1

Visualizing Research

Overview

This chapter begins by defining the concepts of research and methodology. It presents a model of research processes that links different types of research activities into a unified whole. It briefly discusses each of the steps involved in research, starting with the importance of devising a good research question at the outset of a research project.

Introduction

How do we know what we know? If you live in a developed country, you probably live within a knowledge-based economy within an interconnected knowledge-based world. You depend on knowledge-based products in your daily life: things like computers, medicines, and the bridges and roads that you use on the way to work. Your government enacts policies intended for the public good based, sometimes at least, on expert knowledge about the economy and environment. Your very self-identity and values are conditioned to some degree by a cultural milieu that is heavily influenced by scholars from fields like history, political science, and education.

The discovery of new knowledge is, of course, not just a modern phenomenon. For thousands of years, people have been cooperating to learn new things and to build on the knowledge of their predecessors. Sometimes, the process of discovery has involved massive corporate undertakings, strict protocols, and expensive experiments. Other times,

solitary investigators and innovators have blazed new trails of discovery with little more than patience and a curious mind. The one thing that we can be sure about, however, is that mankind will know a little more tomorrow than they know today.

This book is about how people go about understanding how things work. It is through the process of **research**[1] that people pursue knowledge about those things they do not understand, but want to. What sets research apart from other types of learning is that it represents a systematic and intentional effort to answer questions and learn more about a specific subject. We learn things all the time from our environment and through our interactions with others. Experience often confers knowledge without us ever specifically seeking it out.

Research, however, is the process of intentionally seeking out knowledge for the specific purpose of understanding what and why things have happened or are happening. A researcher sets out on a quest to accumulate knowledge and then understands what the knowledge represents. Sometimes, the subject is a narrow one about a particular place, thing, or event, and other times, research involves the effort to understand how things behave in general.

How a researcher best learns about a subject depends on the type of subject they are investigating. Some subjects are best understood by observing them in person, others through rigorous and laborious number crunching and analysis. The subject of **methodology** involves understanding how researchers most sensibly match the way they go about obtaining knowledge with the questions they are trying to answer. With appropriate methodological choices, researchers maximize their approaches to information gathering while minimizing the biases that would accompany less formal attempts to interpret the information that has been gathered.

Research "methodology" refers to a broader idea than the more specific term research "method." Methodologies act as the overarching blueprint for the innumerable types of specific methods that researchers employ in specific disciplines to uncover new information. In military terms, methods are like tactics, and methodologies are like strategies.

While some books may focus on specific methods used in certain fields, I focus more in this work on the "big picture" of how methodologies in different fields interrelate with one another and pursue common goals, albeit in somewhat different ways depending on the questions under

1. A glossary appears at the end of this book that provides succinct definitions of the bold terms.

investigation. I discuss general approaches to collecting information and how that information can be used to build different types of causal theories. I also discuss how some researchers go about testing and evaluating theories and what theories can teach us about the world around us.

Few, if any, efforts have been undertaken in the past to address the "big picture" of research across fields. Even scholars who might rightly view themselves as experts in a particular research tradition are often poorly versed in what is happening outside the silo of their field or subfield. Scholarship in general, however, benefits when researchers are well versed in a variety of disciplinary-born approaches and how research questions might be addressed in a variety of ways.

A major goal of this book is to take a step back, start from the beginning, and provide a simple outline of research in general. The process of demystifying research methodology begins by visualizing its constituent parts.

Visualizing Research

Figure 1.1 provides the basic outline for this book, represents a helpful model for understanding the general progress of research as it unfolds, and, most important, displays the manner in which all research is ultimately interconnected. It reflects a holistic, "bird's-eye" view of research as it takes place across different fields and traditions.

