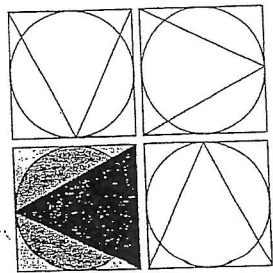


CHAPTER 2

PROBLEMS AND HYPOTHESES



- PROBLEMS
- CRITERIA OF PROBLEMS AND PROBLEM STATEMENTS
- HYPOTHESES
- IMPORTANCE OF PROBLEMS AND HYPOTHESES
- VIRTUES OF PROBLEMS AND HYPOTHESES
- PROBLEMS, VALUES, AND DEFINITIONS
- GENERALITY AND SPECIFICITY OF PROBLEMS AND HYPOTHESES
- THE MULTIVARIABLE NATURE OF BEHAVIORAL RESEARCH AND PROBLEMS
- CONCLUDING REMARKS: THE SPECIAL POWER OF HYPOTHESES

Many people believe that science is basically a fact-gathering activity. It is not. As M. R. Cohen (1956/1997, p. 148) says:

There is . . . no genuine progress in scientific insight through the Baconian method of accumulating empirical facts without hypotheses or anticipation of nature. Without some guiding idea we do not know what facts to gather . . . we cannot determine what is relevant and what is irrelevant.

The scientifically uninformed person often has the idea that the scientist is a highly objective individual who gathers data without preconceived ideas. Poincaré (1952/1996, p. 143) pointed out how wrong this idea is: "It is often said that experiments should be made without preconceived ideas. That is impossible. Not only would it make every experiment fruitless, but even if we wished to do so, it could not be done."

Problems

It is not always possible for a researcher to formulate the problem simply, clearly, and completely. The researcher may often have only a rather general, diffuse, even confused notion of the problem. This is in the nature of the complexity of scientific research. It may even take an investigator years of exploration, thought, and research before he or she can state the questions clearly. Nevertheless, adequate statement of the research problem is one of the most important parts of research. The difficulty of stating a research problem satisfactorily at a given time should not cause one to lose sight of the ultimate desirability and necessity of doing so.

Bearing this difficulty in mind, a fundamental principle can be stated: If one wants to solve a problem, one must generally know what the problem is. It can be said that a large part of the solution lies in knowing what it is one is trying to do. Another part lies in knowing what a problem is and especially what a scientific problem is.

What is a good problem statement? Although research problems differ greatly and there is no one "right" way to state a problem, certain characteristics of problems and problem statements can be learned and used to good advantage. To start, let us take two or three examples of published research problems and study their characteristics. First, take the problem of the study by Hurluck (1925)<sup>1</sup> mentioned in Chapter 1: What are the effects on pupil performance of different types of incentives? Note that the problem is stated in question form. Here, the simplest way is the best way. Also note that the problem states a relation between variables, in this case between the variables *incentives* and *pupil performance* (achievement). (*Variable* will be defined formally in Chapter 3. For now, *variable* is used as the name of a phenomenon, or a construct, that takes a set of different numerical values.)

A *problem*, then, is an interrogative sentence or statement that asks: What relationship exists between two or more variables? The answer is what is being sought in the research. A problem in most cases will have two or more variables. In the Hurluck example, the problem statement relates incentive to pupil performance. Another problem, studied in an influential experiment by Bahrick (1984, 1992), is associated with the age-old questions: How much of what you are now studying will you remember ten years from now? How much of it will you remember fifty years from today? How much will you remember later if you never use it? Formally, Bahrick asks: Does semantic memory involve separate processes? One variable is the amount of time since the material was first learned, a second would be the quality of original learning, and the other variable is remembering (or forgetting). Still another problem, by Little, Sterling, and Tingsstrom (1996), is quite different: Do geographic

<sup>1</sup> When citing problems and hypotheses from the literature, we have not always used the authors' words verbatim. In fact, the statements of many of the problems are ours and not those of the cited authors. Some authors use only problem statements; some use only hypotheses; others use both.

and racial cues influence attribution (perceived blame)? One variable is geographical cues, a second would be racial information, and the third is attribution. Not all research problems contain two or more clear variables. For example, in experimental psychology, the research focus is often on psychological processes like memory and categorization. In her justifiably well-known and influential study of perceptual categories, Rosch (1973) in effect asked the question: Are there nonarbitrary ("natural") categories of color and form? Although the relationship between research the categories were related to learning. Toward the end of this book we will see that factor analytical research problems also lack the relationship form discussed above. In most behavioral research problems, however, the relations among two or more variables are studied, and we will therefore emphasize such relation statements.

