1

THE PURPOSE OF RESEARCH

CHAPTER OUTLINE

Scientific Research and Its Purpose
Theories of Knowledge
Karl Popper's Falsifiability
Thomas Kuhn's Structure of Scientific Revolution
A Quick Look at Qualitative, Quantitative, and Mixed Methods
Qualitative Research
Quantitative Research
Mixed Methods
Ethical Research
Ethical Rules
A Violation of Ethics
Researchers' Biases
Summary
Key Terms

WHAT WILL YOU LEARN TO DO?

1. Describe scientific research and its purpose in furthering knowledge
2. Summarize two theories of knowledge: falsifiability and the scientific revolution
3. Compare and contrast qualitative, quantitative, and mixed methods
4. Explain the importance of ethics and objectivity in research

SCIENTIFIC RESEARCH AND ITS PURPOSE

We humans are great knowledge accumulators. We love knowing about everything, and these days it is quite easy to obtain knowledge. I start the day by listening to news on the radio while driving into work. My eyes catch a new billboard on the highway—something about hospitals and children's health. To get to my office, I walk across campus, but along the way, my senses are bombarded with advertisements, posters, and all kinds of information that beg for my attention. Finally, inside my office, I boot up the computer. Preparing for class is accompanied by checking email, scrolling through my department's Facebook page, tweeting about the latest New York Times article on children diagnosed with attention deficit hyperactivity disorder (ADHD), and, of course, double-checking my Prezi presentation. My eyes also catch some information about a new diet program, a new research methods book, and a new study on children's health. And how can I refuse the latest video from my 10-year-old niece who is programming robots? I am such a proud auntie! Wait! Wasn't that a picture from my friend's newborn twins? How cute!

This is likely to be a familiar scenario in your life as well. We are accustomed to absorbing vast amounts of information every day. But how do we distinguish accurate from inaccurate information? What communications can we actually trust? You will probably agree that some nonscientific knowledge comes from cultural *tradition*, such as how to roast a turkey on Thanksgiving, the right amount to tip a waiter when eating at a restaurant, or even how to dress as a girl or a boy. So, **traditional knowledge** is a form of knowledge that we inherit from the culture we grew up in. This includes everything we were taught as children that has become part of who we are and how we behave.

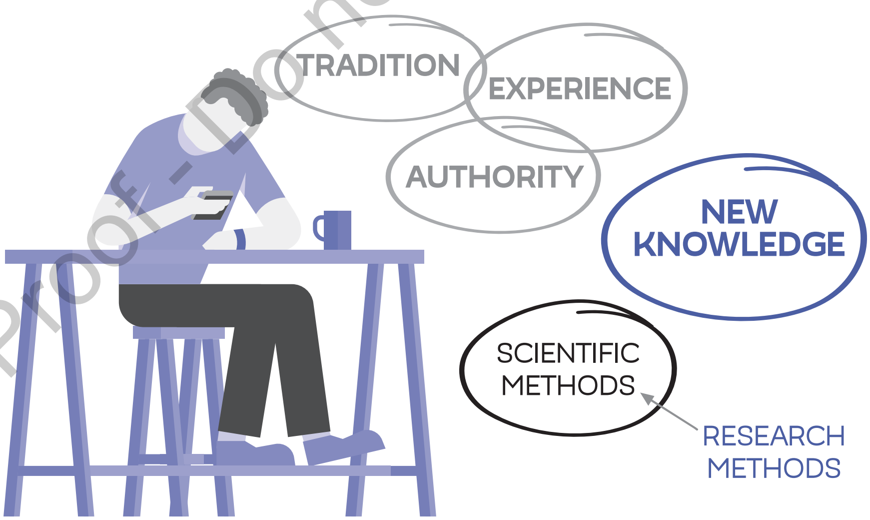
Other types of knowledge emanate from *authority,* for example when you believe your doctor's diagnosis of your ear infection and take the antibiotics he prescribed rather than the advice of a random blogger who suggests you put garlic oil in your ear canal. Therefore, **authority** is a form of knowledge that we believe to be true because its source is authoritative. Parents, teachers, and professional figures are some examples of these sources of knowledge. Knowledge also comes from experience, which is one of the first ways we learn as children. A child learns that it is dangerous to put hands on a hot surface because it can burn him or her. **Experiential knowledge** teaches us through pleasant or unpleasant experiences and continues throughout life.

Scientific knowledge, on the other hand, is based on studies conducted by researchers. In a nutshell, scientific knowledge is knowledge we can trust. It is through systematic research that we produce new scientific knowledge. It appears that scientific knowledge is not directly related to other types of knowledge, but we are all aware that tradition, authority, and experience may drive scientific research, at least theoretically. Conducting research does not simply mean following a specific method and obeying a set of rules. It also means embodying a different way of looking at the world, viewing it through two or more perspectives simultaneously. Sometimes it means gaining a fresh pair of eyes. So, do we actually *know* reality? From the very start we must recognize that *reality and knowledge are two different things.*

By conducting research, we attempt to get closer to reality by attempting to build knowledge about it. But *reality* can be like an abstract concept that fades away every time we get closer. Like ants carrying bits of food, we march forward to find the truths we seek. Therefore, we can say that scientific research is the final product of conducting rigorous research. We generate this product by following a set of specific rules, embodying a set of specific skills, and embodying a specific framework when analyzing our results. This book will familiarize you with the discipline and fortitude of these hard-working ants, while simultaneously trying to instill in you the energy and the passion that it takes to become a great researcher. So, let's have some fun!

Let's be honest, conducting research is not everyone's cup of tea. It is likely that you have plans for your future career that do not involve scientific research, so why bother

FIGURE 1.1 ■ Types of Knowledge



with this stuff? Here are three reasons that may change your mind. Note that none of them include, "because it is required for your major."

1. Conducting research can be fun when you are in charge of your own work or study.
2. Knowing how to do research will open many doors for you in your career. It will open your mind to new ideas on what you might pursue in the future (e.g., becoming an entrepreneur, opening your own nongovernmental organization, or running your own health clinic), and give you an extra skill to brag about in your job interviews.
3. Understanding research will make you an educated consumer. You will be able to evaluate the information before you and determine what to accept and what to reject. Imagine yourself in the supermarket trying to choose between the many types of apples in the store. Some apples are marked as "organic" whereas others as "conventional." There are also different types of apples that come in varying colors, are grown in different locations, and, of course, have different prices.

