal inference and what evidence is lacking?

This study is correlational. The researchers noted a covariation between per-capita consumption of sugary beverages and obesity-related deaths (diabetes, cardiovascular disease, cancer). Covariation is the first condition for making a causal inference. We can presume that the second condition, time-order relationship, is also met because consumption of sugary beverages cannot take place after death. However, the third condition, elimination of plausible alternative explanations, is not met. It is possible some third variable explains the relationship between consumption of sugary beverages and obesity-related deaths. For example, consuming sugary beverages may be associated with other dietary concerns (e.g., salt and fat intake) that increase risk of obesity and obesity-related death. Other potential third variables include amount of exercise or environmental factors.

B. What sources beyond this summary would you want to check before reaching a conclusion about these findings? [You might begin with www.cnn.com/2013/03/19/health/sugary-drinks-deaths.]

It would be important to read the original research report that describes these findings, rather than to rely on news reports. The March 19, 2013 news report was not based on published research, but on a poster presentation at a conference. Searching the scientific literature on obesity and consumption of sugary beverages would identify more research on this topic, including studies that attempt experimental control over the variables.

4. A study was done to determine whether the use of "clickers" as an instructional method would improve students' test performance in an educational psychology class (Mayer et al., 2009). In the clicker class (academic year 2005-'06), students used clickers to respond to multiple-choice questions during lectures. In the paper-and-pencil class (2006-'07), students responded to multiple-choice questions during lectures using a paper-and-pencil format. In the control condition (2004-'05), the instructor did not present multiple choice questions in lectures. Results for the midterm and final exams indicated that students in the clicker class performed better than students in the paper-and-pencil and control classes. The researchers concluded that the use of clickers during lectures helps students to perform better on tests, and suggested that the clickers help students to engage in appropriate cognitive processing during learning.

A. What evidence is present in this summary to meet the conditions for a causal inference between the instructional method and students' test performance? What evidence is lacking? (Be sure to describe the three conditions for a causal inference.)

The first condition required for a causal inference is covariation; that is, two variables must vary together or go together. This condition is met in the study with the evidence that test performance covaried with instructional method. Students receiving the clicker method performed better than students in the paper-and-pencil and control classes. The second condition for a causal inference is time-order relationship (or contingency). In this study, the researchers manipulated the teaching method using three levels (clicker, paper-and-pencil, control) and observed the dependent variable of test performance. Because the teaching preceded the tests, it would appear that a time-order relationship is present. The third condition for a causal inference is the elimination of plausible alternative causes. This condition is not met in this study because instructional method is confounded with the year each experimental condition was implemented. Students in the three different classes over the 3-year period may have differed in ways that could account for their test performance.

B. Identify the four goals of the scientific method and explain whether each is met on the basis of findings from this study.

Description could be met because test performance following the three different instructional methods can be described. Furthermore, prediction might be met because the researchers observed a relationship between the type of instructional method and test performance. Based on their findings, we might predict that students in a class using the clicker method will perform better than students who answer multiple-choice questions using a paper-and-pencil method and students who don=t answer multiple-choice questions (control). However, because of the confounding (i.e., instructional method is confounded with year), test performance may be predicted by the class year, not teaching method. An experiment is needed to achieve the goal of explanation, in this case, that the clicker method causes better test performance. Although these

researchers conducted an experiment by manipulating an independent variable (the instructional method) and observed the effect on the dependent variable (test performance), aspects of their procedure raise alternative explanations. For example, test performance may have differed for the three instructional methods because of differences among the students in the classes over the 3-year period. The goal of application may be met to the extent that additional research demonstrates that the use of clickers during lectures enhances students= learning.

ISSUES AND PROBLEMS FOR CLASS DISCUSSION

Presented below are suggestions and guides for in-class activities that allow students to think critically about Chapter 2 concepts.

1. Reading Research Critically

   This research summary and the accompanying questions could be used in class for small group discussion. The research summary and questions could be distributed to students in the class session prior to the scheduled discussion to allow time for students to prepare answers, perhaps as a homework assignment.
   Note: Answers to the questions for "Reading Research Critically" appear below. The research summary and questions appear on the subsequent page to facilitate photocopying. The Griskevicius et al. (2010) study is also described in the Hypotheses section of Chapter 2.

   Answers to 1. Reading Research Critically

   A. What is the independent variable in this study? Identify the specific levels of the independent variable.

      The independent variable in this experiment is "type of story" with two levels. In one condition, students were randomly assigned to read a story designed to activate their motive for status. In the second condition, the control condition, students read a neutral (non-status) story.

   B. What is the dependent variable in this study?

      The dependent variable in this experiment was participants' three product choices. They made three choices between a luxurious version of a product and a green version of the product.

