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Thinking Scientifically

Why Bother to be Systematic?

The Role of Reasoned Judgment and Opinion

The Role of Imagination, Intuition, and Custom

Every great advance in science has issued from a new audacity of imagination.

—JOHN DEWEY

The phrase "social science" in print gives rise to images of a robot in a statistics laboratory reducing human activity to bloodless digits and simplified formulas. Research reports filled with mechanical-sounding words such as *empirical*, *quantitative*, *operational*, *inverse*, and *correlation* are not very poetic. Yet the stereotypes of social science created by these images are, as we will try to show, wrong.

Like any other mode of knowing, social science can be used for perverse ends; however, it can also be used for humane personal understanding. By testing thoughts against observations of reality, science helps liberate inquiry from bias, prejudice, and just plain muddle-headedness. So it is unwise to be put off by simple stereotypes—too many people accept these stereotypes and deny themselves the power of social scientific understanding.

The word **science** stands for a very great deal in our culture—some even see science as the rival of religion in the modern age. Our objective is not to examine the tangle of issues associated with science;

it is to find a path into the scientific way of thinking about things. In order to find that path, we begin by allowing some descriptions of science to emerge out of contrasts with other forms of knowledge.

First, we have to identify some distractions that should be ignored. Science is sometimes confused with **technology**, which is the application of science to various tasks. Schoolbooks that caption pictures of the latest advances in medicine with the title "Science Marches On!" aid such confusion. The technology that makes such research possible emerged from the use of scientific strategies in the study of botany, physics, bioengineering, and numerous other fields. It is the mode of inquiry that is scientific; the CT scanner is a piece of technology.

Just as science is not technology, neither is it some specific body of knowledge. For example, the popular phrase "Science tells us that smoking can kill you" really misleads. "Science" does not tell us anything; people tell us things—in this case, people who have used scientific strategies to investigate the relationship between smoking and cancer. Science as a way of thought and investigation is best conceived of as existing not in books, machinery, or reports containing numbers but rather in that invisible world of the mind. Science has to do with the way in which questions are formulated and answered; it is a set of rules and forms for inquiry and observation created by people who want verifiable answers.

Another distraction comes from identifying particular people as "scientists." That usage is not false because the people so labeled practice the scientific form of inquiry. However, is it fully honest to say that some people are scientists whereas others are nonscientists. Some people specialize in scientific approaches to knowledge, but we are all participants in the scientific way of thinking. Science is a mode of inquiry that is common to all human beings.

In becoming more conscious of your own habits of thought, you will find that there is a bit of the scientist in each of us. We measure, compare, modify beliefs, and acquire a kind of savvy about evidence in the daily business of figuring out what to do next and how to relate to others. The simplest of games involves the testing of tactics and strategies against the data of performance, and that is crudely scientific. Even trying out different styles of dress for their impact on others has an element of science in it.

The scientific way of thought is one of a number of strategies by which we try to cope with a vital reality: the uncertainty of life.

We do not know what the consequences of many of our actions will be. We may have little idea of the forces that affect us subtly or directly, gradually or suddenly. In trying to accomplish even the simplest task, such as figuring out what to eat, we do elementary calculations of what might taste good or what might be good for us. If there is enough uncertainty on that score, a little advance testing is a good idea: The queen has her taster, and the rest of us—at least when it comes to a certain hamburger—have the assurance that billions have already been sold.

Science is a process of thinking and asking questions. It is one of several ways of claiming that we know something. In one sense, the scientific method is a set of criteria for deciding how conflicts about differing views of reality can be resolved. It offers a strategy that researchers can use when approaching a question. It offers consumers of research the ability to critically assess how evidence has been developed and used in reaching a conclusion.

For Example

Social Science as a Process of Asking and Answering Questions

For ages people have asked, why do nations go to war? The question has been answered in several different ways. For some, war might be seen as a fundamental part of the human condition. Similarly, we might answer the question by claiming that there is "evil" in the world that precipitates war. Wars thus amount to "good" nations defending themselves against "bad" ones. One obvious problem with this view is that opposing sides likely each see the other as the "bad" one. Likewise, how do we measure good versus bad? Others stress the role that the nations' leaders play. Leaders who, accurately or not, think that they are more powerful than an adversary may launch an attack. Still others note that an array of factors both internal and external to a country determine whether or not a nation goes to war.

A social scientific approach to the question involves making claims about the causes of war that can be tested by multiple observations. One might examine some history of international relations to assess how leaders perceived the strength of their adversaries and then use those observations to explain why leaders launched wars when they do. Another ambitious approach involves collecting hundreds of years of data on all interactions between nations and using the data to predict when wars will and will not occur. This sort of work requires that even more questions be asked and answered systematically. What, for example, is a nation? What level of conflict between nations counts as a war?

SOURCES: John Stoessinger, *Why Nations Go to War*, 11th ed. (Cengage, 2011); Correlates of War project at http://www.correlatesofwar.org/

The scientific approach has many competitors in the search for understanding. For many people throughout most of history, the competitors have prevailed. Analysis of reality has usually been much less popular than myths, conspiracy theories, superstitions, and hunches, which have the reassuring feel of certainty *before* the event they try to predict or control, though seldom afterward. Certainly personal beliefs are a vital part of our lives. The point is that the refusal to analyze is crippling, and the skilled analyst is in a position of strength.

WHY BOTHER TO BE SYSTEMATIC?

Most human communication takes place among small groups of people who share a common language, much common experience, and an understanding of the world they live in. There is a ready-made arena for mutual agreement. Not so in a more complex social environment. Although families can transmit wisdom across generations by handing down stories and maxims, societies run into trouble. In its most cynical form, the question is, whose story is to be believed? The need to understand what is happening around us and to share experiences with others makes systematic thought and inquiry essential.

Because society is interesting for the drama it contains, there is a tendency to dispense with systematic understanding and to get on with the descriptions, stories, and personal judgments. Although these can be illuminating, they often have limited usefulness because highly subjective accounts of life form a poor basis for the development of common understanding and common action.

The intricate task of getting people to bridge the differences that arise from the singularity of their experience requires a disciplined approach to knowledge. Knowledge is socially powerful only if it is knowledge that can be put to use. Social knowledge, if it is to be useful, must be communicable, valid, and compelling.

In order to be **communicable**, knowledge must be expressed in clear form. And if the knowledge is intended to be used as a spur to action, it must be **valid** in light of the appropriate evidence and **compelling** in the way that it fits the question

raised. A personal opinion such as "I think climate change is caused by humans" may influence your friends and even your relatives to think that they are contributing to global warming. But it probably will not make any waves with others. If, however, you can cite evidence that there is more carbon dioxide in the atmosphere today than there has been in the past 650,000 years and that global temperatures are rising as a result, you have a more compelling argument because you relate a judgment to measurements of reality.[1] People who do not even like you but who favor efforts to prevent catastrophes associated with global warming might find such a statement a powerful cue to examine critically the major sources of human-caused carbon dioxide, such as coal. Knowledge built on evidence, and captured in clear transmissible form, makes for power over the environment.

Accumulating knowledge so that past mistakes can be avoided has always intrigued civilized humanity. One can record the sayings of wise people, and that does contribute greatly to cultural enrichment. Yet there is surely room for another kind of cumulative effort: the building up of statements evidenced in a manner that can be double-checked by others. To double-check a statement requires that one know precisely what was claimed and how the claim was tested. This is a major part of the enterprise of science. The steps discussed in Chapter Two, in the section on the scientific method, are the guideposts for accomplishing that kind of knowing.

THE ROLE OF REASONED JUDGMENT AND OPINION

All this vaguely ominous talk about systematic thinking is not meant to cast out reasoned judgment, opinion, and imagination. After all, there is no particular sense in limiting the facilities of the mind in any inquiry.

Reasoned judgment is a staple of human understanding. A reasoned judgment bears a respectable relationship to evidence. Because people inevitably have to act in the absence of complete evidence for decision making, the term *judgment* is important.

Judgment connotes decision making in which all the powers of the mind are activated to make the best use of available knowledge.