It is because of research conducted on the harms of pesticides used to grow conventional apples that you know the dangers of conventional products. It is also because of research that you are aware of what happens to the fruit when it is transported from thousands of miles away. Combining this knowledge allows you to decide what types of apples are the best for your health and budget. Though this example refers to something as simple as buying apples, we can use knowledge from research in all other aspects of our lives. Truth be told, understanding research will save you money in the short and long term.

In sum, we can conceptualize scientific knowledge as the kind of knowledge that follows detailed guidelines to reach conclusions. Scientific knowledge provides us with specific findings and information on how these findings became available. The 'how' part is covered by the research methodology where we document all the steps we took to come to a new finding or new knowledge. But, before we go into the details of methodology, we must take a peek into some theories of knowledge. Theories of knowledge attempt to explain in general terms how new knowledge is created and the philosophical approach for creating new knowledge.

THEORIES OF KNOWLEDGE

By conducting research, we develop and construct new knowledge. Many different theories have attempted to define how knowledge is created. The meaning of theory is further explained in Chapter 3, but for now, let us consider theory as a conceptual framework that we use to explain something around us. Theories of knowledge, for example, attempt to explain how new knowledge is developed. It is the reasoning behind creating and discovering new knowledge. Two of the most important and perhaps widely accepted of such theories are Karl Popper's falsifiability and Thomas Kuhn's structure of scientific revolution.

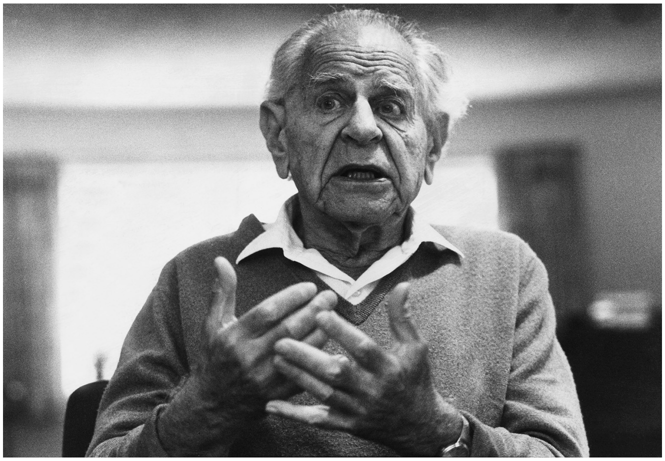
Karl Popper's Falsifiability

Sir Karl Popper was one of the greatest scientific philosophers of the 20th century (Stangroom & Garvey, 2015). His theory of falsifiability is a fascinating explanation of the growth of knowledge that we can apply to our daily lives and can influence the way we think and act. Popper devoted much of his thought and writing to the understanding of how knowledge grows and advances. His ideas are still applicable to today's research.

Popper observed that many grand theories claiming to explain everything about the world often err. What theory could be applied to absolutely everything that exists? Slowly but surely, he realized it was his systematic attempts to prove things wrong that advanced scientific knowledge. Let's illustrate this point with a simple example. If we know—the word "know" here is of key importance—that drinking coffee in the afternoon can keep us up later than our usual bedtime, we may refrain from drinking coffee when we plan to go to sleep as usual. On other occasions, we may want to drink one cup, so we can stay up later to finish a paper that is due tomorrow. We take this knowledge for granted, and we apply it on a daily basis (i.e., drink a cup of coffee early in the morning, stay away from it in the afternoon).

One afternoon, we find that we are extremely tired. In fact, we are so tired that we could go to sleep at 5:00 pm and not wake up until the next morning. However, we don't want to go to sleep yet, so we get a cup of coffee even though it is late in the afternoon. To help ourselves feel energized, we eat some dark chocolate or a double-chocolate brownie from Starbucks, increasing the amount of caffeine in our bodies even more. Remember, we know that coffee will keep us up because this has been our previous experience (let's be professional here and call this experience by its scientific name: **empirical evidence**). Empirical evidence means acquiring data or information by systematically observing people or events. It comes from gathering data from practical experience.

However, this time, the caffeine in our body does not work as we had predicted from empirical evidence. Instead of energizing us and keeping us awake, it actually put us into a deep, dreamy sleep. We wake up three hours later, surprised that the coffee did not work. In Popper's terms, we have **falsified** an established theory. We have proven it wrong. By proving it wrong, we have added a new piece of knowledge to our already known theory. Now, instead of claiming that caffeine always energizes our bodies, we are claiming that sometimes—depending on how the body reacts to it—caffeine can have the opposite



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Karl Popper

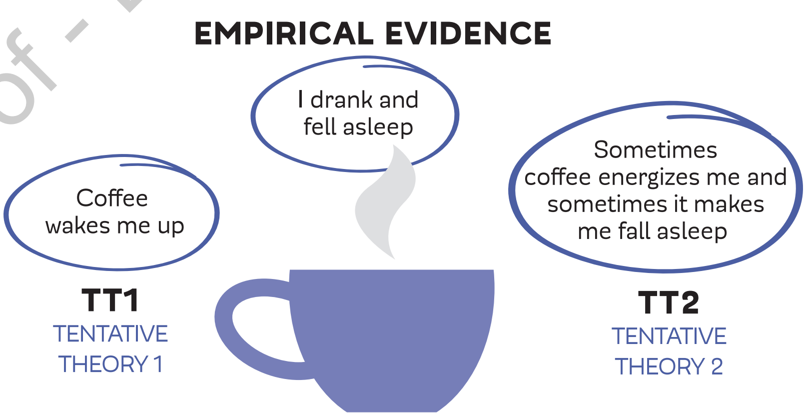
effect and put us into a deep sleep. We falsified an established theory, and built a new theory on this knowledge. Falsifying a theory is our attempt to disprove an established theory, which is how we construct more advanced knowledge.

