



THOUGHT AND KNOWLEDGE

This best-selling textbook, written by award-winning educator and past president of the American Psychological Association, Diane F. Halpern, applies theory and research from the learning sciences to teach students the thinking skills they need to succeed in today's world. This new edition retains features from earlier editions that have helped its readers become better thinkers. A rigorous academic grounding based in cognitive psychology is presented in a clear writing style with a humorous tone and supported by numerous practical examples and anecdotes.

Thought and Knowledge, Fifth Edition has been revised to help students meet the challenges of a global neighborhood and make meaningful conclusions from the overwhelming quantity of information now available at the click of a mouse. The skills learned with this text will help students learn more efficiently, research more productively, and present logical, informed arguments.

Thought and Knowledge, Fifth Edition is appropriate for use as a textbook in critical thinking courses offered in departments of psychology, philosophy, English, humanities, or as a supplement in any course where critical thinking is emphasized.

Diane F. Halpern is the McElwee Family Professor of Psychology and Roberts Fellow at Claremont McKenna College. She is a past president of the American Psychological Association, the Western Psychological Association, the Society for General Psychology, and the Society for the Teaching of Psychology.

Professor Halpern has won many awards for her teaching and research, including the James McKeen Cattell Fellow Award from the Association for Psychological Science (2013); the Arthur W. Staats Lecture on Unifying

Psychology Award from the American Psychological Association (2013); Outstanding Professor Award from the Western Psychological Association (2002); American Psychological Foundation Award for Distinguished Teaching (1999); Distinguished Career Award for Contributions to Education from the American Psychological Association (1996); and the California State University's State-Wide Outstanding Professor Award.

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THOUGHT AND KNOWLEDGE

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Fifth Edition

Diane F. Halpern

Claremont McKenna College

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PREFACE TO THE FIFTH EDITION

It is hard to believe, but it has been 30 years since the publication of the first edition of *Thought and Knowledge: An Introduction to Critical Thinking*. The world has changed in many ways over the last three decades. For the first edition, I wrote all of the text long hand (remember that?) and had it typed by a professional secretary who had a sleek new typewriter with a “tape” that allowed her to white out errors and a return key so she did not have to push the carriage return at the end of every line. I am guessing that most readers have no idea what any of this means because they never lived in a world with typewriters or heard of a “carriage return.”

But, despite all of the changes in technology in the last 30 years (yes, there was a time when there was no Internet), the need to think critically has not changed. One might argue that it is even more important now that everyone has easy access to more information than they can possibly use and much of that information is biased in ways that can be difficult to detect. It is to the users of new and emerging technologies that I dedicate this book.

I have many wonderful colleagues, students, and reviewers to thank for their assistance with this edition. I thank Heather Butler, an extraordinary doctoral student who will be Dr. Butler by the time you are reading this. She has helped me question, research, and rethink much of what I know about critical thinking. I also thank Amanda Franco, a doctoral student at University of Minho in Portugal for carefully reading an early draft of this book and offering insightful recommendations. Special thanks to Dr. Heidi Riggio at California State University, Los Angeles, for her careful and creative work on the instructor’s materials and student online exercises in this edition of *Thought and Knowledge* and in previous editions. This edition has a new publisher, Psychology Press, a division of the international

publisher Taylor & Francis. The psychology editor Paul Dukes and the editor assigned for this book, Fred Coppersmith, have been supportive throughout the process of bringing this book to print. In addition, I have been fortunate to have suggestions from some of the top luminaries in the field of teaching critical thinking. Some of the reviewers have chosen to remain anonymous, so I thank them anonymously. Sincere thanks to the following reviewers:

Alan Bensley, Frostburg State University
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This edition benefited enormously from their insightful comments.

I also thank my dear family, who has been supportive of the very long periods of time I spent at my computer writing this edition, my husband, Sheldon Halpern, and my children Evan and Karen Halpern and Jaye Halpern-Duncan. Finally, there are the lights of my life—my incredible grandchildren, who have taught me much about the world, Amanda, Jason, and Belle.

It is my sincere hope that you will enjoy this book and come away with new skills and knowledge that will stay with you for life. Never stop questioning; never stop thinking. Our future depends on it.

CHAPTER 1

THINKING

AN INTRODUCTION

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Many people would sooner die than think. In fact they do.

—Bertrand Russell (quoted in *Macmillan*, 1989)

Both of my grandmothers came from “the old country”—one from Poland and the other from Romania. I recall stories from my childhood about their dislike for each other, which was always kept as an unspoken but open secret because despite their mutual dislike, my maternal grandmother had a skill that was needed by my paternal grandmother. Because of this need, they had to at least feign liking each other. My maternal grandmother practiced the ancient art of cupping. Many people, including my grandmothers, believed that cupping cured a variety of illnesses. My maternal grandmother would light a match inside a small cup, then after burning off the oxygen in the cup, she would put out the match and place the hot cup on the back of the person seeking the cure. The cup would create a suction so that when it was removed, circles of red welts would appear on the skin where the cup had been placed. The theory behind this treatment was that when the cup was pulled off the body, it would suck out the illness. Did some people who sought this cure feel better afterwards? Anecdotal evidence suggests that they did, but were improvements caused by the sucking action of the cups or the belief that it would work? More importantly, why should we care if at least some people felt better after this treatment? These are all central questions for our discussion of critical thinking.

The Need for Critical Thinking Skills

Researchers have estimated the world’s data storage capacity at 295 exabytes—enough information to fill a pile of CDs that would stretch beyond the moon. That vast pile of information is only getting vaster: It increases by a factor of 10 every five years.

—Lea Winerman (2012, p. 44)

We live in the information age. The pursuit of information has become so all-consuming that many people find that they are constantly multitasking—updating Facebook or other social media pages while in class, checking

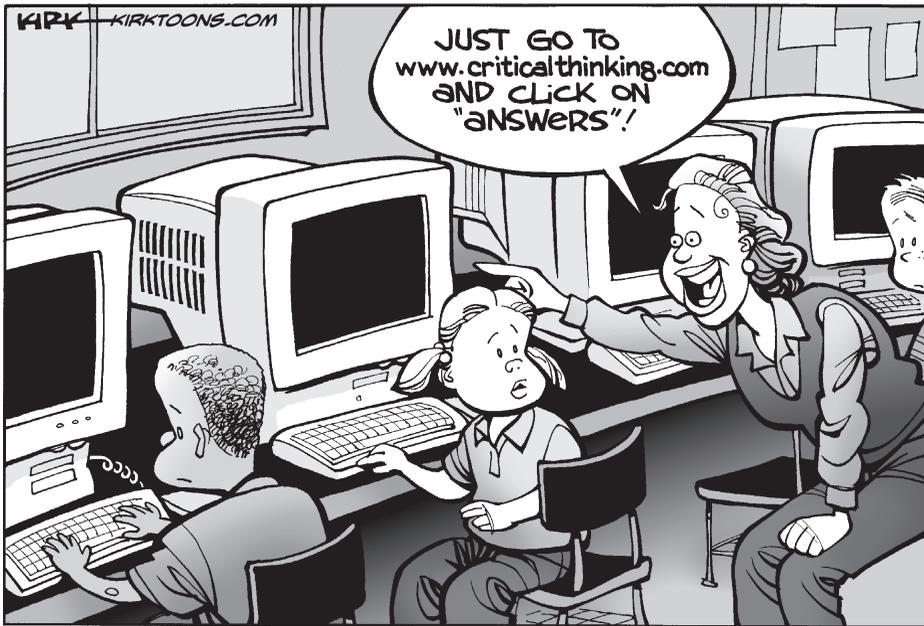
email while driving, and watching television while chatting with family members during dinner. With so much multitasking, many of us are on system overload, with the result that we do each task worse when doing them simultaneously than if we had concentrated on one at a time (Crenshaw, 2008).

The Internet is an integral part of most people's lives, with its wealth of information that exceeds anything we could have imagined even a decade ago. I cannot think of any topic that is so obscure that it cannot be found with just a few keystrokes from a nearby keyboard. The Internet has democratized knowledge. The "important stuff" is no longer kept in dusty library stacks that are available only to a privileged few. Massive quantities of information are available to anyone with a computer (or various other devices) and Internet access—which is almost everyone except those in the most remote regions of the world. But, the widespread availability of information has a down side. A racist-hate website may look like a reliable news source; bogus health information is sold as though it really was "doctor-recommended," and information about international conflicts can provide one-sided accounts that appear to be fair and unbiased. How can any of us know what to believe, and how can we use the massive amounts of information to make informed decisions?

The Twin Pillars of Knowing and Thinking

If we cannot think intelligently about the myriad of issues that confront us, then we are in danger of having all of the answers, but still not knowing what they mean. The twin abilities of knowing how to learn and knowing how to think clearly about the rapidly proliferating information that we must select from are the most important intellectual skills for the 21st century.

Is there evidence that we need to learn how to think critically? Lots of it. In what may be the most horrifying tale ever told by the prolific science fiction writer, Isaac Asimov (1989), he reported on the true state of scientific understanding and knowledge by Americans. In a telephone survey conducted by the Public Opinion Laboratory at Northern Illinois University, Asimov noted that the researchers found over 20% of the more than 2,000 adults surveyed believe that the sun revolves around the earth. Why, asks Asimov, over 400 years since the scientific community agreed on the fundamental scientific fact that the earth revolves around the sun, are the vast majority of adults still unaware of a basic fact that is "taught" in grammar school science? More recent findings include the responses of 6% if



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Americans who say that the moon landing was staged (Griggs, 2009), and there is always the Flat Earth Society, dedicated to the proposition that well, you can guess the rest.

Over 2.5 million people have purchased the Power Balance Wristband, which claims to improve energy, flexibility, and balance (DiSalvo, 2011). More specifically, the Power Balance (2010) company claims that "optimal health and peak performance occur when your body maintains ionic balance (the exchange between negative and positive charges) and free flowing energy pathways (harmony) at the optimum frequency" (Energy Balance & Systemic Harmony Are the Keys, para. 1). These tiny silicon wristbands retail for \$29.95 or more, and in 2010, the company sold over 2.5 million bracelets. Several famous athletes such as Shaquille O'Neal and David Beckham endorsed the product and CNBC even declared the wristband Sports Product of the Year in 2010 (DiSalvo, 2011). In 2010, after demands from the Australian government to produce evidence in support of their amazing claims, Power Balance LLC admitted that there was "no credible scientific evidence" to support their claims, and they offered a full refund to customers (Power Balance, 2010). This is just one example selected from a countless number in which millions of people spent billions of dollars on a worthless product.

The depressing list of findings and reports supports the conclusion that many adults do not have adequate thinking and learning skills. It is difficult to imagine any area where the ability to think clearly is not needed. Yet, few of us have ever received explicit instructions in how to improve the way we think. Traditionally, our schools have required students to learn, remember, make decisions, analyze arguments, and solve problems without ever teaching them how to do so. There has been a tacit assumption that adult students already know “how to think.” Research has shown, however, this assumption is wrong. The situation is succinctly summed up by Bill Brock, formerly the Republican Party chairman and currently an international consultant, who, after reading a recent report on the low level of learning and thinking skills of college graduates, exclaimed, “It ought to terrify everybody” (quoted in Frammolino, 1993, p. A41).

What We Really Need to Know

Proficiency in reading, writing, and arithmetic has traditionally been the entry-level threshold to the job market, but the new workplace requires more from its employees. Employees need to think critically, solve problems, innovate, collaborate, and communicate more effectively.

—American Management Association, 2010, p. 1

What we need to know and be able to do as informed citizens has been changing at an increasingly rapid rate. The workforce is one critical place where we can witness the dizzying pace of change. There is an increased demand for a new type of worker—the “knowledge worker” or the “symbol analyst,” a phrase that is used by the U.S. secretary of labor to describe someone who can carry out multistep operations, manipulate abstract and complex symbols and ideas, acquire new information efficiently, and remain flexible enough to recognize the need for continuing change and for new paradigms for life-long learning. Workers in almost every job category can expect to face novel problems in a workplace that is changing repeatedly. Familiar responses no longer work, and even newly acquired ones will not work for long.

Employers know what they want from their employees and what colleges should be teaching their future employees (Association of American Colleges & Universities, 2010). Their top choice is teach students to communicate effectively both orally and in writing, followed by “critical thinking and analytical reasoning skills.” I would add here that no one can communicate clearly if their thinking is muddy, so these two top concerns are inextricably related. In fact, four of the top five learning outcomes that

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employers want for their employees are subsumed under the general heading of critical thinking—applying knowledge in real-world settings, analyzing and solving problems, connecting choices to actions, and being able to innovate and be creative. The Partnership for 21st Century Skills (2004), a coalition of national organizations that advocate for the skills needed in a global economy, makes it clear that “critical thinking and problem solving” are essential for the citizens of today and for the future. Politicians of every persuasion, blue ribbon panels, workers, and students all recognize the critical importance of critical thinking as the primary objective of education.