One reason that research methodologies seem so "abstract" to many students and scholars has to do with the relation of different methodologies to one another. Picking the best way to address a particular research question is very difficult with a "toolbox approach" that often entails utilizing a particular jargon-laden method and applying it to a problem without much consideration of the "big picture." The research model boils down to the essential features of research, whether **qualitative** or **quantitative**, inductive or deductive, or theoretical or applied. As I describe the different elements of research presented in the model, the reader should refer back to the model frequently to understand how different types of research "fit together" into an integrated picture of knowledge creation.

No single research project employs all of the different steps reflected in the model. Research projects differ in focus and scope depending on the research question they are meant to address. Although some of the more ambitious projects may draw on a variety of methodological steps, it is more common that a project utilizes approaches found in specific areas of the model. To understand how to approach a problem, however,

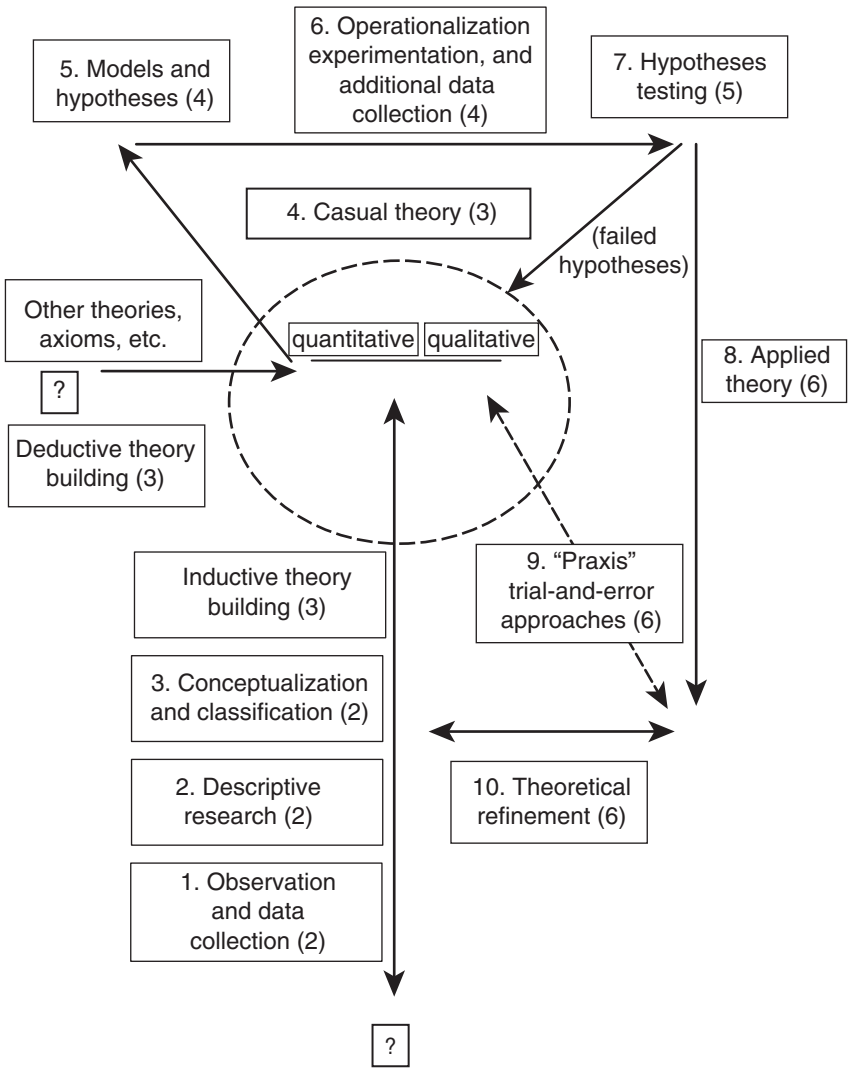

Figure 1.1: A model of the research process

Chapters covering each topic are noted in (#).

it is necessary for scholars to understand what research options are available to them, which options are most appropriate, the limitations of different approaches, and how different approaches are suited for different types of research questions.