## Criteria of Problems and Problem Statements

There are three criteria of good problems and problem statements. One, the problem should express a relation between two or more variables. It asks, in effect, questions like: Is *A* related to *B*? How are *A* and *B* related to *C*? How is *A* related to *B* under conditions *C* and *D*? The exceptions to this dictum occur mostly in taxonomic or methodological research.

Two, the problem should be stated clearly and unambiguously in question form. Instead of saying, for instance, "The problem is . . ." or "The purpose of this study is . . ." ask a question. Questions have the virtue of posing problems directly. The purpose of a study is not necessarily the same as the problem of a study. The purpose of the Hurlock study, for instance, was to throw light on the use of incentives in school situations. The problem was the question about the relation between incentives and performance. Again, the simplest way is the best way: ask a question.

The third criterion is often difficult to satisfy. It demands that the problem and the problem statement must *imply* possibilities of empirical testing. A problem that does not contain implications for testing its stated relation(s) is not a scientific problem. This means not only that an actual relation is stated, but also that the variables of the relation can somehow be measured. Many interesting and important questions are not scientific questions simply because they are not amenable to testing. Certain philosophical and theological questions, while perhaps important to the individuals who consider them, cannot be tested empirically and are thus of no interest to the scientist. The epistemological question, "How do we know?" is such a question. Education has many interesting but nonscientific questions, such as, "Does democratic education improve the learning of youngsters?" "Are group processes good for children?" These questions can be labeled metaphysical in the sense that they are, at least as stated, beyond empirical testing possibilities. The key difficulties are that some of them are not relations, and most of their constructs are very difficult or impossible to define so that they can be measured.

Hypotheses

A *hypothesis* is a conjectural statement of the relation between two or more variables. Hypotheses are always in declarative sentence form, and they relate—either generally or specifically—variables to variables. There are two criteria for “good” hypotheses and hypothesis statements. They are the same as two of those for problem and problem statements. (1) Hypotheses are statements about the relations between variables. (2) Hypotheses carry clear implications for testing the stated relation. These criteria mean, then, that hypothesis statements contain two or more variables that are measurable or potentially measurable and that they specify how the variable are related.

Let us take three hypotheses from the literature and apply the criteria to them. The first hypothesis from a study by Wegner, et al. (1987) seems to defy common sense: The greater the suppression of unwanted thoughts, the greater the preoccupation with those unwanted thoughts (suppress now, obsess later). Here a relation is stated between one variable, suppression of an idea or thought, and another variable, preoccupation or obsession. Since the two variables are readily defined and measured, implications for testing the hypothesis, too, are readily conceived. The criteria are satisfied. In the Wegner, et al. study, subjects were asked *not* to think about “white bear.” Each time they did think of the white bear, they would ring a bell. The number of bell rings indicated the level of preoccupation. A second hypothesis is from a study by Ayres and Hughes (1986). This study’s hypothesis is unusual. It states a relation in the so-called null form: Levels of noise or music have no effect on visual functioning. The relation is stated clearly: one variable, loudness of sound (like music), is related to another variable, visual functioning, by the words “has no effect on.” On the criterion of potential testability, however, we meet with difficulty. We are faced with the problem of defining “visual functioning” and “loudness” so they can be measured. If we can solve this problem satisfactorily, then we definitely have a hypothesis. Ayres and Hughes did solve this by defining loudness as 107 decibels and visual functioning in terms of a score on a visual acuity task. And this hypothesis did lead to answering a question that people often ask: “Why do we turn down the volume of the car stereo when we are *looking* for a street address?” Ayres and Hughes found a definite drop in perceptual functioning when the level of music was at 107 decibels.