Consider this: Most people will finish their formal education between the ages of 18 and 22. Today’s young adults are expected to have the longest average life span in the history of the world, with most living into their 70s and many living into their 80s and 90s. We can only guess what life will be like in the years 2075 or 2085 or beyond, years that many of you who are reading this book will live through. One likely guess is that many of today’s young adults will be working at jobs that currently don’t exist and dealing with technologies that dwarf the imagination of present-day science fiction writers. What do they need to learn during their first two decades of life that will prepare them for their remaining 60+ years?

Thought and Knowledge

Knowledge will forever govern ignorance: And people who mean to be their own Governours, must arm themselves with the power which knowledge gives.

—James Madison

(Texas Library Association

<http://www.txla.org/groups/godort/kip-award.html>)

One of the elementary schools that I attended as a child had the words “Knowledge is Power” chiseled into a concrete block above its front door. If I were asked to amend this maxim based on my experiences over the many years since I last past through those doors, I would edit the concrete block to read, “Thought and Knowledge are Power” because knowledge is powerful only when it is applied appropriately, and thought is powerful only when it can utilize a large and accurate base of knowledge.

This is a book about thought and knowledge and the relationship between these two constructs. It is about thinking in ways that allow us to use previous knowledge to create new knowledge. Everything we know, and

everything everyone else knows—that is, all existing knowledge—was created by someone. When we learn Euclidean geometry, we are learning about knowledge created by the great mathematician, Euclid. Similarly, other eminent inventions and insights such as the wheel, shoes, video games, toilet paper, $E = mc^2$, and the “discovery” of America, all represent knowledge created by people. Knowledge is not something static that gets transferred from one person to another like pouring water from one glass to another. It is dynamic. Information becomes knowledge when we make our own meaning out of it. Of course, it is silly to think that we should all start from “scratch” and recreate the wheel or that each of us needs to reinvent our own version of algebra or knowledge in other fields that is readily available that others have created. We build on the knowledge created by others to create new knowledge.

We also create knowledge every time we learn a new concept. The newly acquired information is used to construct our own internal knowledge structures. (“Knowledge structures” is a technical term used by cognitive psychologists to describe all of the interrelated concepts that each of us has about different subjects.) Knowledge is a “state of understanding” that exists only in the mind of the individual knower (King, 1994, p. 16). We use our existing knowledge when we receive new information in order to make sense of the new information, thus the acquisition of knowledge is an active mental process. This idea was expressed more eloquently by Resnick (1985, p. 130) when she said: “Knowledge is no longer viewed as a reflection of what has been given from the outside; it is a personal construction in which the individual imposes meaning by relating bits of knowledge and experience to some organizing schemata.”

A Working Definition of Critical Thinking

Ultimately, it is not we who define thinking, it is thinking that defines us.
—Carey, Foltz, & Allan (Newsweek, February 7, 1983)

Although many psychologists and others have proposed definitions for the term “critical thinking,” these definitions tend to be similar with

Take a few minutes and think about your own definition of critical thinking. What would it include and what would it not include?

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considerable overlap among the definitions. In a review of the critical thinking literature, Fischer and Spiker (2000) found that most definitions for the term “critical thinking” include reasoning/logic, judgment, metacognition, reflection, questioning, and mental processes. Jones and his colleagues (Jones, Dougherty, Fantaske, & Hoffman, 1995; Jones, Hoffman, Moore, Ratcliff, Tibbetts, & Click, 1995) obtained consensus from among 500 policy makers, employers, and educators who agree that critical thinking is a broad term that describes reasoning in an open-ended manner and with an unlimited number of solutions. It involves constructing a situation and supporting the reasoning that went into a conclusion.

We can think of critical thinking as good thinking, but that definition leaves us with the problem of recognizing what that is and differentiating good thinking from poor thinking. Here is a simple definition that captures the main concepts: *Critical thinking is the use of those cognitive skills or strategies that increase the probability of a desirable outcome. It is used to describe thinking that is purposeful, reasoned, and goal directed—the kind of thinking involved in solving problems, formulating inferences, calculating likelihoods, and making decisions, when the thinker is using skills that are thoughtful and effective for the particular context and type of thinking task.* Critical thinking is more than merely thinking about your own thinking or making judgments and solving problems—it is effortful and consciously controlled. Critical thinking uses evidence and reasons and strives to overcome individual biases. Decisions as to which outcomes should be desirable are embedded in a system of values and may differ from person-to-person, but the idea that critical thinking makes desirable outcomes more likely provides a way of defining critical thinking (Butler & Halpern, 2012; Moseley et al., 2005; Riggio & Halpern, 2006; Sternberg, Roediger, & Halpern, 2007).

One of my favorite definitions of critical thinking was published over 50 years ago (1960) and comes very close to a contemporary notion of critical thinking: “Critical thinking then is the process of evaluation or categorization in terms of some previously accepted standards . . . this seems to involve attitude plus knowledge of facts plus some thinking skills” (Russell, cited in d’Angelo, 1971, p. 6). In short, Russell’s equation is:

$$\text{Attitude} + \text{Knowledge} + \text{Thinking Skills} = \text{Critical Thinking}$$

What's Critical about Critical Thinking?

The “critical” part of critical thinking denotes an evaluation component. Sometimes the word “critical” is used to convey something negative, as when we say, “She is a critical person.” But, evaluation can and should be a constructive reflection of positive and negative attributes. When we think critically, we are evaluating the outcomes of our thought processes—how good a decision is or how well a problem has been solved. Critical thinking also involves evaluating the thinking process—the reasoning that went into the conclusion we’ve arrived at or the kinds of factors considered in making a decision. Daydreams, night dreams, and other sorts of thinking that are not engaged in for a specific purpose are not subsumed under the critical thinking category. Neither is the type of thinking that underlies our routine habits, which although goal-directed, involve very little conscious evaluation, such as getting up in the morning, brushing our teeth, or taking a usual route to school and work. These are examples of **nondirected or automatic thinking**. Other examples of *noncritical thinking* include the rote recall of information (e.g., listing state capitals) or the failure to consider evidence that might support a conclusion that you do not like.

In thinking about critical thinking, consider, for example, someone in need of money who decides to remedy this problem with a trip to the racetrack where he bets on a pretty filly named “Handsome Singer.” There is some (small) chance that he will “win big” if his horse comes in, but this is not an example of critical thinking, even if he reflected on his actions and Handsome Singer was the first to cross the finish line. The most likely outcome is that he will lose the money he bet, surely an undesirable outcome. On the other hand, suppose that he invested his money in a “blue chip” stock instead of betting it on “Handsome Singer.” There is some chance that he will lose his money with this strategy, but on average, in the long run, the likelihood of the desirable outcome of having more money is much higher with the stock investment than it is by betting at the race track. The investment is a rational or reasoned course of action, but it cannot guarantee a desirable outcome. The future is always unknown and there can never be guarantees about the future, even for the best of thinkers. A substantial increase in the likelihood of a desirable outcome is the best that critical thinking can promise, and it is the best hope for the future that anyone can offer.

The focus of this book is on the development and improvement of those skills that characterize clear, precise, purposeful thinking. It is a practical

book, based primarily on applications of cognitive psychology to memory, reasoning, problem solving, creativity, language, and decision making. Despite the fact that some critics have claimed that critical thinking is just a “fad” that will surely go out of style, it has a very long history in psychology and education. John Dewey, the pioneering American educator identified “learning to think” as the primary purpose of education in 1933. Besides, it is difficult for me to consider that the need to think well is a “passing fancy” that will soon be out of style, much like Rubik’s cube, “big hair,” and bell bottom jeans.

Although psychology has been concerned with the way people think for much of its 100+ years of existence as an academic discipline, cognitive psychology, the branch of psychology that is concerned with thought and knowledge, has virtually dominated scientific psychology for the past 50 years. Cognitive psychologists are concerned with learning about the skills and strategies used in problem solving, reasoning, and decision making and the way these abilities relate to intelligence. All of this interest in human thinking processes has given birth to a new area of psychology that has come to be known as **cognitive process instruction**. Its goal is to utilize the knowledge we have accumulated about human thinking processes and mechanisms in ways that can help people improve how they think. For example, by examining correct and incorrect responses in a variety of situations, psychologists have found that at least some of the time, most people’s spontaneous and intuitive approaches to solving problems are wrong. Furthermore, psychologists can often predict when an incorrect response will be made either because of the nature of the problem or because of common biases that a problem solver may bring to the problem. This knowledge is already being put to use to solve a host of applied problems that range from providing military personnel with map reading skills to designing “user-friendly” computer programs. Ariely (2009) has written extensively on what he calls “predictably irrational” behavior. The main theme of Ariely’s writing is that psychologists can predict with a high level of accuracy the type of irrational thinking and behavior most people will engage in when they are faced with certain information and need to make a decision. By understanding how and when we are irrational, we can make better decisions, and by extension, we become better thinkers.

Changing How People Think: Should It Be Done?

We know that the average American, because of changes in the economy at home and abroad, will change work seven or eight times in a

lifetime. . . . If that is true, it is clear that we need an agenda as a people for lifetime learning.

—U.S. President Bill Clinton (“Clinton’s message,” 1994, p. 6A)

The whole idea of influencing the way people think may seem scary. It suggests terms like “mind control” and “propaganda,” or perhaps even a “Big Brother,” like the one in Orwell’s chilling novel *1984*, who knew what you were thinking. In reality, though, critical thinking is an antidote to the kind of mind control that worried Orwell. Learning the skills of clear thinking can help everyone recognize propaganda and thus not fall prey to it, analyze unstated assumptions in arguments, realize when there is deliberate deception, consider the credibility of an information source, and think a problem or a decision through in the best way possible.

When I discuss the topic of critical thinking with students and other people with whom I come in contact, I am sometimes told that there is no such thing as critical thinking because different viewpoints are “all a matter of opinion” and that everyone has a right to his or her own opinion. They argue that a “better way to think” does not exist. I certainly agree that we all have the “right” to our own opinion; however, some “opinions” are better than others. Everyone has the right to believe in phenomena such as astrology and extrasensory perception even if there is no sound evidence to support the existence of these phenomena. If someone wants to have an illness sucked from his body with warmed cups or buys a so-called Power bracelet that is purely bogus, why should anyone care? There is a great web site that answers this question. Aptly named *What’s the Harm* (<http://whatstheharm.net>), it lists a large number of phony medical cures, supernatural and paranormal phenomena, pseudoscience, and more bogus claims than I could imagine and documents the harm that results when, for example, someone opts for a phony medical cure instead of one that is based on sound medical research. Cupping, the “medicine” practiced by my grandmother, is listed and along with it is a story of a man who was badly burned when the cupping procedure caught fire.

James Randi, a magician and escape artist who is best known for his work in debunking claims of psychics and others has a certified \$1 million fund that will be given to anyone who can legitimately demonstrate paranormal ability under test conditions. There is a long list of applicants including psychics, clairvoyants, friends of the dead, someone who claimed she could make people urinate using the power of her mind, and even stranger claims. The \$1 Million Paranormal Challenge is still unclaimed (James Randi Educational Foundation, 2013). All beliefs are *not* equally good.

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There are countless examples of the need for critical thinking. In every political campaign, candidates tell voters that they are opposed to waste, fraud, pollution, crime, and overpaid bureaucrats. These speeches are inevitably followed with loud cheering and applause. (Pay attention to this when you watch the next political convention—regardless of the party.) What’s wrong with these speeches? The candidates never really say anything. I’ve never heard any candidate claim to be *for* waste, fraud, pollution, crime, or overpaid bureaucrats. Voters should ask them to be more explicit about their goals, how they would accomplish them, and where the money would come from to finance political plans.

Here’s another example, presented to a large sample of 13-year-olds: “An army bus holds 36 soldiers. If 1,128 soldiers are being bused to their training site, how many busses are needed?” (Chance, 1986, p. 26). Most of the students tested had no trouble carrying out the computations. The problem came in using the answer in a meaningful way. Many rounded the answer they received to the nearest whole number and concluded that 31 busses were needed. Others gave a decimal answer (31.33) or showed the remainder from their long division. The problem was not one of basic computational skills, but of thinking about the kind of answer that the problem required and using a strategy that was different from one that was taught in school, namely rounding “up” to the next highest whole number rather than rounding to the nearest whole number. Perhaps, simple examples like this one provide the most convincing answer to the question of whether critical thinking should be taught. The most precious commodity of any country is thinking, educated people. We must make this the goal of education.

Commercialization of Schools as a Threat to Critical Thinking

According to the research literature, critical thinking is best cultivated in a school environment that encourages students to ask questions, to think about their thought processes, and thus to develop habits of mind that enable them to transfer the critical thinking skills they learn in class to other, unrelated, situations.

—Alex Molnar, Faith Boninger, & Joseph Fogarty (2011, p. i)

Not surprisingly, many cash-strapped school districts have turned to commercial sponsors to pay expenses. As an often unacknowledged part of this “deal,” commercial sponsors buy the right to promote their products to the

children and adolescents in the schools they sponsor. The sponsor's interest is to promote the product that they sell. They do not want the children to learn to identify and critically evaluate the sponsor's point of view or to generate solutions that would make the children less likely to buy the sponsor's products (Molnar, Boninger, & Fogarty, 2011). I recall a situation in which a beer company paid part of the construction costs for a much-needed new building on a university campus. In return, the large auditorium in that building was named for the beer company. Many years ago (not at my current college), I taught classes in that auditorium. As part of a standard course in introduction to psychology, we would study the harmful consequences of alcoholism, and we did this in a large room named for a beer company!