The Research Question

In its earliest stages, research begins with a question or a set of questions about an occurrence that a researcher wishes to understand better. Thus, the first step in coming up with a research question is to find an interesting question. Research proceeds much more effectively when the researcher is motivated by curiosity. Of course, if only the researcher finds the question interesting and no one else does, it might not be the ideal research topic. The best research topics are often those that answer questions that have not been investigated previously or that aim to rectify or verify previous investigations that may have yielded inconclusive or questionable results.

Practical considerations also are important to take into account before conducting research. For instance, is the question something that can be answered given the time and resources available? Plans to undertake a sophisticated statistical analysis are unlikely to proceed very far without the appropriate computer software, just as a medical study is unlikely to go very far without appropriate laboratory equipment. Even something as seemingly "simple" as opinion polling can require immense human resources and time to conduct convincingly.

Another practical consideration involves the scope of the investigation. The process of coming up with a research question often begins, but doesn't end, with an interest in a broad topic. It is impossible to count how many times a student has approached me with a research question saying something like "I'm interested in conflict in Africa." The research into such topics could easily be imagined as filling a multivolume set of books. Broad topics can be winnowed down to more manageable questions by asking specific questions about what time periods, areas, and subject matter interest a researcher.

It is also helpful to think about what the research will accomplish methodologically. Does a researcher want to build his or her own theoretical argument based on original research into a subject? Does the researcher want to test other competing theories that might already exist and determine which seems to hold the most explanatory value? Is the research case specific, or does it examine broad trends in human or natural behavior?

Two problematic types of research questions I have heard from students in the past have involved a desire to (1) "prove" something that fits their preexisting beliefs and (2) "show" why governments, institutions, and people "should" take action in favor of an issue they believe in.

Unfortunately, neither of these "questions" represents a very good start to the research process. The problem with the first type of question is that it is not really a question but, rather, an expression of a desire to confirm a preexisting belief. It is important not to set out seeking a particular desirable conclusion before the process of discovering new information has even begun. Failing to keep an open mind warps research by transforming understanding into rationalization.

Research is also not, in and of itself, simply an exercise in ethical argumentation. No one can research the rightness or wrongness of beliefs divorced from fact. That is not to say that the goals of research need necessarily be value neutral—far from it. However, to argue what should happen, a researcher must first understand what is happening and why it is happening.

Even after an appropriate research question has been settled on, that question is likely to subsequently change, grow, and/or become further refined as the process of uncovering new information progresses. New understandings are often likely to lead a researcher down new avenues of inquiry in a process that is, during the early stages in particular, often organic and circular.

The Process of Research

The research model (Figure 1.1) that I propose for the purpose of visualizing research begins with research questions (labeled "?") and then lays out the sensible progression of research in a largely linear step-by-step fashion. For each point, I discuss the broad outlines of the type of research represented by the step and some of the main terminology associated with the traditions being discussed. The directional arrows tying each point with others represent the logical flow of one step into another.

The research process is, however, not always an exclusively linear "a to b" process. For instance, theories are built on data, while the process of data collection may also be guided by theory. This cyclical dance between theory and data that is characteristic of theory building is represented by the two-way directionality of the arrow tying together the earlier steps of the research model. Other steps, such as the deduction of hypotheses from existing bodies of theory, are represented by one-way arrows that indicate the logical unidirectional progression of the research process in these areas.

The following points highlight the different steps of the research process model as represented and numbered in Figure 1.1. The overview of

the model I present below highlights some of the basic elements of research and terminology I use in this book. The rest of the chapters of this book explain each area in much greater detail.

1. All knowledge originates in some form with *observation and data collection*, even if some scholarly research projects utilize information that has already been collected by someone else. The first task of research involves the collection of **data**. While many associate the term *data* with statistical and other quantitative research, the term encompasses any type of information that has been created or gleaned by a researcher from the world. The word data, Latin for "something given," can represent anything from "memory, perception, hearsay" that "are usually (though often wrongly) taken to be true" (Bunge, 1996, p. 85) to spreadsheets full of numerical entries.