Social science does not eliminate the role of judgment from the research process. Indeed, judgment plays a crucial role in how scientific evidence is gathered and evaluated. We can observe that the highest-earning 1 percent of Americans collected more than 23 percent of all income by 2007—more than double their share in 1980. The top 1 percent saw their incomes increase by 256 percent from 1980 to 2007. During that same period, the income of the typical American increased by just 21 percent despite American workers becoming more productive than ever. It is another matter, however, to link this evidence to broad social questions about inequality, poverty, wealth, class, productivity, economic development, and other issues. Logic and good judgment are required to interpret the evidence.[2]

Reasoned judgment is the first part of systematic thought. The proposition that "A full moon on the eve of election day promotes liberal voting" could be correct. However, it does not reflect much reasoned judgment because there is neither evidence for linking the two events nor a logical connection between them. An investigator with time and resources might look into such a proposition, but in a world of scarce time, inadequate resources, and serious problems of social analysis to engage rare talents, such an investigation makes little sense.[3] Although the proposition may be intuitive, even intuition usually bears some relationship to experience and evidence.

Opinion, likewise, plays an inescapable role in scientific analysis because all efforts at inquiry proceed from someone's personal interest. No one asks a question unless there is curiosity about what the conclusion might be. Furthermore, each person's angle of vision on reality is necessarily slightly different from another person's angle. Opinion cannot be eliminated from inquiry but it can be controlled so that it does not fly off into complete fantasy. One practice that assists in reducing the role of opinion is for the researcher to be conscious of his or her values and opinions.

Plato's famous aphorism "know thyself" applies here. Much damage has been done to the cause of good social science by those who pretend **objectivity** to the point at which their research conceals opinions that covertly structure their conclusions. No one is

truly objective, certainly not about the nature of society—there are too many personal stakes involved for that.

Ultimately, good science provides its own check on the influence of values in an inquiry. If the method by which the study has been done and the evidence for conclusions are clearly and fully stated, the study can be examined by anyone for the fit of conclusions to evidence. If there is doubt about the validity of what has been done, the study itself can be double-checked, or "replicated," to use the technical term. This feature distinguishes science from personal judgment and protects against personal bias.

No one can double-check everything that goes on, as the mind deals with inner feelings, perceptions of experience, and thought processes. Science brings the steps of inquiry out of the mind and into public view so that they can be shared as part of the process of accumulating knowledge.

THE ROLE OF IMAGINATION, INTUITION, AND CUSTOM

The mind, in its many ways of knowing, is never so clever or so mysterious as in the exercise of **imagination**. If there is any sense in which people can leap over tall obstacles in a single bound, it is in the flight of the mind. But it is one thing to imagine a possible proposition about reality and quite another to start imagining evidence.

Science is really a matter of figuring out relationships between things we can observe. To propose a relationship between things is a creative and imaginative act; however, much systematic preparation may lie in the background. To test a proposition against reality involves a different order of imagination—mainly, the ability to find in the bits and pieces of information elicited from reality the items that are essential to testing the credibility of the idea about a relationship.

It is in the realm of discovery that science becomes a direct partner of imagination. The history of natural science is filled with examples, from the realization that the earth revolves around the sun and not vice versa, to the discovery that matter is made up of tiny atoms. Each discovery was made by bold and imaginative people who were not afraid to challenge a whole structure of customary belief by consulting evidence in the real world. Although these were discoveries on a grand scale, the same sort of effort is

involved in stepping outside accepted explanations of human behavior to imagine other possibilities and test them by the intelligent use of evidence. Gender scholars do this when they examine traditional claims about male–female differences. To be truly imaginative is something like trying to escape gravity—the initial move is the hardest. Even though the social sciences have as yet few discoveries to compare with the feats of natural science, the application of science to social relations is a much more recent and vastly more complicated undertaking.[4]

At a fundamental level, scientific inquiry is motivated by curiosity and a desire to find order in what may seem to be chaos. We see an array of confusing events, incidents, and behaviors and have an urge to know why something happened or what event caused another. Social science allows us to satisfy our curiosity and to gain understanding for its own sake. On another level, social science produces knowledge that is communicable and can be used to explain our understanding to others.

Whatever we may come to say about the careful thinking that scientific analysis requires, there is still no way to capture completely the wondrous process of "having an idea." Science is absolutely not a system for frustrating that exercise of intuition and imagination; rather, it is a set of procedures for making such ideas as fruitful and productive as human ingenuity allows. Even the most wonderful idea is only as good as its relationship to some present or potential reality. Science is the art of reality testing, of taking ideas and confronting them with observable evidence drawn from the phenomena to which they relate.

To step back from the general blur of human relationships and envision alternative possibilities demands a level of imagination that is as uncommon as it is necessary. In the usual run of social and political experience, David Hume's observation may be sadly accurate, "[People], once accustomed to obedience, never think of departing from that path in which they and their ancestors trod and to which they are confined by so many urgent and visible motives."[5] Yet it is in the understanding and reform of social and political arrangements that the world requires the very best application of disciplined imagination. In the absence of imaginative efforts to understand the reality of society, we are confined to the beaten path of custom and the inequities that stifle human potential.

We also may be confined to some very unproductive habits of behavior. It used to be the custom in England to hang pickpockets

publicly in order to discourage others in the trade. Someone noticed, however, that more pockets were picked at pickpocket hangings than at other public events. The custom survived that bit of social science far longer than it should have.

Custom is not all bad, for it may embody the lessons learned from a long, often unhappy, experience with reality—and it is, in a vague way, scientific. Custom frequently holds communities together in the face of enormous and even violent pressures. Yet the task of any social scientist must be to understand why things are the way they are, as well as how the elements of social life can be reformed to allow for more humane patterns of personal development and expression. The weapons in this struggle for understanding are not only science, with its procedures for disciplining inquiry, but also the intuition that life can be better than it is, that a given pattern of behavior may be other than inevitable, that even the smallest transactions of behavior may contain the keys to larger structures of possibility and potential.

The method of any effort at understanding involves a tension between thought and investigation. There are various ways of linking these two components. The mystic perceives an inner truth and interprets "signs" as validation of the insight. The historian looks for patterns in the past and then suggests their usefulness in interpreting the meanings of events. Thus, the "rise of the middle class" in Europe becomes a major interpretive concept for the historian. Someone who is scientific attempts to be more concrete than the mystic and more precise than the historian with respect to the thoughts by which research is guided, the data regarded as significant in the investigation, and the measures used in testing mental constructions against reality.

In the chapters that follow, we look at each step involved in building scientific understanding. As you will see, the technique requires common sense more than technical knowledge or elaborate preparation.

CONCEPTS INTRODUCED

Science
Technology
Communicable knowledge
Valid knowledge
Compelling knowledge
Reasoned judgment
Opinion
Objectivity
Imagination
Custom

QUESTIONS FOR DISCUSSION

1. What are examples of nonscientific modes of understanding? How might these nonscientific modes be used to explain the following:
   - Why are some people wealthier than others?
   - Why do political revolutions occur in some places but not in others?
   - Who will win next year's Super Bowl?
2. How is social scientific knowledge more powerful than other forms of knowledge (such as intuition or custom)? What are its shortcomings and dangers?
3. How might scientific knowledge be useful to someone who is concerned with reforming or changing society?
4. Why is imagination essential to social science?
5. Is the application of imagination more important to social science than to natural science (such as chemistry or biology)?

ENDNOTES

1. See *Climate Change 2007: Synthesis Report Summary for Policymakers* (Valencia, Spain: 2007). Intergovernmental Panel on Climate Change, p. 5.
2. Jacob Hacker and Paul Pierson, *Winner-Take-All Politics* (New York: Simon & Shuster, 2010). "The Rich, the Poor and the Growing Gap Between Them: Rich Are Big Gainers in America's New Prosperity," *Economist* (June 15, 2006). Thomas Piketty and Emmanuel Saez, "The Evolution of Top Income Groups: A Historical and International Perspective," *NBER working paper 11955* (January 2006). These studies showed that the income gap between rich and poor was the largest since 1921 and was growing.
3. Police and bartenders will tell you that the night of a full moon does, in fact, bring out some pretty bizarre behavior; the hypothesis is not completely preposterous.
4. Perhaps one of the earliest attempts to confront social custom with science was the effort in the late nineteenth century by Francis Galton, an English scientist, to test the efficacy of prayer. Observing that prayers were daily offered in churches throughout the land for the long life of royalty, he compared their longevity to that of the gentry and a variety of professionals. He found, after excluding deaths by accident or violence, and including only those who survived their thirtieth year, that the average age of decease for royalty was 64.04 years, the lowest for all his categories. Galton did observe, however, that prayer has many

personal uses aside from the fulfillment of requests. And, who knows, royalty might have died sooner but for such petitions. P. B. Medwar, *Induction and Intuition in Scientific Thought* (Philadelphia: American Philosophical Society, 1969), pp. 2–7.