   C. What information in the summary suggests that the major scientific goal of this study was explanation (i.e., how people make judgments about what they know)?

      In this experiment, Griskevicius et al. (2010) tried to control the experimental situation in order to explain the relationship between status motive and "green" choices. Using stories to activate students' motive, they manipulated the independent variable they believed would explain participants' product choices. Based on their results for the manipulated independent variable, they demonstrated that when status motives were activated, participants made more green choices, compared to a neutral condition.

   D. How do you think the authors would state the research hypothesis for this study?

      The intervening process under investigation in this experiment was motive, or desire, for status.

The hypothesis might be stated as follows: Participants whose status motive is activated, compared to participants in a control condition, will be more likely to choose environmentally friendly (green) products because choosing green products is associated with greater status.

Reading Research Critically

Read the following description of a research study to answer the questions that follow. [Based on the first experiment in an article by: Griskevicius, V., Tybur, J. M., & Van den Bergh, B. (2010). Going green to be seen: Status, reputation, and conspicuous conservation. *Journal of Personality and Social Psychology, 98,* 392-404. doi: 10.1037/a0017346

Status and "Green" Purchases

Why do people purchase environmentally friendly ("green") products, even when those items may cost more and may not be as luxurious as non-green products? Griskevicius, Tybur, and Van den Bergh (2010) argue that one reason may be people's desire for status. Based on a theory of altruism, purchasing green products represents a form of self-sacrifice–a choice to forego more luxurious items and instead make purchases that benefit the environment and society. Furthermore, a person's ability to pay more for these items signals to others that he or she has the resources and status to make an altruistic, green choice. Thus, consumers who choose green products may not be acting entirely unselfishly; they may perceive an increase in their own social status and prestige when they make green purchases. Griskevicius et al. refer to this as "competitive altruism." Based on this theory, these researchers attempted to "activate" people's motive (desire) for status to determine if they would then make more green choices.

To manipulate research participants' status motives, students (*N* = 168) who volunteered for the study were randomly assigned to read one of two stories. In the status condition, students read a story in which they imagined graduating from college, looking for a job, and then securing a position that offered opportunities for advancement. Details of the story focused on the high-status features of the workplace. Previous research with the story indicated that this story successfully increased participants' desire for social status and prestige. In the control condition, participants read a neutral story designed not to enhance desire for status. As they read this story, they imagined losing a concert ticket, searching and finding it, and then going to the concert. After reading the stories, participants were asked to complete a "product preference" measure, ostensibly as part of another study. Each participant considered three types of products (car, household cleaner, and dishwasher), and was asked to choose between a luxurious version of the product and an environmentally friendly (green) version. Results supported the researchers' hypothesis: Participants who read the status story, compared to the control story, were more likely to choose the green product for each of the three products.

A. What is the independent variable in this study? Identify the specific levels of the independent variable.

B. What is the dependent variable in this study?

C. What information in the summary suggests that the major scientific goal of this study was explanation (i.e., how people make "green" choices)?

D. How do you think the authors would state the research hypothesis for this study?

2. Examining Correlational Evidence

To help make the point that with only correlational evidence, the investigator can only hypothesize about possible causal factors underlying a relationship between variables, students can be asked to identify possible causal factors in the reports below; that is, they are asked to speculate on *why* events are correlated. In a preliminary step to research, the investigator considers possible causal factors, perhaps during discussions with other researchers. As a class or in small groups, students can speculate on causal factors in the following reports of covariation.

NOTE: To facilitate use for class handouts, the brief reports appear on the next page. Answers for the brief reports are presented below.

Answers to 2. Examining Correlational Evidence

A. When prospective employers view Facebook profiles, they use the information to make judgments about the job candidates. To the extent that employers value variables such as professionalism over use of drugs and alcohol, they likely judge candidates' profiles with the latter information more harshly.

B. How one eats and how much one eats can affect people's impressions, including judgments of attractiveness. Women are judged more attractive and more feminine when they're seen to eat fewer calories. Women adjust their food selection to conform to beliefs about what men find attractive as a means of impression management.

C. Popularity, as measured by the number of friendships, may be related to personality factors such as extraversion, sociability, and sensation-seeking, which may influence middle-school youth's likelihood of alcohol use. In addition, to the extent that drinking is perceived as "cool" and sociable, students with a greater the number of friends may experience more peer pressure to drink (simply because there are more friends around to exert pressure). It's also possible that as popular students spend more time with peers, they may have less parental monitoring of their behavior.

Examining Correlational Evidence

Instructions: Identify possible causal factors in each of the following reports. That is, *why* do you think the events are correlated? Note that by identifying potential causal factors, you are generating hypotheses regarding the relationships between variables.