Data attempt to represent facts, but the terms are not synonymous. Facts are what exist; they are the true descriptors of the underlying nature of things. Data are information that researchers have translated and filtered from their observations in an attempt to reproduce facts. Unlike facts, data can be correct or incorrect, can be measured more precisely or less, or cannot be really measured at all.

Data are filtered or "made" by a researcher who is drawing from his or her environment through **observation** or experimentation. All data that derive from the effort to reproduce concrete facts are **empirical** data. Empirical data reflect factual information that is measurable, observable either directly or indirectly, and usually tangible. Other nonempirical data can involve attempts to reproduce perceptions or intangible interactions among individuals. Such data form the cornerstone of **interpretivist** and **constructivist approaches**.

In Chapter 2, I cover a range of topics related to observational research. The first part of the chapter is divided into sections that deal with quantitative data collection and less empirical-oriented qualitative data collection. I discuss three major sources of "observable" information: (1) firsthand observation; (2) "mediated" information taken from third-party sources such as TV, radio, and print; and (3) data collected through interviews and surveys.

2. **Descriptive research** involves both the outlining of the nature and shape of data as well as the search for further information based on preexisting data. Since it answers factual questions like what, where, and

when, all original research involves some degree of description. These facts can be tangible and perceptible, as how John Wilkes Booth went about planning and carrying out the execution of President Lincoln, or they can be imperceptible, such as the fact that I enjoy the process of writing.

Often the description of factual information serves as a springboard to causal theories that attempt to explain how and why events happen, but other times, descriptive research represents an important contribution to knowledge by itself. For instance, in the 1870s, the archaeologist Heinrich Schliemann uncovered the ruins of ancient Troy, conclusively establishing that such a city had existed. This discovery represented a major contribution to Western civilization simply because it introduced a new understanding of something factual.

In the name of furthering knowledge, archaeologists and historians routinely attempt to describe the daily lives of peoples in times past, just as cultural anthropologists examine the ways of little-known ethnic groups in the present. Journalists frequently seek to answer important questions descriptively, like when Woodward and Bernstein found out where the money trail led in the Watergate scandal. Such research provides important answers to interesting questions without necessarily attempting to address the issues of causality that we associate with theoretical research.

Research involving statistics is often descriptive in nature as well. Simple opinion polling to determine the likely outcome of an election is descriptive research. "Toyota sells the highest percentage of foreign cars in the United States" is a descriptive sentence. Correlational research in the medical sciences often starts with little or no understanding of theory. For instance, researchers first suggested the likelihood of an association between lung cancer and smoking during the 1930s—even though they had no idea why this would be the case and could not offer a strong theoretical explanation for decades thereafter.

As a researcher begins to describe data, he or she may also derive **inferences**. An inference is what a researcher believes is occurring even though he or she may not be able to directly observe the phenomenon in question. The goal of inference is either descriptive or causal. While drawing descriptive inferences represents an effort to predict the properties of unobserved things and events, causal theory inference seeks to understand how and why some things affect other things.

Causal inferences are often built on descriptive inferences. The inference that motion distorts sound waves is a descriptive inference that can

be drawn by simply standing next to railroad tracks and listening to the whistle of an approaching train. To develop a causal inference, a researcher would have to know something about the nature, frequency, and pitch of sound waves and be able to infer from this information how the distortion of sound waves influenced the sound perceived by human ears.

The discussion of descriptive research in the middle of Chapter 2 is intended in large part to help the reader distinguish the difference between descriptive and causal questions and research. Much important descriptive research has been conducted over the years in an effort to better understand the characteristics of people and past and present events, but causal research adds an additional layer of complexity by helping us understand why things happen. Nevertheless, while solid descriptive research may exist in the absence of causal understandings, causal research conducted without the underpinning of description is necessarily relegated to the realm of the abstract.