5. David Hume, "Of the Origins of Government," In Charles Hendel, ed. *Political Essays* (New York: Liberal Arts Press, 1953), p. 41.

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The Elements of Science

> [Scientific inquiry] begins as a story about a Possible World—a story which we invent and criticize and modify as we go along, so that it ends by being, as nearly as we can make it, a story about real life.
>
> —P. B. MEDAWAR

To see scientific thought in the context of other kinds of thinking, as we have tried to do, tells us why we should be interested in science. Now it is time to see what science is made of.

The elements of a scientific strategy are, in themselves, simple to understand. They are concepts, variables, hypotheses, measurements, and theories. The way in which these are combined constitutes the scientific method. It is the function of theory to give meaning and motivation to this method by enabling us to

interpret what is observed. First, we will try to put each element in place.

THE ORIGIN AND UTILITY OF CONCEPTS

If you had to purge all words and other symbols from your mind and confront the world with a virgin mind, what would you do? Without a body to sustain, you might do nothing. The necessities of survival, however, start closing in, and the first act of the mind might be to sort out the edible objects from the inedible, then the warm from the cold, the friendly from the hostile. From there it is not very far to forming concepts such as food, shelter, and warmth and symbolizing these concepts in the form of words or utterances. Thus, humbly, emerges the instrument called language. The search for truly usable concepts and categories is under way. Languages are huge collections of **concepts**—names for things, feelings, and ideas generated or acquired by people in the course of relating to each other and to their environment.

Some concepts and classifications might not be very helpful. To conceptualize all plants under a single designation would preclude further distinctions between those that are edible, those that heal, and those that poison. Some concepts relate to experience too vaguely: English has but one word for something so varied and complicated as love. Greek allows three concepts: *eros* for romantic love, *agape* for generalized feelings of affection, and *filios* for family love. The inadequacy of English in dealing with the concept of love affects everyone's experience through the tricky ways that the word is used in our culture.

Notice that reality testing is built right into the process of naming things. That back and forth between the stimuli of the environment and the reflections of the mind makes up the kind of thought we will be trying to capture for analysis.

After several thousand years of human history, we still have to face the fact that the process of naming things is difficult. Language emerges essentially by agreement. You and I and the other members of the family (or tribe, state, nation, world) agree, for example, to call things that twinkle in the sky *stars*. Unfortunately, these agreements may not be very precise. In common usage, the term *star* covers a multitude of objects, big and small, hot and cold, solid and gaseous.

To call a thing by a precise name is the beginning of understanding, because it is the key to the procedure that allows the mind to grasp reality and its many relationships. It makes a great deal of difference whether an illness is conceived of as caused by an evil spirit or by bacteria on a binge. The concept *bacteria* is tied to a system of concepts in which there is a connection to a powerful repertoire of treatments, including antibiotics.

To capture meaning in language is a profound and subtle process, even if it is a little sloppy. For example, the abstract concept *race* expresses differences in the ways that groups are identified. When names are given to categories or properties of race, the problems, power, and difficulty of naming things become evident. Researchers often name people "white" or "nonwhite" (or "Anglo" or "non-Anglo") when using simplistic classifications of race. Such a distinction, although common practice, trivializes differences among a large portion of the world's people. Also, the names themselves can raise complex issues. Think of the various names used in the United States to refer to African Americans (Negro, African American, person of color, black) or Hispanic Americans (Latino, Latina, Hispanic, person of color, Latin American, Mexican American, Central American, Puerto Rican, and so forth).

Naming is a process that can give the namer great power. Properties of the concept *race* are not easily named. Names of races, moreover, confer different identities on different people. In your own expression of social scientific thinking, although you are invited to be precise about concepts, you are not invited to be arrogant about the utility of your new knowledge for reworking lives, societies, and civilizations.

The importance of having the right name for a thing can hardly be overestimated. Thomas Hobbes, a seventeenth-century English political theorist, thought the proper naming of things so important to the establishment of political order that he made it a central function of the sovereign. King James understood the message and ordered an authoritative translation of the Bible as a way of overcoming violent squabbles about the precise meanings of words in the Scriptures.

More germane to the modern scene, George Orwell, in his anti-utopian novel *1984*, gave us a vision of a whole bureaucracy devoted to reconstructing language concepts to enhance the power of a totalitarian society. In recent U.S. political history,

American presidents have attempted to defuse controversy about unpopular wars that they conducted by redefining the concept of military success. These examples are intended to make you aware that by cynically manipulating the meanings of concepts, one can play with the foundations of human understanding and social control.

But it will be a while before you master the scientific method sufficiently to pull off anything very grand. For now, the point is that for scientific purposes, concepts are (1) tentative, (2) based on agreement, and (3) useful only to the degree that they capture or isolate some significant and definable item in reality.

What have concepts got to do with science? If you have spent any time around babies, you might notice that they often try to show off by pointing at things and naming them. It gets a little boring the tenth or fifteenth time through, but babies take justifiable pride in the exercise. Next come sentences. From naming things, from being able to symbolize something rather than simply pointing at it, comes the next step in moving reality around so that it can produce things that are needed. The first sentence Andrew Hoover spoke was to his sister, Erin. Sitting on a little cart, he said, "Erin, push me!" She did.

What you are reading now is an effort to link concepts in order to expand your understanding. People speak sentences by the thousands in an attempt to move reality to some useful response. Most people do not have the good luck that Andrew did on his first try. Often, the concepts are confusing and the connections vague or unlikely, not to mention the problem that the speaker has with the listener's perceptions and motives.

Thought and theory develop through the linking of concepts. Consider, as an example, Pierre Proudhon's famous proposition "Property is theft!" *Property*, as a concept, stands for the notion that a person can claim exclusive ownership of land or other resources. *Theft*, of course, means the act of taking something without justification. By linking these two concepts through the verb *is*, Proudhon meant to equate the institution of private property with the denial of humankind's common ownership of nature's resources. The concept of privately owned property was, he thought, unjustifiable thievery. Although Proudhon's declaration illustrates the linkage of concepts at the lofty philosophical level, the humblest sentence performs the same operation.

Science is a way of checking on the formulation of concepts and of testing the possible linkages between them through references to observable phenomena. The next step is to see how scientists turn concepts into something that can be observed. When concepts are defined as variables, they can be used to form a special kind of sentence, the hypothesis.

WHAT IS A VARIABLE?

A **variable** is a name for something that is thought to influence (or be influenced by) a particular state of being in something else. Heat is one variable in making water boil, and so is pressure. Age has been established as a modestly important variable in voting. However, there are many other more significant variables including socioeconomic standing, parental influence, race, gender, region of residence, and so on.

A variable is, in addition, a special kind of concept that contains within it a notion of degree or differentiation. Temperature is an easily understood example of a variable. It includes the notion of more or less heat—that is, of degree. As the name suggests, variables are things that vary. Interesting questions in social science center on concepts that can be discussed in terms of variation. We are interested in how changes in one phenomenon help to explain variation in another.