This is how we build new knowledge. Popper believed that in order to construct new knowledge, our goal should be to falsify the established theories. Advancing knowledge is an evolutionary process that he expressed through the following formula:

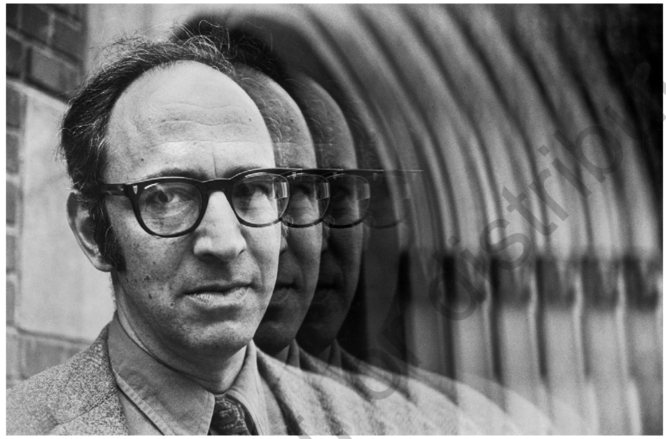
PS1 -> TT1 -> EE1 -> PS2

PS1 is a problem situation or issue that interests us or has a question attached to it. To explain this problem, there are a number of tentative theories, or TT1. If we try to falsify these tentative theories by error of elimination, EE1—or a process similar to natural selection—we find that most of our tentative theories are incorrect and there is a new explanation for the first problem we started on. Through this natural selection process, we build new knowledge and end up with a new problem situation, PS2.

FIGURE 1.2 ■ Popper's Tentative Theory Development Illustrated



To revisit our coffee example, we could say that our new problem situation, PS2, is that caffeine works sometimes to keep us awake, but not always. There are cases when caffeine will cause the opposite effect on our bodies and put us to sleep.



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Thomas Kuhn

We end up with a new, stronger theory about caffeine and sleep. However, that does not mean this is an absolute principle. Rather, it is simply accepted until we succeed in falsifying it again. Popper brought to us a simple but important understanding of how knowledge is built, and this is how our everyday knowledge is constructed as well. We accept something as true until the moment we falsify it. Once we manage to prove it wrong, we build a better understanding on that particular theory or piece of knowledge.

Thomas Kuhn's Structure of Scientific Revolution

From early on in life, Thomas Kuhn was interested in the history of science and how knowledge is constructed. He defined knowledge as a summary of general truths and laws about the world that are scientifically proven. But, how does science develop further? Most scientists occupy themselves with *normal science,* which, according to Kuhn, is basically what we know: general rules, general laws, paradigms we have accepted as truths, and so on. **Normal science** does not aim to explore new ideas, to build on scientific knowledge, to experiment, or to risk. It functions on what is already known and uses what we know as the ultimate truth. Normal science is SAFE. It is doing what we have been doing: relying on existing knowledge and not testing it.

This reminds me of my husband's cooking habits. He will follow a recipe to a tee. If one ingredient is missing, he becomes paralyzed. If the recipe calls for onions, and instead we have leeks—a cousin of onions—he will never use leeks. In Kuhn's terms this is normal science.

Normal science is made of accepted **paradigms**. A paradigm is an unchangeable pattern that we use over and over again. There are specific rules and regulations governing the paradigm that are widely accepted from a specific scientific community. Normal science is composed of many such paradigms, and we follow those in order to reinforce what we already know. Scientists who subscribe to normal science, according to Kuhn, will not discover anything new, just like my husband will never know whether compared to onions leeks work better, worse, or the same in the recipe. They are invested in reproducing the same normal science over and over again. Boring, if you ask me.

The following direct quote from Kuhn's (1962) *The Structure of Scientific Revolution* explains the paradigm in more detail

> Paradigm is a term that relates closely to "normal science." By choosing it, I mean to suggest that some accepted examples of actual scientific practice—examples which include law, theory, application, and instrumentation together—provide models from which spring particular coherent traditions of scientific research. . . . The study of paradigms, including many that are far more specialized than those named illustratively above, is what mainly prepares the student for membership in the particular scientific community. (p. 8)

Every now and then, we encounter **anomalies**, or things that do not fit into the paradigms of normal science. When these anomalies occur, our understanding of normal science shatters. An anomaly is something that happens once or twice that does not fit into our commonly accepted patterns. When these anomalies start to occur left and right, they are no longer anomalies, but a **crisis**. A crisis is further defined as the accumulation of many anomalies against an accepted truth or normal science. We encounter a crisis when the normal science does not seem to fit with reality any longer.

Sometimes, this makes me think of the prevalence of mental disorders in our society. Often, mental disorders, as defined by the *Diagnostic Statistical Manual of Mental Health* (DSM), refer to behaviors that are abnormal—meaning that they are different from what is widely considered normal. Now, if the number of such abnormalities increases all the time, we may need to reconsider the definition of what is truly normal. According to the Center for Behavioral Health Statistics and Quality (2016) an estimated 43.4 million U.S. adults aged 18 or older have some form of mental illness. This represents 17.9 % of the population of U.S. adults. If almost 20% of the population exhibits behaviors that deviate from what is defined as normal, then maybe we are encountering a crisis and need to reevaluate the definition of normality. Maybe we should conclude that having a disorder is the new norm rather than an anomaly.

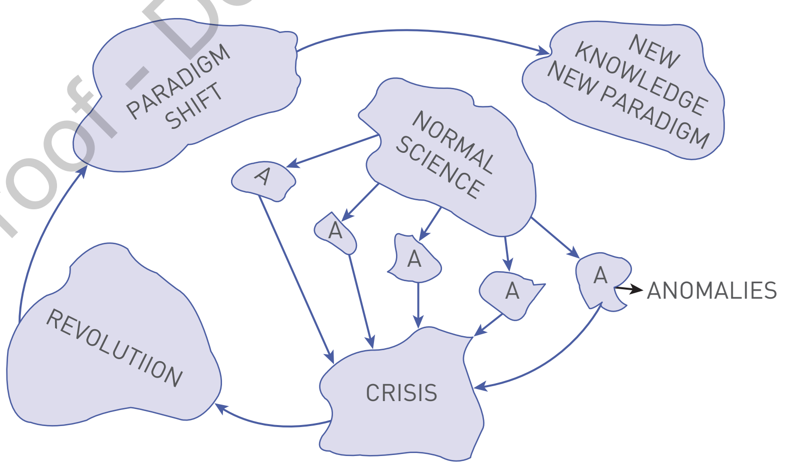
When anomalies accumulate, we start questioning what we have accepted as truth, or normal science. Kuhn believed that in order to change established paradigms, we must undergo some form of crisis. Crisis can lead to a **revolution** of science. The revolution replaces the old paradigm with a new paradigm. This is when we see a **paradigm shift**. So, a paradigm shift happens when the widely accepted paradigm encounters many anomalies that lead to a crisis, then a revolution, and finally settle into a new paradigm. There is a specific note from Kuhn (1962) in explaining the revolution of science that concerns all young researchers: "Almost always the men who achieve these fundamental inventions of a new paradigm have been either very young or very new to the field whose paradigm they change" (p. 90). This quote should encourage and excite you as you launch your first attempt to construct new knowledge.