A. A number of studies have demonstrated that the type of information posted on job applicants' Facebook profiles is related to the likelihood the job applicant will be offered a position. For example, profiles that emphasize family values or professionalism are related to increased likelihood of job offers, whereas profiles that contain information about use of drugs and alcohol are related to decreased likelihood of job offers. Why might this occur?

B. Researchers observed students' lunch and dinner choices at college cafeterias, and then converted the choices into the number of calories in their meals. When women ate with a male companion, they chose foods with fewer calories than did women who ate with another woman. Furthermore, the number of calories women selected decreased as the number of men in their dining group increased. The number of calories men selected was not related to the presence of men or women.

C. In a study of middle school youth, researchers observed a relationship between popularity and alcohol use. Popularity was measured by asking students to list five friends ("peer nominations"), and the number of peer nominations received by each student was summed. Subsequently, students responded to questions about their alcohol use. As the number of peer-nominated friendships increased, the likelihood of alcohol use also increased. Why might this occur?

3. Additional Challenge Questions

These challenge questions (along with the concepts illustrated in each question) can be used for class discussion or possible test questions.

A. Consider how you would respond if you read the following report in a newsletter.

Is your child's behavior out of control? While considering this question are you reaching for a cigarette to "calm" your nerves? Before you smoke it, consider this: Researchers investigated 2,356 children from ages 4 to 11 and found a direct link between parents who smoke and children with behavioral problems. Misbehavior increased with the number of cigarettes smoked by a parent. Smoking more than a pack a day increased behavioral problems 1.5 times; smoking less than a pack a day still increased problems 1.4 times. Researchers have several theories to explain this link, but the bottom line is this: *TO IMPROVE YOUR CHILD'S BEHAVIOR, GIVE UP YOUR SMOKING HABIT.*

The last sentence (the italic one) clearly implies a causal relationship between smoking and children's behavior. Explain why a causal relationship is not warranted on the basis of this study.

A covariation is present in that increased cigarette smoking is associated with increased behavioral problems. Thus, one may predict that the more parents smoke, the greater is the likelihood that they will have children with behavioral problems. However, correlation alone does not imply causation. Time-order is questionable. For example, perhaps the children's increased behavior problems lead to increased smoking (and not the opposite as was implied). Or perhaps the general level of tension in the home, a third variable (alternative explanation) influences both the parents' smoking and the children's behavior problems. We should not make a causal inference without more information and an analysis of additional variables.

B. A faculty adviser at a small college worked diligently over the summer to prepare an attractive brochure to give to her advisees when she first met them on campus. The brochure described the various ways the adviser could be helpful to the students, and the adviser hoped that using the brochure would increase the number of students who came in to see her early in the semester. To try to maximize the effectiveness of the brochure the adviser also worked hard at being especially upbeat and friendly during the first advising meeting with students. Seventy percent of the students who received the brochure came in to see her more than once, as compared to only 35% of the students who came in to see her the previous year (when no brochure was used). The adviser concluded that the brochure had the desired effect.

(1) What problem with the way the adviser carried out her study would lead you to be hesitant to conclude that the brochure was effective?

In addition to giving the students the brochure, the adviser also worked hard at being especially upbeat and friendly during the first advising meeting. It is not possible to determine whether it was the brochure or the adviser's attitude that led to the increase in the number of students coming to see her. This represents a confounding of the brochure variable and the adviser's attitude when meeting with students.
<u>NOTE:</u> Students may note other problems. For example, the comparison of the current year's students to the previous year's students may not be appropriate because the two groups of students may not be comparable; or events occurring on campus during the two years may have had different effects on the students' interest in seeing their adviser.

(2) On the basis of the problem you have identified would you be able to conclude that the brochure was not effective? Why or why not?

The confounding of the brochure and the adviser's attitude would NOT lead to the conclusion that the brochure had not been effective. It is possible that the brochure did work; but because of the way that the study was conducted (i.e., because of the confounding), it is impossible to determine whether the brochure did or did not have an effect on the students. All that we know for sure is that we can't conclude anything about the effectiveness of the treatment.

C. One of your friends who is taking introductory psychology this semester tells you about something her professor covered in class that was a little distressing for her. The professor described a study dealing with how satisfied married people are in their marriages. The professor emphasized that the study was very well done. For example, a large sample was used from a well-defined population and the measures of marital satisfaction were reliable and valid. The finding from the study that your friend found distressing was that, on average, 65% of the married people surveyed were less satisfied with their marriage than they had expected they would be. Your friend is now wondering whether this finding means that she will end up being less satisfied with her marriage someday.

(1) Identify whether the study described by your friend's professor in her introductory psychology class represents the nomothetic or idiographic approach to research in psychology.

The nomothetic approach involves studying large numbers of individuals and determining what organisms are like "in general," often based on the average or overall performance of a group. This study, because it is based on a large sample of married people and because it seeks to show what in general married people experience, is clearly an example of a nomothetic research study.