3. **Conceptualization** and **classification** represents an intermediary step between description and causal theory. Data are organized in a more rigorous manner to aid in the recognition of patterns and the development of causal inferences. It is collected and defined in broad terms, ordering it in some type of logical and understandable fashion.

Every field classifies objects, events, and phenomena in some way so that there are common frames of reference among scholars and so that causal relationships are easier to understand. Among other things, historians and paleontologists classify time periods, geographers classify regions, and biologists classify animals.

Social scientists often have a more difficult job than natural scientists, as they are called on to differentiate between different types of intangible variables such as liberal and conservative or democratic and nondemocratic. Much of the field of psychology, a social science, is built on the idea of psychological "constructs"—somewhat subjective categorizations of different mental states. The last part of Chapter 2 discusses how typologies of latent ideas are convincingly conceptualized and put into use as an organizing framework for causal theories.

4. The development of **causal theory** lies at the heart of the research process. While many excellent projects focus on the whos, whats, and whens, knowledge progresses most when a researcher is able to establish convincingly why and how something has occurred or is

occurring. While sometimes simply finding out descriptive facts is a major contribution to knowledge, most researchers want to know how and why things happen in the world as they do. Causal theories can most succinctly be thought of as a series of related cause-and-effect propositions that explain the mechanisms through which something affects something else.

Once beyond simple descriptive endeavors, research always involves causal theory in some fashion, whether a project involves the

- development of new theories,
- testing of theories, and/or
- application and refinement of theories.

As reflected in Figure 1.1, research may be thought of as always headed toward (theory building) or away from (testing and application) theoretical causal explanation.

In Chapter 3, the discussion revolves around theory building across a variety of disciplines. Within the course of the discussion, I distinguish the process deriving theory *inductively*, through the process of observation, description, and classification, from the process of deriving theory *deductively*, based on assumptions that are logical and/or mathematical in nature. Furthermore, I explore the relationship of causal theories that are based on qualitative research, which analyzes a small number of things in greater detail, with those based on quantitative research, which involves analyzing larger-scale trends in data. I provide detailed examples of major traditions that deal with each of these approaches, introducing terms such as "phenomenalism," "structuralism," and "behavioralism," and conclude with a discussion of how researchers think about the process of building their own theories.

5. **Models** and **hypotheses** are created to simplify theories and help point the way toward the process of verifying the propositions of the theory.

Models are simplified versions of the whole or parts of a theory. While causal theories entail a nuanced examination of why things happen, models usually just display the relationships between the variables described in a theory. Since they represent the essential features of theories, models aid in the formulation of concise and testable hypotheses. The efforts of researchers to develop testable models are central to quantitative efforts in the natural and social sciences.

Hypotheses are best understood as serving a specific role in research; namely, bridging the propositions of "abstract" theories and models to the expected empirical implications of those theories and models. Researchers use hypotheses to point the way to future analysis by suggesting what relationship should exist between variables that have already been rigorously examined and specified.

I examine models and hypotheses in the first part of Chapter 4. Throughout the whole chapter, I identify the steps that a researcher takes in preparing to test quantitatively oriented theories through different types of empirical analysis. Models and hypotheses are important steps in framing the testing process, but as discussed next, access to quantifiable data, which can be measured or created observationally or experimentally, is generally required as well.

6. **Operationalization** and **experimentation** are two methods of obtaining quantifiable data that can be used for statistical analysis. *Operationalization* is a term more common in the social sciences than the natural sciences. It involves efforts to measure intangible concepts quantitatively. *Experimentation* involves the deliberate manipulation of a controlled environment by a researcher to create data.

Not all data need to be transformed or "made" through experimentation. Some types of data, such as temperature or polling data, are collected in quantified form in the first place. In the absence of such naturally occurring quantitative data, a researcher might embark on the task of transforming latent, difficult-to-measure concepts into empirically measurable variables through the process of operationalization. The process of operationalization flows from the conceptualization and classification of data described in Step 3. Concepts can be ordered qualitatively and still be useful for the formulation of causal theory. However, if a researcher is investigating statistical patterns, concepts must be quantified to be useful in analysis.