Now, if you closely observe Figure 1.3, you will notice that we move from normal science, to anomalies, to a crisis, and to a revolution that gives way to a paradigm shift. However, the paradigm shift is connected back to normal science. It should not be forgotten that the new paradigm we built in response to the crisis and the revolution will soon be accepted and will become the new normal science. In Kuhn's (1962) words

> Scientific revolutions are here taken to be those non-cumulative developmental episodes in which an older paradigm is replaced in whole or in part by an incompatible new one. . . . The man who is striving to solve a problem defined by existing knowledge and technique is not, however, just looking around. He knows what he wants to achieve, and he designs his instruments and directs his thoughts accordingly. Unanticipated novelty, the new discovery, can emerge only to the extent that his anticipations about nature and his instruments prove wrong. (p. 96)

To illustrate this point, I will go back to my husband's cooking. He loves to cook a dish with shallots and chicken breast. The recipe involves putting a lot of shallots

FIGURE 1.3 ■ An Illustration of the Scientific Revolution



and garlic together in a pressure cooker. He adds some chicken breast, a bay leaf, black pepper, cinnamon, and one tablespoon of tomato sauce. It cooks for 30 minutes and, voila, becomes a wonderful, aromatic dish. We call it "çomlek," pronounced [chomlak] a popular dish in my home country of Albania.

One day, I was really craving çomlek, but there were no shallots in my pantry. I had everything else, but no shallots. I had some very large onions instead. I wondered how this famous dish would taste if I substituted the main ingredient with a related one. Shallots are, after all, onions of a different size. I peeled the big onions, partially sliced them, and inserted garlic in between the slices. I followed the rest of the recipe as usual, and waited for results. My çomlek was delicious! It tasted much better than the classic one because the garlic had melted inside the onion, giving it a very special texture and taste. After a crisis (not having shallots on hand) I caused a revolution and recreated the recipe with a different type of onion. The outcome was a delicious paradigm shift! Now, we never use shallots to cook çomlek. My new çomlek turned into normal science.

A QUICK LOOK AT QUALITATIVE, QUANTITATIVE, AND MIXED METHODS

There are three basic types of research methods: (1) qualitative research, (2) quantitative research, and (3) mixed methods. Qualitative research analyzes narratives in the form of words, texts, illustrations, videos, and other non-numerical formats. It is the type of research that requires deep interpretation and analytical thinking about what we are researching. It is almost an art form as much as it is scientific and allows researchers to express new creative ideas and innovative threads of knowledge. Quantitative research is the type of research that heavily relies on information retrieved numerically. It follows a strict methodology and requires attention to details prior to conducting the study and gathering data. Quantitative research allows us to try to falsify established theories and build a stronger knowledge.

Mixed methods is the combination of the two forms of research that allows for the flexibility to expand beyond one type of methodology and add information gathered by both types. Mixed methods provide us with numerical information as well as in-depth understanding of the data that were analyzed qualitatively. It is a favorite form of conducting research because of its undeniable strengths in providing additional information that cannot be covered by quantitative or qualitative studies alone. Let's see how they differ from each other.

Qualitative Research

Qualitative research aims at gaining insight and *depth* into whatever topic we want to know about. In qualitative research, we are not satisfied with simply drawing a picture of the facts; we want to know more insights, emotions, events, experiences, and details about the topic of research. We can be creative, connect issues, interpret the details we find, draw patterns from the raw information we collect, and so on. Surely, there are rules on how this is done, but the process is very exciting and highly creative. If we are studying people, we get to talk to them, hear their stories, find out their concerns, understand their issues, sympathize with them, and truly try to understand their actions.

A good qualitative study looks at an issue from various perspectives and attempts to detail a richer picture with a deeper understanding of people and events. We can use our artistic skills to describe what we have observed, bring out minutia that the common eye might miss, and direct attention to aspects of our research that no one thought about. Our work can be deep and engaging. In fact, there have been a few cases where researchers publish their work as a book and people enjoy it as fiction.

Conducting qualitative research means being immersed in the study and having a great deal of determination, attention to detail, and sense of commitment. Qualitative research requires a lot of contemplation on the topic in all stages, but especially during data collection and analysis. That is why qualitative research is more often based on what researchers call **inductive reasoning**. Inductive reasoning begins with specific observations and moves to a broader understanding of a topic or problem, which often leads to creating new theories of science. Inductive reasoning allows researchers to become immersed in their study without many preconceived notions or assumptions regarding how the results will look, but with the hope that many answers will be revealed as the work progresses. Therefore, being creative and interpreting the data collected are important parts of a qualitative researcher's work. Inductive reasoning allows researchers to shift the focus of their study as necessary during the process of data collection. In other words, researchers follow what they find interesting to investigate further.

Quantitative Research

Quantitative research starts with a lot of work up front, before the data are collected, and requires a good grasp of the topic of study and research conducted in that specific topic of interest. A quantitative researcher knows exactly what data are going to be analyzed, how the information will be collected, and even the types of procedures that will be used to analyze data. Their entire work is based on the systematic calculation of data. Researchers involved in this type of research are usually adept at designing and

RESEARCH IN ACTION 1.1

ILLUSTRATION OF A QUALITATIVE STUDY

In the following qualitative study, we can see how the author explains the qualitative methodology used and the rationale for using it. We can become familiar with the strict guidelines followed to ensure the highest quality possible.

