CHAPTER

2

Importance of Skills

We are all confronted daily with the problem of information saturation. The human mind has automatic mechanisms that help us navigate through this constant flood of information without drowning, but these automatic mechanisms run outside our awareness. If we want to control how we navigate our way through this tide of information, then we need particular skills. The better we are able to use these skills, the more control we will exercise over exposure to messages, how we access meaning from those messages, and how we use those meanings to enlarge our understanding of the world and ourselves.

I. The Media Challenge

We are living in a culture shaped by a constant flood of information. Because we were born into this information culture, we take much of it for granted. As the size of the information flow grows at an accelerating rate each year, we unconsciously adapt without really thinking through what those adaptations mean. So in this section, I will first help you understand the enormous size of this flood of information. Then I will show you how we have been unconsciously adapting to this growth.

Flood of Information

With the widespread use of each new mass medium, the amount of information flowing into our culture has increased. Furthermore, the rate of those increases has been accelerating, especially over the last several decades with the pervasiveness of the digital media.

As for the printed word, we now have more than 140 million book titles in existence, and another 1,500 new book titles are published throughout the world each day. Visual messages also proliferate. Hollywood releases more than 700 hours of feature films each year, which adds to its base of more than 100,000 hours of films studios have already released in previous years. Commercial television stations generate about 48 million hours of video messages every year worldwide and radio stations send out 65.5 million hours of original programming each year. As large as these numbers are, they represent only the contribution of information from traditional mass media.

Growth Is Accelerating

Not only are we already saturated with media messages, the rate of that saturation is growing at an accelerating pace. More information has been generated since you were born than the sum total of all information throughout all recorded history up until the time of your birth. And the rate continues to accelerate! In 2012, Silver estimated that the amount of information was doubling every year and by now the rate of growth is even higher.

The really dramatic acceleration in the growth of information in our culture has been coming from the newer mass media that disseminate information using the Internet, which has grown so large in a few short decades that no one knows how big it really is. Google has been attempting to index all the webpages available on the Internet, and that index has now reached over 60 billion webpages on its 900,000 company servers (WorldWideWebSize.com, 2019). However, Google has estimated that the Internet is likely to be over 130 trillion webpages (Schwartz, 2016), which means that Google has been able to index only 0.05% of the total Internet. Even Google cannot keep up with the flood of information into our culture.

How is it that so much information is now being produced? One reason is that there are now more people producing information than ever before. Half of all the scientists who have ever lived are alive today and producing information. Also, the number of people in this country who identify themselves as musicians has more than doubled in the last four decades, the number of artists has tripled, and the number of authors has increased fivefold (U.S. Census Bureau, 2017).

Another—and even more important—reason for the accelerating growth of information in our culture is that much of it is being produced by nonprofessionals. Now, we all create information every day and make it widely available, because we now have easy-to-use platforms to create and share information. You no longer need to be a musician to create songs; you can use GarageBand or other computer synthesizers. You don't need to be signed to a recording contract by a record company to distribute your songs. You don't need to work at a Hollywood film studio to be able to produce videos and widely disseminate them. You can create videos on your smartphone, edit them easily, and disseminate them on a platform such as YouTube, which now has more than 1 billion videos available for viewing and users are uploading more than 300 new hours of video *every minute of every day* (YouTube, 2018). You can also be a journalist, a fiction writer, a photographer, or even a video game designer as a hobby and make your messages easily available to millions of people, just like professional artists. Or you could generate and share smaller forms of information such as e-mails and tweets. There are now 3.2 billion Internet users worldwide and they send and receive 300 billion e-mail messages each day; Twitter users generate more than 500 million tweets per day; and Facebook reports that 100 million photos are uploaded each and every day (Pingdom, 2019).

Each of us is adding to this information flow like never before. Tucker (2014) explains:

> Between checking your phone, using GPS, sending e-mail, tweets, and Facebook posts, and especially streaming movies and music, you create 1.8 million megabytes a year. It's enough to fill nine CD-ROMs every day. The device-ification of modern life in the developed world is the reason why more than 90 percent of all the data that exists was created in just the last three years. (p. xv)

Tucker continues, "And it's growing exponentially, with 44 times as much digital information expected to be created in 2020 compared to 2009" (p. xvi).

High Degree of Exposure

The media are highly attractive, so we increase the time we spend with media messages each year. Over the last 3 decades, every new survey of media use has shown that people on average have been increasing their exposure time every year. For example, in 2010, people spent an average of 10 hours and 46 minutes with all forms of the media each day (eMarketer, 2014). By 2017, people were spending more time with the media than with anything else, with the average person spending 12 hours and 1 minute per day on media (eMarketer, 2017).

It is clear that the media are an extremely important part of our everyday lives. In our information-saturated culture, we are constantly connected to our friends, our society, and the entire world through the media.

How Do We Keep Up?

Multitasking

How do we keep up with all this information? One technique that many people use is multitasking. For example, a person can listen to recorded music, text friends, and watch video on a pop-up window all at the same time—thus experiencing 3 hours of media usage or exposure for each hour of clock time.

Multitasking, however, is not a good enough strategy for helping us keep up with the flood of information. If you wanted to view all the videos uploaded to YouTube in just 1 day, it would take you an entire year of viewing with no breaks and you would have to multitask by constantly watching 16 screens! While multitasking helps increase our exposure, it cannot help us keep up with even a tiny fraction of the media messages we are exposed to every day.