The third hypothesis represents a numerous and important class. Here the relation is indirect, concealed, as it were. It customarily comes in the form of a statement that groups *A* and *B* will differ on some characteristic. For example: Women more often than men believe they should lose weight even though their weight is well within normal bounds (Fallon & Kozin, 1985). That is, women differ from men in terms of their perceived body shape. Note that this statement is one step removed from the actual hypothesis, which may be stated: Perceived body shape is in part a function of gender. If the latter statements were the hypothesis stated, then the first might be called a subhypothesis or a specific prediction based on the original hypothesis.

Let us consider another hypothesis of this type but removed one step further. Individuals having the same or similar characteristics will hold similar attitudes toward cognitive objects significantly related to their occupational role (Saal & Moore, 1993). (*Cognitive objects* are defined as a concrete or abstract thing perceived and "known" by individuals. People, groups, job or grade promotion, the government, and education are examples.) The relation in this case is, of course, between personal characteristics and attitudes (toward a cognitive object related to the personal characteristic, for example, gender and attitudes toward others receiving a promotion). In order to test this hypothesis, it would be necessary to have at least two groups, each with a different characteristic, and then to compare the attitudes of the groups. For instance, as in the case of the Saal and Moore study, the comparison would be between men and women. They would be compared on their assessment of fairness toward a promotion given to a coworker of the opposite or same sex. In this example, the criteria are satisfied.

## The Importance of Problems and Hypotheses

There is little doubt that hypotheses are important and indispensable tools of scientific research. There are three main reasons for this belief. The first reason is that they are, so to speak, the working instruments of theory. Hypotheses can be deduced from theory and from other hypotheses. If, for instance, we are working on a theory of aggression, we are presumably looking for causes and effects of aggressive behavior. We might have observed cases of aggressive behavior occurring after frustrating circumstances. The theory, then, might include the proposition: Frustration produces aggression (Berkeowitz, 1983; Dill & Anderson, 1995; Dollard, Doob, Miller, Mowrer, & Sears, 1939). From this broad hypothesis we may deduce more specific hypotheses, such as: To prevent children from reaching desired goals (frustration) will result in their fighting each other (aggression); if children are deprived of parental love (frustration), they will react in part with aggressive behavior.

The second reason is that hypotheses can be tested and shown to be probably true or probably false. Isolated facts are not tested, as we said before; only relations are tested. Since hypotheses are relational propositions, this is probably the main reason why they are used in scientific inquiry. They are, in essence, predictions of the form, "If A, then B," which we set up to test the relation between A and B. We let the facts have a chance to establish the probable truth or falsity of the hypothesis.

Reason three is that hypotheses are powerful tools for the advancement of knowledge because they enable scientists to get outside themselves. Although constructed by humans, hypotheses exist, can be tested, and can be shown to be probably correct or incorrect apart from a person's values and opinions (biases). This is critical: there would be no science in any complete sense without hypotheses. As just as important as hypotheses are the problems behind the hypotheses. As Dewey (1938/1982, pp. 105-107) has pointed out, research usually starts with a problem. He states that there is first an indeterminate situation in which ideas are vague,

doubts are raised, and the thinker is perplexed. Dewey further points out that the problem is not enunciated; indeed, cannot be enunciated until one has experienced such an indeterminate situation.

The indeterminacy, however, must ultimately be removed. Although it is true, as stated earlier, that a researcher may often have only a general and diffuse notion of the problem, sooner or later he or she has to have a fairly clear idea of just what the problem is. Even though this statement seems self-evident, one of the most difficult things to do is to state one's research problem clearly and completely. In other words, one must know what one is trying to find out. When this is finally known, the problem is a long way toward solution.

## Virtues of Problems and Hypotheses

Problems and hypotheses, then, have important virtues: (1) they direct investigation (The relations expressed in the hypotheses tell the investigator what to do); (2) problems and hypotheses, because they are ordinarily generalized relational statements, enable the researcher to deduce specific empirical manifestations implied by the indeed true that children in one type of culture (white Americans), then it follows that children in the Chilean culture should do more poorly in academics than children in the American culture. The Chilean children also should perhaps have a lower self-esteem or more external locus-of-control when it comes to school and academics.

