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The Psychology of
THINKING

Reasoning, Decision-Making & Problem-Solving

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1 THE PSYCHOLOGY OF THINKING

Thinking is so central to the human experience that it has been described as the essence of being. We are all familiar with the phrase, "*Je pense donc je suis*" or "I think therefore I am." This comes, of course, from Descartes' *Discourse on the Method* (1637) and underscores what is so crucial and compelling about the study of thinking. Humans, like other animals, behave, learn, respond, communicate, and remember. But humans also think. We can discover something new by thinking about it. We can solve problems in the mind, visualize solutions, and arrive at an important decision by thinking. We can be aware of our own thoughts and aware of the consequences of our actions and behaviours.

This book is about the **psychology** of thinking. That might sound redundant, given that psychology is often defined as the study of the mind or of mental activity. In other words, if psychology is not about thinking, what else can it be about? Psychology is a very broad field, encompassing everything from the study of neurotransmitters and basic neuroanatomy to the study of learning and memory to the understanding of mental health and the study of group behaviour. **This book is concerned with the study and understanding of the thought process.** Thinking is usually studied within the broader field of cognition. **Cognitive psychology** has traditionally been defined as the study of information processing and behaviour. This encompasses everything from basic attention and perception to memory, concepts, and thinking. As a topic within the study of cognitive psychology, the psychology of thinking is concerned with complex mental behaviours, such as problem-solving, reasoning, decision-making, and becoming an expert. A good understanding of basic cognition is very useful in understanding the psychology of thinking, but it is not necessary. In other words, if you are reading this book as part of a course on thinking, a course on reasoning and decision-making, or even a business or marketing course, and you have already taken a course on cognition, then you may find some helpful overlap in some of the topics covered. But if you have not taken a course on cognition, I do not think you will have any additional difficulty. I have tried to write this text so that it builds on prior

knowledge, although that knowledge is not strictly necessary and you can enjoy and use this book without any prior formal study in cognition.

In this first chapter, I want to describe what thinking is (and also what it is not, for the purposes of this book). I want to consider several examples of thinking, and several challenges to clear thinking. I will also describe some of the ways in which thinking has traditionally been studied.

WHAT IS THINKING?

A basic description

Thinking is mental activity, but it is not just any mental activity. Or rather, thinking and mental activity are not synonymous. For example, basic visual perception, memory consolidation, and coordination of sensory motor activity are all very sophisticated mental activities, but these kinds of behaviours are not usually considered to be thinking. **Thinking is a very specific subset of mental activity that involves working with mental representations, planning and executing behaviours, and the coordination of cognitive resources.** For example, solving an algebra problem, analyzing the themes in a film, discussing the prospects for your favourite sports team, or making a split-second decision about which route to take when a road is closed are all examples of thinking. Daydreaming, fantasy, depressive thoughts, and anxious ruminations are also examples of thinking, although in this book I will deal primarily with thinking as a cognitive phenomenon and will spend less time considering the contents of unstructured thought or the clinical ramifications of thoughts that are difficult to control.

Different kinds of thinking

Thinking can be divided up in many ways, including divisions based on content, effort, the desired outcome, underlying cognitive processes, and function. These kinds of divisions are intuitive but also allow researchers to study thinking at different levels. For example, we must make a distinction between the kind of thought that one engages in when solving an introductory physics problem and the kind of thought that one engages in when catching a fly ball in baseball. For readers not immediately familiar with fly balls, a fly ball is a ball that is hit with a high, slow arc. Catching one is fairly easy with practice and involves being able to predict exactly where the ball will land, and placing oneself in that location (McBeath, Shaffer, & Kaiser, 1995). Solving a physics problem and catching a fly ball both require attention and both have a measurable outcome (passing the exam or catching the ball), and both are essentially physics problems. But solving an introductory physics problem requires sustained attention, the recall and generation of learned facts, the conscious application of those facts, and the ability to engage in some kind of explicit

monitoring of the behaviour. This is a conscious and effortful process, even if the solver in question has some experience with physics problems. Catching a fly ball, on the other hand, is a process that often defies verbal description. It is intuitive and does not seem to rely on the recall of facts, but rather on the replay of hand–eye coordination routines. These are both examples of complex thinking, and yet they differ in terms of what psychological processes are active during the execution. A thorough understanding of the psychology of thinking requires being able to differentiate between these two kinds of thought processes, the cognitive processes that underlie them, and to be able to have an adequate theoretical description of thinking that encompasses both kinds of thinking.