(2) Identify whether the study described in your friend's class represents qualitative or quantitative research.

The study is quantitative, not qualitative, because it is based on statistical summaries and analysis. For example, the findings are reported in terms of the percentage of people who are more or less satisfied with their marriages than they had expected to be.

(3) How would you respond to your friend's concern that these research results mean that she will end up being less satisfied with her marriage if she should someday get married?

The results of a nomothetic study apply to everyone and to no one at the same time. The overall percentage of people who are not as satisfied as they expected tells us what in general is true of married individuals. However, there is no way to know whether the friend will fall in the satisfied (35%) or not satisfied (65%) group. You can say there is a better than 50:50 chance that the friend's future marriage would be less satisfying than she expected, but there is no way, based on a nomothetic study, to say how satisfying any one individual's marriage will be.

D. A physiological psychologist developed a drug that she thought would revolutionize the world of

horse racing. She named the drug Speedo, and it was her contention that this drug would lead horses to run much faster than they do now. (For the sake of this hypothetical problem, we are ignoring the fact that it is illegal to give drugs to racehorses.) She selected two groups of horses and gave one of the groups injections of Speedo once a week for 4 weeks. Because Speedo was known to have some negative effects on the horses' digestive systems, those horses given the Speedo had to be placed on a special high-protein diet. Those horses not given the Speedo were maintained on their regular diet. After the 4-week period, all the horses were timed in a 2-mile race and the mean (average) times for the horses given Speedo were significantly faster than the mean times for those not given Speedo. The psychologist concluded that her drug was effective.

(1) Identify the independent variable of interest (and its levels) and a potentially relevant independent variable with which the primary independent variable is confounded. Explain clearly how the confounding occurred.

The independent variable of interest is the drug treatment with two levels, the Speedo condition and the no-drug (control) condition. Another potentially important independent variable in this example is the horses' diet, with two levels: high protein diet and regular diet. A confounding is present because the administration of the drug covaries with the presence of the high-protein diet. That is, the horses given Speedo were also given the high-protein diet and horses not given the drug were maintained on their regular diet.

(2) State exactly what conclusion about the effect of the drug Speedo can be supported by the evidence presented.

The psychologist mistakenly concluded that the drug is effective. Because of the confounding it is impossible to determine whether the drug or the high-protein diet caused the improvement in the horses' speed. Thus, the psychologist cannot draw any conclusion about the effectiveness of the drug.

(3) Finally, suggest ways in which the study could be done so that you could make a clear conclusion about the effectiveness of the drug Speedo.

Because the horses given Speedo must be placed on the high-protein diet, this factor must be held constant in the control group. Thus, horses in the control condition also should be placed on the high-protein diet. If the horses given Speedo demonstrate significantly faster racing times than control horses, we can more confidently make the causal inference that Speedo caused them to run faster.

E. The *New York Times* reported the results of a 2-year, $1.5 million study by researchers at Carnegie Mellon University funded by the National Science Foundation and major technology companies. There were 169 participants in the study drawn from the Pittsburgh area. The researchers examined the relationship between Internet use and psychological well-being. A director of the study stated that the study did not involve testing extreme amounts of Internet use. The participants were normal adults and their families. On average, for those who used the Internet the most, psychological well-being was the worst. For example, 1 hour a week of Internet use led to slight increases on a depression scale and on a loneliness scale and a reported decline in personal interaction with family members. The researchers concluded that Internet use appears to cause a decline in psychological well-being. They suggested that users of the Internet were building shallow relationships that led to an overall decline in feelings of connection to other people.

(1) The researchers claim that use of the Internet leads to a decline in people's well-being. What evidence is present in this summary of the report to meet the conditions necessary for drawing this causal inference and what evidence is lacking?

This study is correlational. The researchers noted a covariation between amount of time spent on the Internet and measures of well-being (loneliness, depression, and personal interaction). This is the first condition for making a causal inference. However, the second two conditions, time-order relationship and elimination of plausible alternative explanations are not met. For example, the time-order relationship could be that declines in well-being cause greater Internet use. It's also possible that some third variable explains the relationship between Internet use and measures of well-being.

(2) What sources beyond this question would you want to check before reaching a conclusion about the findings reported here? [You might begin with the *New York Times* piece "The Lonely Net," August 30, 1998 and the *Washington Post* piece "Net Depression Study Criticized," September 7, 1998.]

It would be important to read the original research report that describes these findings, rather than to rely on the newspaper articles. In addition, a literature search of psychological research on well-being and computer use would identify other research on this topic.