There are important differences between problems and hypotheses. Hypotheses, if properly stated, can be tested. A given hypothesis may be too broad to be tested directly, yet if it is a "good" hypothesis, then other testable hypotheses can be deduced from it. Facts or variables are not tested as such. The relations stated by the hypotheses are tested. And a problem cannot be solved scientifically unless it is reduced to its hypothesis form because a problem is a question, usually broad in nature, and not directly testable. One does not test questions: Does the presence or absence of another person in a public restroom alter personal hygiene (Pedersen, Keithly, & Brady, 1986)? Do group counseling sessions reduce the level of psychiatric morbidity in police officers (Doctor, Curtis, & Issacs, 1994)? Perhaps, one tests one or more hypotheses implied by these questions. For example, to study the latter problem, one may hypothesize that police officers who attend stress-reduction counseling sessions will use fewer sick days than those police officers who did not attend counseling sessions. The hypothesis in the former problem could state that the presence of a person in a public restroom will cause the other person to wash his or her hands.

Problems and hypotheses advance scientific knowledge by helping an investigator confirm or disconfirm theory. Suppose a psychological investigator gives a number of subjects three or four tests, among which is a test for anxiety related to an arithmetic test. Routinely computing the intercorrelations between the three or four tests, one finds that the correlation between anxiety and arithmetic is negative. One

therefore concludes that the greater the anxiety the lower the arithmetic score. But it is quite conceivable that the relation is fortuitous or even spurious. If, however, the investigator had hypothesized the relation on the basis of theory, he or she could have greater confidence in the results. Investigators who do not hypothesize relations in advance do not, in short, give the facts a chance to prove or disprove anything. The words *prove* and *disprove* are not to be taken here in their literal sense. A hypothesis is never really proved or disproved. To be more accurate we should probably say something like: The weight of evidence is on the side of the hypothesis, or the weight of the evidence casts doubt on the hypothesis. Braithwaite (1953/1996, p. 14) says:

Thus the empirical evidence of its instance never proves the hypothesis: in suitable cases we may say that *it establishes* (italics added) the hypothesis, meaning by this that the evidence makes it reasonable to accept the hypothesis; but it never *proves* the hypothesis in the sense that the hypothesis is a logical consequence of the evidence.

This use of the hypothesis is similar to playing a game of chance. The rules of the game are set up and bets are made in advance. One cannot change the rules after an outcome, neither can one change one's bets after placing them. One cannot throw the dice first and then bet. That would not be "fair." Similarly, if one gathers data first and then selects a datum and comes to a conclusion on the basis of the datum, one has violated the rules of the scientific game. The game is not "fair" because the investigator can easily capitalize on, say, two significant relations out of five tested. What usually happens to the other three is that they are forgotten. In a "fair" game, every throw of the dice is counted, in the sense that one either wins or does not win on the basis of the outcome of each throw.

Hypotheses direct inquiry. As Darwin pointed out over a hundred years ago, observations have to be for or against some view if they are to be of any use. Hypotheses incorporate aspects of the theory under test in testable or near-testable form. Earlier, an example of reinforcement theory was given in which restable hypotheses were deduced from the general problem. The importance of recognizing this function of hypotheses may be shown by going through the back door and using a theory that is very difficult, or perhaps impossible, to test. Freud's theory of anxiety includes the construct of repression. By repression, Freud meant the forcing of unacceptable ideas deep into the unconscious. In order to test the Freudian theory of anxiety it is necessary to deduce relations suggested by the theory. These deductions will, of course, have to include the repression notion, which includes the construct of the unconscious. Hypotheses can be formulated using these constructs; in order to test the theory, they have to be so formulated. But testing them is another, more difficult matter because of the extreme difficulty of defining terms such as "repression" and "unconscious" so that they can be measured. To the present, no one has succeeded in defining these two constructs without seriously departing from the original Freudian meaning and usage. Hypotheses, then, are important bridges between theory and empirical inquiry.

Problems, Values, and Definitions

To clarify further the nature of problems and hypotheses, two or three common errors will now be discussed. First, scientific problems are not moral and ethical questions: Are punitive disciplinary measures bad for children? Should an organization's leadership be democratic? What is the best way to teach college students? To ask these questions is to ask value and judgmental questions that science cannot answer. Many so-called hypotheses are not hypotheses at all. For instance: The small-group method of teaching is better than the lecture method. This is a value statement; it is an article of faith and not a hypothesis. If it were possible to state a relation between the variables, and if it were possible to define the variables so as to permit testing the relation, then we might have a hypothesis. But there is no way to test value questions scientifically.