Although we are all saturated with information, and each year the media are more aggressive in seeking our attention, we are able to deal with it. How is this possible? The answer lies in the way the human brain is wired and programmed—its hardware and software.

Hardware

The most remarkable piece of hardware on Earth is the human brain. Although the human brain is relatively small (weighing only about 1 kilogram), it has a remarkable capacity to take in information from the five senses (sight, hearing, touch, taste, and smell); process all that information by filtering it or storing it; then making decisions that result in action. The human brain is composed of 100 billion neuron cells, which is the number of stars in the Milky Way (Storr, 2014). Each cell is linked by synapses to as many as 100,000 other cells. That means your brain has created over

500 trillion string-like fibers called axons and dendrites that connect with other neurons at junctions called synapses. "These synapses constantly form and dissolve, weakening, and strengthening in response to new experiences" (Haven, 2007, p. 22).

As the human brain is constantly monitoring the environment, thousands of neurons are receiving stimulation from thousands of other neurons and must decide whether to ignore the input or respond in some way by sending a signal to another specific neuron. "Somehow, through this freeway maze of links, loops, and electric traffic jams, we each manage to think, perceive, consider, imagine, remember, react, and respond" (Haven, 2007, p. 22).

Software

How does this complex piece of hardware know what to do? The answer to this question is that the brain has been programmed to fulfill certain functions. This software tells the brain how to function, much like the software on your computers tells them what functions to perform and how to perform those functions.

Some of this software has been programmed into the brain before birth. For example, this prebirth software guides the brain's constant monitoring of automatic bodily functions such as the performance of the organs (heart, lungs, kidneys, etc.) to keep them functioning properly. The brain also has been programmed to monitor a person's environment for threats. For example, the orienting reflect directs the brain to pay attention to the environment for sudden changes like loud noises; when a potential threat is identified, the brain creates an attentional state that forces the person to examine the thing that triggered the attention to determine whether it is an actual threat or not. Also, the brain has been hard-wired with a fight-or-flight reflex so that when a potential threat is encountered, the body is automatically made ready (increased heart rate and blood pressure) to either fight off the threat or run away to safety.

In addition to the prebirth software that helps us maintain physical well-being, we are also born with software that enhances our social well-being. For example, scientists believe all humans are born with the capacity to communicate with other humans by expressing their meaning for things and accessing the thoughts of others. Although humans are born with the software that provides them with the capacity to learn and use language, we all must learn the language of our culture through experience; this is why humans have developed thousands of different languages. Thus, being human is a combination of using our innate programming (prebirth programmed software) as the potentials and then maximizing the development of those potentials through how we manage our experiences.

As we accumulate experiences in life, our minds accumulate additional programming that tells our brains how to perform additional functions, like math and logical reasoning; how to work through moral problems; how to control one's emotions; and how to expand and grow one's skills that would

lead to rewarding careers and relationships. This additional programming initially comes from one's parents and siblings. It also comes from one's contact with cultural institutions, such as education, religion, politics, and government. It comes from one's friends, acquaintances, and even one's enemies. And it comes from the mass media. All of this additional programming shapes how we make decisions in our everyday world about what to wear, what to eat, what is important, how to act, and how to spend our resources of time and money. This programming is constantly running in our unconscious minds in the form of automatic routines.

Automatic Routines

The human mind can be wondrously efficient. It can perform many everyday tasks quickly by using **automatic routines**, which are sequences of thoughts and behaviors that we learn from experience then apply again and again with little effort. Once you have learned a sequence—such as tying your shoes, brushing your teeth, driving to school, or playing a song on the guitar—you can perform it over and over again with very little effort compared to the effort it took you to learn it in the first place.

As we learn to do something, we are writing the instructions like a computer code in our minds. That code then runs automatically in our unconscious minds and serves to guide us through the task with very little thought or effort. To illustrate, recall your experience in first learning to type. You had to think of the individual letters in each word, think about which key controlled which letter, and then command a finger to press the correct key. It took you a long time to type out each word. But now after much practice, your fingers (or thumbs) move over the keyboard quickly as you type out messages in seconds. Now when you message someone, you think only about the message while not having to think at all about the task of typing.

Psychologists refer to this automatic processing of information as **automaticity**. Automaticity is a mental state where our minds operate without any conscious effort from us. We encounter almost all media messages in a state of automaticity; that is, we put our minds on "automatic pilot" where our minds automatically filter out almost all message options. I realize that this might sound strange, but think about it. We cannot possibly consider every possible message and consciously decide whether to pay attention to it or not. There are too many messages to consider. Over time, we have developed automatic routines that guide this filtering process very quickly and efficiently so we don't have to spend much, if any, mental effort.

To illustrate this automatic processing, consider what you do when you go to the supermarket to buy food. Let's say you walk into the store with a list of 25 items you need to buy, and 15 minutes later you walk out of the store with your 25 items. In this scenario, how many decisions have you made? The easy answer is to say 25 decisions, because you made a separate decision to buy each of your 25 items as you put each item into your cart. But what about

all the items you *decided not to buy*? The average supermarket today has about 40,000 items on its shelves. So you actually made 40,000 decisions in the relatively short time you were in the supermarket—25 decisions to buy the 25 products and all those other decisions not to buy the remaining 39,975 products. How did you accomplish such an extensive task in such a short period of time? You relied on automatic routines. See how these automatic routines govern your buying habits?