The need to make concepts operational exists primarily in the social sciences, where phenomena are often not naturally quantified. Examples include concepts such as "IQ" and "power." To quantify such concepts, social scientists find related empirical referents such as test scores or size of GDP (gross domestic product). The quality of a research project often depends on how "validly," "reliably," and "precisely" information is quantified. I will discuss each of these terms at length in the middle of Chapter 4.

Unfortunately, the operationalization of intangible concepts is an inexact process. There is always room for debate about whether something was measured validly. This is a challenge that tends to face social scientists more than natural scientists, who generally employ data that are directly quantifiable through observation or experimentation.

Classic experimental techniques, on the other hand, represent the "gold standard" when it comes to the collection or creation of quantifiable data that are most appropriate for statistical testing. The reasons that experimentally derived data are often superior to observationally derived data for the purposes of testing theory are a bit complex and discussed further in the final parts of Chapter 4.

Unfortunately, not every research question is amenable to experimentation, either because of the nature of the question, the resources available to investigate the question, or the ethics involved in conducting experiments on, for example, human subjects. Thus, especially in the social sciences, experimentation is often a luxury that is out of reach for many research projects.

7. *Hypothesis testing* is conducted to determine whether, and to what degree, empirical evidence exists to support causal hypotheses. Most testing procedures help determine whether a nonrandom trend exists in data that are analyzed. This nonrandomness suggests that a relationship exists among the variables being tested. In other cases, **critical tests** examine presumed universal phenomenon and ascertain, in one-shot "experiments," whether empirical observations confirm or disconfirm whether those phenomena operate as theorized.

Statistical tests that are used to assess hypotheses differ from "descriptive statistics" in that they are designed to assess whether large sets of data support hypotheses derived from causal theory. The methods available for statistical testing are numerous and fill entire textbooks. What they all have in common, however, is the effort to ascertain the probability that patterns of data exist that provide evidence of the causal linkages posited in a researcher's theory. If a relationship is found, then statistical tests also provide answers concerning the magnitude to which independent variables affect dependent variables. Of course, if no pattern exists, that is, if statistical evidence suggests that patterns within data cannot be sufficiently differentiated from random

patterns of numbers, then hypotheses must be abandoned and a theory reexamined in part or whole.[2]

Critical tests are nonstatistical in nature but can still be used to assess hypotheses. These tests, which are most associated with the natural sciences, examine specific phenomena that are presumed to reflect universal laws. This differs from the statistical testing of hypotheses, which examines trends in data rather than particular events, and does not purport to necessarily analyze universal trends. Critical testing can be summed up best as "we would expect to see" this happen if "this theory is correct." I briefly examine such critical tests in Chapter 5 before turning to a discussion of some of the basic concepts used in statistical hypothesis testing and providing a summary of some of the more common statistical methods employed by researchers.

8. **Applied theory/applied theoretical research** seeks to learn how theories might be fruitfully utilized to understand actual events. Unless research is conducted simply for "knowledge's sake," the knowledge gained from research is presumably applied to help understand real-world problems. At the same time, examining the real world helps us understand and refine theory better.

The discussion in Chapter 6 reveals how researchers use theories to achieve practical understandings of the past, present, and even future world through the use of scholarly methods such as "structured-focused" analysis and simulations. Ultimately, the utility of good theories lies in the fact that they provide the framework for understanding how things happened historically and how events might be understood today, and they can provide the lens through which predictions about the future might be made.