Consider, as an example, the relationship between religion and voting. In the first place, religion is a different kind of variable than, say, temperature. Although there may be such a thing as degrees of "religiosity,"[1] we might also discuss variation in the concept *religion* in terms of religious denominations such as Buddhist, Christian, and Muslim. There is substantial variation in the religions with which people identify. For example, exit poll data were used to assess the importance of religion in the 2008 election when Democratic presidential candidate Barack Obama challenged Republican candidate John McCain. Data collected by a consortium of media firms found that fully 78 percent of Jewish voters supported Obama (compared with 21 percent for McCain), whereas 65 percent of white Protestants voted for McCain (compared with 34 percent for Obama). Fifty-four percent of Catholics voted for Obama, while 45 percent voted for McCain. Obama won 75 percent of the votes from those reporting no religious

affiliation, while McCain won 67 percent of the vote from Protestants who attended church weekly.[2] Data such as these permit us to say something meaningful about the relationship between the variable *religion* and the variable *voting behavior.*

Although most variables deal with differences of degree, as in temperature, or differences of variety, as in religion, some variables are even simpler. These deal with the most elementary kind of variation: present or absent, there or not there, existent or nonexistent. Take pregnancy, for example. There is no such thing as a little bit of it. Either the condition exists or it does not.

Turning concepts into variables, dull as it may seem, is a very creative process and often raises intriguing questions. Consider, as an illustration, such an ordinary variable as *time.* The early Greeks puzzled a good deal over how to turn this concept into a variable. It seems obvious that time has to be thought of as having a beginning—so philosophers went about trying to figure out when the beginning was. Yet the nagging question always popped up, what happened before that?

Plato and Aristotle both played with the idea that time might not be linear at all, that is, it might not have a beginning, a progression, and presumably an end. It just might be cyclical! This seems crazy to us children of linear time, but they were thinking that universal time might be something like the cycle of the body, a rhythm found everywhere in nature. Historic time, therefore, might best be conceived of as an unfolding structure of events in which one follows the other until the whole pattern is played out and the entire cycle starts over again. Aristotle commented that it just might be that he himself "was living before the Fall of Troy quite as much as after it, since, when the wheel of fortune had turned through another cycle, the Trojan War would be reenacted and Troy would fall again."[3]

The social science done by introductory students seldom involves such mind-boggling conceptual problems, yet it would not do to pretend that these problems do not exist. The variable *personality,* for example, is reputed to have more than 400 definitions in the professional literature, partly because personality is a compound of a huge range of other variables such as class, status, self-concept, race, socialization, and so forth. The complexity of personality as a variable has driven social scientists to such awkward definitions as "one's acquired, relatively enduring, yet dynamic,

unique system of predispositions to psychological and social behavior."[4]

Even when social scientists agree on the description of a variable, that does not mean that the definition possesses the qualities of eternal truth—it just means that some people who have thought about it carefully agree that a given definition seems to help answer some questions. Moreover, researchers often settle on a definition of a variable for reasons of convenience. Identification with political parties in the United States is conventionally measured using responses to survey questions that place voters on a continuum reflecting their identification with the two major political parties. The continuum is represented by this seven-point scale:

← strong Dem — weak Dem — Ind leaning
Dem — Ind — Ind leaning Rep — weak Rep — strong Rep →

Political independents are assumed to be in the center of the political spectrum. Yet the truth of the matter might be that many "independents" think of themselves as radicals who are outside the center. Some might be so nonpartisan or apolitical that they just do not think of themselves in terms of political parties at all. Furthermore, some "leaning" independents are nearly as partisan in their voting as "weak" partisans.[5] Although this definition of the variable might not perfectly reflect the underlying truth of the concept partisanship, it continues to have predictive power. The question has been asked on surveys for decades, so it allows researchers to evaluate trends in partisanship over time. As the difficulties of categorizing independents on this spectrum become apparent, new definitions of partisanship will emerge. Ignoring the problem of specifying how concepts should be turned into variables does not make the problem go away; it just gets you further into the linguistic soup.

The huge stock of concepts in language creates enormous possibilities for linking up variables to explain events. People have muddled around for centuries trying to sort through significant connections. Science is a slightly elevated form of muddling by which these connections are tried out and tested as carefully as possible. In medical science, it took centuries to isolate the many variables affecting disease. Only recently has medical science become so disciplined that it can diagnose many diseases through highly significant blood-chemistry analysis. This development

represents the present stage of a long process of isolating and eliminating a host of unimportant or marginally significant variables. Increasingly in the West, doctors come up against an ancient form of medicine developed to a high art in China, and now we have medical scientists trying to figure out how acupuncture works. New sets of variables must be considered, new conceptual bridges built, and the resistance of conventional understanding overcome.

Unfortunately for social science, we have barely figured out how to lay the foundation for a structure of theory to explain social behavior. Many new students of social science do not see—especially when confronted by thick texts in introductory courses—the context of struggle and accomplishment, tentativeness and probability, behind what has been achieved in social understanding.

Social science currently contains many subdivisions (including political science, sociology, economics, psychology, and education), all of which are working to define, observe, and link specific variables within subsystems of behavior. Social scientists are in the process of chasing a good many possible connections between variables. The bits of tested knowledge that do emerge await an integration across the lines of these inquiries. Relatively few have been attempted, though these efforts are bound to increase in view of the dramatic need for comprehensive social understanding.

Quantification and Measurement: Turning Concepts into Variables

We said earlier that social scientists turn concepts into variables. This is done so the concept can be expressed in a form that is observable and includes some notion of degree or differentiation. The next question is, how does one pin down that degree or differentiation? The answer involves a two-step process: quantification and measurement.

The idea of quantification means setting up a standard amount of a thing and putting a label on it. When we do this, we make it possible to express abstract concepts (such as length) in a manner that provides a common reference for observation. The origins of some quantifications are pretty strange. The ancient Greeks, for example, needed a standard quantity of distance, so they settled on the length of Hercules's foot. For a long time the foot competed with the cubit,

which was the length of someone else's forearm. The trouble with the cubit was that people could never agree on how long the standard forearm was—some said 17 inches, some said 21 inches. Consequently we do not hear much about cubits anymore.

Isolating standardized units increases the power of description and analysis. When Gabriel Fahrenheit established the idea of a degree of temperature, he made a much more useful description of hot and cold possible. It makes a considerable difference with respect to a puddle of water if the temperature is 32 degrees rather than 33 degrees; the words *cold* and *colder* do not work very well for capturing that vital degree of difference.

Quantification in social science takes two forms: discrete and continuous. **Discrete quantification** relates to counting the presence or absence of a thing. It also relates to counting differences of quality as they are captured in categories. A vote for a candidate is a discrete and specific act that can be counted in a conventional manner. A person's sex is a quality that can be counted as being male, female, or transgender.

Some quantifications, however, have to capture the notion of variation along a continuum. Age is an example of a **continuous quantification**. True, one can count the number of years in a person's age, but the quantification of age is an expression of something that is ongoing. A reader of this book may be 20.72 years old today; in a few weeks, she will be 21 years old. Continuous quantification deals not with discrete items but with dimensions such as age, length, and time. The mark of continuous quantification is that the variable involved may have any value on a scale, whereas in discrete quantification, only whole numbers appear (such as in counting sheep).

Each variable has its own peculiar problems and potentials for quantification. One distinguishing characteristic of a well-developed science is the array of quantifiable variables that are useful to people working in the field. One mark of a smart scientist is the ability to find ways to quantify important variables in a reliable and meaningful way. Economics has come a long way by using money as a unit of analysis (though economists, among others, sometimes confuse money with value). Many powerful economic indicators, such as the gross domestic product or the consumer price index, are based on money.

Unfortunately for the other social sciences, there are not such easily quantifiable units for measuring power or representing

psychological stress, alienation, happiness, personal security, or, for that matter, value. Yet inventive scientists have found more or less successful ways of capturing quantifiable pieces of these variables. A text in any of these areas contains dozens of illustrations of how concepts are turned into quantifiable variables, and we will see some of them in the next chapter. The importance of quantification is that when it can be accomplished, there is potential for more precise measurement.

Measurement is not something we choose to do or not do—it is inherent in every analytic discussion. If you doubt this, in the next conversation you have with someone, listen carefully and notice your dependence on terms that imply measurement. A simple political statement such as, "Democrats generally favor a public role in health care," involves several bits of measurement. The verb *favor* implies degrees of difference; the terms *public* and *health care* can have several meanings; and *Democrats* is a classification. The modifier *generally* attempts to qualify the measurement by indicating that it is not a universal characteristic of all Democrats.