Source: Two paradigmatic waves of public discourse on nuclear waste in the United States, 1945-2009: Understanding a magnitudinal and longitudinal phenomenon in anthropological terms by Judi Pajo (2016), published in *PLOS One*. http://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0157652. CC BY 4.0 https://creativecommons.org/licenses/by/4.0/

FROM THE ABSTRACT

This project set out to illuminate the discursive existence of nuclear waste in American culture. Given the significant temporal dimension of the phenomenon as well as the challenging size of the United States setting, the project adapted key methodological elements of the sociocultural anthropology tradition and produced proxies for ethnographic fieldnotes and key informant interviews through sampling the digital archives of the New York Times over a 64-year period that starts with the first recorded occurrence of the notion of nuclear waste and ends with the conclusion of the presidency of George W. Bush.

From the abstract we become familiar with the scope of the study. This is a qualitative research about the existence of nuclear waste in American culture. Let us take a look at the methodology where the researcher explains the qualitative methodology used.

FROM THE METHODOLOGY

The core of the sociocultural anthropology tradition, as it is commonly taught and understood, lies with the researcher personally going to an unfamiliar human community where the researcher spends a substantial amount of time, often in the range of several consecutive months. Known as participant observation or ethnographic fieldwork, this methodology consists of observing the broadest possible range of daily practices, in which, and for as much as possible, the researcher also personally participates. The purpose of such effort is to achieve an understanding of the world from the community's shared perspectives. The data collected through this traditional methodology consists mostly of a record of the researcher's own observations and impressions as well as statements from exchanges and interviews with the members of the previously-unknown community that, ideally, becomes better-known over the course of this process.

This is an excellent description of qualitative research and how it is carried out traditionally. Although some terms included here will be explained later in the text (such as participant observation), please note the importance of qualitative research to capture the community's perspective as well as the researcher's.

FROM THE FINDINGS

Nuclear waste continued to make headlines after 1969. Between 1969 and 2009, the New York Times reports that included in their headlines some combination of the keywords "nuclear," "radioactive," "atomic," and "waste" appeared amidst reports on political and environmental protests. The body of reporting identified here as "the second wave" corresponds to the presidencies of Richard M. Nixon (1969–1974), Gerald R. Ford (1974–1977), James Carter (1977–1981), Ronald Reagan (1981–1989), George H.W. Bush (1989–1993), William J. Clinton (1993–2001), and George W. Bush (2001–2009). The body of reporting since 2009 has not been included in the second wave, as the presidency of Barack H. Obama is currently ongoing. A total of 608 items of reporting are distributed by presidency as follows: 22 reports under the Nixon presidency, 18 under Ford, 157 under Carter, 160 under Reagan, 79 under the first Bush, 100 under Clinton, 72 under the second Bush. The core paradigm identified as characterizing this

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wave is actually focused on nuclear waste: here nuclear waste appears to be a topic on its own right. This paradigm characterizes nuclear waste primarily in terms of the harm it causes, dissociated from the benefits of nuclear exploitation. The unspoken understanding appears to be that nuclear waste carries risks that cannot be eliminated, and that cleaning it up will involve costs that cannot be avoided. So instead of optimistic hope for a final and safe solution for the disposal of radioactive waste, this paradigm is preoccupied with assigning responsibility for radioactive waste.

Here the researcher is presenting one of the paradigms she concluded. Note how the keywords are identified at the beginning followed by illustrations of exactly where and how many of these keywords were found. After the information is given, the researcher provides us with the paradigm she identifies. We can see how the media primarily emphasizes the harm it causes rather than describing the benefits of nuclear waste.

using different means of data collection, a very difficult task, but necessary for collecting information properly.

Thinking ahead and taking measures for almost every detail of the study is the most difficult aspect of their work. In quantitative studies, a good sense of organization, categorization, and calculation is necessary before the study is launched. Quantitative researchers must be very specific on what they are testing for and put a great deal of work in preparing the most effective tool possible (e.g., questionnaire, survey) to measure the concepts and constructs they are targeting. Conducting this work in advance of data collection is crucial because once the study starts, there is little room for change. These pre-calculations and strong sense of organization give the quantitative researcher the ability to capture large amounts of data.

Quantitative research is commonly based on **deductive reasoning**. Deductive reasoning begins with a broad theory that can lead to a specific idea or concept that is ready to be tested. The researchers decide how and what measures to use in order to test the idea. This means that we have narrowed our focus of interest into measurable pieces and have specific expectations for the results of the study. Once the preliminary work is completed, we are able to collect our data. Data collection in quantitative studies is straightforward and there are no digressions or other routes taken by the researcher in the middle of the work. However, quantitative studies can be creative during the analysis of the data, especially if the researcher has collected enough information on various aspects of the population of interest.

RESEARCH IN ACTION 1.2

ILLUSTRATION OF A QUANTITATIVE STUDY

In this example, we can see how a researcher goes about sampling, data collection, and analysis of a quantitative study. This is a great example that can help us familiarize with the terminology used as well as the steps taken by the researcher to ensure high quality of data and the transformation of information into numbers.

Source: Food art does not reflect reality: A quantitative content analysis of meals in popular paintings by Brian Wansink, Anupama Mukund, and Andrew Weislogel (2016), published in *SAGE Open.* http://sgo.sagepub.com/content/6/3/2158244016654950 by Brian Wansink, Anupama Mukund, and Andrew Weislogel. CC BY 3.0 https://creativecommons.org/licenses/by/3.0/

FROM THE ABSTRACT

Can the frequency with which a food is depicted in paintings give historical insight into family meals over the years and across countries? To initially explore this question, 750 food-related paintings were screened down to 140 paintings from Western Europe and the United States depicting small, family meals. Quantitative content analyses showed the most frequently eaten foods (such as chicken, eggs, and squash) were least frequently depicted in paintings. In contrast, the most aspirational foods such as shellfish were commonly painted in countries with the smallest coastlines (Germany), and more than half (51.4%) of the paintings from the seafaring Netherlands contained non-indigenous tropical lemons. Moreover, although bread and apples have been commonly available over time, bread has been painted 74% less frequently and apples painted 302% more frequently.