F. A study was done to determine whether taking notes in a developmental psychology course affected students' test performance. Students recorded their notes over the entire semester in a 125-page study guide. The study guide included questions on course content covered both in the textbook and in class lectures. Students' notes were measured using three dimensions: completeness, length, and accuracy. Results of the study indicated that students with more accurate notes performed better on essay and multiple-choice tests in the course than did students with less accurate notes. Based on these findings, the researchers suggested that instructors should use instructional techniques such as pausing for brief periods during the lecture and asking questions to clarify information. The researchers argued that these techniques could facilitate the accuracy of the notes students take in class, and that accurate note taking could contribute significantly to students' overall success in college courses.

(1) What evidence is present in this report to meet the conditions for a causal inference between accuracy of students' notes and their test performance? What evidence is lacking? (Be sure to identify clearly the three conditions for causal inference.)

The first condition required for a causal inference is covariation; that is, two variables must vary together or go together. This condition is met in the study with the evidence that test performance was correlated with the accuracy of students' notes; the more accurate the notes, the better students' test performance. The second condition for a causal inference is time-order relationship (or contingency). In this study, note-taking presumably preceded the tests so it would appear that a time-order relationship is present. However, it's also possible that students who perform well on tests are also accurate note-takers. Based on the correlation, it's not possible to conclude that accurate note-taking precedes good test performance. The third condition for a causal inference is the elimination of plausible alternative causes. There are many potential alternative explanations for the relationship between note accuracy and test performance that need to be explored before a causal

inference can be made. For example, the study guide and questions may have been the causal factor, or some unexamined factor related to characteristics of students may explain the relationship between note accuracy and test performance (e.g., intelligence, number of previous psychology courses). Based on the report of this study, only the first condition for causal inference, covariation, is met. Therefore, the ability of these researchers to make a causal inference is seriously constrained.

(2) Identify a goal of the scientific method that could be met on the basis of findings in this study.

Description could be met because students' note taking and test performance in developmental psychology can be described. Furthermore, prediction can be met because the researchers observed a correlation between the accuracy of notes and test performance. Thus, if we know the extent to which students' notes are accurate, we can predict their test performance. The goal of explanation is not met because little data exist in this study to explain why the accuracy of notes may be related to exam performance. Finally, one could possibly argue that the goal of application is met based on the correlation observed. However, given that other alternative causes of improved test performance exist (i.e., other than accuracy of notes), this argument is tenuous.

LEARNING BY DOING RESEARCH

Early research assignments can help students get a feel for what doing research is like. We describe two assignments here that can be done as a class or in small-groups.

1. Translating Answers Into Research Questions

   Step 1. Begin by asking the students in your class a question like the following: "Are students on our campus friendly?" The students in class generally respond quickly that students are friendly.

   Step 2. Ask your students how they know that students on campus are friendly. Their response may be a bit slower to this question, but they generally describe how students greet each other with friendly gestures or words, or they may say that the students they know on campus are friendly.

   Step 3. Ask your students how they could test the idea that the students are friendly. This question opens the door to consideration of several research issues: systematic and controlled observation vs. casual observation; sampling; clear definitions; reliable and valid measurement; and stating a testable hypothesis. This exercise begins to alert students to things that they will need to consider when doing research (e.g., merely observe or "manipulate" something).

   Step 4. Ask students to collect some observational data to test their hypothesis for the next class meeting. We tell students at this point that this will be a naturalistic observation project and this type of research design will be covered in Chapter 4; at that point they will be able to address many related issues more fully. Nevertheless, this assignment serves as a good way to whet their appetite to do a research project.

2. Just What Is a Good Research Idea?

   Sternberg (1997) suggests several questions that students can ask themselves before deciding they have identified a good research question. These questions were presented at the end of Chapter 1; it may be instructive to return to these questions after students have read more about the scientific

method and the goals of research in Chapter 2. Sternberg's questions are focused for a situation in which students generate their own research questions. In this assignment students can practice addressing these questions by applying them to published research reports. There are at least three ways in which students can identify a published research report. Students can use a reference cited in a text they have read for one of their psychology courses. Or the instructor can give students a list of possible articles from which they can choose an article they find interesting. Finally, students can identify a journal article by doing a literature search following the guidelines described in Chapter 13 in the textbook. Choosing among these three alternatives depends on students' abilities to use electronic search techniques and to read journal articles. Once the students have chosen an article that they find interesting, they then write a brief response to each of the following questions based on that article.

Alternatively, this exercise can be done in small groups after asking each student to propose a research question. The instructor may begin by posing a research question (perhaps unknown to the students) based on a published study.

A. What is the research question the authors are asking in your journal article? What is it about this question that is interesting to you?

B. Why might this question be scientifically important?

C. To what extent will the science of psychology be advanced by knowing the answer to this research question?

D. Why would anyone be interested in the results obtained by asking this question?

E. What goal of psychological research (description, prediction, explanation, application) did the researchers try to meet? Identify one or more aspects of their research methods that allowed you to make your conclusion.