Our culture is a grand supermarket of media messages. Those messages are everywhere whether we realize it or not, except that there are far more media messages in our culture than there are products in any supermarket. In our everyday lives—like when we enter a supermarket—a program is loaded into our mind that tells it what to look for and automatically filters out the rest. This automatic processing guides most, but certainly not all, of our media exposures. With automatic processing, we experience a great deal of media messages without paying any attention to them. Every once in a while something in the message or in our environment triggers our conscious attention to a media message. To illustrate this, imagine yourself driving in your car and you have music playing through your car's sound system but your attention is on the conversation you are having with your friend who is seated next to you. Then your favorite song starts playing, and your attention shifts from the conversation to the music. Or perhaps your conversation is interrupted when your friend notices that the radio is playing her favorite song and she starts singing along with the music. In both scenarios, you are being exposed to a stream of media messages from your car sound system without paying conscious attention to them, but then something happens to trigger your conscious attention to the music.

There are advantages and disadvantages to automaticity. The huge advantage of automatic processing is efficiency. When the filtering software is running automatically, it is making thousands of decisions for us without requiring us to expend any effort.

There are, however, some significant disadvantages. When we rely exclusively on our automatic routines, we get into a rut and miss out on paying attention to many messages that may be highly useful to us; we never know what we are missing. When our minds are on automatic pilot, we may be missing a lot of messages that might be helpful or enjoyable to us. We might not have programmed all the triggers we need to help us get out of automatic processing when a potentially useful message comes our way. Returning to the supermarket example from above, let's say you are very health conscious. Had you been less concerned with efficiency when you went into the supermarket, you would have considered a wider range of products and read their labels for ingredients. Not all low-fat products have the same fat content; not all products with vitamins added have the same vitamins or the same proportions. Or perhaps you are very price conscious. Had you been less concerned with efficiency, you would have considered a wider variety of competing products and looked more carefully at the unit pricing so you

could get more value for your money. When we are *too* concerned with efficiency, we lose opportunities to expand our experience and to put ourselves in a position to make better decisions that can make us healthier, wealthier, and happier.

Another disadvantage is that over the long run we start to experience message fatigue. When we feel overwhelmed with too many media messages, we try to protect ourselves even more by narrowing down our focus and thus filtering out even more messages. Eventually we end up exposing ourselves to the same type of message over and over, and the value of each message keeps decreasing and we lose the ability to concentrate. In 1971, the Nobel Prize–winning economist Herbert Simon observed that "a wealth of information creates a poverty of attention" (Angwin, 2009, p. 239). This is illustrated by a study where experimenters set up a jam tasting table in a food store. Half the time, they offered 6 jams and the other half the time they offered 24 jams. While the table with more jams attracted 50% more visitors and tasters, the table with fewer jams stimulated more sales. Among the visitors to the table with the larger number of jams, only 3% bought some jam, while among the visitors to the table with the smaller number of jams, 30% bought some jam (Anderson, 2006). The lesson here is that while choice is attractive, too much choice can paralyze us into inaction. When we feel overwhelmed, we rely more and more on automatic routines and this leads us into a deeper and deeper rut of doing the same things over and over.

II. Types of Problems

Fully Specified Versus Partially Specified Problems

You probably have heard the phrase "Once you understand the problem, you are already halfway to a solution." This saying is true in the sense that the more clearly a problem can be understood, the easier it is to move toward a solution.

It also helps to know the type of problem—that is, whether it is a **fully specified problem** or a **partially specified problem**. To illustrate the difference between fully specified and partially specified problems, consider this:

$$6 + 18 = \_\_\_\_\_$$

If you understand that "6" and "18" represent numbers with particular values and that the symbol "+" means addition, then the problem has provided you with enough information that you can arrive at a solution of 24 with ease and have confidence that your solution to this problem is the correct one. If you have some training in arithmetic, then this problem is fully specified. The combination of what you already know along with the information presented in the problem itself is enough for you to solve the problem, arriving at one and only one correct answer.

Now consider this problem:

$$Y + Z = 24$$

This problem has two unknowns (Y and Z), so there is not enough information to arrive at one solution with confidence. You could answer 6 and 18, while I might answer 12 and 12. We would both be right. There are also many other correct answers to this problem. But this does not mean that there are no wrong answers, because there are also many wrong answers. The purpose of education is to train us so we can bring enough information to problems to make them fully specified and therefore allow us to solve them by arriving at a single correct answer. However, we are constantly challenged with partially specified problems in our everyday lives.

How can we recognize partially specified problems? We need to look for one of three characteristics. The first characteristic is that there is not one clearly best endpoint to the process; that is, several people could all solve the problem with different solutions. All solutions could be correct but none is more correct than the others, so we are not sure which is *the* solution. This is illustrated above with the problem of $Y + Z = 24$.