In a recent report on the way commercialization of schools has negatively affected critical thinking, the authors (Molnar, Boninger, & Fogarty, 2011) noted the importance of asking questions such as: "What additional information would you want?" "Are the assertions credible?" "What are two solutions for a given problem?" These and other similar questions are presented in multiple places throughout this book, but do students learn to ask these questions?

Not for distribution

Empirical Evidence That Thinking Can Be Improved

Everyone agrees that students *learn* in college, but whether they learn to *think* is more controversial.

—Wilbert J. McKeachie (1992, p. 3)

If you have been thinking critically about the idea of improving how you think, then you've probably begun to wonder if there is any evidence that thinking can be improved. Although there has been some debate about whether it is possible to produce long lasting enhancements in the ability to think effectively, we now have a considerable body of evidence that thinking skills courses and thinking skills instruction that is embedded in other courses can have positive effects that are transferable to many situations. Numerous qualitatively different forms of outcome evaluations for thinking courses provide substantial evidence for the conclusion that it is possible to use education to improve the ability to think critically, especially when instruction is specifically designed to encourage the transfer of these skills to different situations and different domains of knowledge. In

fact, it is difficult to identify any aspect of critical thinking that could not be taught and learned. We learn mathematics in the belief that mathematical skills can be used in real-world contexts where they are needed; similarly, we learn writing and speaking skills in the belief that learners will use these skills when they write or speak in any context. When students take courses designed to improve their ability to work with numbers, write, or speak, most students show improvements. There is no reason why we should believe that instruction in critical thinking would not show the same positive effects as when teaching mathematical, writing, or speaking skills. Here is a sampling of some positive outcomes:

(1) In a large-scale review of the critical thinking literature, the Thinking Skills Review Group (a group of professionals in Great Britain that conducted an extensive review of critical thinking, 2004, p 4) concluded that “The majority of studies report positive impact on pupils’ attainment across a range of noncurricular measures (such as reasoning or problem-solving). No studies report negative impact on such measures.” Even more importantly, they found evidence that pupils can apply or translate this learning to other contexts.

(2) A formal evaluation of a nationwide thinking skills program in Venezuela showed that students who had participated in classes designed for instruction in thinking skills showed greater gains in orally presented arguments and in answering open-ended essay questions than a comparable control group (Herrnstein, Nickerson, de Sanchez, & Swets, 1986). Although this is an older study, it is particularly notable because the researchers used an experimental design that allowed them to conclude that it was the instruction and not some extraneous factor that caused students in the experimental group to improve in their ability to think critically. Students were assigned at random either to receive the thinking skills instruction or some other “control” instruction. Additionally, the oral arguments and writing samples were graded blind; that is, the graders did not know if the students they were assessing had received the thinking skills instruction or were in the control group. The results showed that the targeted thinking skills were transferred and used appropriately with novel topics. Also, they showed greater gains than the control group students on tests of general aptitude (sometimes called intelligence tests), problem solving, decision making, reasoning, creative thinking, and language. This experiment provides strong support for the conclusion that improvements in thinking are possible when instruction is designed for this purpose.

(3) Van Gelder (2001) taught college students how to recognize the various components of an argument, including ways of determining how good any argument is and including ones that you make yourself. After one semester of training, he found that students made large gains on a multiple-choice test of critical thinking and a written test that was loosely based on the Graduate Record Examination's Writing Assessment (a commonly used test for entrance to graduate schools). He concluded that teaching students how to recognize the structure and strength of arguments "appears to dramatically accelerate improvement in critical thinking when compared with the 'indirect' strategy" (i.e., just being at university)" (p. 546).

Other studies support the idea that critical thinking is learned best when the skills are explicitly taught. In a study with high school students at low-performing schools, Marin and Halpern (2010) compared the critical thinking skills of students taught with explicit methods (labeling the skills, teaching ways to analyze arguments, recognize when correlations are being used to make causal claims, confirmation bias and stereotypes, and how to make sound decisions) to those of students who were taught these skills implicitly as part of the course materials. Critical thinking gains were assessed with the Halpern Critical Thinking Assessment, which uses both open-ended and multiple-choice responses. The results showed a clear benefit for explicit instruction in critical thinking.

(4) Researchers in the Netherlands examined the effect of critical thinking instruction on training and transfer in complex decision making. One group of students received the instruction while working with realistic scenarios that required complex decisions, and the other group used the same scenarios, but did not receive the training (Helsdingen, van den Bosch, van Gog, & van Merriënboer, 2010). The researchers concluded that "The results of this study warrant the implementation of critical thinking instruction . . . for decision makers that have to operate in complex and highly interactive dynamic environments" (p. 537).

(5) Using a skills approach, Facione (1991; Facione, Facione, & Giancarlo, 2000) found that college students who received coursework in critical thinking scored significantly higher on a multiple-choice test of thinking skills than comparable students who had not taken such a course. Other studies have also documented improvements on multiple-choice tests of critical thinking. For example, Lehman, Lempert, and Nisbett (1988) found that graduate-level college students improved significantly on a critical

thinking test that included short scenarios about realistic situations. They concluded that training with general “rules” of thinking is generalized to other contexts.

(6) Strong support for beneficial outcomes from critical thinking instruction comes from a collection of studies by Nisbett and his colleagues (Nisbett, 1993). For example, in one study, Nisbett and his coauthors phoned students at their homes after the coursework was completed, under the guise of conducting a survey. They found that students spontaneously applied the thinking skills that they had been taught in school when they encountered novel problems, even when the school-related context cues were absent (Fong, Krantz, & Nisbett, 1986). In a different study, inductive reasoning tasks were taught to college students using realistic scenarios from many different domains. Students were able to use these skills on a later test. The authors concluded that critical thinking is “a skill” and that “it is transferable” (Jepson, Krantz, & Nisbett, 1993, p. 82). Nisbett’s (1993) edited book contains 16 chapters that show that rules of logic, statistics, causal deduction, and cost-benefit analysis can be taught in ways that will generalize to a variety of settings. A similar conclusion about the positive effects of courses designed to promote critical thinking was reached in another independent review of the literature (Chance, 1986; Bruer, 1993).

(7) Additional support for the conclusion that improvements in critical thinking transfer across settings was reported by Kosonen and Winne (1995), who studied the transfer of critical thinking skills to a novel domain in a study that used college, secondary school, and middle-school students as participants. Like Nisbett, they found that when students learned general rules about reasoning and practiced these skills with everyday “ill-structured” problems, the thinking skills transferred to new contexts and different domains. Appleton-Knapp, Bjork, and Wickens (2005, p. 266) reported similar results. They found that variation in how information is encoded results in “more multi-faceted memory representations, which enhanced recall.” Thus, it seems that critical thinking skills are learned best and are most likely to transfer to novel situations when they are taught using a variety of different examples. Principles derived from empirical studies like these (and others) that show the successful transfer of critical thinking skills can serve as a model for instructional design. Many important principles from cognitive psychology are applied in this text to encourage effective learning that lasts.

All of the diverse findings (and many others that are not reviewed here because the relevant research literature is huge) point to the same

conclusion: students can learn to think more critically when they receive instruction that is designed for this purpose.

Is Critical Thinking a Byproduct of a Good Education?

Freshmen who enter higher education at the 50th percentile would reach a level equivalent to the 57th percentile of an incoming freshman class by the end of their sophomore year. Three semesters of college education thus have a barely noticeable impact on students' skills in critical thinking, complex reasoning, and writing.

—Richard Arum and Josipa Roksa (2011, p. 35)

The evidence is clear: We can get good gains in critical thinking when teachers deliberately teach for critical thinking. But, what if teachers don't? Do students become better thinkers as a routine part of getting a good education? In fact, most do not. Arum and Roksa (2011) make this point in their condemnation of what happens in many college classes. They followed 2,300 students at 24 universities over four years. They concluded that more than one third showed no improvement in critical thinking. Critical thinking does not automatically result as a byproduct of standard instruction in a content area. Critical thinking instruction needs to focus overtly and self-consciously on the improvement of thinking, and the learning experience needs to include multiple examples across domains in order to maximize transfer.

Transfer of Training

Why Johnny can't read was one of the central questions raised about American education in the 1970s. Why Johnny can't think replaced it in the 1980s.

—A.L. Brown and J.C. Campione (1990, p. 108)

All of these studies that attest to the effectiveness of critical thinking instruction are studies of the generalizability or transfer of critical thinking skills. The real goal of any instruction to improve thinking is **transfer of training**. What I mean by transfer is the use of critical thinking skills in a wide variety of contexts. The whole enterprise of learning how to improve thinking is of little value if these skills are only used in the classroom or only on problems that are very similar to those presented in class. Ideally, critical thinking skills should be used to recognize and resist unrealistic campaign promises, circular reasoning, faulty probability estimates, weak arguments by analogy, or language designed to mislead whenever and wherever it is encountered. Critical thinkers should be better able to solve or offer reasonable

solutions to real world problems, whether it is the problem of nuclear war or how to set up a new computer. These skills should also be long lasting and useful for the many decades of critical thinking that most of us will face. Admittedly, these are lofty goals, but they are important ones. The best way to promote the kind of transfer I am advocating is with the conscious and deliberate use of the skills that are learned in a wide variety of contexts.

Psychologists know that learning is enhanced when study time includes at least one test of the material being learned (Roediger & Karpicke, 2006), but more recent work shows that transfer is also enhanced when learners are tested during learning (Rohrer, Taylor, & Sholar, 2010). It seems that by recalling information, the strength of the memory increases and the information to be learned is then more available when it is needed in novel situations. It is important to work through a variety of different types of materials where critical thinking skills are needed to get the most of critical thinking instruction. For that reason, there is a variety of different types of problems presented about different topics in the ancillary materials that accompany this book. By working through these problems, you will increase the likelihood that you will recall and use the thinking skills that are presented in the text and in real life when you really need them. Be sure to be on the lookout for other instances when these thinking skills are needed, and be sure to use them!

Learning to Think Critically: A Four-Part Model

The model that I have proposed for critical thinking instruction consists of four parts (Butler & Halpern, 2011; Halpern, 1998):

1. Explicitly learn the skills of critical thinking.
2. Develop the disposition for effortful thinking and learning.
3. Direct learning activities in ways that increase the probability of transcontextual transfer (structure training).
4. Make metacognitive monitoring explicit and overt.

Let's consider each of these parts.

A Skills Approach to Critical Thinking

As you work your way through the chapters in this book, you will come across many different thinking skills, with each chapter containing those

skills that are especially useful in thinking about the chapter topic. For example, the thinking skills used in understanding likelihood and uncertainty are presented in that chapter. You may be wondering what a “thinking skill” is. Some examples should help. Here is a list of some generic skills that are important in many situations.

A critical thinker will:

- recognize semantic slanting and guilt by association
- seek out contradictory evidence
- use the metacognitive knowledge that allows novices to monitor their own performance and to decide when additional help is needed
- make risk: benefit assessments
- generate a reasoned method for selecting between several possible courses of actions
- give reasons for choices as well as varying the style and amount of detail in explanations depending on who is receiving the information
- recall relevant information when it is needed
- use skills for learning new techniques efficiently and relate new knowledge to information that was previously learned
- use numerical information including the ability to think probabilistically and express thoughts numerically
- understand basic research principles
- demonstrate an advanced ability to read and write complex prose
- present a coherent and persuasive argument on a controversial, contemporary topic
- use matrices and other diagrams for communication
- synthesize information from a variety of sources
- determine credibility and use this information in formulating and communicating decisions.

Critical thinking instruction is predicated on two assumptions: (a) there are clearly identifiable and definable thinking skills that students can be taught to recognize and apply appropriately, and (b) if recognized and applied, the students will be more effective thinkers. Thus, one part of the

model for learning to become a better thinker is learning how to use the skills of critical thinking and how to recognize when a particular skill (or set of skills) is needed.

The Disposition for Effortful Thinking and Learning

All man's dignity lies in thought.

—Blaise Pascal (1670, p. 83)

No one can become a better thinker just by reading a book or even by just learning a set of thinking skills that would be useful if they were used. An essential component of critical thinking is developing the attitude or disposition of a critical thinker. Good thinkers are motivated and willing to exert the conscious effort needed to work in a planful manner, to check for accuracy, to gather information, and to persist when the solution is not obvious or requires several steps.

In an empirical test of the relationship between a disposition to think critically and actual performance on a test of critical thinking, Butler (2012) found that adults who reported that they were more likely to engage in the effortful process of thinking (e.g., less likely to rely on gut decisions or to prefer one example to a well-conducted study and more likely to research products before buying) had higher scores on a critical thinking assessment and actually engaged in fewer negative behaviors that were indicative of poor thinking (e.g., rented a movie but had to return it without watching it, bought new clothes but never wore them, got locked out of the house) than those who were less inclined to think critically.