A quick and relatively easy way to detect value questions and statements is to look for words such as *should, ought, better than (instead of greater than)*. Also, one can look for similar words that indicate cultural or personal judgments or preferences, (biases). Value statements, however, are tricky. While a "should" statement is obviously a value statement, certain other kinds of statements are not so obvious. Take the statement: Authoritarian methods of teaching lead to poor learning. Here there is a relation. But the statement fails as a scientific hypothesis because it uses two value expressions or words, "authoritarian methods of teaching" and "poor learning," neither of which can be defined for measurement purposes without deleting the words *authoritarian* and *poor*.<sup>2</sup>

Other kinds of statements that are not hypotheses, or are poor ones, are frequently formulated, especially in education. Consider, for instance: The core curriculum is an enriching experience. Another statement type, used too frequently, is vague generalization: Reading skills can be identified in the second grade; The goal of the unique individual is self-realization; Prejudice is related to certain personality traits.

Another common defect of problem statements often occurs in doctoral theses: the listing of methodological points or "problems" as subproblems. These methodological points have two characteristics that make them easy to detect: (1) they are not substantive problems that spring from the basic problem; and (2) they relate to techniques or methods of sampling, measuring, or analyzing. They are usually not in question form but rather contain such words as *test, determine, measure*. "To determine the reliability of the instruments used in this research," "To test the significance of the differences between the means," or "To assign pupils at random to the experimental groups" are examples of this mistaken notion of problems and subproblems.

<sup>2</sup> An almost classic case of the use of the word *authoritarian* is the statement sometimes heard among educators: The lecture method is authoritarian. This seems to mean that the speaker does not like the lecture method and is telling us that it is bad. Similarly, one of the most effective ways to criticize a teacher is to say that teacher is authoritarian.



## Generality and Specificity of Problems and Hypotheses

One difficulty that a researcher usually encounters, and that almost all students working on a thesis find annoying, is the generality and specificity of problems and hypotheses. If the problem is too general, it is also too vague to be tested. Thus, it is scientifically useless, even though it may be interesting to read. Problems and hypotheses that are too general or too vague are common. For example: Creativity is a function of the self-actualization of the individual; Democratic education enhances social learning and citizenship; Authoritarianism in the college classroom inhibits the creative imagination of students. These are interesting problems but, in their present form, are worse than useless scientifically because they cannot be tested and because they give one the spurious assurance that they are hypotheses that can "someday" be tested.

Terms such as "creativity," "self-actualization," "democracy," "authoritarianism," and the like have, at the present time at least, no adequate empirical referents. It is quite true that we can define *creativity*, say, in a limited way by specifying one or two creativity tests. This may be a legitimate procedure. Still, in so doing, we run the risk of getting far away from the original term and its meaning. This is particularly true when we speak of artistic creativity. We are, of course, often willing to accept the risk in order to be able to investigate important problems. Yet a term like "democracy" is almost hopeless to define. Even when we do define it, we often find we have destroyed its original meaning. An outstanding exception to this statement is Bolten's (1980) definition and measurement of "democracy." We will examine both in subsequent chapters.

The other extreme is too great specificity. Every student has heard that it is necessary to narrow down problems to workable size. This is true. But, unfortunately, we can also narrow the problem out of existence. In general, the more specific the problem or hypothesis, the clearer is its testing implications. But triviality may be the price we pay. Researchers cannot handle problems that are too broad because they tend to be too vague for adequate research operations. On the other hand, in their zeal to cut down the problems to workable size or to find a workable problem, they may cut the life out of it. They may make it trivial or inconsequential. A thesis, for instance, on the simple relation between the speed of reading and size of type, while important and maybe even interesting, is too thin by itself for a doctoral study. The doctoral student would need to expand on the topic by also recommending a comparison between genders and considering variables such as culture and family

Although many studies of authoritarianism have been done with considerable success, it is doubtful that we know what authoritarianism in the classroom means. For instance, an action of a teacher that is authoritarian in one classroom may not be authoritarian in another classroom. The alleged democratic behavior exhibited by one teacher may even be called authoritarian if exhibited by another teacher. Such elasticity is not the stuff of science.

background. The researcher could possibly expand the study to look at levels of illumination and font types. Too great specificity is perhaps a worse danger than too great generality. The researcher may be able to answer the specific question but will not be able to generalize the finding to other situations or groups of people. At any rate, some kind of compromise must be made between generality and specificity. The ability to make such compromises effectively is a function partly of experience and partly of critical study of research problems.