Students can get feedback on these brief written reports by turning them in to the instructor. Another option is for students to discuss each of their brief reports in small groups in class to see whether their fellow students concur that the research questions are important ones.

Reference: Sternberg, R. J. (1997, September). What do students still most need to learn about research in psychology? *APS Observer, 14,* 19.

INSTRUCTOR'S LECTURE/DISCUSSION AIDS

The following pages reproduce content from Chapter 2 and may be used to facilitate lecture or discussion.

1. Psychology Questions: This simple True-False test is designed to pique students' curiosity regarding some research findings in psychology. [NB: These questions do not appear in the text.]

2. Answers to Psychology Questions: This page provides answers to the questions posed on the first page.

3. References for Research Questions: The references for the research cited on the first two pages are provided on this page.

4. The Scientific Method: This page outlines the differences between the scientific approach to gaining knowledge and the "everyday" or nonscientific approach to gaining knowledge (see Table 2.1 of the text).

5. Scientific Observation: This page describes systematic control in experiments through the manipulation of independent variables.

6. Independent Variables and Dependent Variables: This page asks students to identify independent and dependent variables in several examples.

7. Constructs and Operational Definitions: This page defines these terms and asks students to match sample operational definitions to constructs.

8. Measurement: Validity and Reliability: This page defines and contrasts reliability and validity.

9. Testable Hypotheses: This page outlines the characteristics of testable hypotheses.

10. Goals of Research in Psychology: This page identifies the four goals investigators may strive to meet in their psychological research.

11. Description: Important concepts for the goal of description, nomothetic *vs.* idiographic research and quantitative *vs.* qualitative research, are described on this page.

12. Prediction: On this page correlation and prediction are described.

13. Explanation: Features of the Explanation goal are described on this page, including the three conditions for causal inference.

14. Confounding: This page explains confounding among variables.

15. Generalization: This page describes researchers' interest in generalizing the findings of a specific study to populations, settings, and conditions that were not studied. [NB: The term "external validity" is used in Chapter 4.]

16. Application: This page describes the difference between basic and applied research.

17. Scientific Theory Construction and Testing: This page identifies key information about theories in psychology.

18. Intervening Variables: This page describes intervening variables in psychological theories and depicts the example of "thirst."

19. Identifying Intervening Variables: This page requires students to identify constructs that could serve as intervening variables between an independent variable and a dependent variable.

Psychology Questions

Why conduct research in psychology?

We don't always know how people will think or behave.

Can you anticipate the results of some research questions?
Answer "true" or "false" to the following statements.

1. Mothers talk to their younger children differently than they talk to their older children. *True or false?*

2. Few students will confess to ruining a computer program if they didn't do it. *True or false?*

3. Most individuals will notice if a person they are talking to is replaced by another person. *True or false?*

4. Writing about adjusting to college improves students' grades. *True or false?*

Answers to Psychology Questions

1. Mothers talk to their younger children differently than they talk to their older children. True or false?

   False. Researchers found that mothers use the same conversation styles ("elaborative" or "repetitive") with their different-age children.

2. Few students will confess to ruining a computer program if they didn't do it. True or false?

   False. Researchers found that 69% of students in a study falsely confessed to ruining a computer program and signed a written confession.

3. Most individuals will notice if a person they are talking to is replaced by another person. True or false?

   False. Researchers found that only 47% of participants in one study and 33% of participants in a second study noticed that a person changed to a different person mid-way through their conversation.

4. Writing about adjusting to college improves students' grades. True or false?

   True. Researchers found that students who wrote about adjusting to college had a higher GPA (M = 3.08) the following semester compared to students who wrote about superficial topics (M = 2.86).

References

1. How mothers speak with their children:

Haden, C. A. (1998). Reminiscing with different children: Relating maternal stylistic consistency and sibling similarity in talk about the past. *Developmental Psychology, 34,* 99—114.

2. False confessions:

Kassin, S. A., & Kiechel, K. L. (1996). The social psychology of false confessions: Compliance, internalization, and confabulation. *Psychological Science, 7,* 125-128.

3. Failure to notice a conversation partner has changed:

Simons, D. J., & Levin, D. T. (1998). Failure to detect changes to people during a real-world interaction. *Psychonomic Bulletin and Review, 5,* 644-649.

4. Writing and adjustment to college:

Pennebaker, J. W., & Francis, M. E. (1996). Cognitive, emotional, and language processes in disclosure. *Cognition and Emotion, 10,* 601-626.