Many errors occur not because people can't think critically, but because they do not. One of the major differences between good and poor thinkers, and correspondingly between good and poor students, is their attitude. A critical thinker will exhibit the following dispositions or attitudes:

Willingness to Plan

If everybody thought before they spoke, the silence would be deafening.

—George Barzan

I have watched thousands of students (literally) take exams. There are always some students who begin to write as soon as the exam hits their desk. They just plow ahead and begin writing before they begin thinking. Not surprisingly, the results are a disoriented jumble that often bears little

relation to the questions being asked. When asked a question in class, they will often answer with the first idea that comes to mind. These students need to learn to check their impulsivity and plan their response. They should be outlining or diagramming the structure of a response before they begin to write. Planning, the invisible first step in critical thinking, is essential. Planning seems to be an important component for changing many behaviors, especially health-related behaviors such as healthy eating and avoiding drug and alcohol abuse (Wiedemann, Lippke, Reuter, Ziegelmann, & Schwarzer, 2011). Regardless of the content, it is useful to plan how you will think and act. Plans are prescriptive descriptions about what to do and they prevent habitual responses that may not work. With repeated practice, anyone can develop the **habit of planning**.

Self-regulation is a popular concept in the psychological research literature. It is a complex term that has multiple components, which includes using feedback, monitoring comprehension, assessing progress towards a goal, and making judgments about how well something is learned (Bednall & Kehoe, 2011). There is voluminous literature showing that self-regulation is important in learning. It is now clear that critical thinkers are self-regulated learners (Phan, 2010). Researchers taught college students how to use self-regulatory behaviors, and they found that when compared with control groups, students who learned how to self regulate performed better on a test that required detecting and explaining thinking fallacies (Bednall & Kehoe, 2011).

Flexibility

In a classic old book, Rokeach (1960) talks about rigidity and dogmatism as the characteristics of a “closed mind.” A person with a closed mind responds negatively to new ideas by stating, “That’s the way I’ve always done it.” Another common retort that shows the unwillingness to consider new ideas is the well-worn phrase, “If it ain’t broke, don’t fix it.” This sort of close-minded response cuts off consideration of new ideas. By contrast, an attitude of flexibility is marked by a willingness to consider new options, try things a new way, and reconsider old problems. Cognitive flexibility is the ability to change how we think about something—to see things from another person’s point of view, consider multiple options, think of several ways to respond, and seek information that may not be readily available (Dennis & Wal, 2010). An open-minded person is willing to suspend judgment, gather more information, and attempt to clarify difficult issues. This does not mean that all opinions are equally good or that judgment should take a back-seat to openness. It does not mean accepting every nonsense

opinion that is offered. It does mean, though, that a critical thinker is willing to think in new ways, review evidence, and stick with a task until all reasonable options have been considered.

Persistence

You may be disappointed if you fail, but you are doomed if you don't try.

—Beverly Sills (quoted in James Rogan, *Bits & Pieces*, 1993, p. 7)

There are many factors that influence academic and career success, but persistence may be the most important one (Andersson & Bergman, 2011). It is the willingness and ability to keep at a task. It is key factor in successful problem solving. Closely related to persistence is the willingness to start or engage in a thoughtful task. Some people look at a seemingly difficult task and opt not to even begin the thinking process. They are defeated at the start. Good thinking is hard work that requires diligent persistence. It can make you as tired as any physical labor, but can be much more rewarding. In a comparison of students who were unsuccessful in mathematics with those who were successful, researchers found that much of the difference in success rates was directly attributable to differences in attitudes. The unsuccessful students believed that if a problem could not be solved in less than 10 minutes, then they would not be able to solve it. By contrast, the successful students persisted in working on difficult problems (Schoenfeld, 1985).

Willingness to Self-Correct, Admit Errors, and Change Your Mind when the Evidence Changes

In science it often happens that scientists say, "You know that's a really good argument; my position is mistaken," and then they would actually change their minds and you never hear that old view from them again. They really do it. It doesn't happen as often as it should, because scientists are human and change is sometimes painful.

—Carl Sagan

We all make mistakes. In fact, creative thoughts and actions would not be possible if we were unwilling to make mistakes, at least some of the time. Instead of becoming defensive about errors, good thinkers can acknowledge them and learn from them. Unfortunately, there is wide spread tendency to justify our mistakes—our faulty beliefs, our bad decisions. In a delightful book, Tavris and Aronson (2007) review multiple political and

private mistakes. A main deterrent to admitting mistakes is **self-justification**. Self-justification is extremely strong because it keeps our image of ourselves intact. For example, is it important to think of yourself as an informed and intelligent citizen? For many of us, this is an important component of our self-image. Suppose that you believed that there really were “weapons of mass destruction in Iraq” at the time when the President of the United States was urging its allies to protect themselves and the future of their countries by invading Iraq. Later, the overwhelming evidence shows that there were no weapons of mass destruction. What now? Many people chose to ignore the evidence and maintain their original belief. It is not hard to see why. By maintaining, even strengthening the original belief, believers can continue to see themselves and to convince others that they were not wrong about something so important. Self-justification, which is making excuses for a belief or behavior, is a very strong human tendency and can be found everywhere—it is not just for politicians. Tavis and Aronson present many examples—husbands and wives each justifying a belief or action even when there is good evidence that the belief or action was wrong, defendants on trial for a variety of crimes, supervisors and the people they supervise, and so on. The disposition to be self-critical (evaluative) and consider when a mistake is a learnable moment and not a time for the auto-pilot of self-justification is a hallmark of critical thinkers.

It is interesting to note that the general public usually does not like it when a public figure changes his or her mind, especially when the change is away from a conclusion that was popular. However, if a person is open to a fair evaluation of new information, sometimes that information will lead to a different conclusion. It would be foolish to hold to an old conclusion or belief when it is no longer warranted. The ability to change one’s conclusion when new or better information becomes known is not “waffling” or some other negative term that is used to describe someone whose views change as readily as the shifting direction of the wind. What is needed is a new term that has positive connotations to be used for critical thinkers who are willing to change conclusions when sound evidence warrants a change. Unfortunately, this is one attitude of critical thinking that is still all too rare.

Politics is filled with instances where one side took advantage of a change in the position of an opposing candidate. In a news article that lists numerous people throughout history who have changed their position on core issues, including various candidates for the presidency of the United States (both Democrats and Republicans), the author (Schulman, 2007, para. 8) asks,

But are all flip-flops really so objectionable? Isn't it equally fair to argue that a willingness to shift, often abruptly and fundamentally, in response to changing circumstances is a venerable tradition in American governance? Indeed, the willingness to compromise is a crucial ingredient of serious leadership. The nation's most respected presidents, from the founding generation to modern times, have proudly and, in some cases, defiantly flip-flopped on important issues.

Being Mindful

In order to develop basic thinking skills, it is necessary to direct your attention to the processes and products of your own thoughts. Langer (2000) defines **mindfulness** as "the simple act of drawing novel distinctions" (p. 220). It is the opposite of the "automatic pilot" that we use for routine tasks like setting the dinner table, getting to school or work every day, or watching television in the evening. According to Langer, learning requires a mindful engagement with the task and materials. She told a humorous personal story about a case of mindlessness that makes this point well (Langer, 1989). When shopping one day, the clerk told her that she had not signed the back of the credit card she was using. Langer signed the card, and then handed it back to the clerk. The clerk then processed the sale and had Langer sign the credit slip. Then, dutifully, as she had no doubt been instructed, the clerk checked the signature on the back of the newly signed credit card with the signature on the credit slip. She never realized that she had just seen Langer sign both! As long as we respond in a mindless or routinized way, problems worth solving will never be recognized, and creative solutions will be missed.

Consensus-Seeking

Committee and group organizational structures are most often the norm in the world of work. Critical thinkers need to be predisposed to seek ways in which consensus among group members can be achieved. They maintain an awareness of the social realities that need to be overcome so that thoughts can become actions. Consensus-seekers need high-level communication skills, but they also need to find ways to compromise and to achieve agreement. Without this disposition and related interpersonal skills, even the most brilliant thinkers will find that they cannot convert thoughts to actions.

Consensus-seeking does NOT mean caving in to majority opinion, and it does not mean forcing others to agree with you. It is a disposition that

allows individuals to accept what is good or true about an alternative position as a way of gaining support for one's own position. In the chapter on decision making, I talk about "group think," which is the pressure for conformity in group decision making. Consensus-seeking is a different concept—it refers to an openness in thinking that allows members of a group to agree on some aspects of a solution and disagree on others—but the goal is to allow other people and yourself to express doubts while working toward a solution that can be achieved.

Transfer of Training

In becoming a better thinker, it is important to have a large repertoire of critical thinking skills and to be willing to engage in the effortful process of using them. The third component of this model involves recognizing when critical thinking is needed so that you can select the most appropriate skills for the situation. This is the Achilles' heel of transfer. The problem in learning thinking skills that are needed in multiple contexts is that there are no obvious cues in the context to trigger the recall of the thinking skill. Critical thinkers need to create the recall cues from the structural aspects of the problem or argument so that when the structural aspects are present, they can serve as cues for retrieval.

When critical thinking skills are learned so that they transfer appropriately and spontaneously, critical thinkers can focus on the structure so the underlying characteristics become salient instead of the domain specific surface characteristics. An example should help here because the idea of transferring skills to novel areas is highly abstract.

Suppose that you understand the way contrast effects can influence one's judgment. For example, if you are offered several part-time jobs that pay \$10 an hour, \$13.50 an hour will seem like more money than if you had been offered several part-time jobs that pay \$14 an hour. Even if you know that contrast effects can influence judgments, will you be able to recognize the power of contrast effects on your judgment in a totally different situation, such as when your friend begins a story about his "brush with the law" by telling you about all of the people from your old high school class who are now in jail? His "brush with the law" will seem much less serious when it is told after stories about people you know who committed serious crimes than it would if he had told it after stories about people who have not committed any crimes. In this example, your hypothetical friend is making his own crime seem less bad by contrasting it with more serious ones. How can

you recognize that the same principle of contrast is affecting your judgment in both situations (judgments about pay per hour and seriousness of a crime)? If you can recognize that the same principle is at work, you could use the same critical thinking skills to prevent the effect of contrast from influencing how you think. In other words, how can you learn to apply your knowledge about contrast effects in different sorts of situations?

There is an old saying in psychology that “the head remembers what it does.” It is important to direct your own learning so that the skills of critical thinking are learned in a way that will facilitate their recall in novel situations. It is what learners do that determines what gets learned. Here are some examples of thinking tasks that are designed to help with the transfer of critical thinking skills. They require readers to perform certain tasks or answer carefully crafted questions that draw attention to structural aspects of the problem or argument:

- Draw a diagram or other graphic display that organizes the information.
- List additional information you would want before answering a question.
- Explain why a particular multiple-choice alternative was selected. Which is second best? Why?
- State the problem in at least two ways.
- Identify which information is most important. Which information is least important? Why?
- Categorize the findings in a meaningful way.
- List two solutions for problems.
- Identify what is wrong with an assertion that was made in the question.
- Present two reasons that support the conclusion and two reasons that do not support the conclusion.
- Identify the type of persuasive technique being used.
- Present two actions you would take to improve the design of a study that was described.

Tasks like these require learners to focus on structural aspects of the problems so that the learner can identify and use an appropriate critical thinking skill.

Metacognitive Monitoring

Metacognition refers to our knowledge of what we know (or what we know about what we know) and the use of this knowledge to direct further learning activities. When engaging in critical thinking, you will need to monitor your thinking process, check whether progress is being made toward an appropriate goal, ensure accuracy, and make decisions about the use of time and mental effort. Metacognition is the executive or “boss” function that guides how adults use different learning strategies and make decisions about the allocation of limited cognitive resources. Numerous studies have found that good learners and thinkers engage in more metacognitive activities than poor learners and thinkers, and that the skills and attitudes of metacognitive activities can be taught and learned so that students can direct their own learning strategies and make judgments about how much effort to allocate to a cognitive task.

For example, when learners are required to provide reasons and evidence to support a conclusion and counter-reasons and conflicting evidence that refute the conclusion, they must focus on the quality of their thinking. They also have to consider both positive and negative evidence. It is well documented that we tend to weigh evidence much more heavily when it favors a belief that we hold over evidence that disconfirms a personal belief (Lilienfeld, Ammirati, & Landfield, 2009).

A schematic diagram of the critical thinking process, including individual differences and situation variables is shown in Figure 1.1.

Intelligence and Thinking Skills

If we want to improve America’s schools, we will have to apply in the classroom what we know about humans as intelligent, learning, thinking cultures.