Here are a few examples contrasting research problems stated as too general or too specific:

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| <p>1. Too General:<br/>There are gender differences in game playing.<br/>Tommy's score will be 10 points higher than Carol's on Tetris Professional Gold.<br/>Video game playing will result in a higher transfer of learning for boys than girls.<br/>People can read large-size letters faster than small-size letters.<br/>Seniors at Duarte High School can read 24-point fonts faster than 12-point fonts.<br/>A comparison of three different font sizes and visual acuity on reading speed and comprehension.</p> | <p>About Right:<br/>Too Specific:<br/>2. Too General:<br/>About Right:<br/>Too Specific:</p> |
|--|--|

## The Multivariable Nature of Behavioral Research and Problems

Until now the discussion of problems and hypotheses has been limited to two variables,  $x$  and  $y$ . We must hasten to correct any impression that such problems and hypotheses are the norm in behavioral research. Researchers in psychology, sociology, education, and other behavioral sciences have become keenly aware of the multivariable nature of behavioral research. Instead of saying: If  $p$ , then  $q$ , it is often more appropriate to say: If  $p_1, p_2, \dots, p_k$ , then  $q$ ; or: If  $p$  then  $q$ , under conditions  $r, s$ , and  $t$ .

An example may clarify the point. Instead of simply stating the hypothesis: If frustration, then aggression, it is more realistic to recognize the multivariable nature of the determinants and influences of aggression. This can be done by saying, for example: If high intelligence, middle class, male, and frustrated, then aggression. Or: If frustration, then aggression, under the conditions of high intelligence, middle class, and male. Instead of one  $x$ , we now have four  $x$ s. Although one phenomenon may be the most important in determining or influencing another phenomenon, it is unlikely that most of the phenomena of interest to behavioral scientists are determined simply. It is much more likely that they are determined multiply. It is much more likely

that aggression is the result of several influences working in complex ways. Moreover, aggression itself has multiple aspects. There are after all, different kinds of aggression.

Problems and hypotheses thus have to reflect the multivariable complexity of psychological, sociological, and educational reality. We will talk of one  $x$  and one  $y$ , especially in the early part of the book. However, it *must* be understood that behavioral research, which used to be almost exclusively univariate in its approach, has become more and more multivariable. We have purposely used the word "multivariable" instead of "multivariate" for an important reason. Traditionally, "multivariable" studies are those that have more than one  $y$  variable and one or more  $x$  variables. When we speak of one  $y$  and more than one  $x$  variable, we use the more appropriate term "multivariable" to make the distinction. For now, we will use "univariate" to indicate one  $x$  and one  $y$ . "Univariate," strictly speaking, also applies to  $y$ . We will soon encounter multivariate conceptions and problems. And later parts of the book will be especially concerned with a multivariate approach and emphasis. For a clear explanation on the differences between *multivariable* and *multivariate* (see Kleinbaum, Kupper, Muller, & Nizam, 1997).

## Concluding Remarks: The Special Power of Hypotheses

One sometimes hears that hypotheses are unnecessary in research. Some feel that they restrict the investigative imagination unnecessarily, and that the job of science and scientific investigation is to discover new things and not to belabor the obvious. Some feel that hypotheses are obsolete. Such statements are quite misleading. They misconstrue the purpose of hypotheses.

It can almost be said that the hypothesis is one of the most powerful tools yet invented to achieve dependable knowledge. We observe a phenomenon. We speculate on possible causes. Naturally, our culture has answers to account for most phenomena—many correct, many incorrect, many a mixture of fact and superstition, many pure superstition. It is the business of scientists to doubt most explanations of phenomena. Such doubts are systemic. Scientists insist on subjecting explanations of phenomena to controlled empirical testing. In order to do this, they formulate the explanations into theories and hypotheses. In fact, the explanations are hypotheses. Scientists simply discipline the business by writing systematic and testable hypotheses. If an explanation cannot be formulated into a testable hypothesis, it can be considered to be a metaphysical explanation and thus not amenable to scientific investigation. As such, it is dismissed by scientists as being of no interest.