Consider another example, the thinking processes behind a game of chess. Playing chess effectively requires the coordination of several cognitive processes and behaviours. One must have sufficient knowledge of the rules, a good recall of the rules, and the correct application of the rules. Playing chess, especially playing chess effectively, also involves recall for common chess positions and recall of previously played games of chess (Chase & Simon, 1973; De Groot, 1965). Playing chess effectively also involves thinking ahead, thinking about what your opponent might do, and developing a strategy for how to react based on what you think the other player will do. This second set of behaviours involves what is known as a **theory of mind**, which means being able to consider the contents of another person's thoughts.

Playing chess can be contrasted with playing a visually oriented video game. Many games, especially the simple, action games found on mobile platforms such as "Angry Birds", place much less emphasis on rule acquisition and retrieval of rules for memory, and place a greater premium on procedurally learned motor responses. As with the previous example (catching fly balls versus solving physics problems), the first behaviour is a conscious and effortful process whereas the second behaviour is an intuitive and procedural process that defies verbal description. Interestingly, both rely on some degree of retrieved memories. In the chapter on expertise in this text, we will discuss at length the degree to which expert chess players rely on rapid retrieval of previously learned patterns. This may share some overlap with the kind of rapid retrieval of previously learned motor responses involved in many visually oriented video games. So although these two kinds of thinking are quite different in many ways, and solve different problems, there are shared underlying mechanisms – in this case, retrieval of prior instances from memory.

We could go on with many other examples, dissecting them to consider what principles of thought and cognition are involved. Writing a paper for a course requires reading and retaining new ideas, considering more than one idea simultaneously, being able to examine the parallels and analogies among ideas, and being able to make use of basic linguistic processes to communicate the idea. Learning to play a short piece on the piano involves the mapping of written notes to motor action, the focus of attention on the sound of the piece, and the coordination of several different motor behaviours. Diagnosing patients involves

attending to symptoms, comparing the similarity of the observed symptoms to memory representations of previously seen patients. Looking over many of these examples, we start to see commonalities: focusing attention, making judgements about similarity, considering several ideas simultaneously. These common attributes will eventually become the objects of study for understanding the psychology of thinking.

CHALLENGES TO THE THINKING PROCESS

Thinking occurs on many levels and, as described above, different actions require different levels of thought. In fact, most of the time we either arrive at correct decisions or we arrive at decisions for which there was little cost for an incorrect decision. Furthermore, many researchers argue that humans are quite capable of predicting and judging information even in the face of incomplete and sparse information. For example, a recent study by Tom Griffiths and Joshua Tenenbaum looked at people's ability to make quick judgements about things that they were not experts in, such as how much money a movie might make, a person's lifespan given a quick summary, or how long it takes to bake a cake (Griffiths & Tenenbaum, 2006). They found that most people were able to make predictions that fell closely in line with statistical models of optimal outcome. In other words, people often make really good judgements and predictions even if they are not exactly sure how or why they are doing it. A possible explanation is that people are very efficient at using their existing knowledge, memory, and understanding to fill in gaps and make quick predictions.

But if you have ever arrived at the wrong conclusion, solved a problem incorrectly, or made a bad decision, you've probably realized that thinking can sometimes be a challenge. We make mistakes. Sometimes we have to think about too many things at once, or we do not have all the information needed to arrive at a good decision. The section below considers some of the primary challenges that we face. We will consider many more "thinking challenges" later in this book.

Multitasking

Multitasking is both commonplace and misunderstood. We know that multitasking refers to being able to do more than one thing at a time, like reading and listening to music, talking while cooking, checking Facebook during a lecture, texting and driving, etc. The human brain and mind is designed to be able to divide attention and resources among several input and output channels (Pashler, 1994). What is challenging about understanding multitasking is that most people are aware that it often occurs with some cost to behaviours but at the same time people often assume that it is a necessary action, a positive skill, or both. It would not be uncommon to hear someone claim to be "good at multitasking". But is it really possible to be good at multitasking?