9. Chapter 6 also contains an exploration of more informal approaches to theoretical learning and application. The applied **"trial-and-error" approach**

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2. As a last note about statistics, it is important to note, as presented in the model, the unidirectionality of the arrow tying together the movement from hypothesis to hypothesis testing. If a hypothesis is tested and not confirmed (or, technically, the "null hypothesis" is confirmed), it is necessary to reexamine the theoretical bases of the hypothesis, formulate a different hypothesis based on an improved understanding of the phenomenon, and collect new data with which to test the hypothesis. It is generally not appropriate to simply test and retest similar hypotheses with slightly different variables over and over again in the hope of obtaining a positive result. This is known as "data mining." For the purposes of hypothesis testing, data mining is likely to lead to a false-positive error (or Type 1 error) that will be interpreted and reported as confirmation of some element of a theory.

to knowledge reflects how real businesses and organizations function. **Theoretical refinement** and application alternate with one another in a search for "best practices." Sometimes, the process takes place as *praxis*—an attempt to put theoretical ideas into practice in the field. Other times, the approach is more passive and top-down, with a researcher observing how his or her ideas seem to illustrate what is already happening.

A researcher's theory might suggest that the world works one way and come to find that reality suggests otherwise. Confronted with a different version of causality than his or her theory presents, an author must either alter his or her understanding of theory or his or her understanding of reality. As theory and perception converge, theories become more credible and reality more decipherable.

10. The final step of research discussed in Chapter 6 involves theoretical refinement. Researchers and academics will always have jobs, because the overarching process of research is cyclical and never-ending. Few theories posited about natural and social relations turn out to be complete, universal, or display clockwork precision. The process of building on preexisting knowledge and refining the research of one's predecessors or one's own work lies at the heart of the collective effort to understand how things work. As the fruits of research are applied and understood in "real-word" contexts, researchers learn more about what they do not know and how to proceed with a different set of theoretical assumptions.

Every iteration of the research cycle can provide a greater understanding of the world. Without a firm understanding of process of research, however, our contributions as researchers will be diminished or, worse, lead future researchers to build their projects on foundations we constructed on sand.

Conclusion

In this chapter, I have laid out the basic framework for conducting research. Very few, if any, projects entail all of the steps set in Figure 1.1. However, by thinking of research as a unified whole, it is easier to visualize exactly why researchers are engaged in the particular tasks they undertake for specific projects.

In the chapters that follow, I break down Figure 1.1 into several different larger processes. The first area, which I discuss in Chapter 2, involves the effort to find, describe, and organize information (Steps 1 to 3). The second

process discussed in Chapter 3 is that of theory building (Step 4). In Chapter 4 (Steps 5 and 6), I look at how researchers bridge the gap between theory and empirical testing when they conduct quantitative research. Chapter 5 is about the methods used to test whether or not causal theories are likely to be correct or not (Step 7). In Chapter 6, I discuss how researchers grapple with causal theories and their relation to the "real world" and argue that theories can inform researchers about reality, while the empirical world points the way to more refined theoretical understandings.

Each of the steps and chapters should be thought of in terms of its relationship to causal theory. Unless they are purely descriptive in nature, research projects always involve moving "toward" the creation of causal theories through the processes of inductive or deductive theory building or "away" from these theories when they are empirically tested or applied in framing and understanding events in the "real world." As such, the book is divided into three further parts, the first describing how theories are derived (Chapters 2 and 3), the second explaining how theories are empirically verified (Chapters 4 and 5), and the final section (Chapter 6) describing how theories are applied.

DISCUSSION QUESTIONS

1.1 Look at the following types of research activities. Which one do you think can best be described as (a) theory building, (b) theory testing, and (c) theory application. Why?

Using a mathematical electoral model to predict who will win an election.

Conducting an experiment and analyzing the results to determine whether a medicine improves the health of one group of people over another.

Interviewing policymakers to better understand how decisions were made in a crisis.

1.2 Look through periodicals or browse the Internet and find a news article that interests you. Think of a research question that involves the event being described and why something happened or happens. Now think of three different factors that would be worthy of investigating as potential factors explaining the outcomes described in the article you found.