As we can see in this quantitative study, the researcher is analyzing the portrayal of meals in paintings from Western Europe and the United States. The abstract tells us that 750 paintings were screened to select 140 paintings of interest. Note that the researcher is also giving us some numerical understanding of the findings here as well.

FROM THE METHODOLOGY

The 750 food paintings originally identified were screened down to those focusing on family meals. After screening out paintings

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of banquets, feasts, and still lives of food that were decorative and probably not full meals (such as bowls of fruit or game meat hanging on the wall), out of family meals that depicted food, a final total of 140 paintings from the years 1500 to 2000 were collected. Each painting was coded for all of the foods visible in the painting. The paintings were categorized by country as well as time period. The time periods were chosen as a rough representation of different periods in Western history. Paintings created from 1500 to 1650 were categorized as Era of European Exploration and Colonization, paintings from 1651 to 1850 were categorized as Era of Enlightenment, and paintings from 1851 to 2000 were categorized as Industrial and Post-Industrial Era.

At this part of the quantitative methodology, you can see how the sample of paintings was selected. It is important to note the amount of details about each step entailed in selecting the appropriate sample. The researcher is showing the guidelines followed for selecting the sample as well as how different periods were categorized with cut points.

FROM THE FINDINGS

Across years and countries, 19.29% of the paintings included a vegetable, 75.71% contained fruit, 38.57% contained a meat, and 41.43% contained bread. The vegetables with the highest incidence in the total number of paintings were, in descending order, artichoke, tomato, onion, squash, and radish, $\chi 2$ (4, 2380) = 13.997, $p = .007$. Similarly, the meats with the highest incidence in the total number of paintings were shellfish, fish, and ham, $\chi 2$ (4, 2238) = 24.324, $p < .001$. Shellfish, in particular, were depicted in over 22% of all the paintings, and they were most prevalent in Dutch paintings (56.76%) as well as in one fifth of the German paintings (20%). Fish and ham also had the highest incidences in Dutch paintings (13.51% each), although they were not as common as shellfish.

Even if some of the statistics are unclear to you at this stage, you should be able to see how the numerical findings are portrayed. We can clearly see how fruits occupied the highest percentage, followed by bread, meat, and finally vegetables.

Quantitative researchers often use structured questionnaires, surveys, or other types of questions with pre-defined multiple-choice answers, so it becomes possible to access information on a large number of subjects. To put this into perspective, we can think of the qualitative researcher as someone who knows a whole lot about one small, specific group of people and the quantitative researcher as someone who has access to fewer in-depth details, but the information available targets a much larger population. The qualitative researcher studies information in depth, whereas the quantitative researcher has a bird's-eye view.

Mixed Methods

Mixed methods refer to cutting-edge research studies that combine the best features of both qualitative and quantitative methodologies. Years ago this was not a viable possibility. The quantitative and the qualitative researcher were almost in opposing corners. But all of that has changed and researchers were quick to realize the great potential of combining these approaches. What are the benefits? One can collect a lot of information about a large quantity of subjects, in addition to much needed details and depth on some of the participants. Mixed methods has become a desirable approach to research with excellent outcomes.

To better understand the benefits of a mixed-methods approach, let us look at a hypothetical example: Maia, a researcher, was interested in understanding whether eating cake was related to weight gain. She conducted a short questionnaire and surveyed many people at a local bakery. Maia asked them: (1) How often did you eat cake during a typical week this last year? (2) How much weight have you gained/lost this last year? (3) How often did you exercise during a typical week this last year? She wanted to see whether eating cake was related to weight gain in any way, and whether this was the same for each participant regardless of how much a person exercised. Maia also wanted to know more about the population she was interviewing. She randomly picked a few people to speak with at length, adding some qualitative work to her quantitative research and conducted some in-depth, unstructured interviews. When analyzing her data, she found that eating cake on a daily basis was related to participants' weight gain over the last year, but the relationship was not extremely strong. In some cases, the relationship was nonexistent regardless of whether people exercised regularly or not. It almost seemed like some people would lose weight and eat cake without exercising. This surely didn't make sense.

Maia investigated this topic further by analyzing her in-depth interviews. By talking to people, she realized that the participants who ate cheesecake daily rather than the ones who ate different types of cake gained the most weight. She also learned from these interviews that the bakery was strategically located next to La Leche League Clinic, which could indicate that a number of the women she surveyed had just had a baby and perhaps were still breastfeeding. Regardless of their sugar intake, they were losing weight from their previous pregnancy in conjunction with breastfeeding, instead of gaining weight. Maia was aware of the research findings from other studies that showed how breastfeeding was associated with weight loss for mothers. She then took another look at the quantitative data and saw that the majority of her participants were women. The combination of these details and insights on the quantitative information she gathered added depth to her study and explained why the relationship between cake and weight gain was not as strong as she had anticipated. Mixed-methods research led Maia to have more confidence in drawing conclusions.

ETHICAL RESEARCH

Now that we've gone over the basics of the types of research that can be conducted, we must discuss **ethics**. In daily use of the word, we may understand ethics as the group of morals and values that govern our behaviors and decisions. Deriving from this general understanding, we use a set of rules and regulations that are primarily concerned with protecting the rights of people who participate in research studies. These rules are called research ethics.

The ethical treatment of research participants is perhaps the most basic rule of conducting research. But what does this mean? Obviously, we should never do anything that may cause harm to participants. There are a number of ethical rules that must be followed to ensure that a researcher's participants are protected from harm.

Ethical Rules

One of the most important ethical rules is providing participants with information about the study, particularly about any risks that could be involved. Consider drug trials, for example. Pharmaceutical companies are eager to test new drugs on people. How else could they determine a drug's effectiveness? However, the drugs could have adverse side effects. Participants must be informed about these potential risks before participating in the trial. If English is not their first language, they need to be informed about these risks in their own language.

Furthermore, when a drug is tested for effectiveness, researchers use a second group of people with the same characteristics as the group of people who are testing the new drug. The second group of people is referred to as the control group. Without their knowledge, this group is given a placebo (a sugar pill or another non-pharmacological substance with no effects) instead of the testing drug. Therefore, the control group will not be aware of whether they took the medicine or the placebo and the researcher can measure the results from both groups. This way, researchers are able to compare the outcome of the drug they are testing between users and nonusers of the drug.