If quantities can be established, measurement becomes much easier. The most obvious measurement deals with the problem of how much: how much distance, how much money, and so forth. Some questions of how much are not so easy to measure—public opinion, for example. Using responses to questions as the quantifiable unit of analysis, one crude survey technique provides respondents a "forced choice" and divides opinion into favorable versus unfavorable. Here, opinion is quantified as a discrete, categorical variable: are you for it or against it? Public-opinion polling is often done on this basis. One thing such a simple measurement conceals, of course, is the intensity of the opinion. On many political issues there may be minorities who are passionately on one side and majorities who are lukewarmly on the other side. Some public-opinion polls deal with this by using five categories instead of two:

strongly for — somewhat for — neither for nor
against — somewhat against — strongly against

A political system that simply acts on majority sentiment without taking intensity into account can get itself into a lot of trouble—as the United States did over the Iraq War. A large but rather unenthusiastic majority of the public initially supported the war when

President George W. Bush ordered the initial invasion on March 20, 2003. In less than one year, majority support dissipated. Nine years later, as U.S. personnel were withdrawing from Iraq after nearly 4,500 U.S. military fatalities, opinion reversed with large majorities opposing the war and claiming that it was not worth fighting.[6]

A fancier way of measuring intensity of preferences is to measure opinion in terms of degree. Some surveys ask people to evaluate candidates or parties on a "feeling thermometer" scale where 0 is negative, 50 is neutral, and 100 is positive. To help reveal more accurately the state of opinion, we also want to account for how many people are able to rank something on the scale.[7]

Consider the responses to "feeling thermometer" questions asked in 2011 about candidates for the 2012 Republican presidential nomination. As Table 2.1 illustrates, Mitt Romney was rated highest among all respondents, but, early in the contest, other candidates were rated more highly by Republican voters. Table 2.1

TABLE 2.1 Measuring Feelings about 2012 Republican Presidential Candidates

Candidate	Average Rating, %	People Unable to Rank, %
All respondents' ratings of candidates		
Mitt Romney	50.4	23
Tim Pawlenty	48.4	67
John Huntsman	47.9	84
Ron Paul	46.3	34
Michele Bachmann	45.6	55
Rick Santorum	43.9	63
Newt Gingrich	42.7	17
Republican respondents' ratings of candidates		
Tim Pawlenty	68.1	63
Michele Bachmann	65.8	57
Mitt Romney	63.1	15
Newt Gingrich	61.9	14
Rick Santorum	60.6	60
John Huntsman	58.2	88
Ron Paul	56.5	33

SOURCE: Quinnipiac University poll archived at http://www.quinnipiac.edu/institutes-and-centers/polling-institute/national/release-detail?ReleaseID=1564. Accessed June 15, 2012.

For Example

Religion and Religiosity as Variables

Religion is a complex phenomenon. It can mean membership in a group or a personal feeling. People may think of themselves as part of a particular religion because of how they were raised or due to choices they made. One major study measured this by asking people, "What is your religion, if any?" Respondents were free to offer any reply. The result was a variable that measured a personal, subjective sense of religion. The most common response was "Catholic," followed by "Baptist," "no religion," and "Christian." Others offered many different responses that defined their personal religion.

Identification with a particular religion does not necessarily mean that someone is religious. A person may identify as Catholic, but never attend mass nor believe in Church doctrine. Religiosity is a different concept than religion. How do we translate it into a variable? One way is to ask people about behavior and beliefs that are assumed to reflect piety and being religious. One study asked people, "Do you believe that Jesus Christ is the son of God, or do you believe that Jesus Christ is not the son of God?" This might help us measure religiousness of Christians, but not Jews, Sikhs, and other non-Christians. A broader measure asks people how often they attend religious services and how much religion provides them guidance in day-to-day living. Scholars may debate how to best measure religiosity, but their measures allow us to test how religious identification, and religiosity, are associated with human behavior.

SOURCE: American Religious Identification Survey (ARIS) 2008. Barry Kosimin and Ariela Keysar, Principle Investigators. Trinity College, Hartford, CT.

also illustrates that Tim Pawlenty and Michele Bachmann were viewed more warmly than Romney among Republicans who could rank the candidates, but Romney was much better known. Romney won the nomination.

Reliability and Validity of Variables

Quantified measurement of variables, properly conceived and executed, has the potential for specifying differentiation and degree more effectively than fuzzy words in vague sentences. However we decide to measure variables, we hope to find a method of counting that would provide reliable results if it were to be used by other researchers.

As an example, we could decide to measure presidential approval by asking a random sample of respondents if they like or dislike the president, thereby forcing a choice between only two

alternatives. We might expect that other researchers could use the same measure the next day with a comparable random sample and produce results similar to ours.

Conversely, we might ask the first four people we see on a bus to "discuss what they think" about the president. We could then rate presidential approval based on our personal impression of their responses. Other researchers using this measure the next day on the same bus might produce wildly different results. The answers might be vague, and the values influencing the interpretation may differ.

Measurement of a variable is said to have **reliability** if it produces the same result when different people use it. The forced choice question would probably produce consistent results, because each researcher using comparable samples simply has to count up the number of "likes" and "dislikes" to find a measure of approval. Open-ended discussions with people on the bus, however, require that the researcher interpret a variety of comments that might or might not reflect approval. The answers are meaningful—in some ways even more meaningful than the forced-choice responses measured in a random sample survey. But they are less likely to get us a reliable answer to the question of presidential popularity.

Theoretical concerns about measures of variables can be subtle. Each measure we use is supposed to do a good job of representing the underlying truth of the abstract concept we claim to be representing with a quantified variable. A measure is said to be valid "if it does what it is intended to do."[8] The closer a quantified measure comes to reflecting the definition of the underlying concept the research is concerned with, the more valid the measure is. One of the difficulties of social science is that there are not always clear ways of directly assessing **validity**. For example, the IQ test is a measure that might be used reliably by many researchers attempting to quantify intelligence. It will always be debatable, however, just how accurately this test measures a concept as rich, varied, and powerful as intelligence. IQ tests might be reliable, but are they entirely valid? Validity could be limited if IQ scores are inflated for people who simply have more experience at taking standardized tests.

Improperly conceived measurement is dangerous precisely because it can be so powerful. A tragic and repugnant example was the use of body counts as a key to "progress" in the U.S. effort in the Vietnam War. Newscasts about the war would usually report the military's figures on how many "enemies" were killed

each day. The implication was that the more we killed, the faster we would win the war. There were two things wrong with this quantified measurement.

First, it did not measure what some policy makers alleged that it measured, that is, the amount of success or failure in achieving overall objectives in the war. Because the war was at least as much a political and psychological struggle as a military conflict, the body counts were largely useless as an index of success. They might have told the military something about the condition of the enemy, but reliance on them promoted adverse political and psychological effects in the Vietnamese population and in our own. The Vietnamese began to notice that it was mainly people of their own race and nationality who were being killed by Americans, regardless of whatever else the war was about. Americans thus came to be feared rather than welcomed as allies by many Vietnamese. At the same time, Americans began to see themselves as technological warriors wreaking havoc in a poor country.

A second flaw in the measurement was its implementation. Troops in the field were supposed to count enemy dead and report the number. Several factors, however, intervened, including the confusion (sometimes deliberate) about who was the enemy, the error introduced by having more than one person counting in a particular location, and the chain-of-command pressures for a high body count. Consequently, although the body counts kept going up and led to predictions of success in the war, the actual situation deteriorated.[9]

The very important point is that sloppy or invalid measurement can be worse than no measurement at all. Interpreting the results of measurement requires an understanding of the measurement itself. Measurements are only as good as the instrument used to do the measuring. When deciding on how a variable should be measured, the validity of that measure can be considered in a number of ways. A measure can be said to have **predictive validity** if it does a good job predicting something external to the measure. For example, if the SAT and ACT tests used for college admission actually predicted how well a person would do through their undergraduate years, the tests could be seen as valid measures. By this standard, feeling thermometer scores such as those listed in Table 2.1 could be seen as a valid measure of a candidate's prospects if they do a good job predicting who wins and who loses.