A second characteristic that indicates a partially specified problem is an unclear beginning point. We have some information but we are really not sure which elements in that information set are going to be useful and which are not. An example of this is what takes place in detective stories. While there is a clear ending point (discovery of the perpetrator), the beginning point is unclear. The detectives are missing important clues or they have some clues but they don't know which of those clues are useful and which are "red herrings," so the detectives fumble around chasing false leads, which deflect them away from arriving at the correct solution. Of course, in fictional stories, the detectives stick with it until they figure out which clues *are* more valid, and this gives them the traction they need to begin moving forward toward solving the crime.

A third characteristic that indicates a partially specified problem is an incomplete process that links a clear beginning point with a clear goal as a solution to the problem; that is, there are steps missing that are needed to arrive at one solution. This is rather like a professor giving students some information to begin a project and giving them some examples for what the outcome of the project should look like (such as a term paper) but then not telling them the full set of steps to go from the beginning to the outcome successfully. There are steps missing. Another example of this third characteristic is trying to solve the problem of where to go for dinner tonight. There are many good restaurants, each with its own advantages and disadvantages (quality of food, service, atmosphere, price, distance from home, parking, etc.). It is like comparing apples and oranges when considering the advantages and disadvantages of each. Usually there are many solutions to this problem, but which one is best? What is missing is an articulation of the

criteria for choosing one solution over the rest. Perhaps restaurant A has the best food, restaurant B has the best service, restaurant C has the best atmosphere, and restaurant D has the best prices. All of these restaurants are good choices but for different reasons. What is missing in the solution process is the criterion that should be used. If you have little money, then price is the most important criterion; restaurant D is thus not just one of four possible solutions, it is the best solution. Thus when we have an unclear method of assessing the value of outcomes, we find ourselves stuck with a partially specified problem.

Partially specified problems are not uncommon. We often encounter them in our everyday lives. With most of these everyday partially specified problems, we quickly come up with a solution then move on. The consequences of being wrong are usually trivial. However, when we must make a decision on a problem that has major consequences for our lives and that problem is partially specified, we may agonize over the solution. As we try to solve that type of problem, we know that we have no model to follow, so we ask other people what they would do. If we find that most people would do the same thing, we usually use that advice and do the same thing also. However, if we find all kinds of suggestions as advice, then we must make some assumptions and engage our feelings.

The key difference between fully and partially specified problems is how much relevant information the problem itself provides. If it provides a complete set of information like with the first example above, then we can use a learned algorithm (in this case, the arithmetic algorithm of simple addition). With partially specified problems, algorithms are not enough; we also need heuristics.

Algorithms Versus Heuristics

There are some standard rules that can be provided to you for traversing just about any problem-solving path. These are called **algorithms**. Algorithms are formulas or lists of steps. Algorithms are the rules that tell us what to do step by step. If the problem is fully specified, then the algorithm will tell us all we need to know in order to solve the problem with confidence. An algorithm is a procedure for solving a problem, which (if followed accurately) guarantees that we will find a workable solution to the problem in a finite number of steps.

Computers follow algorithms to progress down a problem-solving path. If the problem is fully specified, the computer can quickly solve the problem. But if the problem is only partially specified, the algorithm does not provide enough guidance to complete the problem-solving process.

Humans also use algorithms to solve problems. If the problem is fully specified, then the algorithm provides enough guidance to complete the problem-solving process. With partially specified problems, algorithms still help, but these algorithms rarely take you all the way to a solution because

they leave out parts of the solution path; that is, they are too general to provide the full amount of guidance for all particular problems. How do we bridge these gaps along the problem-solving path? We employ what cognitive psychologists call heuristics.

Heuristics are suggestions about how we should go about exercising our judgment. They are guidelines or recommendations more than rules or prescriptions. While algorithms provide a complete sequence of rules for moving logically to a problem's one correct solution, heuristics are suggestions for ways of proceeding to a solution under conditions of uncertainty. Heuristics can lead you to solutions, but there are no guarantees.

In order for heuristics to work, the problem solver needs to be more active and more creative. The problem solver needs to regard the heuristic as only a suggestion—a suggestion that requires the problem solver to use things like lateral thinking, metaphor, personal judgment, and even intuition.

Lateral Thinking. We are taught to solve problems by thinking sequentially beginning at the first step and continuing one step at a time all the way to the one solution at the end of the path, which is called **vertical thinking**. This vertical form of thinking is concerned with achieving a solution using a logical process. It is efficient when it keeps us on track toward a goal and prevents us from wandering into unproductive or incorrect thought processes.

We can often get stuck when we use vertical thinking, especially with partially specified problems. Sometimes we are moving smoothly down the problem-solving path as we systematically use a step-by-step procedure as specified in an algorithm, but then we suddenly run into a barrier that prevents us from moving logically to the next step. When this happens, we need to try a different approach such as lateral thinking. **Lateral thinking** involves brainstorming and creative thinking as we try to figure out a way around the barrier.

Lateral thinking is a way of restructuring old patterns to gain new insights. It is not as useful in generating the one "right" answer as much as it is helpful in leading us to brainstorm and think about fresh approaches. Therefore, lateral thinking is most useful when we are stuck and logic does not help us move toward a solution to a problem.