—Bruer (1993, p. 1)

One of the most frequently asked questions concerning thinking skills instruction is whether learning to be a critical thinker can make someone more intelligent. As noted earlier, several reviews of the literature and individual studies (e.g., Moseley et al., 2005) conclude that instruction in critical thinking really can help people think better and that improved thinking will transfer to novel contexts. Can critical thinking improve

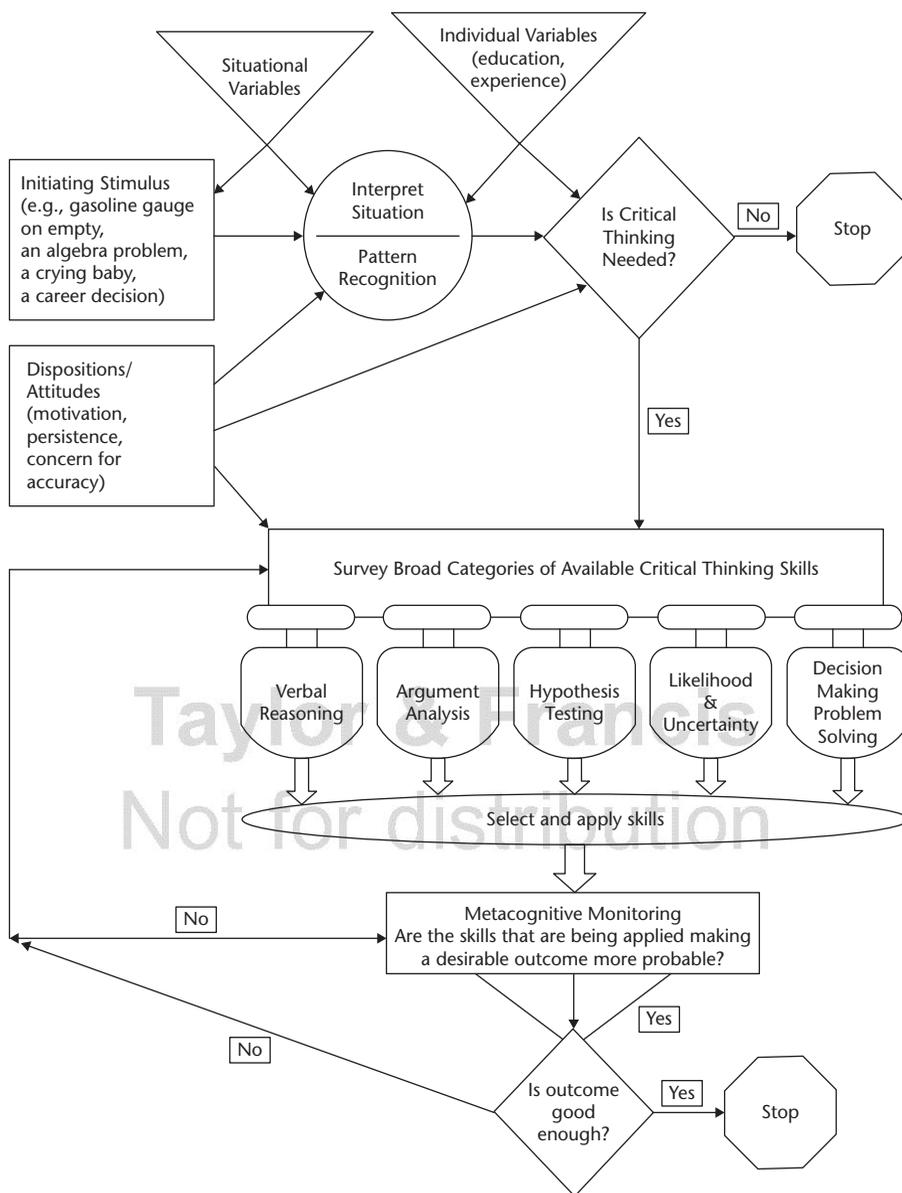


Figure 1.1 A schematic model of the critical thinking process. Notice how dispositions, individual background variables, and situational variables all influence the way a situation is interpreted and the decision as to whether or not it requires the effortful process of critical thinking. If critical thinking is needed, then individuals select the critical thinking skills that are most likely to be appropriate for the situation. Five categories of skills are shown in this diagram. Good critical thinkers have a large repertoire of critical thinking skills to choose from and are skilled at making selections that are appropriate for the situation. (Critical thinking skills and the selection of the appropriate skill are learned.) Metacognitive monitoring is repeatedly cycled as individuals determine if the skills they are using are increasing the likelihood of a desirable outcome or if other skills are needed. When a “good enough” outcome is achieved, the process is stopped.

intelligence? The answer to this important question depends upon how intelligence is defined.

Before you read further, stop for a minute to think about your own definition of intelligence. If a program of instruction can help learners think better, have they become more intelligent?

The Nature of Intelligence

IQ tests measure only a small set of the thinking abilities that people need.

—Keith E. Stanovich (2009, p. 3)

Intelligence is one of the most controversial topics in psychology. It is a basic topic in thinking because intelligence is the “stuff” of which thought is made. It is difficult to imagine a context in which intelligence is not manifested or needed. The term intelligence is used commonly in everyday language. Most people believe that they are at least about average or above average in intelligence (Brim, 1966). (Despite Garrison Keillor’s assurances to the contrary, you should realize that this is mathematically absurd because most people cannot be above average.)

Psychologists continue to debate exactly what the term “intelligence” *should* mean. Here is a good working definition that was offered by Gottfredson (1997b):

[Intelligence] . . . involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts. Rather it reflects a broader and deeper capability for comprehending our surroundings—‘catching on’, ‘making sense’ of things, or ‘figuring out’ what to do. (p. 13)

Intelligence is measured with tests that have been standardized on large groups of people. Most people are familiar with the concept of IQ, which stands for “intelligence quotient” (because it was originally formulated for children by dividing their mental age by their physical age). I agree with critics who claim that no single score can reflect the complexity of human intelligence, no measure is free from cultural bias, and there is a potential

to misuse these scores, but it is also true that IQ scores can do a reasonable job at predicting grades in school, success at work, and other variables related to success in life (Nisbett et al., 2012). As many writers have noted, IQ tests measure only a subset of the thinking skills that people need to be successful in life. In his book on what intelligence tests miss, Stanovich (2009, p. 3) wrote “IQ tests are good measures of how well a person can hold beliefs in short-term memory and manipulate those beliefs, but they do not assess at all whether a person has the tendency to form beliefs rationally when presented with evidence.” What we really want for our politicians, lawyers, doctors, and everyone else is to gauge their ability to think critically, which is largely absent from intelligence tests.

In other words, what *should* we mean when we refer to intelligence? This question leads to another and even more important question: Who is the appropriate authority to decide what it means to be intelligent? (The importance of thinking about definitions is a critical thinking skill that is presented in more detail in “Chapter 3: The Relationship between Thought and Language.”) When Sternberg (1982) asked people to list the characteristics of an intelligent person, the following answers were frequently given: “reasons logically and well,” “reads widely,” “keeps an open mind,” and “reads with high comprehension.” Most people share these intuitive everyday notions of intelligence, which are consistent with the definition of critical thinking. Thus, for most people, intelligent thinking is very similar to the idea of critical thinking.

If people can learn to think better, and there are many types of evidence that show that they can, then by everyday definitions, they can learn to be intelligent. The idea that intelligence can be taught is not new. The notion of intelligence as learning and thinking was articulated early in the last century by the famous Russian psychologist, Lev Vygotsky (1978). He offered an alternative to the static view of human learning and intelligence as a “fixed quantity” that could be observed and assessed in laboratory settings. According to Vygotsky, intelligence is best indexed by the way in which people learn, especially when they receive feedback about their learning, rather than in the level of learning they have achieved at some point in time. This emphasis is not surprising in light of Vygotsky’s work with disadvantaged populations in the aftermath of the Russian Revolutionary war, where many children never had the opportunity to develop their intelligence because of the severe privations of war. These same children often learned new skills and knowledge very quickly when they were given the opportunity to learn, demonstrating a level of intelligence that

could not have been predicted by any standardized measure that might have been used to test them. Thus, it was their ability to learn from their experiences that Vygotsky used to define and measure intelligence, not a score on a test or similar other measure.

The Measurement of Intelligence

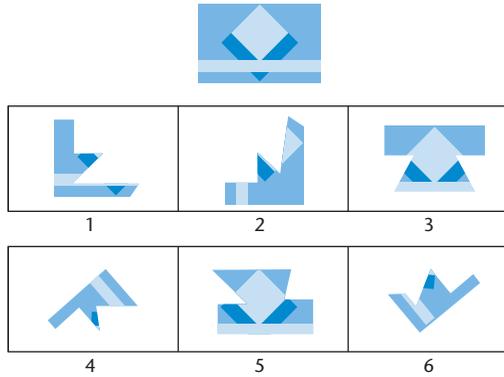
Rational thinking can be surprisingly dissociated from intelligence.

—Keith Stanovich (2009, p. 39)

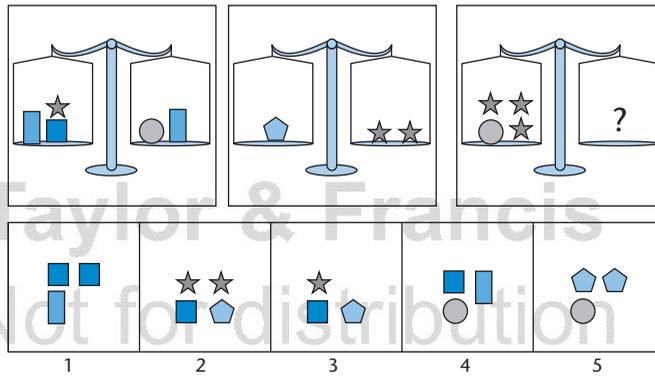
As you can imagine, the measurement of intelligence has proven to be a difficult task. The underlying idea is that intelligence exists, and since it exists, it exists in some quantity (in each individual), and since it exists in some quantity, it can be measured. The only difficulty with this line of reasoning is: “How?”

There is an obvious need to be able to quantify or measure intelligence. Historically, intelligence tests were designed for a very practical reason. In the early part of the 20th century, the French government realized the need to know which children should receive regular classroom instruction and which should receive remedial or accelerated instruction. Binet and Simon were given the job of designing a test that could be used to place children in the appropriate educational setting. Modern day intelligence tests are still used for this purpose. The test designed in France by Binet and Simon has been revised many times. One popular revision was undertaken by Lewis Terman, a psychologist at Stanford University. Terman’s revision of the earlier intelligence test is commonly referred to as the Stanford–Binet. Another popular battery of intelligence tests was written by David Wechsler. He authored two separate tests, the Wechsler Intelligence Scale for Children (WISC) and Wechsler Adult Intelligence Scale (WAIS) designed for adults over 15 years of age. The newest version of the WAIS is designated as “WAIS-IV.” It yields four subscores of intelligence and an overall IQ score. The four subscores, which are usually called scales, include (a) a Verbal Comprehension Score comprised of scores on verbal subtests (e.g., similarities, vocabulary, information, and comprehension); (b) a Working Memory Score (remembering digits, arithmetic, and letter–number sequences); (c) a Perceptual Reasoning Score (making block designs, matrix reasoning, visual puzzles, picture completion, and figure weights); and (d) a Processing Speed Score (symbols search, coding, and cancellation) (Pearson Assessment, 2008).

“Which 3 of these pieces go together to make this puzzle?”



“Which one of these goes here to balance the scale?”



“When I say go, draw a line through each *medium blue* square and *light blue* triangle.”

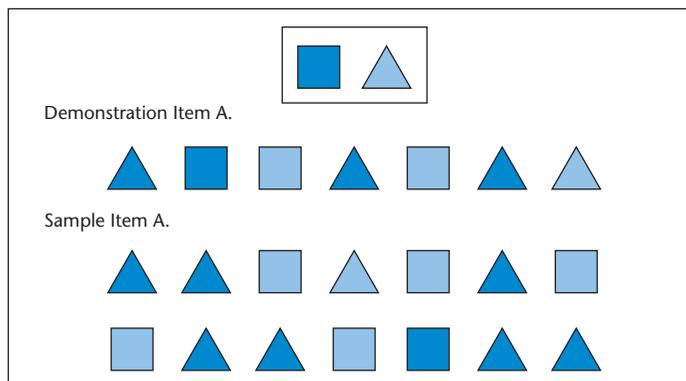


Figure 1.2 Wechsler Adult Intelligence Scale, Fourth Edition (WAIS-IV). Copyright © 2008 NCS Pearson, Inc. Reproduced with permission. All rights reserved. “Wechsler Adult Intelligence Scale” and “WAIS” are trademarks, in the United States and/or other countries, of Pearson Education, Inc. or its affiliates(s).

Sample items from three of the subtests that are new to the latest edition of the WAIS are shown in Figure 1.2.

As you can see from these items, intelligence is measured with a variety of questions. If you are hiring someone for a complex job or selecting students for admissions to a high-level educational program, you will want people who are intelligent. But, as measured with traditional tests, intelligence will be indexed as the ability to remember long lists of numbers, define words, and put puzzles together. These are important measures, but for many people, the ability to think about complex issues means that using the skills of critical thinking (for example, making strong conclusions from evidence, avoiding or minimizing common biases, and not being misled by commonly misused techniques for persuasion) is a better way to define intelligence. Critical thinking ability is not assessed with standard measures of intelligence. It is possible to obtain a high score on an intelligence test and then turn to astrology or palm reading when making decisions. Neither of these “ways of knowing” (astrology or palm reading) has any scientific basis or are better in selecting a good outcome than the proverbial “dart-throwing monkey” (a favorite phrase used by Kahneman, a Nobel Prize winner, when he wants to make the point that a random process is as good as the one being considered).