Content validity reflects the extent that a measure includes sufficient content that is appropriately related to the concept being measured. Ideally, if we wanted to measure how much a person participates in politics, we would identify a range of behaviors that are related to the concept of "political participation," including voting, joining interest groups, boycotting products, discussing politics with friends, attending meetings, and so on. Because the domain of political participation is expansive, measuring it simply in terms of whether or not someone votes might not be a content-valid measure.

Construct validity may be the most important way to think about validity. This involves the degree that a measure is logically consistent with the underlying concept you seek to measure. Put simply, construct validity is the extent to which the measurement of some thing measures what it is supposed to measure. In most cases with social science, the validity of a measure is not something that is tested or proven, yet the researcher must always be asking, are we really measuring what we think we are?

THE HYPOTHESIS

Although much of the preceding discussion may seem like a serial review of bits and pieces of scientific thinking, a discussion of hypothesis will bring these matters together.

A **hypothesis** is a sentence of a particularly well-cultivated breed. The purpose of a hypothesis is to organize a study. If the hypothesis is carefully formed, all the steps of the scientific method will follow, as does an outline for the project, a list of resources needed, and a specification of the measures appropriate to the study. The hypothesis provides the structure.

A hypothesis proposes a relationship between two or more variables. For example, political participation *increases* with education. This simple assertion can be seen as a hypothesis. It has a subject (the variable *political participation*), a connective verb (a relationship, *increases*), and an object that is said to cause something (the variable *education*).

To illustrate the point further:

- Obesity *increases* with poverty.
- Union members are *more likely* than nonunion members to vote Democratic.

Or, less obviously (and, for exercise, you can identify the variables and relations):

- Absence makes the heart grow fonder.
- An apple a day keeps the doctor away.
- Early to bed, early to rise, makes people healthy, wealthy, and wise.

It is crucial to realize that a hypothesis is a supposition, as the Oxford English Dictionary points out, "which serves as a starting point for further investigation by which it may be proved or disproved...." A hypothesis stands at the beginning, not the end, of a study, although good studies may suggest new paths of fruitful inquiry and new hypotheses.

So far, most of our examples of hypotheses have been quite simple. But to go from the straightforward to the bizarre, let us cite an experience in teaching scientific thinking. A student came to one of us with the following proposal for research:

> The fragile psycho-pathological type of double helical existence issuing from the precarious relationship of the colonizer and the colonized (which figuratively is similar to the relationship of Siamese twins) and their respective interaction within the colonial situation is psychologically effective, which ramifications lead to psychological maladjustments, i.e., neuroses which subsequently define the nature of the political particulars therein.

That was just the beginning of the proposal! In all that confusing language, there are lots of variables and many relationships. Sorting it out, however, yields two hypotheses:

1. Colonialism *is associated with* neurotic behavior by colonizer and colonial.
2. This neurotic behavior *influences* the political structure of colonialism.

These two hypotheses, large as they are, are somewhat manageable. The concept *colonialism* describes a well-established political situation. Saying that the relationship *is associated with* was a retreat from saying *causes*—a precaution taken in view of the limited research resources available to the student. Neurotic behavior is a tricky concept, but it has parentage in the literature of psychoanalytic theory;

there are behaviors that can respectably be labeled neurotic. From there it becomes a matter of showing the links between the kinds of neurotic, self-destructive behavior that occur in colonial situations and the repressive and authoritarian patterns of colonial politics.

Had the student accomplished all that these hypotheses imply by way of evidence gathering, measurement, and evaluation, he would have been in line for a doctorate degree. As long as we both knew that he was just scratching the surface, his paper (bravely titled "Colonialism: A Game for Neurotics") was good enough for undergraduate requirements.

One thing that this example illustrates is that there is often a step prior to hypothesis formation. The step is called **problem reformulation**. In the preceding example, we began with a generalized concern about colonialism and neurosis. The student elaborated that concern into a complex description of the problem. We narrowed it down by specifying variables and relationships into something that could be dealt with, at least in a general way. With a workable reformulation, defining the ways that variables are represented becomes easier.

One art of social science is skillful problem reformulation. Reformulation requires, in addition to some analytic common sense, the ability to see the variables in a situation and the possible relationships between them. A good first step is to break the problem into its component variables and relationships. Writing down lists of hypotheses associated with a problem enables you to select the ones that answer two questions: Which hypotheses are crucial to the solution of the whole problem? For which hypotheses is there information within the range of your resources? Sometimes these questions force some unpleasant choices, but they help prevent arriving at the end of a research effort with nothing substantial on which to hang a conclusion. The preceding example on colonialism and neurosis illustrates the point.

The importance of establishing a hypothesis correctly before starting off on a research task can hardly be overstated. The following rules will help:

1. The variables must be clearly specified and measurable by some technique you know how to use.
2. The relationship between the variables must be precisely stated and measurable.

3. The hypothesis should be testable, so that evidence of the relationship can be observed, demonstrated, or falsified.

If these rules are not followed, the hypothesis may be unwieldy, ridiculous, or just too hard to research in view of available resources. Precise definitions and thoughtful specification of measurements are, in short, the keys. The struggle to form a hypothesis carefully may not be enjoyable, but the questions raised in the process have to be answered sooner or later.

The hypothesis, then, provides the structure for your entire research effort, whether it involves interviews and surveys, analysis of previously collected data, library research, or all three. It will direct you to relevant information so that you do not waste time and effort. The variables you have selected can be researched through library search engines, Internet resources such as Google Scholar, book indexes, periodical guides, online services, and other computer database searches. The relationships proposed between the variables suggest the measurement tools and standards for evaluation that you will need to use. The results of the hypothesis test are the substance of your conclusions.

Once relationships between variables have been established through hypothesis formation and testing, these relationships can be expressed as **generalizations**. Generalizations based on tested relationships are the object of science. A generalization is a hypothesis affirmed by testing. As generalizations in a field of study accumulate, they form the raw stuff of theories. But this gets us ahead of the story. For now, we need to see how the scientific method sets the procedure for research into a logical sequence.

THE SCIENTIFIC METHOD

The technique known as the **scientific method** is quite commonsensical. The model inquiry proceeds by steps that include the following:

1. Identify the variables to be studied.
2. Form a hypothesis about the relation of one variable to another or to a situation.
3. Perform a reality test whereby changes in the variables are measured to see if the hypothesized relationship is evidenced.

4. Compare the measured relationship between the variables with the original hypothesis and develop generalizations about the findings.
5. Provide suggestions about the theoretical significance of the findings, factors involved in the test that may have distorted the results, and other hypotheses that the inquiry brings to mind.

Although we have sketched here the bare bones of the scientific method, the actual procedure of research does not always start directly with hypothesis formation. As a preliminary to stating hypotheses, social scientists often examine the data collected in a subject area to see if there are connections between the variables. The relationships brought to light by various statistical processes frequently suggest the hypothesis it would be fruitful to explore. Occasionally, simply getting involved with a set of data triggers an interesting thought, a chance insight, or a new idea. Because a large quantity of data has been generated over the past few decades, researchers can often avoid having to begin at the beginning with every inquiry. The analysis of existing data can be extremely helpful in identifying new data needed to test a crucial relationship.

This is only an outline of the scientific method. In the hands of a skilled analyst, other elements are introduced, such alternative ways to measure results, detailed conceptual analysis of the variable description, relationships between one's own study and others, assessments of the validity of the measuring instruments, the use of experimental and control groups, and, equally important, careful conjecture that goes beyond what is established in the test itself. These embellishments on the methodology, however, relate more to the tools used to carry out the method than to the method itself.

The point is that the scientific method seeks to test thoughts against observable evidence in a disciplined manner, with each step in the process made explicit.

Consider the differences between two kinds of studies: (1) an empirical scientific study in which the author states his or her ideas about concepts, forms hypotheses about how the concepts are related, lays out a testing procedure, carefully translates concepts into variables that are validly measured, produces a specific result, and relates this to the hypotheses; and (2) a nonscientific study in

which the author expresses ideas, develops a general thesis, examines relevant examples, and states the conclusions.