The power of hypotheses go further than this, however. A hypothesis is a prediction. It says that if  $x$  occurs,  $y$  will also occur; that is,  $y$  is predicted from  $x$ . If, then,  $x$  is made to occur (vary), and it is observed that  $y$  also occurs (varies concomitantly), then the hypothesis is confirmed. This is more powerful evidence than simply observing, without prediction, the covarying of  $x$  and  $y$ . It is more powerful in the

betting-game sense discussed earlier. The scientist makes a bet that  $x$  leads to  $y$ . If, in an experiment,  $x$  does lead to  $y$ , then one has won the bet. A person cannot just enter the game at any point and pick a perhaps fortuitous common occurrence of  $x$  and  $y$ . Games are not played this way (at least in our culture). This person must play according to the rules, and the rules in science are made to minimize error and fallibility. Hypotheses are part of the rules of the science game.

Even when hypotheses are not confirmed, they have power. Even when  $y$  does not covary with  $x$ , knowledge is still advanced. Negative findings are sometimes as important as positive ones, since they reduce the total universe of ignorance and sometimes point up fruitful further hypotheses and lines of investigation. But the scientist cannot tell positive from negative evidence unless he or she uses hypotheses. It is, of course, possible to conduct research without hypotheses, particularly in exploratory investigations. But it is hard to conceive modern science in all its rigorous and disciplined fertility without the guiding light and power of hypotheses.

## CHAPTER SUMMARY

1. Formulating the research problem is not an easy task. The researcher starts with a general, diffused, and vague notion and then gradually refines it. Research problems differ greatly and there is no one right way to state the problem.
  2. Three criteria of a good problem and problem statement
    - a. The problem should be expressed as a relationship between two or more variables.
    - b. The problem should be put in the form of a question.
    - c. The problem statement should imply the possibilities of empirical testing.
  3. A hypothesis is a conjectural statement of the relationship between two or more variables. It is put in the form of a declarative statement. A criteria for a good hypothesis is the same as (a) and (b) in criteria of a good problem.
    4. Importance of problems and hypotheses
      - a. It is a working instrument of science and a specific working statement of theory.
      - b. Hypotheses can be tested and be predictive
      - c. Advance knowledge
    5. Virtues of problems and hypotheses
      - a. Direct investigation and inquiry
      - b. Enable the researcher to deduce specific empirical manifestations
      - c. Serve as the bridge between theory and empirical inquiry.
    6. Scientific problems are not moral or ethical questions. Science cannot answer value or judgmental questions.

7. Detection of value questions: Look for words such as *better than, should, ought*.
8. Another common defect of problem statements is the listing of methodological points as subproblems.
- a. They are not substantive problems that come directly from the basic problem
- b. They relate to techniques or methods of sampling, measuring, or analyzing; not in question form.
9. On problems, there is a need to compromise between being too general and too specific. The ability to do this comes with experience.
10. Problems and hypotheses need to reflect the multivariate complexity of behavioral science reality.
11. The hypothesis is one of the most powerful tools invented to achieve dependable knowledge. It has the power of prediction. A negative finding for a hypothesis can serve to eliminate one possible explanation and open other hypotheses and lines of investigation.

## STUDY SUGGESTIONS

1. Use the following variable names to write research problems and hypotheses: frustration, academic achievement, intelligence, verbal ability, race, social class (socioeconomic status), sex, reinforcement, teaching methods, occupational choice, conservatism, education, income, authority, need for achievement, group cohesiveness, obedience, social prestige, permissiveness.
2. Ten problems from the research literature are given below. Study them carefully, choose two or three, and construct hypotheses based on them.
- a. Do children of different ethnic groups have different levels of test anxiety (Guida & Ludlow, 1989)?
- b. Do cooperative social situations lead to higher levels of intrinsic motivation? (Hom, Berger, Duncan, Miller, & Belvin, 1994)?
- c. Are affective responses influenced by people's facial activity (Strack, Martin & Stepper, 1988)?
- d. Will jurors follow prohibitive judicial instructions and information (Shaw & Skolnick, 1995)?
- e. What are the positive effects of using alternating pressure pads to prevent pressure sores in homebound hospice patients (Stoneberg, Pitcock, & Myton, 1986)?
- f. What are the effects of early Pavlovian conditioning on later Pavlovian conditioning (Lariviere & Spear, 1996)?
- g. Does the efficacy of encoding information into long-term memory depend on the novelty of the information (Tulving & Kroll, 1995)?