The notion of intelligence that is embedded in standardized tests is that intelligence is a fixed quantity, although recent research clearly shows the critical importance of environmental influences on intelligence. Because this text is concerned with thinking and helping you to learn how to improve your thinking, it seems reasonable to return to the question posed at the beginning of this section: “Will learning to be a critical thinker make you more intelligent?” For those psychologists who view intelligence as a fixed quantity that can be measured with test items that depend, in part, on the opportunities that are afforded to individuals (e.g., the rich have more and better educational opportunities than the poor, so on average they would be expected to score higher on intelligence tests), then their answer will be “no.” However, along with an increasing number of psychologists, I believe that the static notion of intelligence is wrong and damaging. If any individual can learn to be a better thinker and subsequently can use newly acquired thinking skills across a wide variety of contexts, then I believe that, by definition, that person has learned to be more intelligent. There will always be some people who are more intelligent than others. There are individual differences and limits on how well

each of us can think and reason, and certainly intelligence is also determined, in part, by genetics. However, we all have some amount of undeveloped potential; everyone can make substantial gains in his or her intellectual abilities. Even though we cannot all be geniuses, we can all learn to think more intelligently.

Many contemporary psychologists agree that intelligence is comprised of skills that can be enhanced with training. Stanovich (2009) has argued that intelligence tests do not test for rational thinking. For example, physicians who score high on standard intelligence tests may use shallow processing and choose less effective medical treatments, “smart” people may fail to assess risks, and parents may be misled by unsubstantiated claims that vaccines cause autism. He advocates for a test of critical thinking skills when assessing and conceptualizing what it means to be intelligent. (He uses the term “rational thought.”) Thus, although there is a positive relationship between critical thinking and intelligence test scores, the relationship is not strong. So, will becoming a critical thinker make you smarter? No, if intelligence is measured with standardized IQ test, but yes, if we want to know how well someone thinks in everyday situations.

Becoming a Better Thinker: The Quick and Easy Way

A sucker is born every minute.

—P.T. Barnum (cited in Bartlett, 1980, p. 460)

As I raced through the supermarket after work one day, I was surprised to see a candy bar called “Think!” Just what I needed, a candy bar with “mind enhancing ingredients.” And to think (oops, pardon the pun) that I was working hard to learn better thinking skills when all I had to do was eat a candy bar. This “food for thought” can be found on a web page that claims to advertise “natural products and more.” Apparently, I am not the only one to wonder about “Think!” candy bars. The Center for Science in the Public Interest, a nonprofit organization, investigated this candy bar (Science in the Public Interest, 2000). They contacted the candy bar company for evidence to back up the claim that the ingredients in Think! can help you “stay sharp.” Here’s the company’s response: “‘We’re not claiming that it helps you think,’ insists Garret Jennings, the inventor of Think!, the ‘Food for Thought’ bar. . . . But, if somebody feels great after a Think! Bar,’ asks Jennings, ‘who cares if that is just a placebo effect?’” (p. 12).

I hope that your response to the question posed at the end of the last paragraph is, “I do.” A placebo is used as a control or comparison whenever drugs are tested—it is the condition that contains no active drugs—you may know it as a “sugar pill.” Sometimes just the belief that we are taking a “drug” that will improve the ability to think can lead us to believe that we really are thinking better, even when we are not. But then, I guess this thinking-candy is targeted at consumers who are not good thinkers in the first place. Of course, it is possible that there are some ingredients that could enhance the ability to think. The question for thoughtful consumers is “What is the evidence that this product does what the manufacturer claims?” According to *Science in the Public Interest*, the answer is “none.”

Unfortunately, there are no quick and easy programs that will make you a better thinker, despite some unscrupulous claims that you can think better instantly, without really trying. A trip through most so-called “health food stores” will reveal a wide variety of products and pseudo-medicines that claim or suggest that they can improve your memory, enhance your thinking, or do whatever else is desirable (e.g., make you thin, sexy, strong, and smart); there is usually little or no valid evidence that any of these products can bring about their promised effects.

Two Types of Thinking—Fast and Slow

Bush told me, “I am a gut player, not a textbook player.”

—Bob Woodward (quoted in Love, 2010, para. 19)

Daniel Kahneman, the cognitive psychologist famous for his groundbreaking work in how people think and decide, has popularized the idea that there are two broad types of thinking, System 1 and System 2. System 1 is what is commonly thought of as intuition. It is automatic, effortless, and when it is good, it most likely associated with expertise. The quote about the way George Bush, a former president of the United States, described his thinking as from the “gut” is an example of System 1 thinking. By contrast, System 2 thinking is slow, effortful, and deliberate, and thus close in its definition to critical thinking, when it is done well.

System 1 Thinking

Intuition is not subliminal perception; it is subtle perception and learning—knowing without knowing that you know.

—Michael Shermer (2003, para. 11)

36 Thinking

To understand the distinction between System 1 and System 2 thinking, try this simple exercise:

1. A bat and a ball cost \$1.10
 - i. The bat costs \$1.00 more than the ball.
 - ii. How much does the ball cost? (Kahneman, 2011, p. 44)

OK raise your hand if you said \$.10—obvious and intuitive answer. If you answered \$.10, the answer came to you in flash. It is as though you did not have to think at all. Unfortunately, you also came up with the wrong answer if you said \$.10. With this answer, the bat is \$1 and the ball is \$.10, which makes the bat \$.90 more than the ball. Of course, you could use simple algebra:

$$\text{Bat} + \text{Ball} = \$1.10$$

and

$$\text{Bat} = \text{Ball} + \$1.00$$

Now substitute the definition of Bat (it equals Ball + .10) into the first equation and you get

$$\text{Ball} + \$1.00 + \text{Ball} = \$1.10$$

$$2 \text{ Ball} = \$1.10 - \$1.00$$

$$2 \text{ Ball} = \$.10$$

$$\text{Ball} = \$.05$$

If you gave the incorrect, but intuitive answer, you are in good company. More than half of the students at Harvard, MIT, and Princeton gave this answer, and more than 80% of the students at less selective universities did as well (Frederick, 2005). The Cognitive Reflection Test is a three-question test that assesses the extent to which people tend to give intuitive answers to simple problems. One of the three questions is the bat and ball question. The other two questions are

2. If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? ___ minutes

3. In a lake, there is a patch of lily pads. Every day, the patch doubles in size. It takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half the lake? ____ days

How did you do? Did you answer 100 minutes for the second question? Buzz—as you probably guessed by now, that is the wrong answer. The correct answer is five minutes. The third problem appeared in all earlier versions of this book and was originally attributed to Fixx (1978, p. 50). The only way to solve this problem is to work backwards. Can you solve it with this hint? If the lake is covered on the 48th day and the area covered by the lilies doubles every day, how much of the lake is covered on the 47th day? The answer is half. Thus, by working backwards, the problem is easy to solve.

Respondents who gave the intuitive, fast, and in this case, wrong responses, were less likely to delay rewards (for example, they were more likely to prefer getting \$5 now than \$7 next week), thus suggesting that people who rely more on intuitive and quick thinking differ in other important ways.

Intuition

It's no secret that when researchers have pitted intuition against statistical prediction, the formula usually wins. Statistical prediction is fallible. But for predicting future behavior, human intuition—even professional intuition—is even more fallible.

—David Myers (2010, p. 376)

We love stories about human intuition. I remember spending an evening with a friend, who suddenly said that she was thinking about a third person whom we both knew well. This third friend was “very pregnant,” a strange description for someone who has already gone past the projected due date that was given to her by her obstetrician. Wouldn't it be weird if this overdue friend was having her baby just when we thought about her? Well, actually no, although it might seem that way.

The intuitions of experts differ from everyday intuitions in important ways—most importantly, they are more likely to be useful if (1) the area of expertise is one that is governed by regularities and (2) the expert had repeated experience with immediate feedback in that area. It seems that these two criteria can explain why “professional intuition is sometimes marvelous and sometimes flawed” (Kahneman & Klein, 2009). Consider chess players. Expert chess players actually organize the information on a

chess board into meaningful units in just fractions of a second (de Groot, 1946, 1965), and expert Scrabble players can recall more information on Scrabble boards, with those players with the longest history of playing outperforming experts who played fewer years (Halpern & Wai, 2007). In other words, experts developed a quick knowledge in these domains that have regular rules that can be learned over time. Or, consider this example (Klein, Calderwood, & Clinton-Cirocco, 1986). An experienced firefighter led several firefighters into the kitchen in a burning building. It was very quiet in the burning building, but something was not right—he did not know what it was, but he ordered everyone out of the building immediately. The building soon blew up. This experienced firefighter had a “sixth sense” about the danger. But another way of understanding his intuition that something very bad was about to happen is to think about the situation as recognition. Perhaps his feet were too warm—maybe this registered consciously and maybe it did not, but the fire was under the kitchen floor and the pattern of sensations on his body differed from the ones he felt when the fire was in an adjacent room. It is much like the superior recognizing abilities of the expert chess or Scrabble player. This intuition was the result of many years of practice with feedback (knowledge of results) regarding fires. It is not a magical gift that is possessed by a few lucky individuals. Years of practice can pay off with superior abilities to recognize situations, but only if the expert has received immediate feedback about earlier decisions and has been able to use that feedback in ways that make him a “true” expert in a field where there are regularities such as firefighting.

By contrast, the intuitions of experts where the domain is highly irregular or they do not get immediate feedback for their decisions are not any better than those of a novice. Kahneman reviews evidence showing that the professionals who select stocks for investment are no better at this task than novices because the field is so irregular they cannot learn what makes some stocks increase in value and others decrease. Interestingly, regardless of the quality of the intuitions, many people are highly confident in their ability to make rapid decisions that are correct. Kahneman tells about an early job that he had in the Israeli army selecting recruits who would undergo leadership training. Kahneman devised a task in which groups of eight men had to work together to lift an enormous pole over a high wall. He observed who took charge, who gave up, and who devised a plan that worked and persuaded others to carry it out. Confidently, he selected those who were most likely to become leaders and recommended them for additional training. One big problem—this test, which seemed to be so good to him

(and sounds good to me), really did not work; there was no relationship between how the recruits performed on this task and their later abilities as leaders, yet Kahneman was highly confident in his expertise in this area. What was missing? He did not get immediate feedback on how well the selected future leaders performed in real leadership tasks, so he never developed the skill in knowing when and why a particular selection was right or wrong.

Intuitions are like visual illusions in some ways. They can sometimes help us understand the world, but they are often distorting and very difficult to ignore.

The two tables tops in Figure 1.3 appear to be very different in their size and shape, but if you cut out a piece of paper to fit over one table top, you would find that it also fit perfectly over the other table top. This is a common visual illusion. Thinking illusions, such as the belief that our intuitions are most often correct, are similar to visual illusions. With effort, we can learn that our intuitions are often wrong and we can use that knowledge to be wary of our own intuitions and those of others. Additionally, we can learn when intuitions are more likely to be correct—when they are done by an expert who has had repeated experience with feedback in her field of expertise.

In deciding when to trust the intuitions (or fast thinking) of an expert, ask these three questions: How much experience does the expert have that is directly relevant to the task? Is it a task where there are regular outcomes

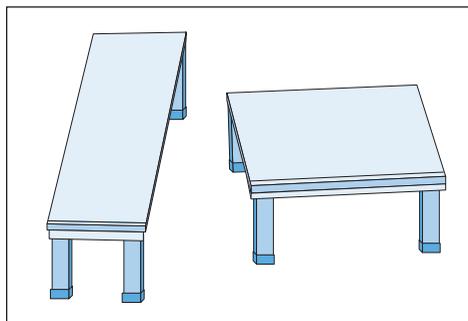


Figure 1.3 “Illustration of two tables,” from the book *Mind Sights: Original Visual Illusions, Ambiguities, and Other Anomalies* by Roger N. Shepard. Copyright © 1990 by Roger N. Shepard. Reprinted by permission of Henry Holt and Company, LLC.

can be learned from experience? Is the “expert” in a field where there is immediate feedback about the quality of the decisions that were made?

System 2 Thinking

Both self-control and cognitive effort are forms of mental work.

—Daniel Kahneman (2011, p. 41)

Critical thinking is System 2 thinking. It is slow, deliberate, and effortful. It is also the engine that drives System 1 thinking, because the fast recognition processes of System 1 were originally learned in a deliberate and effortful way. If System 1 can be thought of as intuition, then System 2 can be thought of as critical thinking. It involves weighing evidence, evaluating risk, calculating probabilities, judging credibility, and similar activities that are the hallmark of good thinking. Thinking can be rational and people can learn to engage in rational thinking. We can learn from our mistakes, and by keeping track of them, make them less likely to occur in the future.

