

Darwin, and Herbert Simon, were master theoreticians, and they are remembered for the theories they postulated that transformed the course of science. Methodological skills are needed to be an ordinary researcher, but theoretical skills are needed to be an extraordinary researcher!

Scientific Method

In the preceding sections, we described science as knowledge acquired through a scientific method. So what exactly is the “scientific method”? **Scientific method** refers to a standardized set of techniques for building scientific knowledge, such as how to make valid observations, how to interpret results, and how to generalize those results. The scientific method allows researchers to independently and impartially test preexisting theories and prior findings, and subject them to open debate, modifications, or enhancements. The scientific method must satisfy four key characteristics:

- *Logical*: Scientific inferences must be based on logical principles of reasoning.
- *Confirmable*: Inferences derived must match with observed evidence.
- *Repeatable*: Other scientists should be able to independently replicate or repeat a scientific study and obtain similar, if not identical, results.
- *Scrutinizable*: The procedures used and the inferences derived must withstand critical scrutiny (peer review) by other scientists.

Any branch of inquiry that does not allow the scientific method to test its basic laws or theories cannot be called “science.” For instance, theology (the study of religion) is not science because theological ideas (such as the presence of God) cannot be tested by independent observers using a logical, confirmable, repeatable, and scrutinizable. Similarly, arts, music, literature, humanities, and law are also not considered science, even though they are creative and worthwhile endeavors in their own right.

The scientific method, as applied to social sciences, includes a variety of research approaches, tools, and techniques, for collecting and analyzing qualitative or quantitative data. These methods include laboratory experiments, field surveys, case research, ethnographic research, action research, and so forth. Much of this book is devoted to learning about these different methods. However, recognize that the scientific method operates primarily at the empirical level of research, i.e., how to make observations and analyze these observations. Very little of this method is directly pertinent to the theoretical level, which is really the more challenging part of scientific research.

Types of Scientific Research

Depending on the purpose of research, scientific research projects can be grouped into three types: exploratory, descriptive, and explanatory. **Exploratory research** is often conducted in new areas of inquiry, where the goals of the research are: (1) to scope out the magnitude or extent of a particular phenomenon, problem, or behavior, (2) to generate some initial ideas (or “hunches”) about that phenomenon, or (3) to test the feasibility of undertaking a more extensive study regarding that phenomenon. For instance, if the citizens of a country are generally dissatisfied with governmental policies regarding during an economic recession,

exploratory research may be directed at measuring the extent of citizens' dissatisfaction, understanding how such dissatisfaction is manifested, such as the frequency of public protests, and the presumed causes of such dissatisfaction, such as ineffective government policies in dealing with inflation, interest rates, unemployment, or higher taxes. Such research may include examination of publicly reported figures, such as estimates of economic indicators, such as gross domestic product (GDP), unemployment, and consumer price index, as archived by third-party sources, obtained through interviews of experts, eminent economists, or key government officials, and/or derived from studying historical examples of dealing with similar problems. This research may not lead to a very accurate understanding of the target problem, but may be worthwhile in scoping out the nature and extent of the problem and serve as a useful precursor to more in-depth research.

Descriptive research is directed at making careful observations and detailed documentation of a phenomenon of interest. These observations must be based on the scientific method (i.e., must be replicable, precise, etc.), and therefore, are more reliable than casual observations by untrained people. Examples of descriptive research are tabulation of demographic statistics by the United States Census Bureau or employment statistics by the Bureau of Labor, who use the same or similar instruments for estimating employment by sector or population growth by ethnicity over multiple employment surveys or censuses. If any changes are made to the measuring instruments, estimates are provided with and without the changed instrumentation to allow the readers to make a fair before-and-after comparison regarding population or employment trends. Other descriptive research may include chronicling ethnographic reports of gang activities among adolescent youth in urban populations, the persistence or evolution of religious, cultural, or ethnic practices in select communities, and the role of technologies such as Twitter and instant messaging in the spread of democracy movements in Middle Eastern countries.

Explanatory research seeks explanations of observed phenomena, problems, or behaviors. While descriptive research examines the what, where, and when of a phenomenon, explanatory research seeks answers to why and how types of questions. It attempts to "connect the dots" in research, by identifying causal factors and outcomes of the target phenomenon. Examples include understanding the reasons behind adolescent crime or gang violence, with the goal of prescribing strategies to overcome such societal ailments. Most academic or doctoral research belongs to the explanation category, though some amount of exploratory and/or descriptive research may also be needed during initial phases of academic research. Seeking explanations for observed events requires strong theoretical and interpretation skills, along with intuition, insights, and personal experience. Those who can do it well are also the most prized scientists in their disciplines.

History of Scientific Thought

Before closing this chapter, it may be interesting to go back in history and see how science has evolved over time and identify the key scientific minds in this evolution. Although instances of scientific progress have been documented over many centuries, the terms "science," "scientists," and the "scientific method" were coined only in the 19th century. Prior to this time, science was viewed as a part of philosophy, and coexisted with other branches of philosophy such as logic, metaphysics, ethics, and aesthetics, although the boundaries between some of these branches were blurred.