The Scientific Method

- Way to gain knowledge about behavior and mental processes

Approaches to Gaining Knowledge

	Nonscientific (Everyday)	Scientific
General Approach and Attitude	Intuitive, uncritical accepting	Empirical, critical, skeptical
Observation	Casual, uncontrolled	Systematic, controlled
Concepts	Ambiguous	Clear definitions
Reporting	Biased, subjective	Unbiased objective
Instruments	Inaccurate, imprecise	Accurate precise
Measurement	Not valid nor reliable	Valid and reliable
Hypotheses	Untestable	Testable

Scientific Observation

- Systematic and controlled
  - Control: essential ingredient of science
  - Greatest control: *experiment*
- Features of an experiment
  - Manipulate (control) one or more factors → *independent variable*
  - Observe effects of manipulation on behavior → *dependent variables*
- Independent Variable (IV)
  - Must have at least two conditions or levels
    - Treatment condition
    - Control condition
- Dependent Variable (DV)
  - Measures of the effects of the IV
- The word “experiment” is often used in everyday language to mean the same thing as “research,” but the word *experiment* refers to a very specific type of research study.

Independent Variables and Dependent Variables

Read the following descriptions of research and identify the independent and dependent variables:

1. In the Pennebaker and Francis (1996) study on adjustment to college, students wrote about their emotions associated with beginning college or they wrote about superficial events that took place during their day. Pennebaker and Francis obtained information about the participants' GPA and their frequency of visiting the student health center.

What is the independent variable and what are the dependent variables?

IV: Type of writing: emotional (treatment) and superficial (control)
DVs: GPA and the number of health center visits

Results: Students who wrote about their emotions had a higher GPA and fewer health center visits than students who wrote about superficial events.

2. In a study on factors that influence people's willingness to help others, a researcher mimicked (copied) the behavior of participants (e.g., sitting position, posture) or did not mimic the participants' behavior. The researcher then dropped pens and observed whether participants helped to pick up the pens.

What is the independent variable and what is the dependent variable?

IV: Mimicry: present (treatment) or absent (control)
DV: Whether participants helped by picking up the pens (yes or no)

Results: van Baaren (2004) and his colleagues found that *all* of the participants whose behavior was mimicked helped, whereas only 33% of non-mimicked participants helped.

Constructs and Operational Definitions

- Construct: concept or idea used to explain behaviors or mental processes
  - Examples: *aggression, depression, intelligence, memory, personality*
- Operational definition: specific procedure used to produce or measure a construct
  - Advantages:
    - Allow scientists to define specifically what they mean
    - Allow clear communication among scientists
  - Disadvantages:
    - A potentially limitless number of operational definitions exists for any particular construct.

Match the construct with its operational definition:

Construct	**Operational Definition**
Aggression	A. score on the Minnesota Multiphasic Personality Inventory
Depression	B. score on the final exam of this course
Intelligence	C. number of times person hits another person
Personality	D. number of depression symptoms from the *Diagnostic and Statistical Manual*
Memory	E. score on the Wechsler Adult Intelligence Scale (WAIS)
Knowledge of research methods	F. score on the Digit-span Test of memory

Measurement: Validity and Reliability

- Accurate and precise instruments
- Physical measurement
  - Dimensions have agreed-upon standards and instruments
  - Examples: *length, weight, time*
- Psychological measurement
  - Measure psychological constructs
  - No agreed-upon standard or instrument
  - Examples: *beauty, intelligence, aggression*
  - Psychologists develop measures to assess these constructs.
- Validity: truthfulness
  - Measures what it claims to measure
- Reliability: consistency
  - Example: different observers consistently agree about an observation

Testable Hypotheses

- Hypothesis: tentative explanation for a phenomenon
- Often stated in the form of a prediction and an explanation for the prediction
- Scientific hypotheses must be testable.

  A hypothesis is *not* testable if it has any of these three characteristics:

  - Constructs not adequately defined
  - Circular—the event itself is used as an explanation of the event
  - Refers to ideas or forces not recognized by science

Goals of Research in Psychology

1. **Description** Researchers define, classify, catalogue, or categorize events and their relationships to describe mental processes and behavior.

2. **Prediction** When researchers identify correlations (relationships) among variables they are able to predict mental processes and behavior.

3. **Explanation** Researchers understand and can explain a phenomenon when they can identify its cause(s).

4. **Application** Psychologists apply their knowledge and research methods to improve people's lives.