If you are familiar with Malcolm Gladwell, the popular writer for *The New Yorker* magazine and author of many books, you probably know about his notion of “Blink.” According to Gladwell, it is sort of intuitive thinking that happens rapidly—in the time it takes to blink. In his book by this name, he tells many stories about the way professionals arrived at good decisions without going through the hard work and time-consuming effort to consider all available and relevant information. Indeed, there are many good stories where the rapid cognitive processes of System 1 thinking do a good job. But it is important to keep in mind that these stories tend to be about experts who spent many thousands of hours doing the hard work of System 2 thinking before they got good at making fast, intuitive decisions. Holt (2011) summed up the relationship between System 1 and System 2 thinking this way: “If you’ve had 10,000 hours of training in a predictable, rapid-feedback environment—chess, firefighting, anesthesiology—then blink. In all other cases, think” (para.23). This is good advice. You will learn the skills associated with System 2 thinking throughout this book, and after you put in the hard work of developing expertise, then you can be more confident of your intuitions.

Bounded Rationality

We do understand today many of the mechanisms of human rational choice. We do know how the information processing system called Man, faced with complexity beyond his ken, uses his information pro-

cessing capacities to seek out alternatives, to calculate consequences, to resolve uncertainties, and thereby—sometimes, not always—to find ways of action that are sufficient unto the day, that satisfice.

—Herbert A. Simon (Nobel Memorial Lecture, 1978, p. 368)

In 1978, Herbert Simon was recognized with a Nobel Prize for understanding the boundaries of human thinking, especially when people are confronted with complex and changing environments. Simon coined the term “bounded rationality,” which is a label for the idea that people are not completely rational; there are limits or boundaries on our ability to think rationally. We are limited by the fact that we can never have complete knowledge of the consequences of our decisions because the consequences will occur sometime in the future, and the future can never be known with certainty. We can never generate a complete list of alternative decisions, and very often, the amount of information we need to consider when making decisions is more than we can keep in mind at one time. Most of the time, people are **satisficers**, which means that they make “good enough” decisions. I return to Simon’s notion of satisficing later in this book when I discuss decision making.

Fast and Frugal Thinking

Relying too heavily on intuition has its perils. Cogent medical judgments meld first impressions with deliberate analysis.

—Jerome Groopman (2007, p. 9)

Although Kahneman has been described as “the most important social scientist of his generation” (Goldstein, 2011), there are critics of his work. Gigerenzer, (2007; Gigerenzer, Hoffrage, & Goldstein, 2008) a German psychologist, takes a more positive view of rapid System 1-type thinking, stating that many of our “thinking shortcuts” are smart and lead to good decisions. According to Gigerenzer, thinking shortcuts are “fast and frugal,” where frugal means that they do not require extensive mental work, and they are effective when time and information are limited. Here is one of Gigerenzer’s favorite examples to demonstrate the (sometimes) superiority of fast and frugal thinking:

Which city has a higher larger population: San Diego or San Antonio?
(Goldstein & Gigerenzer, 2002, p. 76)

If you live in the United States, you probably know something about the relative size of these two cities and will use that knowledge to answer that San Diego has a larger population. But, what if you live in Germany, and

you have little or no knowledge about the relative size of these two cities. Guess what, you are more likely to answer correctly than are Americans who are more likely to know something about the comparative size of these two cities. Approximately two-thirds of people in the United States correctly answered that San Diego has a larger population than San Antonio. If you live outside the United States, it is likely that you have heard something about San Diego, maybe its world famous zoo or beautiful beaches, but never heard of San Antonio. You would quickly reason that a city you heard of is probably larger than one that you never heard of, and in this example, you would be correct. In fact, in one study, 100% of the respondents from Germany answered this question correctly (Goldstein & Gigerenzer, 2002). Gigerenzer uses examples like this one as evidence that intuitive fast thinking can be better than slow thinking.

But critics of the idea that fast thinking is better thinking have been vocal. For example, Gropman (2007) wrote a book describing how good doctors think, especially when they make diagnoses. He began his book with a story about a woman who had suffered with irritable bowel syndrome for many years, and, despite numerous doctor visits, her condition continued to get worse. After seeing somewhere between 15 and 30 different physicians, she found one that did not make a fast and frugal diagnosis—he did not rely on his first hunch or intuition. Instead, he painstakingly considered a wide variety of possible causes for her illness—recognizing that rare illnesses do occur. Instead of treating her for irritable bowel syndrome, he reassessed her illness history and came up with a new diagnosis that led to different treatments and ultimately to getting better. This is just one of many examples in which the fast and intuitive processes in thinking were wrong.

So, what can we conclude from all of the examples of fast and slow thinking? Fast thinking is more likely to be good thinking when done by an expert in the field where intuitions were born from thousands of hours of more careful thinking and with feedback. Sometimes we can rely on thinking short-cuts, but most often, we will need to put in the hard work of thinking before we should trust our intuitions or those of others.

Emotions Color our Thinking

What I want to believe based on emotions and what I should believe based on evidence does not always coincide.

—Michael Shermer (2009, para. 3)

A key idea from the field of classical economics is that people are rational, which means that they think in ways that maximize outcomes. But, as Simon, Kahneman, and others have shown, people are far from rational. For example, suppose that you are playing the Ultimatum Game. It is a simple game. There are two players. One of the players is given some money and told to divide it between herself and a second player. If the second player accepts the split, each side keeps what they have, but if the second player rejects the split, neither side gets to keep any money. Ready to play?

Game 1. I am given \$50 and I decided to give you \$25. Is this OK with you?

Almost everyone agrees to a 50–50 split.

Game 2. I am given \$50 and I decide to give you \$2. Is this OK with you?

Probably not. It is likely that you would decide to get no money at all rather than accept the \$2 offered.

Now this is not a rational choice because it means that you will get no money at all instead of the \$2 I offered you, but it is a likely one because people want a fair division, and when the division strays too far from fair, people reject the choice. It will probably not surprise readers to learn that there is considerable support for the idea that emotions are important influences on how and what we think. In support of this idea, psychologists used brain imaging techniques (functional magnetic resonance imaging, fMRI) that can detect which areas of the brain are active when people perform different tasks (Sanfey, Rilling, Aronson, Nyström, & Cohen 2003). They found that participants who rejected an offer while playing the Ultimatum Game showed high levels of activity in brain areas that are related to emotion and cognition. These images correlated with participants' reports that they felt angry when the other player offered them an unfair amount of money. The authors conclude that "models of decision making cannot afford to ignore emotion as a vital and dynamic component of our decisions and choices in the real world" (p. 1,758).

Unconscious Influences on How We Think

At long last, we have scientific guidance regarding that great question of social lubrication: Should you ask someone to meet for a drink or a cup of coffee.

—Lawrence Williams and John Bargh (2008, p. 606)

We are often unaware of the multiples influences on how we think, feel, and behave. Something in the environment can trigger a stream of thought without our being aware of the trigger. Bargh and his colleagues (Bargh, 2008; Bargh & Williams, 2006) referred to the unconscious influences as the “automaticity of everyday life.” They happen automatically without any conscious intent or awareness. Here are some examples.

In one study (Bargh, 2007), students showed up in a laboratory waiting room ready to participate in an experiment. When the researcher showed up, he had his hands full with books, clip boards, and a cup of coffee. He asked the participants to hold the coffee while he opened the door to the laboratory. Half of the participants held a hot cup of coffee; the other half held a cup of ice coffee. The participants who held the hot coffee rated a third person as “warmer” than those who held the ice coffee. None of the participants believed the coffee could have influenced the way they rated a third person, but it did. Many did not even recall if the coffee they held was hot or cold, but it affected the way the thought about a person whom they just met.

Along similar lines, when people lifted a heavy clipboard as opposed to a light one, they were more likely to evaluate a job candidate as “better overall” and as having “more serious interest in the position,” suggesting that the additional weight of the clip board unconsciously triggered ideas of being weighty and serious (Ackerman, Nocera, & Bargh, 2010). In addition, when participants sat on a hard chair as opposed to those who sat on a soft chair, they were more likely to make judgments about a hypothetical employee that reflected “strictness, rigidity, and stability” (p. 1,714). It seems clear that the way we think about people and objects in the world is influenced in ways that we are not only unaware of, but seem hard to believe.

We cannot know about all of the influences on our behavior, but we can develop an awareness of our environment that can help. If for example, you notice that you have positive feelings about a store that always plays upbeat positive music, you can consider the possibility that it is the music that is creating or contributing to how you feel about this store.

Thinking about Thinking

You are today where your thoughts have brought you; you will be tomorrow where your thoughts take you.

—James Lane Allen

There are many different ways to conceptualize the thinking process. From the perspective of a neuropsychologist or biologist, thinking is the activation of groups of neurons. Other researchers study the medium of thought, the conscious and unconscious use of symbols, images, and words. Another approach is to conceptualize thinking as the flow and transformation of information through a series of stages. But, can our brain reveal its own mysteries? Can we use our brain to think about how we use our brain to think?

Thinking as a Biological Process

The brain exists in order to construct representations of the world.

—Philip Johnson-Laird (quoted in Restak, 1988, p. 235)

Researchers from many fields have spent their lifetimes trying to understand what people do when they think. Brain researchers are interested in understanding how the brain and other parts of the nervous system work. Every time you have a thought, feel an emotion, or receive information through your senses, your nervous system is involved. If you could examine your own brain, you would no doubt be surprised to find that it looks like a giant mushy walnut with the consistency of a soft-boiled egg. There is nothing in its appearance to even suggest that it is the foundation of human thought.

The capacity of the human brain is awesome. “If each of the brain’s 10 to 15 billion neurons is capable of only two states, on or off, the capacity of the brain would be 2^{10} billionth power. To write out this number at the rate of one digit per second would take ninety years” (The Chronicle of Higher Education, 1987, p. A2). Even if these figures are off by a few billion or so, and more recent estimates put the number of neurons as somewhere between 86 billion and 100 billion, it is clear that we each have some undeveloped potential. The human brain has remained essentially unchanged since the dawn of modern history, yet during that time humans have used this amazing mass to develop advanced technologies that include the ability to visit distant planets and have more than doubled the average expected life span. What has changed is “the information that is going into the brain and the processing it receives” (Machado, cited in Walsh, 1981, p. 640.) It is the ability to learn and to think that has changed the world.

Everything that we are or ever will be can, at least on one level, be attributed to patterns of neurons that communicate via chemical messengers. The connections among neurons change as a function of experience (and

genetically coded information). Experience is the major architect of the brain. Consider, for example, a study in which adolescent girls played the popular computer game called “Tetris” for 1.5 hours a week for three months (Haier, Karama, Leyba, & Jung, 2009). In Tetris, different shapes appear to fall across the computer screen. The player learns to rotate each piece so that it completes a row at the bottom of the screen. Neuroimaging of the girls’ brains before and after training showed increased cortical thickness relative to control participants (who did not play Tetris) that were associated with Tetris training. These large changes in the structure of the brain resulted from a relatively small manipulation. We can change our brains by selecting different sorts of experiences. Every time you learn something new, you have changed your brain. If you have learned anything new since you started reading this book, you are already a changed person—I have “messed with” your brain. I hope you will agree that I left it better than it was before you started reading.

Thinking as Imagery and Silent Speech

Thinking is the talking of the soul with itself.

—Author unknown; found in a fortune cookie

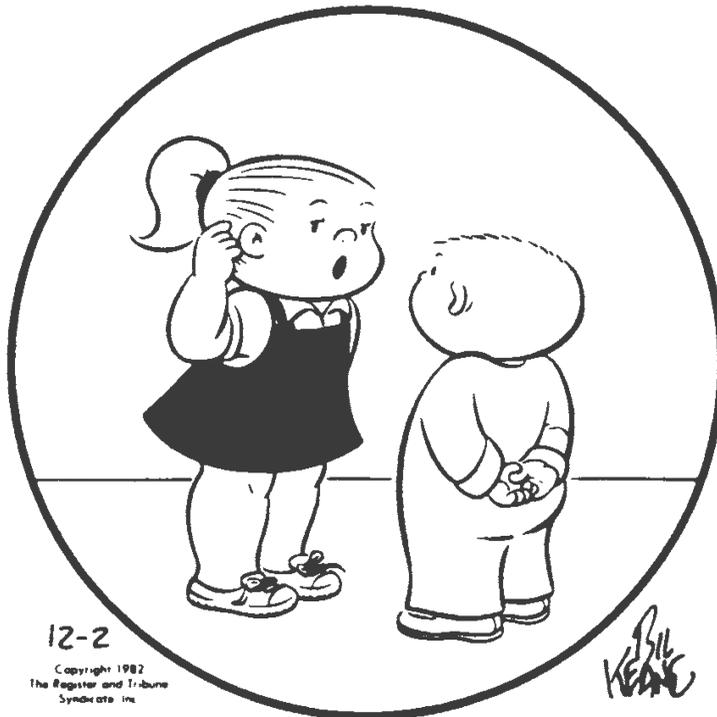
Psychologists at the beginning of the 20th century believed that thinking was composed of mental images. Later, other psychologists hypothesized that thinking was simply a form of “silent speech,” much like talking to yourself without vocalization. In order to test these hypotheses, psychologists would ask subjects to describe what they did when responding to certain questions. Let’s try some examples. As you answer each question posed below, try to be aware of what you did as you “thought about it.”