In the earliest days of human inquiry, knowledge was usually recognized in terms of theological precepts based on faith. This was challenged by Greek philosophers such as Plato, Aristotle, and Socrates during the 3rd century BC, who suggested that the fundamental nature of being and the world can be understood more accurately through a process of systematic logical reasoning called **rationalism**. In particular, Aristotle's classic work *Metaphysics* (literally meaning "beyond physical [existence]") separated *theology* (the study of Gods) from *ontology* (the study of being and existence) and *universal science* (the study of first principles, upon which logic is based). Rationalism (not to be confused with "rationality") views reason as the source of knowledge or justification, and suggests that the criterion of truth is not sensory but rather intellectual and deductive, often derived from a set of first principles or axioms (such as Aristotle's "law of non-contradiction").

The next major shift in scientific thought occurred during the 16th century, when British philosopher Francis Bacon (1561-1626) suggested that knowledge can only be derived from observations in the real world. Based on this premise, Bacon emphasized knowledge acquisition as an empirical activity (rather than as a reasoning activity), and developed **empiricism** as an influential branch of philosophy. Bacon's works led to the popularization of inductive methods of scientific inquiry, the development of the "scientific method" (originally called the "Baconian method"), consisting of systematic observation, measurement, and experimentation, and may have even sowed the seeds of atheism or the rejection of theological precepts as "unobservable."

Empiricism continued to clash with rationalism throughout the Middle Ages, as philosophers sought the most effective way of gaining valid knowledge. French philosopher Rene Descartes sided with the rationalists, while British philosophers John Locke and David Hume sided with the empiricists. Other scientists, such as Galileo Galilei and Sir Issac Newton, attempted to fuse the two ideas into **natural philosophy** (the philosophy of nature), to focus specifically on understanding nature and the physical universe, which is considered to be the precursor of the natural sciences. Galileo (1564-1642) was perhaps the first to state that the laws of nature are mathematical, and contributed to the field of astronomy through an innovative combination of experimentation and mathematics.

In the 18th century, German philosopher Immanuel Kant sought to resolve the dispute between empiricism and rationalism in his book *Critique of Pure Reason*, by arguing that experience is purely subjective and processing them using pure reason without first delving into the subjective nature of experiences will lead to theoretical illusions. Kant's ideas led to the development of **German idealism**, which inspired later development of interpretive techniques such as phenomenology, hermeneutics, and critical social theory.

At about the same time, French philosopher Auguste Comte (1798-1857), founder of the discipline of sociology, attempted to blend rationalism and empiricism in a new doctrine called **positivism**. He suggested that theory and observations have circular dependence on each other. While theories may be created via reasoning, they are only authentic if they can be verified through observations. The emphasis on verification started the separation of modern science from philosophy and metaphysics and further development of the "scientific method" as the primary means of validating scientific claims. Comte's ideas were expanded by Emile Durkheim in his development of sociological positivism (positivism as a foundation for social research) and Ludwig Wittgenstein in logical positivism.

In the early 20th century, strong accounts of positivism were rejected by interpretive sociologists (antipositivists) belonging to the German idealism school of thought. Positivism was typically equated with quantitative research methods such as experiments and surveys and without any explicit philosophical commitments, while **antipositivism** employed qualitative methods such as unstructured interviews and participant observation. Even practitioners of positivism, such as American sociologist Paul Lazarsfield who pioneered large-scale survey research and statistical techniques for analyzing survey data, acknowledged potential problems of observer bias and structural limitations in positivist inquiry. In response, antipositivists emphasized that social actions must be studied through interpretive means based upon an understanding of the meaning and purpose that individuals attach to their personal actions, which inspired Georg Simmel's work on symbolic interactionism, Max Weber's work on ideal types, and Edmund Husserl's work on phenomenology.

In the mid-to-late 20th century, both positivist and antipositivist schools of thought were subjected to criticisms and modifications. British philosopher Sir Karl Popper suggested that human knowledge is based not on unchallengeable, rock solid foundations, but rather on a set of tentative conjectures that can never be proven conclusively, but only disproven. Empirical evidence is the basis for disproving these conjectures or "theories." This metatheoretical stance, called **postpositivism** (or postempiricism), amends positivism by suggesting that it is impossible to verify the truth although it is possible to reject false beliefs, though it retains the positivist notion of an objective truth and its emphasis on the scientific method.

Likewise, antipositivists have also been criticized for trying only to understand society but not critiquing and changing society for the better. The roots of this thought lie in *Das Capital*, written by German philosophers Karl Marx and Friedrich Engels, which critiqued capitalistic societies as being socially inequitable and inefficient, and recommended resolving this inequity through class conflict and proletarian revolutions. Marxism inspired social revolutions in countries such as Germany, Italy, Russia, and China, but generally failed to accomplish the social equality that it aspired. **Critical research** (also called critical theory) propounded by Max Horkheimer and Jürgen Habermas in the 20th century, retains similar ideas of critiquing and resolving social inequality, and adds that people can and should consciously act to change their social and economic circumstances, although their ability to do so is constrained by various forms of social, cultural and political domination. Critical research attempts to uncover and critique the restrictive and alienating conditions of the status quo by analyzing the oppositions, conflicts and contradictions in contemporary society, and seeks to eliminate the causes of alienation and domination (i.e., emancipate the oppressed class). More on these different research philosophies and approaches will be covered in future chapters of this book.