Metaphors. The essence of a **metaphor** is its evocative power to help us understand one thing in terms of another. We encounter something new and in order to see its nature, we liken it to something with which we are familiar. For example, let's say we run into a barrier in solving a problem and don't know how to proceed when our path is blocked. We could use the game of football as a metaphor. If we can't run the ball straight ahead, then we need to run around the end; once we turn the corner, we can see some daylight and run for the end zone. Or we could throw a long pass. These metaphors get us thinking about either moving around the barrier or jumping over it in some way. We look for connections between the game of football and our present situation. By making these connections, we can help break out of the place where we are stuck.

Oftentimes, metaphors we try might not be appropriate and sometimes we will not be able to help us find insight in the connections we make. But the value of metaphors is still there; that is, playing with metaphors keeps our thinking fresh by helping us perceive things from different perspectives. And perhaps one of these perspectives might suggest an innovative solution path.

Some educators regard metaphors as the key to knowledge, because all new knowledge is first encountered in terms of our experience with our existing knowledge. Again, this is why having good knowledge structures is so important. When we encounter new information, we can search our existing knowledge structures for something that looks and acts like the new information. Something that "looks or acts like something else" is a metaphor. Metaphors then give us the insight to understand something new in terms of our understanding of something old.

Personal Judgment. Some tasks, like spelling, are lower-order tasks, because if you follow the rules you can complete the task. If you memorize that *chair* is spelled c-h-a-i-r, you can finish the spelling without having to exercise any **personal judgment**. But if I asked you to spell a word that you had not memorized, you would not have much confidence in being prepared to complete the task well. Instead, you may feel like you must make a wild guess. However, often we do not have to risk a wild guess but instead can use good judgment to generate an educated guess. We can use what we know (about translating sounds into letters, the spelling of other English words, and other guides such as "i before e except after c") to construct a reasonable spelling. It requires judgment to translate rules that are designed for one kind of problem to try to solve a different kind of problem.

Intuition. The use of heuristics is also helped by intuition. **Intuition** engages the emotions and helps us guess at what could be plausible solutions without having to go through a systematic process. Often the insightful guess or the creative leap to a tentative conclusion can help us see a reasonable solution that we could not see by reason alone. We need to explore our hunches. However, we should not rely solely on hunches or intuition to solve problems, especially important ones. Intuition is one of many useful tools, but not the only tool of an educated person.

To summarize this distinction, algorithms are relative simple formulas or prescriptions that tell us how to go about solving fully specified problems. Heuristics are also guides, but they are not simple or complete. Whereas algorithms are rules, heuristics are suggestions. Algorithms give us the steps of how to apply our skills in solving a problem. Heuristics tell us what to think about when we encounter gaps in that process, and this serves to help us shift our perspective, see the problem in a new way, construct elements to help us bridge the gaps, then eventually complete the problem-solving process. To be good problem solvers, we need to be able to apply both algorithms and heuristics. The stronger our skills, the better we will be able to use both.

The Problem-Solving Process

If partially specified problems are missing information, does this mean we can never solve them? No, of course not. But in order to solve them, we need to take a different perspective than we do with fully specified problems. We cannot approach a partially defined problem and expect to solve it as if it were a fully specified problem.

Problem solving is a process that begins with an awareness of a challenge facing you. You search your mind for information relevant to the challenge. If you find enough information, it is likely that you have a fully specified problem and that you have already arrived at a solution by following what is called an algorithm. But if you do not have enough information to arrive at a solution, you must search out more information. And even when you have accessed a great deal of information, there are times when you still cannot solve the problem because you are not sure what to do with the information; that is, the formula you are using to solve the problem has some missing parts. In this situation, you need more than an algorithm; you also need some heuristics.

If we are to be successful in solving partially specified problems, we cannot be stopped by the gaps where we don't have enough information. Instead, we need to use the information we have to construct the additional information we need, then use that newly constructed information to bridge the gaps and keep us progressing toward a solution. Heuristics can help us construct those missing pieces by providing us with guidelines that tell us what to think about as we build the bridges over the gaps.

Does this mean that this process of solving challenging problems is idiosyncratic? Yes, in the sense that each challenging problem is different in what it leaves unspecified. Thus no one can provide you with a set of rules—an algorithm—that lays out a complete set of steps to solve any problem. Instead algorithms provide rules for general processes; they give you a generic structure solving different kinds of problems. You will also need to use heuristics. The heuristics are less formal, less constraining, and less directive than are algorithms. They give you freedom to try different things in different sequences.

The heuristics we use are influenced by context (our knowledge structures); because different people have different knowledge structures, they use slightly different heuristics and thereby end up with different solutions. Heuristics rely more on lateral thinking than vertical thinking. They nudge us to be more creative by suggesting metaphors. They sanction the use of individual human judgment and intuition, rather than relegating these characteristics to second class status in problem solving.

Skills are typically important in applying algorithms. The more highly developed our skills are, the more efficiently we can use algorithms. But even more importantly, skills are essential with heuristics, because heuristics require us to think more deeply and creatively about how to solve partially specified problems.

III. The Development of Skills

There are three factors that explain where a person's level of skill is: **natural abilities**, **maturation**, and **self-improvement**. The first two of these factors occur naturally; that is, we are born with certain abilities and those abilities develop on their own without much effort required from us. The third factor—self-improvement—requires conscious effort.

Natural Abilities

We are born with certain natural aptitudes that can shape the development of our knowledge style. Some of these abilities are cognitive in nature, while others are more emotional in nature.