1. How many windows are in your living room?
2. What does your mother look like?
3. What letter comes after N in the alphabet?
4. Name a word that rhymes with “shoe.”
5. How much is $2 + 3$?
6. Can you define “critical thinking?”

As you answered these questions, were you aware of the use of images and/or words? Most people find that when they are asked to describe some concrete object, like the number of windows in their living room or their mother, they are aware of picture-like images. In fact, it seems almost impossible to answer these questions without generating an internal

THE FAMILY CIRCUS

By Bil Keane



"Thinking is when the picture is in your head
with the sound turned off."

The Family Circus by Bil Keane. Used with permission by King Features.

representation or utilizing **imagery** in some way. Can you describe your mother or anyone else without creating an image? Questions like 3 or 4, which involve the order of letters in the alphabet and the sounds of words, usually require an individual to recite the items silently. (Did you sing "l-m-n-o-p" to yourself in order to answer Question 3?) When answering questions like 5 and 6, people are often unable to say how they arrived at an answer. (By the way, if your answer to Question 6 was "no," you should go back and reread the beginning sections in this chapter.) Most people feel that the answers just seemed to "pop into their heads" without their being conscious of the "medium" or "stuff" of thought.

Sometimes, thinking can be improved if we "work at" generating an image or using speech-like thought. Albert Einstein often credited his ability to solve difficult problems to his extensive use of imagery. The most famous use of imagery was recorded by the chemist Kekulé. He knew that if he could understand the structure of a benzene molecule he would have hit

on one of the most important discoveries in organic chemistry. Kekulé knew that most chemical molecules are long strands of atoms, and that the structure of a benzene molecule had to be different. In order to solve this problem, Kekulé practiced generating visual images that might help him to find the right one. His hard work was rewarded when the historic answer came to him this way: “Again the atoms were gamboling before my eyes . . . My mental eye . . . could now distinguish larger structures . . . all twining and twisting in a snakelike motion. But look! What was that! One of the snakes had seized hold of its own tail, and the form whirled mockingly before my eyes. As if by a sudden flash of lightning I awoke” (Kekulé, quoted in Rothenberg, 1979, pp. 395–396; I note here that some experts are not convinced that this is a true story).

Words also serve to direct and stimulate thought. Although it may be obvious that thoughts are usually communicated with language, it is also true that language helps to generate thoughts. The generative role of language can be seen in an experiment by Glucksberg and Weisberg (1966). They used a classic problem in the psychology literature that was originally devised by Duncker (1945). In this problem, subjects are required to attach a candle to a wall so that it could be lit. They are given a candle, a box of matches, and some thumbtacks. Stop now and think how you would go about solving this problem if you were given only these materials. Do not go on until you’ve thought about it.

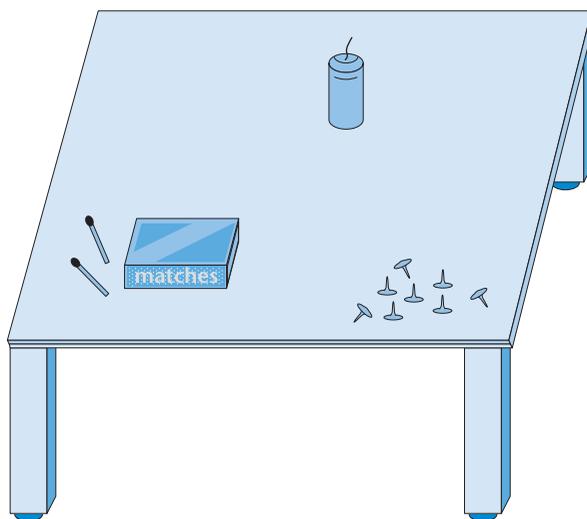


Figure 1.4 Using only the materials show in this figure, how would you attach the candle to the wall so that it can be burned?

The best solution is to dump the matches from their box, tack the box to the wall and set the candle in the box. Most subjects have difficulty with this task because they fail to think of the box as part of the solution—they see it only as a “box of matches.” Glucksberg and Weisberg had people solve this problem under one of two conditions. The items were either labeled (“box,” “tacks,” “candle,” and “matches”) or they were not labeled. Subjects in the labeled condition solved the problem in about one minute, while those in the unlabeled condition took an average of nine minutes. The labels directed attention to the relevant items and changed how the subjects in the first group solved this problem. (I return to this problem in Chapter 9, where I discuss problems in problem solving.)

Let’s consider a different example of the way language directs thought. There is a popular riddle that goes something like this:

A young boy and his father went for a Sunday drive. A drunken driver swerved in front of their car, killing the father on impact. The young boy was rushed to the nearest hospital where the chief of neurosurgery was summoned to perform an operation. Upon seeing the boy, the chief of neurosurgery cried out, “I can’t operate on him, he’s my son!” How is this possible?

When I’ve posed this riddle to students, they have sometimes replied: “The chief of neurosurgery is the boy’s stepfather”; “The real father didn’t die”; or “It’s impossible.” Have you guessed the correct answer? The answer is that the chief of neurosurgery is the boy’s mother. The reason for the difficulty is that in our society, when we hear terms like “chief of neurosurgery” we tend to consider only males. The words we use can determine the kinds of thoughts we think. (This concept is developed more fully in Chapter 3.)

Critical Thinking: Hollywood Style

Unfortunately, critical thinking sometimes has a pejorative connotation. This is especially true in common media depictions of the good thinker as someone who is cold and calculating. The quintessential example of stereotype is the pointy-eared Mr. Spock of Star Trek fame. As you probably know, Mr. Spock is a fictitious character from the popular television series and movies about space travel in the distant future. Spock, as he is most commonly called, is only half-human, a fact that is revealed by his pointy-ears.

The other half of his bi-species heritage is Vulcan, a species of being whose thinking is totally rational. In fact, he is so reasoned, that he is unable to understand the mushy and sentimental emotions that seem to plague mere humans—emotions like love and hate, which have no rational counterpart. The media depiction of this popular fictitious character presents the message that rational thought is cold and incompatible with human feelings.

Other times, the media depicts the “good thinker” or good student as the “nerd.” The good thinker is rarely the attractive beauty queen or the athletic stud. More typically, this character is ridiculed for wearing thick glasses (often held together with masking tape), wiping at or sniffing with chronic rhinitis, and expressing a predilection for plaid clothing. This negative message about good thinking is a common theme in movies made for the huge teen market. In many ways, the idea that thinking reflectively or following a reasoned plan of action instead of an emotional one is made to appear “uncool.” The impulsive and dashing bubbleheads who are portrayed as the heroes in this genre of immensely profitable movies are as ludicrous a stereotype as the nerdy good thinker. Perhaps if the movies showed the lives of these stereotyped teens a few years later, when the impulsive bubblehead is working at a low-paying job (or in jail) and the nerdy thinker is doing interesting work for a better salary, critical thinking would suddenly look very “cool.” As long as these stereotyped movie images make money, it will be difficult to correct these negative stereotypes and make critical thinking a desirable goal.

The negative image of thinking is not just restricted to teen movies. After every televised presidential debate, a small army of “spin masters” come on the air to tell the American public what the candidates just said. Their task is to put a positive “spin” on their preferred candidate (e.g., He provided a clear vision for America . . . blah, blah, blah) and a negative spin on the opponent (e.g., He was perspiring and did not smile enough . . . blah, blah, blah). In one retelling of what the candidates just said, a prominent spin master faulted the opposition candidate for providing too much information and for hesitating before answering complex questions! It seems to be the expected format that candidates will provide quotable snippets that are completely unrelated to reasoned responses about immensely important issues (e.g., I knew John Kennedy and you’re no John Kennedy; Read my lips!) and short answers that reduce complex issues to one liners. The general public often responds negatively when candidates give thoughtful,

intelligent responses to complex questions, perhaps because we have been conditioned to associate this sort of response with the “loser” image that Hollywood and the other media seem to enjoy.

Critical thinking has been unfairly portrayed as cold and unemotional. The desirable goal of a problem or decision is often based on values, feelings, and predilections. In addition, one frequently recommended skill in improving an outcome is to try to “see” the issue from the perspective of other individuals. Empathy, imagination, and value setting are all part of critical thinking.

Becoming a Better Thinker: A Skills Approach

Critical thinking skills are those strategies for finding ways to reach a goal. Of course, dividing the thinking process, which is fluid and continuous, into discrete skills is artificial, but it is necessary to break the massive topic of critical thinking into manageable pieces. Although I have divided the topic of critical thinking into several chapters, each of which focuses on a different type of problem (e.g., reasoning, analyzing arguments, testing hypotheses, making decisions, and estimating likelihoods), these problems are not easily separable in real life. You will often need to estimate likelihoods when making a decision or generate possible solutions in a reasoning task. The division is necessary for teaching and learning and is not meant to imply that critical thinking can be cut into neat packages.

The development of critical thinking skills requires specific instruction, practice in a variety of contexts, feedback, and time to develop. I hope that working your way through this book will be mostly enjoyable and well worth all of the effort. An important part of learning is applying the skills of critical thinking to the many different examples that appear throughout the book. To become a critical thinker, you will need to practice, practice, practice. As the old joke goes, it is the only way to get to Carnegie Hall. So, please get comfortable, prepare for some interesting work, and enjoy this book.

Chapter Summary

- The rapidly accelerating pace of change and widespread availability of a glut of information has made the ability to think critically more important than at any other time in history.

- Critical thinking can be defined as the use of those cognitive skills or strategies that increase the probability of a desirable outcome. It is used to describe thinking that is purposeful, reasoned, and goal directed.
- There is considerable empirical evidence from a variety of sources that cognitive skills can be learned from instruction specifically designed to teach these skills and that these skills transfer to real-world settings when they are practiced in multiple contexts.
- Developing a critical thinking attitude and disposition is at least as important as developing the skills of critical thinking. The skills are useless if they are not used. The attitude of a critical thinker must be cultivated and valued.
- The attitude or disposition for critical thinking includes the willingness to plan, flexibility, persistence, the willingness to acknowledge one's errors and change your mind when the evidence supports a change in position, being mindful, and consensus-seeking.
- Metacognition refers to people's knowledge of their own thought processes. We often have little conscious awareness of how we think. Self-monitoring your own thought processes is one way to improve how you think.
- It is useful to consider thinking as having two components—a fast or intuitive component known as System 1 and a slower, more deliberate component known as System 2. Critical thinking is System 2 thinking.
- Although many people believe in their powers of intuition, intuitive thinking is more likely to be good thinking when done by an expert who has had repeated experience with feedback in her field of expertise.
- There are limits or boundaries on how rational people can be. Because we can never have complete information or know the outcome of our decisions with certainty, people are satisficers, which means that in most circumstances, they make “good enough” decisions.
- Emotions interact with how we think and can lead us to make decisions that are not purely rational. We are thinking and feeling beings; the emotional aspects of thinking cannot be ignored.

- What and how we think are influenced by multiple environmental cues that we are not aware of and that most of us find hard to believe are affecting the judgments we make.
- People report that thinking sometimes seems to rely on visual imagery and sentence-like propositions. There are individual differences and task differences in the use of these modes of thought.
- Remember, you are what (and how) you think! Have fun with this book.

Terms to Know

You should be able to define the following terms and concepts. A good way to review and check your comprehension is to cover up the definition, try to define each term, and then uncover the definition and compare your answer with the brief one that is provided. (Your answer is expected to be more complete than the one presented in this review.) The goal is not to memorize the terms; instead, you should be sure that your definition captures the meaning of the term. Be sure to cover the definition because it is easy to believe you know it when the answer is in front of you, but hard to fool yourself when you have to generate your own answer. If you find that you're having difficulty with any term, be sure to reread the section in which it is discussed.

Critical Thinking. The use of those cognitive skills or strategies that increase the probability of a desirable outcome. It is purposeful, reasonable, and goal directed. Also known as directed thinking. Compare with nondirected thinking.

Nondirected Thinking. Daydreams, night dreams, and rote memorization. Compare with directed (or critical) thinking.

Transfer of Training. The spontaneous use of skills that are learned in one context in a different context.

Habit of Planning. The repeated use of plans until the process becomes automatic.

Self-regulation. Using feedback, monitoring comprehension, and assessing progress toward a goal.

Self-justification. Making excuses for a belief or a behavior instead of considering the possibility that the belief or behavior may be wrong.

Metacognition. Our knowledge about our memory and thought process. Colloquially, what we know about what we know.

Intelligence. The ability to reason, plan, solve problems, and think abstractly.

System 1 Thinking. Type of thinking that is fast and effortless. It is sometimes thought of as an intuition.

System 2 Thinking. Type of thinking that is slow and effortful. It informs System 1 thinking. Critical thinking is System 2 thinking.

Imagery. The use of an internal picture-like representation while thinking.

Critical Thinking Attitude. The willingness to plan, be flexible in one's thinking, be persistent, to self-correct, maintain mindful attention to the thought process, and seek consensus. It is not possible to be a critical thinker without this sort of attitude.

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