- h. What is the effect of alcohol consumption on the likelihood of condom use during causal sex (MacDonald, Zanna, & Fong, 1996)?
- i. Are there gender differences in predicting retirement decisions (Talaga & Behr, 1995)?
- j. Is the Good Behavior Game a viable intervention strategy for children in a classroom that require behavior change procedures (Tingstrom, 1994)?
3. Ten hypotheses are given below. Discuss possibilities of testing them. Then read two or three of the studies to learn how the authors tested them.
- a. Job applicants who claim a great deal of experience at nonexistent tasks overstate their ability on real tasks (Anderson, Warner, & Spencer, 1984).
- b. In social situations, men misread women's intended friendliness as a sign of sexual interest (Saal, Johnson, & Weber, 1989).
- c. The greater the team success, the greater the attribution of each team member toward one's ability and luck (Chambers & Abram, 1991).
- d. Increasing interest in a task will increase compliance (Rind, 1997).
- e. Extracts from men's perspiration can affect women's menstrual cycles (Cuder, Preti, Kreiger, & Huggins, 1986).
- f. Physically attractive people are viewed as having higher intelligence than nonattractive people (Moran & McCullers, 1984).
- g. One can receive help from a stranger if that stranger is similar to oneself, or if the request is made at a certain distance (Glick, DeMores, & Hotze, 1988).
- h. Cigarette smoking (nicotine) improves mental performance (Spillich, June, & Kemner, 1992).
- i. People stowing valuable items in unusual locations will have better memory of that location than stowing valuable items in usual locations (Wingard & Soloway, 1986).
- j. Gay men with symptomatic HIV disease are significantly more distressed than gay men whose HIV status is unknown (Cochran and Mays, 1994).
4. Multivariate (for now, more than two dependent variables) problems and hypotheses have become common in behavioral research. To give the student a preliminary feeling for such problems, we here append several of them. Try to imagine how you would do research to study them.
- a. Do men and women differ in their perceptions of their genitals, sexual enjoyment, oral sex and masturbation (Reinholtz & Muehlenhard, 1995)?
- b. Are youthful smokers more extroverted whereas older smokers are more depressed and withdrawn (Stein, Newcomb, & Bender, 1996)?
- c. How much do teachers' ratings of social skills for popular students differ from rejected students (Frentz, Gresham, & Elliot, 1991; Stuart, Gresham, & Elliot, 1991)?

- d. Do counselor-client matching on ethnicity, gender, and language influence treatment outcomes of school-aged children (Hall, Kaplan, & Lee, 1994)?
- e. Are there any differences in the cognitive and functional abilities of Alzheimer's patients who reside at a special care unit versus those residing at a traditional care unit (Swanson, Maas, & Buckwalter, 1994)?
- f. Do hyperactive children with attention deficit differ from nonhyperactive children with attention deficit on reading, spelling, and written language achievement (Elbert, 1993)?
- g. Will perceivers see women who prefer the courtesy title of Ms. as being higher on instrumental qualities and lower on expressiveness than women who prefer traditional courtesy titles (Dion & Coia, 1991)?
- h. Will an empowering style of leadership increase team member satisfaction and will perceptions of team efficacy increase effectiveness (Kumpfer, Turner, Hopkins, & Librett, 1993)?
- i. How do ethnicity, gender, and socioeconomic background influence psychosis proneness: perceptual aberration, magical ideation, and schizotypal personality (Porch, Ross, Hanks, & Whitman, 1995)?
- !. Does stimulus exposure have two effects, one cognitive and one affective, which in turn affect liking, familiarity, and recognition confidence and accuracy (Zajonc, 1980)?

The last two problems and studies are quite complex because the stated relations are complex. The other problems and studies, though also complex, have only one phenomenon presumably affected by other phenomena, whereas the last two problems have several phenomena influencing two or more other phenomena. Readers should not be discouraged if they find these problems a bit difficult. By the end of the book they should appear interesting and natural.