Description

Most psychological research is ***nomothetic* rather than ***idiographic.***

- Nomothetic research
  - Large sample sizes
  - Describe what is true *on average* or *in general*
  - Emphasize similarities among individuals
- Idiographic research
  - Intensive study of a single case
  - Focus on uniqueness

Most psychological research is ***quantitative* rather than ***qualitative.***

- Quantitative research
  - Statistical summaries and analyses
- Qualitative research
  - Verbal summaries of research observations

Prediction

- Statistical correlations between *variables* allow predictions about behavior and mental processes
  - *Variable*: Dimension on which people differ, or vary.
  - Examples: childhood loss of a parent (yes/no), symptoms of depression, aggressiveness, age, stressful life events, physical illness
- *Correlation*: Two measures of the same people, events, or things vary together or go together.
  - Example: The more stressful life events people experience (one variable), the more physical illness they are likely to experience (a second variable).
  - *Positive correlation*: As scores on one variable increase, scores on the second variable increase.
  - *Negative correlation*: As scores on one variable increase, scores on the second variable decrease.
- Prediction: When two variables are correlated, if we know people's scores for one variable, we can statistically compute (predict) scores for the second variable.
- Correlation does not imply causation.

Explanation

- Conduct *experiments* to identify the causes of a phenomenon
- *Causal inferences*: statements about the cause of an event or a behavior.

  Three conditions:

  - Covariation of events
  - Time-order relationship
  - Elimination of plausible alternative causes
- *Example of a causal inference:*

  - Exposure to media violence *causes* an increase in the likelihood of aggressive and violent thoughts, emotions, and behaviors immediately after the exposure.

  Based on this causal inference, we know that:

  - Exposure to media violence and aggression covary together.
  - Aggression follows *after* the exposure (not before).
  - Other explanations for the relationship between exposure to media violence and aggression have been ruled out.

Confounding

- Two potentially effective independent variables are allowed to vary together simultaneously
  - Cannot determine which, if any, variable produced an effect on the dependent variable.
  - Causal inference requires no confounding

Describe the confounding in this research example:

A psychologist seeks to demonstrate the effectiveness of a new therapy for helping students to cope with stress. One group of students receives the new treatment; a second group of students is placed on a waiting list to receive the treatment during the next term (control group). To make sure the students in the control group maintain their interest in the research project, an assistant calls them every week to “check in and see how they’re doing.” The psychologist measures the coping of students in both the treatment and control groups at the end of the term and discovers no difference in their coping. The researcher decides to abandon the new therapy.

Generalization

- Researchers are not simply interested in the one sample of people or the one set of circumstances they studied.
- They seek to *generalize* a study's findings to
  - Populations
  - Settings
  - Conditions beyond those tested in a specific study
- *Generalization* (also called *external validity*)
  - Can we generalize or apply the findings from psychology studies with college student samples to describe other people?
  - Can we generalize the findings of highly controlled laboratory studies to real-world settings?

Application

Psychologists apply their knowledge and research methods to improve people's lives.

- Basic research
  - Research to understand behavior and mental processes
  - Develop and test theories about behavior and mental processes
  - "Knowledge for its own sake"
  - Most often conducted in laboratory settings
- Applied research
  - Research to change people's lives for the better
  - Often conducted in "real world" or natural settings
- Basic and applied research studies are complementary; both necessary.

Scientific Theory Construction and Testing

- Theory

  Logically organized set of propositions (claims, statements, assertions) that serves to

  - Define events (concepts)
  - Describe relationships among these events
  - Explain the occurrence of these events

- Scope

  Theories differ in the breadth of events they seek to explain, from specific phenomena (e.g., flashbulb memory) to complex phenomena (e.g., love).

- Functions

  A theory organizes empirical knowledge from previous studies and guides future research by suggesting testable hypotheses.

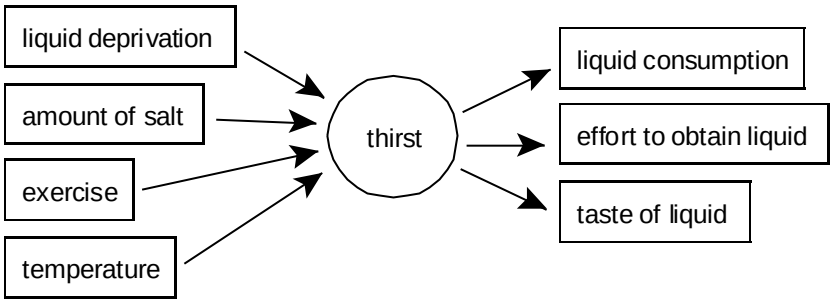
- Important Features

  Good theories are

  - Logical
  - Precise
  - Parsimonious

Intervening Variables

- Processes or mechanisms to explain the relationship between an independent variable and a dependent variable
  - "Hidden" processes represented by psychological *constructs*
  - Example: "thirst"



Identifying Intervening Variables

For each of the following, think of an intervening variable that may explain the relationship:

Independent Variable	Intervening Variable	Dependent Variable
Presence/absence of an insult	?	Aggressive response
Amount of time spent studying	?	Score on a test
Length of time without liquid	?	Amount of water consumed
Amount of positive feedback	?	Improved performance