Cognitive Abilities

Some of us have higher IQs, some of us are naturally more field independent, and some of us seem to have been born with higher creative abilities and a tendency to think laterally. Other people have innate learning disabilities, such as dyslexia, that make it much harder for them to process information.

Some people can memorize facts very well, while others cannot. Some are able to think about problems in many different ways, while others seem stuck in one perspective when they view a problem. Some people are continually playing with information by creating new categories and looking for patterns, while other people either try to ignore information or try to find quick and easy ways to deal with it. Knowledge styles are characterized primarily by four cognitive abilities: field dependency, type of intelligence, type of thinking, and conceptual differentiation.

Field Dependency. Perhaps the most important characteristic in a person's cognitive style is field dependency. Think of **field dependency** as your natural ability to distinguish between the signal and the noise in any message. Noise is the chaos of symbols and images. Signal is the information that emerges from the chaos. People who are highly field dependent get stuck in the field of chaos—seeing all of the details but missing the patterns and the "big picture," which is the signal. Field-independent people are able to sort quickly through the field to identify the elements of importance and ignore the distracting elements.

For example, when watching a story during a television news show, field-independent people will be able to identify the key information of the who, what, when, where, and why of the story. They will quickly sort through what is said, the graphics, and the visuals to focus on the essence of the event being covered. People who are field dependent will perceive the same key elements in the story but will also pay an equal amount of attention to the background elements of how the news anchors are dressed, their hairstyles, their make-up, the color of the graphics, and so on. To the field-dependent person, all of these elements are of fairly equal importance, so they are as

likely to remember the trivial as they are to remember the main points of the story. This is not to say that field-dependent people retain more information because they pay attention to more; to the contrary, field-dependent people retain less information, because the information is not organized well and is likely to contain as much noise (peripheral and tangential elements) as signal (elements about the main idea).

Let's try one more example of this natural ability. Have you ever had to read a long novel and gotten so lost about 100 pages into it that you had to quit in frustration? You may have felt that just when the author was getting the story going with one set of characters, he or she would switch to a different setting at a different time with a totally new set of characters. This may have been happening every few pages! There were too many characters talking about too many different things. You were overwhelmed by all the detail and could not make sense of the overall story. This indicates that the novelist was making demands on you to be much more field independent than you could be as you read the novel. People who are much more field independent are able to see through all the details and recognize a thematic pattern of some sort, then use that thematic pattern as a tool to sort through all the details about characters, settings, time, dialogue, and action in order to direct their attention efficiently to those elements that are most important.

In our information-saturated culture, we are constantly forced to make filtering decisions when those messages that are regarded as signal are filtered into our consciousness while those messages that are regarded as noise are filtered out. Most of this filtering is done rapidly and unconsciously while our programmed mental codes run automatically. If those codes have been programmed by media producers, then those producers are defining what is important—thus what is important to them gets filtered in, while much of what may be important to us gets filtered out. This is why it is important for us to periodically examine the codes and make adjustments that give us more control over this filtering.

Type of Intelligence. It is helpful to make a distinction between two types of intelligence: **crystalline intelligence** and **fluid intelligence**. One type of intelligence is called crystalline, which is the ability to memorize facts. Highly developed crystalline intelligence gives us the facility to absorb the images, definitions, opinions, and agendas of others.

The other type of intelligence is fluid, which is the ability to be creative and see patterns in complex sets of facts. Highly developed fluid intelligence gives us the facility to challenge what we see on the surface, to look deeper and broader, and to recognize new patterns.

Type of Thinking. Most people are what are called vertical thinkers (recall that this idea was introduced earlier in this chapter). Vertical thinking is systematic, logical thinking that proceeds step by step in an orderly progression. This is the type of thinking we need to learn the basic introductory information on any topic. We need to be systematic when we are trying to learn basic arithmetic, spelling, and dates in history.

As we discussed earlier, there is another type of thinking called lateral thinking. Lateral thinking, in contrast, does not proceed step by step in the usual vertical manner. Instead, when confronted with a problem, the lateral thinker jumps to a new and quite arbitrary position, then works backward and tries to construct a logical path between this new position and the starting point. Lateral thinkers are more intuitive and creative. They reject the standard beginning points to solving problems and instead begin with an intuitive guess, a brainstorming of ideas, or proposed solution "out of the blue." The lateral thinker works backward from innovative conclusions to the beginning of a problem. Lateral thinkers tend to arrive at a solution to a problem that other thinkers would never arrive at because they are constrained by a lock-step form of thinking.

Few people have a natural aptitude for lateral thinking. Those who have it use it often. Many inventors and scientists usually produce a string of new ideas, not just one. For example, Thomas Edison invented so many things that by the end of his life he had over 1,300 patents in the areas of the telegraph, telephone, phonograph, movie camera, and projectors. This suggests that there is a capacity for generating new ideas that is better developed in some people than in others. This capacity does not seem to be related to sheer intelligence but more to a particular way of thinking. There are smart and not-so-smart lateral thinkers, just like there are smart and not-so-smart vertical thinkers.

There are advantages and disadvantages to both forms of thinking. Vertical thinkers tend to do best at solving traditional problems for which the solutions can be learned. However, when their traditional methods of solving problems break down and they reach a dead end, they are stuck and have nowhere to go. In contrast, lateral thinkers can often be flighty and may come up with many unique ideas; however, none of those ideas may work or be feasible ways of addressing a problem. When others are stuck at a dead-end of thinking, it is the lateral thinkers that break through the barriers. People who are good at both and who know when to try each approach are, of course, the most successful problem solvers.