Notice that the tension between thought and investigation is present in both studies. But one important difference is the feasibility of checking the soundness of the conclusions in the first example, as opposed to the second, by repeating the study. Social scientists use the word **replication** to indicate the ability to repeat a study as a way of checking if it is solid. Replication constitutes someone else redoing an existing study in order to find errors that might have crept in through the procedures and evaluative judgments contained in the original study. Good science can be replicated by others.

A second difficulty with a nonscientific study lies in the problem of relating one study to another. One person's idea may be interesting, but if stated without a systematic method to test it, the idea might be difficult to defend.

A good scientific study presents all the information needed to see what took place. For example, if standard variable definitions are used, a study of voters' assessments of candidates can be added to studies of how voters view issues, parties, or whatever. As scientists try to build cumulative bodies of knowledge, different studies of the same variables using different measures can be compared to see if measurement techniques create alternative results. The point, once again, is that science regulates and specifies the relationship between thought and investigation in such a way that others may know exactly what has been done.

THE MANY ROLES OF THEORY

Science rests its claim to authority upon its firm basis in observable evidence about something called "reality." We have occasionally described science as, simply, reality testing. Because everyone thinks he or she knows what reality is, science acquires a fundamental appeal. Yet the necessary partner of realism in science is that wholly imaginary phenomenon, **theory**. Without the many roles that theory plays, there would be no science (and, some would argue, there would be no understandable "reality," either).

Just as language arises out of the experience of coming to grips with human needs, so too does theory arise from tasks that people face. The hardest task is to explain what is really going on out

there. Volumes have been written about what theory is and is not. For our purposes, a theory is a set of related propositions that suggest why events occur in the manner that they do.

The propositions that make up theories are of the same form as hypotheses: they consist of concepts and the linkages or relationships between them. Theories are built up as hypotheses are tested and new relationships emerge.

Theory abounds in the most ordinary transactions of life. There are theories of everything from the payoff of slot machines to the inner meaning of Dilbert cartoons. The grandest theories of all are religious and philosophical, embracing huge orders of questions about the origin of the physical universe, the history of the species, the purposes of life, and the norms of behavior that lead to virtue and, possibly, happiness. To the faithful, such theories are made true by a belief in supernatural phenomena. These kinds of theories are presented as if they were embedded in the larger cosmos of our existence, awaiting our arrival at understanding.

Social science, by contrast, generally operates from a different perspective on theory. The most conventional posture of a social scientist is one of pragmatism: a theory is only as good as its present and potential uses in generating hypotheses and explaining observations. The point of any science is to develop a set of theories to explain the events within their range of observation.

It is tempting, but misleading, to conceive of theory as something rock-like and immobile behind the whiz and blur of daily experience. Rather, theory is a sometimes ingenious creation of human beings in their quest for understanding. People create theories in proportion to needs, and the theories they create can be either functional or dysfunctional to those needs. A theory could contain a complete system of categories and generalizations but still be useless. If, for example, one were to categorize the world in terms of tall things and short things and characterize all the relationships between them, a theory would have been born, but it would be one of dubious utility—not false, but useless.

Social science theory is often derived from fundamental assumptions about human behavior. Rational actor theories suggest that individuals, organizations, and nation-states are motivated by a desire to maximize their material interests. Based on this type of theory, we might hypothesize that voters select candidates that further their own economic interest. Alternatively, psychological

theories assume that voting actions are determined by people's long-term feelings of attachment for political parties. Voters are thought to be socialized, via the family, to be loyal to a particular party. From this theory, we might hypothesize that voters act like their parents, or that they select candidates of the same party year after year. The origins of wars have been explained by rational actor theories and psychological theories, as well as by Marxian theories and other forms of social theory.

We have been discussing what theory is and is not. The next question is, what does it do? The answer is, many things. We list four particular uses of theory in social scientific thinking:

1. Theory provides patterns for the interpretation of data.
2. Theory supplies frameworks within which concepts and variables acquire substantive significance.
3. Theory links one study with another.
4. Theory allows us to interpret the larger meaning of our findings for ourselves and others.

The four uses of theory are illustrated in the text that follows by looking at the question of voter participation. The rate of voter participation is an important indicator of democracy. It is reasonable to expect that different types of election rules will affect the number of people who think it is worth their time and effort to vote. We will show how theory influences the way we look at questions of political participation under contrasting sets of election rules. The patterns observed in the data, the links established between studies, the substantive significance of the findings, and their larger meaning are all shaped by the theories the researcher uses.

In this illustration, we focus on how election rules translate people's votes into seats for parties in a legislature. In the United States, nearly all elections are for single-member districts. These rules award a single seat to the candidate who wins the most votes in each district. Where the rules allow a wider variety of parties to win seats (as in proportional representation [PR] systems), presumably more people will vote.[10] In PR systems, each party wins a proportion of the total number of seats based on its percentage of the vote. Thus, if 10 legislative seats are to be allocated in an election, most of the seats would likely go to candidates from large

parties, but smaller parties can elect candidates to one or two seats by winning 10 or 20 percent of the vote.

Some theorize that winner-take-all rules in single-member districts might reduce participation. In the United States, the rules mean that nearly all seats are won by candidates from the Democratic and Republican parties. The hypothesis would be that citizens who are not oriented toward candidates from the major parties might be discouraged from voting.[11] Because a large slice of the electorate see themselves as "independents," this becomes an important factor in assessing the effectiveness of U.S. democracy.

Consider the data presented in Table 2.2. The table shows the average level of turnout for elections held in various countries under three types of election rules. Winner-take-all rules award seats only to candidates that finish first in a single district. Proportional systems typically allow voters to select a party's slate of candidates, then allocate multiple seats roughly proportionate to each party's vote share. Some nations elect part of their legislature with winner-take-all rules and the rest with proportional rules. These nations have mixed systems.

What message do these data provide? Looking at the top row of data in Table 2.2, we find that election rules might affect participation in national elections. Countries that use PR averaged 72.1 percent turnout, compared with a 62.7 percent turnout rate for the nations that use winner-take-all rules. These data are averages based on elections in different countries. The data suggest,

TABLE 2.2 Turnout at National Elections, 2002–2012

	Type of Election Rules for National Legislature		
	Winner-take-all[a]	Proportional[b]	Mixed[c]
Average turnout, %	62.7	72.1	73.4
Standard deviation, %	2.9	10.4	6.6
Number of nations	4	12	3
Number of elections	10	34	9

[a]Canada, Great Britain, France, United States

[b]Denmark, Finland, Greece, Iceland, Ireland, Israel, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland

[c]Germany, Japan, New Zealand

NOTE: Average turnout for national elections held in 19 advanced industrialized democracies where voting is largely noncompulsory.

SOURCE: Authors' calculations from data posted at the Institute for Democracy and Electoral Assistance website, http://www.idea.int/. Accessed June 28, 2012.

but do not prove conclusively, that proportional representation influences more citizens to vote. Rival explanations and intervening variables, such as cultural differences, however, might explain these patterns as well.[12]

Where does the theory enter in? What theories fit this pattern of data? One theory is that people are more likely to act—in this case, to vote—when they think their action will have tangible consequences. In other words, they are more likely to vote if they think their most preferred party might win or if they think their vote might make a difference in a close election. Thus, PR systems might attract followers of smaller parties to vote because of the greater likelihood that their vote could have the effect of electing a representative. Because PR allows more parties in a legislature, the data in Table 2.2 seem to support the theory that PR mobilizes a wider range of citizens because their vote is more likely to have a tangible result.

Another theory proposes that people vote out of a sense of civic duty. Under this theory, they vote regardless of perceptions about their preferred party's chances of winning seats.[13] Because we have no data about how the public's sense of civic duty varies across these nations, the fact that our data are consistent with one theory does not mean that we can reject the rival theory.

Being aware of different theories allows social scientists to link their studies with previous research. It also provides a means to generate additional tests that might allow us to reject rival theories that offer alternative explanations for patterns seen in the data. If we found, for example, that there were no differences in perceived civic duty among the places reflected in the data in Table 2.2, a stronger case could be made that PR motivates more people to vote than do winner-take-all elections.