Participants are assigned to a control group or testing group without knowing which group they are in, so this needs to be clear to them from the start of the study. Sometimes patients are eager to try a new drug because of a problematic illness and must be informed that they may not receive the medication as they had hoped. In some extreme cases, ethics would dictate that a participant's condition is so critical that immediate medical attention is required and participation in the study would be ill-advised. In other words, researchers must be honest with participants and inform them about how the study will be conducted and explain any issues that may occur. This is the first and most basic rule in conducting research.

Another important ethical rule is confidentiality. Researchers go to great lengths to protect the identity of and data about their participants, from using fictional names to securing records to ensure that participants cannot be identified. We often conduct research with vulnerable populations, such as illegal immigrants, drug users, victims of abuse, and people with mental health issues who would be unwilling to participate were we careless about confidentiality. As a general rule, regardless of how sensitive the research topic is, we must always obey the rules of confidentiality.

Along the same lines is the rule of coercing. It is unethical to coerce people to take part in a study even if the coercion is subtle. For example, say a professor is investigating drug use among college students. Do you think it would be ethical to survey students who enroll in his or her classes? Students enrolled in this researcher's class may feel obligated to participate in the study because of the power that professor has over the classroom and they may participate unwillingly. In addition, students may not feel comfortable providing information about their personal drug use habits to someone who may judge their behaviors. Such cases can easily result in biased studies and is a violation of ethics. You can easily imagine how students may not provide accurate information to the researcher about their drug experiences in such a study versus a study where anonymity is provided. These responses will lead to inaccurate or biased study results because the researcher will collect inaccurate data.

Conflict of interest is also an ethical factor. It refers to the possibility that the study we are conducting may protect or be part of an agenda of some third parties. For example, if we were to conduct a study on the likability of the latest movie shown in theaters and we are sponsored for the study by the film studio that produced the movie; we may be prone to look favorably at the likability rates. The fact that the film studio sponsored our study is a conflict of interest that needs to be disclosed when we present our findings. Conflict of interest should not be confused with offering incentives (e.g., money or gifts) to people participating in a research study. Sometimes, in-depth interviews or focus groups require a few hours with the researcher, and some researchers offer incentives that show appreciation for the participants' time. It is not mandatory to offer incentives for participation and it depends on how much financial freedom is available to the researcher. Keep these rules in mind as you embark on your first research study.

RESEARCH WORKSHOP 1.1

COMPLETE A COURSE ON PROTECTING HUMAN RESEARCH PARTICIPANTS

Go to https://phrp.nihtraining.com/users/login.php to complete Protecting Human Research Participants, a free course that discusses how to protect the rights of research participants. (When you register, check the box that allows you to participate in continuing medical education (CME) credits.) This online training course takes about three hours to complete and consists of seven modules. The information provided is rich with details, definitions, and case studies. There are four quizzes that you will also need to complete that measure your understanding and knowledge of research ethics. You can reenter and continue the course at your convenience. After you have completed the modules and quizzes, you will have the opportunity to print your certificate of completion.

A Violation of Ethics

The Tuskegee Syphilis study is an infamous case of an ethics violation in research. Between 1932 and 1972, the United States Public Health Service and the Tuskegee Institute conducted a study on the effects of syphilis on the human body. The researchers recruited 600 African-American men to participate, but did not disclose the focus of their study to their participants, who were simply told they were being treated for "bad blood." Many believed they were receiving free health services from the government.

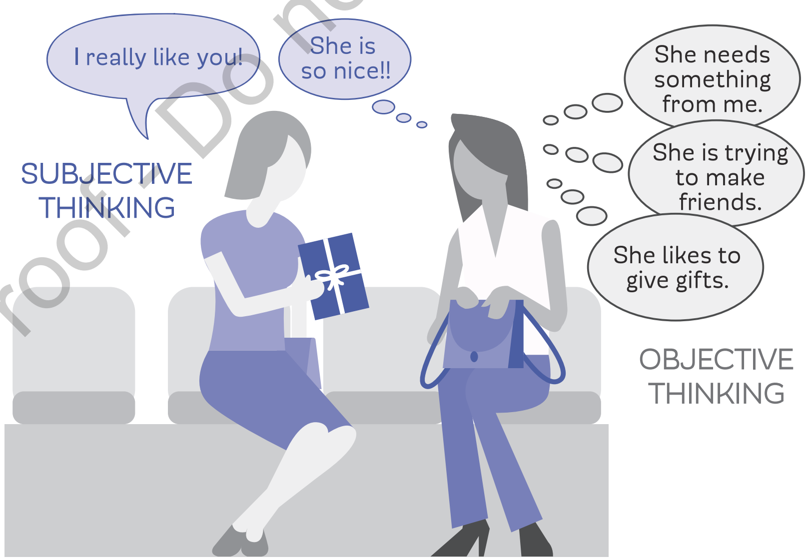
Two-thirds of the participating men had syphilis, and despite the fact that penicillin was validated as an effective treatment in 1942, not one of the men in the Tuskegee study received treatment. This continued for an additional 30 years, and was finally revealed through a leak to the newspapers in the early 1970s. Only 74 participants survived. Around 40 of their wives were also infected and 19 children were born with syphilis (U.S. Public Health Service Syphilis Study at Tuskegee, 2013). The tragedy of the Tuskegee study is not only measured in numbers directly affected, but in the lasting resentment it caused within the African-American community.

Researchers' Biases

An important skill of being a researcher is the ability to study concepts objectively. **Objectivity** means perceiving something from different angles without personal preferences or judgments. Objective thinking is based on the facts of what has happened rather than our thoughts or emotions about it. Being objective is difficult and some may argue even impossible, but we can get close to it. One way of getting closer to being objective is our ability to recognize our personal biases and be aware of them. This awareness will allow us to guard ourselves from subjective thoughts and preferences and little by little we can get close to being objective. Biases are detrimental to our research and although we may never fully get rid of them, it is important to reduce them as much as possible.

Subjective thinking is based on personal emotions, experiences, and prejudices. All people are subjective in one form or another because we are molded by our unique personalities and backgrounds. One common type of bias is called **selective observation**.

FIGURE 1.4 ■ Illustration of Researcher's Bias



Selective observation happens when we are focused on a specific occurrence or a specific group of people instead of including an entire sample in our observation. It implies focusing on what interests us, and consciously or unconsciously, failing to notice other things that may contradict our theory.