It is easier to teach vertical thinking than lateral thinking, because vertical thinking is a process of systematically following steps and procedures. In contrast, lateral thinkers know how to approach things from a different and creative point of view; this is difficult to teach. Because it is easier to teach and evaluate the quality of vertical thinking, educational institutions focus much more on vertical thinking at the introductory level where you need to absorb the formulas and lists that authorities deem most important. However, once you get beyond this type of challenge, you will encounter more significant challenges where you will need to solve partially specified problems. You will need to move beyond memorizing information and instead look for fresh patterns, synthesize your own opinions, and project future trends. These more challenging tasks will frequently present barriers that can be circumvented only through lateral thinking.

Conceptual Differentiation. **Conceptual differentiation** refers to how people group and classify things. People who classify objects into a large number of mutually exclusive categories exhibit a high degree of conceptual differentiation. In contrast, people who use a small number of categories have a low degree of conceptual differentiation.

Related to the number of categories is category width. People who have few categories to classify something usually have broad categories so as to contain all types of messages. For example, if a person only has three categories for all media messages (news, ads, and entertainment), then each of these categories must contain a wide variety of messages. In contrast, someone who has a great many categories would be dividing media messages into thinner slices (breaking news, feature news, documentary, commercial ads, public service announcements, action/adventure shows, sitcoms, game shows, talk shows, cartoons, and reality shows).

Emotional Abilities

A person's knowledge style is composed of more than purely cognitive abilities. It is important to recognize the role of emotional abilities. Some people are naturally excited by new information and have a strong drive to seek out more. However, other people feel exhaustion when experiencing new information, because they already feel overwhelmed. In the paragraphs below, I will illuminate three characteristics of emotional ability that contribute to a person's knowledge style. These are: emotional intelligence, tolerance for ambiguity, and impulsiveness.

Emotional Intelligence. Our ability to understand and control our emotions is called **emotional intelligence**. Emotional intelligence is thought to be composed of several related abilities, such as the ability to read the emotions of other people (empathy), the ability to be aware of one's own emotions, the ability to harness and manage one's own emotions productively, and the ability to handle the emotional demands of relationships.

People with stronger emotional intelligence have a well-developed sense of empathy; they are able to see the world from another person's perspective. The more perspectives people can access, the more emotional intelligence they have. Highly developed people are also more aware of their own emotions and understand what causes and alters them. These people are also less impulsive and are able to exercise more self-control. They can concentrate on the task at hand rather than becoming distracted by peripheral emotions. When we are higher developed emotionally, we are better able to understand how messages evoke feelings, and we can therefore seek out messages to enhance our emotional reactions.

Tolerance for Ambiguity. Every day, we encounter people and situations that are unfamiliar to us. To prepare ourselves for such situations, we have developed sets of expectations. What do we do when our expectations are not met and we are surprised? That depends on our tolerance level for

ambiguity. People who have a low **tolerance for ambiguity** choose to ignore those messages that do not meet their expectations; they feel too confused or frustrated to work out the discrepancies. In contrast, those people who are willing to follow situations into unfamiliar territory that goes beyond their preconceptions have a high tolerance for ambiguity. Initial confusion does not stop them; instead it motivates them to search harder for clarity.

People with a high tolerance for ambiguity do not feel an emotional barrier that prevents them from examining messages more closely. They are willing to break any message down into components and make comparisons and evaluations in a quest to understand the nature of the message and to examine why their initial expectations were wrong. People who consistently attempt to verify their observations and judgments are called scanners, because they are perpetually looking for more information.

Nonimpulsiveness. **Nonimpulsiveness** refers to people's ability to control their emotions when dealing with information. Some people get swept away with negative emotions, such as frustration or anger. They cannot control their emotions, so they let negative emotions force them to make quick decisions so as to eliminate the negative drive. When people make quick decisions, their choices are usually not optimal. There is typically a trade-off between speed and accuracy. When we are impulsive, we make decisions very quickly and this moves us out of the uncomfortable emotion of stress. However, when we take our time and reflect, we usually make better decisions. People who take a long time and make few errors are reflective, and those who are quick and make many errors are impulsive.

How much time we take to make decisions is governed by our emotions. If we feel comfortable encountering new information and like to work through problems carefully, we are likely to act reflectively and take our time. However, if we feel a negative emotion (such as frustration), we tend to make decisions as quickly as possible in order to eliminate the negative emotional state.

As we encounter information throughout the course of our lives, our natural abilities (or deficiencies) make it easier (or more difficult) to deal with this information. Also, dealing with information becomes less difficult when we are at higher levels of maturation on a wide range of abilities. However, regardless of our innate abilities and our levels of maturation, there is another factor that arguably is most responsible for our knowledge style—that is, conditioning.

Maturation

Our innate abilities mature on their own early in our lives. This means that we get better at understanding more difficult concepts and in controlling our emotions. Much of this maturation happens outside our control or awareness. Children have difficulty comprehending certain ideas until their minds mature to a point where they are capable of understanding the nature of what they are doing. For example, you cannot teach a 1-year-old to add and

subtract, no matter how good of a teacher you are. The child does not understand what adding and subtracting are and is not ready to learn these things at 1 year of age. However, over the next few years, the child's mind matures and becomes ready to learn these things.