PR might cause the perceived benefits of voting (greater chances of representation) to outweigh the costs. It might be that nonvoters in the United States are those who feel politically marginalized by electoral institutions that prevent their preferred candidates from winning office. Through these links in reasoning, social scientists can accumulate knowledge of relationships between different theoretical constructs. So far we have seen two uses of theory in relation to the example in Table 2.2: the patterns the theory provides and the ways the theory links one study to another.

The third use of theory is now apparent. We need to assess the substantive significance of what is observed here.[14] That is, we need

to ask if the observations have implications that are interesting or important. This result could be important for testing the usefulness of rational action theories in explaining political behavior. In this case, we might infer that a switch to PR rules could boost turnout substantially in a nation using winner-take-all elections.[15]

It would seem that giving people more choices in elections might lead to greater citizen participation. This raises a host of interesting substantive questions: How would the participation of these voters change a political system? What new parties might succeed? How would institutions such as Congress function with several parties?

The larger meaning of these findings for theories relating political institutions to human behavior lies beyond these specific substantive questions. Participation in a representative democracy is not just a matter of having the formal right to vote. People are also sensitive to the results of the process and to the constraints that institutions create. Clearly, other factors are involved, but it would seem that election systems that lead to the representation of more social groups also encourage more people to vote. Proportional rules that produce representation for a wider variety of people are also likely to have broader effects on citizens' attitudes about politics and government generally.[16]

In discussing theory, we presented an illustration of its uses in social scientific research. Most researchers are intent on proving their theory to be "right." Karl Popper, an influential analyst of the social sciences, however, shows us that the best use of science is often to refute theories rather than to "prove" them:

> Of nearly every theory it may be said that it agrees with many facts: this is one of the reasons why a theory can be said to be corroborated only if we are unable to find refuting facts, rather than if we are able to find supporting facts.[17]

In other words, data may be more impressive as evidence for the theories they refute than for the theories they support.

What we have not captured in this discussion of theory is the subtlety and creativity with which people think about what they are observing. Theory illuminates observations. Yet, like a beam of light playing on an object, every theory leaves shadows that challenge our imaginations.

On the one hand, we can only say that without theory, social science would be an incoherent and meaningless pile of observations,

data, and statistics. On the other hand, not all social science can be tied to rigorous and specific theoretical formulations. It is absolutely clear, however, that complex social problems need all the well-informed study we can develop. The organization and evaluation of that knowledge in theoretical form is almost as important as gathering it in the first place. History is littered with the wreckage of poorly conceived social theories—sometimes with tragic results—though the power of theoretical imagination has been responsible for some of civilization's greatest advances.

We now have in hand the basic tools of scientific thinking. But tools alone do not get the job done. We need a plan or, as described in the next chapter, a strategy for putting those tools to work to produce some knowledge.

CONCEPTS INTRODUCED

Concepts
Variable
Discrete quantification
Continuous quantification
Measurement
Reliability
Validity
Predictive validity
Content validity
Construct validity
Hypothesis
Problem reformulation
Generalizations
Scientific method
Replication
Theory

QUESTIONS FOR DISCUSSION

1. Consider the concept *unemployment.*
   - How can it be given a definition so that it can be measured as a variable?
   - How many definitions of unemployment can you think of?
   - How do these definitions differ?
2. Evaluate different measures of unemployment in terms of reliability and validity.
   - In terms of reliability, if other researchers used your measures (variables), would they produce similar results?
   - In terms of validity, do the measures do a good job of representing the concept *unemployment*?

3. Consider the data about religion and voting in the 2008 election. Develop a table that expresses the relationship between the two variables. Can you form hypotheses about how (or why) religion is associated with voting?
4. One of the more complex questions that social scientists deal with is, why do people rebel against their governments? Consider three examples of major revolutions (seventeenth-century England, eighteenth-century France, early twentieth-century Russia). Based on these examples, can you form some hypotheses about why revolutions occur? When forming your hypotheses, consider the following:
   - What variables are associated with the occurrence of revolutions?
   - How do you define concepts such as *revolution?*
   - Is your definition something that other researchers could apply reliably to other nations in which revolutions have or have not occurred?
   - How are the variables in your hypotheses linked together?
   - How would you test the hypotheses?
   - Would another person reach the same conclusions as you if he or she used your measures and the tests you suggest?

ENDNOTES

1. Various attempts have been made to measure degrees of individual "religiosity" in terms of attitudinal and behavioral traits such as regularity of church attendance. For an example, see Lyman A. Kellstedt and Mark A. Noll, "Religion, Voting for President and Party Identification, 1948–1984," in *Religion and American Politics: From the Colonial Period to the 1980s*, ed. Mark A. Noll (Oxford, England: Oxford University Press, 1990), p. 347.
2. CNN.com Election 2008 Results. U.S. President Exit Poll. At www.cnn.com/ELECTION/2008/results/polls.main. Accessed June 30, 2012.
3. Stephen Toulmin and June Goodfield, *The Discovery of Time* (New York: Harper & Row, 1965), p. 46.
4. Gordon DiRenzo, *Personality and Politics* (Garden City, N.Y.: Anchor Books, 1974), p. 16.
5. Russell J. Dalton, *The Apartisan American* (Los Angeles: Sage, 2013). The author notes that the American electorate is becoming less partisan overall, but that educated "apartisans" often match their levels of engagement with politics with those of partisans.

6. A CNN poll in late 2011 found just 29 percent saying they favored the war, with 68 percent opposed. A CBS poll taken in late 2011 found just 24 percent saying the war was worth fighting. In April 2003, on the other hand, 75 percent replied that the war was worth fighting. Results archived at www.pollingreport.com/iraq.htm. Accessed June 15, 2012.
7. Problems with nonattitudes are discussed in Herbert Asher, *Polling and the Public: What Every Citizen Should Know*, 7th ed. (Washington, D.C.: Congressional Quarterly Press, 2007), chapter 2.
8. Edward G. Carmines and Richard Zeller, *Reliability and Validity Assessment.* Sage University Paper Series on Quantitative Applications in the Social Sciences, no. 17 (Beverly Hills, Calif.: Sage Publications, 1979).
9. During the Iraq War, the allied military command avoided these problems by not announcing estimates of Iraqi casualties.
10. See, for example, G. Bingham Powell, "American Voter Turnout in Comparative Perspective," *American Political Science Review* 80, no. 1 (1986), p. 1743.
11. One study attempted to hold cultural differences constant by comparing turnout in U.S. local elections that used winner-take-all with those using "semi-proportional" elections. It found that "semi-PR" systems increased turnout by about 5 percent. See Shaun Bowler, David Brockington, and Todd Donovan, "Election Systems and Voter Turnout: Experiments in the United States," *Journal of Politics*, 63, no. 3 (2001), pp. 902–915.
12. Douglas Amy, *Real Choices, New Voices* (Cambridge, UK: Cambridge University Press, 1993), pp. 140–153; Arend Lijphart, "Unequal Participation: Democracy's Unresolved Dilemma," *American Political Science Review* 91, no. 1 (1997), pp. 1–14.
13. For a discussion of these rival theories, see Donald Green and Ian Shapiro, *Pathologies of Rational Choice Theory* (New Haven, Conn.: Yale University Press, 1994). Cf. Kristen Monroe, *The Heart of Altrusim: Perceptions of a Common Humanity* (Princeton, N.J.: Princeton University Press, 1996).
14. This should not be confused with statistical significance (see Chapter Five), which tells whether the difference between winner-take-all and PR elections may have occurred by chance. Substantive significance relates to theory rather than to statistical probability.
15. Comparative studies that account for additional variables suggest that the independent effect of PR on turnout varies between 3 and 7 percent. See Andre Blais and Agnieszka Dobrzynska, "Turnout in Electoral Democracies," *European Journal of Political Research* 18 (1998), pp. 167–181; Andres Lander and Henry Milner, "Do Voters Turn Out More Under Proportional Than Majoritarian Systems?," *Electoral Studies*, 18 (1999), pp. 235–250.
16. C. Anderson and C. Guilloty, "Political Institutions and Satisfaction with Democracy: A Cross-National Analysis of Consensus and Majoritarian System," *American Political Science Review* 91, no. 1 (1997), pp. 68–81.
17. In *Popper Selections*, ed. David Miller (Princeton, N.J.: Princeton University Press, 1985), p. 437.