Another common type of bias is called **overgeneralization**. Overgeneralization happens when we use a small number of cases to draw conclusions about the entire population. Similar to selective observation, we overgeneralize when we use something we have seen once or twice and believe that this is how "it always happens." But can we get rid of all our biases? Perhaps not. However, to brighten this gloomy answer, we can reduce our biases, though we cannot completely stop our subjectivity.

In our effort to reduce biases and reach objectivity, we conduct research according to widely accepted rules. We are our greatest enemy. Our misconceptions, assumptions, and preconceived notions of the world interfere with the research process. However, though on the surface a contradiction, it is because of our assumptions, creativity, and understanding of the world that we can deliver magnificent research. Your creativity and your imagination play an important role in conducting research. Without it, your work will be monotonous. You may be great at following the rules of the game, but you need your own brand of creativity to make the most of your research efforts.

Summary

This chapter discusses the ways we receive new knowledge and distinguishes among the different types of knowledge. Traditional knowledge comes from information we gather from our culture and social environment, particularly from the rules, regulations, and behaviors we learn as children. Authoritative knowledge includes what our parents, teachers, and professionals tell us about life, behaviors, and social circumstances. We learn from experiential knowledge where our behaviors are modified because of our experiences. Although these different types of knowledge tell us about how life works around us, they may not be scientific. Scientific knowledge is the type of knowledge we trust the most because it follows strict scientific rules of discovery.

You were introduced to two main theories of developing knowledge: Popper's falsifiability and Kuhn's scientific revolution. In Popper's terms, knowledge is advanced when we are able to disprove an established theory and falsify it. By building empirical evidence that contradicts an established theory, we can create a new tentative theory that is stronger than the previous one. Popper believed that we should always try to falsify theories in order to advance knowledge.

Kuhn's scientific revolution is conceptually similar. Kuhn saw the advancement of knowledge as a small revolution in itself. We have some accepted truths that he called normal science. Normal science functions on what is already known and does not occupy itself with exploring new ideas. Normal science also includes accepted paradigms. However, occasionally we encounter anomalies—things that do not fit into the accepted normal science. The more anomalies we encounter, the more likely we are to move toward a crisis. The crisis will bring a revolution and a paradigm shift. This paradigm shift will substitute the old normal science with the new advanced science.

The chapter introduced the three main types of research methodologies: qualitative, quantitative, and mixed methods. Qualitative research is based on inductive reasoning and begins with specific observations and moves to a broader understanding of a topic. It attempts to bring new insights and create new theories based on specific observations of a topic. Quantitative research is based on deductive reasoning or the type of reasoning that looks at a problem with specific expectations and assumptions about the results of the study. Deductive reasoning begins with a broad theory and applies it to a specific measurable problem. Mixed methods is a combination methodology that uses the best features of quantitative and qualitative research. Mixed methods allows for a better understanding of a problem and the ability to look at a specific topic both broadly and narrowly.

This chapter also introduced you to ethical considerations in research and how to conduct research while protecting participants in any study. Whereas some forms of protection are more obvious than others, such as not causing any intentional harm to participants, others are subtler. There are rules of anonymity and confidentiality at the core of every study. Other rules include not coercing subjects to participate in research or being careful about conflicts of interest.

Finally, this chapter brings forth the researcher's capability of being objective and the importance of perceiving a problem from different angles without allowing our personal preferences to take over. Objectivity is difficult to achieve, but we can train ourselves to reduce our biases by becoming aware of them. Subjectivity is based on personal emotions, experiences, and biases that are part of who we truly are. Subjective thinking sometimes causes selective observation or overgeneralization. Selective observation happens when we pay attention only to a few selective cases or subjects in our study rather than its entirety. Overgeneralization happens when we think that we can apply the same findings from a small group of participants to the society at large. Though subjective thinking has its flaws, it is also a channel of our creativity—an important part of being a researcher.

Key Terms

Anomaly: something that does not fit into the paradigms of normal science.

Authority: a form of knowledge we believe to be true because it comes from authoritative sources, such as parents, teachers, and professional figures.

Crisis: an accumulation of many anomalies against an accepted truth.

Deductive reasoning: reasoning that begins with a broad theory that leads to a specific idea or concept to be tested.

Empirical evidence: acquiring information by systematically observing people or events.

Ethics: a set of guidelines that are primarily concerned with protecting the rights of study participants and are mandatory for the researcher.

Experiential knowledge: a form of knowledge that we learn through pleasant or unpleasant experiences.

Falsify: prove that a theory is incorrect.

Inductive reasoning: reasoning that begins with specific observations and moves to a broader understanding of a topic or problem.

Mixed methods: research studies that combine the best features of qualitative and quantitative methodologies.

Normal science: the work of scientists using the general rules, laws, and paradigms that are accepted as truths. It does not explore new ideas or build on scientific knowledge.

Objectivity: perceiving something from different angles without personal preferences or judgments.

Overgeneralization: a type of bias that occurs when a researcher uses a small number of cases to draw conclusions about an entire population.

Paradigm: an unchangeable pattern that is used over and over again.

Paradigm shift: occurs when a widely accepted paradigm encounters many anomalies that lead to a crisis, then a revolution, and then a new paradigm.

Qualitative research: research that seeks to gain insight and depth on a topic.

Quantitative research: research based on the systematic calculation of data.

Revolution: when an old paradigm is replaced with a new paradigm.

Scientific knowledge: a form of knowledge based on studies conducted by researchers.

Selective observation: a type of bias that occurs when a researcher is focused on a specific occurrence or group of people instead of including an entire sample.

Subjective thinking: thinking based on personal emotions, experiences, and prejudices.

Traditional knowledge: a form of knowledge we inherit from our culture that includes information that we learned as children that is now part of who we are and how we behave.

Taking a step further

1) What is the difference between reality and knowledge?
2) What is research methodology and what do we need it for?
3) Can you think of examples that can illustrate Popper's falsifiability?
4) How does inductive reasoning differ from deductive reasoning?
5) What are some examples that can illustrate Kuhn's paradigm shift?
6) How does traditional knowledge differ from subjective thinking?