The leading thinker about human cognitive development, Jean Piaget, observed that a child's mind matures from birth to about 12 years of age, during which time it goes through several identifiable stages. Other psychologists have examined how the human mind matures beyond the age of 12. Psychologists still have a lot to learn about how humans develop cognitively and emotionally throughout the entire lifespan. However, what we do know is that we continue to mature on all sorts of abilities throughout both childhood and adulthood and that those patterns of maturation differ across people. We also know that there are some things we can do to accelerate certain kinds of maturation and there are other things we don't do that can atrophy the process and keep us stuck at a low level of development for our entire adult lives.

Self-Improvement

All of us have the potential to continue developing our skills at any point in our lives. Regardless of our innate abilities, we can still get better. Once we have reached college, we cannot rely on maturation for improvement; our minds have matured to a point where maturation is no longer a barrier. Regardless of how we have been conditioned, we can take control of our futures. Even if we have been conditioned to believe we are not very smart, we can still improve. We can develop our skills on our own. To do so, we need to become committed to our improvement and we need to work on it.

IV. Chapter Review

- We live in an information-saturated culture.
    - In order to survive, we have developed automatic routines that help us navigate this flood of information.
    - These routines help us make decisions efficiently about what exposures to seek and how to process meaning from those messages.
    - These routines are composed of programming that has been designed by other people and institutions, so those routines may not be running in our best interest.
- The way we solve problems differs depending on whether the problems are fully specified or partially specified.
    - We depend on algorithms to solve fully specified problems so we can arrive at the one and only correct solution.

- When we solve partially specified problems, algorithms help us get started but we also need to use heuristics.

- Our level of skills is determined by a combination of natural ability, maturation, and self-improvement efforts.
  - We are all born with different combinations of natural abilities.
  - Our abilities to use cognitive and emotional skills mature as we age throughout childhood.
  - Beyond childhood, the most important determinant of people's levels of skill is traceable to their efforts at self-improvement.

Exercise 2.1 Recognizing Types of Problems

Which of the following are examples of fully specified problems and which are partially specified problems?

1. $(2 + 6 + X)/3 = 5$
2. $(6 + 4 + X)/2 = 3X$
3. $2 + X + Y = 10$
4. Train Number 1 leaves the station in City X at noon heading toward City Y, which is 1,000 miles away. Train Number 2 leaves City Y at 1:00 p.m. traveling toward City X. Both trains travel at 70 miles per hour. At what mile marker will the trains pass each other?
5. A red train leaves the station in City X at noon heading toward City Z at 60 miles per hour. At the same time, a blue train leaves City Z traveling at 80 miles per hour. City X and City Z are 560 miles apart. At what mile marker will the trains pass each other?
6. In a vote by a legislature, a bill gets 55 votes. Does it pass and become a law?
7. Joey is a 12-year-old boy who has just watched half an hour of wrestling on the World Wrestling Entertainment (WWE) network. His younger sister comes into the TV room, grabs the remote control, and changes the channel. Will Joey act aggressively toward her?
8. When will the U.S. economy get better?

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Answers for Exercise 2.1

1. This is a fully specified problem. There is one unknown, *X*. The solution is 7.
2. This also is a fully specified problem. Although *X* shows up twice in the equation, *X* is only one unknown. The answer is 2.
3. This is a partially specified problem, because there are two unknowns.
4. This is a fully specified word problem. Because the trains travel at the same speed, they should be expected to meet halfway—at the 500-mile marker. However, Train 1 leaves an hour early, so they should pass each other 570 miles from City X.
5. This might look like a fully specified problem, but if you look closely, there is no information about where the blue train is headed. That is a crucial piece of information that is not provided. However, you could make this into a fully specified problem by learning that the blue train is indeed heading toward City X.
6. This is a partially specified problem, because it is missing two pieces of information. First, we are not told how many members there are in the legislature and whether the bill needs a majority, a plurality, or a certain percentage of the vote to pass. Second, we are not told if there are steps beyond the vote in order for the bill to become a law. Perhaps a member of an executive branch of the government needs to sign the bill; perhaps there needs to be a general election. However, you could make this into a fully specified problem by finding out what the rules are.
7. This is a partially specified problem. It is tempting to jump to the conclusion that Joey will scream at his sister and grab the remote control. But we don't know enough to conclude this. Perhaps the sister was assaulted by the neighborhood bully and has just come back from the doctor after getting her broken arm put in a cast. Joey is feeling protective over his sister and his anger flares up at the bully, not his sister. Or perhaps Joey was responsible for his sister's broken arm and he is feeling remorseful. You could move this more toward a fully specified problem by finding out more information about Joey and his sister.
8. This is a classic partially specified problem. There are hundreds of factors that influence the economy. Also, there are many economists who continually track these factors and make predictions, and most of those economists are wrong at any given time. Still it is a fascinating and important problem, so people continually address it. You can work to make it less partially specified by gathering information on the hundreds of factors over time and plotting trends. This will serve to reduce the ambiguity in the problem, but it will not take you all the way to a solution in which you can have 100% confidence.