Current research suggests that there is nearly always a cost, and that this cost may even last beyond the multitasking event. For example, Ophir, Nass, and Wagner (2009) created a questionnaire that allowed them to measure light, medium and heavy media multitaskers. In this case, media multitasking refers to using more than one media device or following more than one media stream at the same time. Examples might include studying while watching a show on Netflix, or taking notes in class while checking a Twitter feed, or listening to music while reading. Heavy media multitaskers were those who were more than one full standard deviation above the average score on the questionnaire. Participants in the experiment were asked to engage in a number of tasks that required them to switch quickly between responses and to detect targets in the presence of distractors. If people were really good at multitasking, they might be expected to do well at a task like this, because good performance relies on the ability to switch quickly and to screen out irrelevant information.

This was not the finding, however. Being a heavy media multitasker did not seem to predict better performance on these cognitive tasks. In fact, the researchers found the opposite pattern. They found that heavy or "chronic" media multitaskers performed worse on a test of task-switching ability, likely due to a reduced ability to filter out interference from the irrelevant task set. In other words, the very people who were the heaviest multitaskers and who should have been "good at multitasking" were not really very good at all, and they actually performed worse on a test of actual multitasking. One possible explanation for this counterintuitive result is that heavy media multitaskers have adopted an attentional style that results in greater distractibility. In other words, instead of being better at selectively attending and screening out, heavy media multitaskers were worse because they were constantly switching and being distracted. This does not mean that media multitaskers will suffer on all tasks, but it does suggest that multitasking may not always be a benefit.

BOX 1.1

One of the most prevalent things in many of our lives is the smartphone. For those of us that use or rely on a smartphone, we know the challenges that it presents, and the relative costs and benefits. Without getting into a long list of features and aspects of phones, consider what the smartphone can do to help (or hurt) the thinking process. The positive aspects are pretty clear. People use their phones for communication, texting, as cameras, as clocks, as weather stations, and as a newspaper. As long as the device is connected to a network, users have access to

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more knowledge than has ever been possible before. One of the most likely negative effects of having a smartphone is multitasking. Our cognitive systems are designed to process multiple channels of information but there is almost always a cost. As you are reading this now, you may have a smartphone. You may have even thought to look at it right now to see if any text message, emails, etc. have arrived.

Consider another dimension to smartphone multitasking. Not only do people find themselves splitting their attention between several things (e.g., taking notes, listening to a lecture, and checking a smartphone), but you may also find yourself spending energy actively ignoring one of those things. That is, the smartphone uses cognitive recourses when you are checking it or responding to a text, but it also uses cognitive resources when you try to ignore it. As an example, several years ago, I was in the middle of a lecture and my smartphone buzzed because of an incoming text message. Only a handful of people send me text messages (my wife, my kids, etc.) and they would not text me during a class. But this happened to occur at a time when a member of my extended family was in the hospital with a serious condition. The result was that I simply could not concentrate on the lecture, and had to stop to read the text (everything was fine!). The point is that the process of trying to inhibit the urge to read the text message was draining on my cognitive resources.

Heuristics and biases

Another potential challenge to the thinking process is the tendency for humans to rely on heuristics and to show biases when making decisions. A **heuristic** is generally defined as a cognitive shortcut. When people use heuristics they are relying on knowledge to solve a problem or arrive at a solution, rather than a more active thought process. Heuristics are not just guesses, though. Heuristics provide reasonably good solutions or decision outcomes based on personal knowledge. The more extensive the person's knowledge is, the more likely the heuristic will be to provide the correct answer or optimal decision. The advantage of a heuristic is that the solution can be generated quickly. Heuristics are faster than working through a problem, and they are usually correct.

As an example, imagine that you are the designated driver for an evening out with your friends. You want to pick everyone up and drive to your destination in the shortest way possible. One solution to this problem would be to map out the driving distance from your home to the home of each of your friends, and from each friend's home to the homes of your other friends, and then from each friend's home to your destination.

You would then compare every possible permutation and see which of these produces the actual shortest distance. This **algorithm** might be time-intensive but it is guaranteed to find the correct solution. But, in practice, you would probably not carry out this set of calculations. You would rely on a **heuristic** that takes advantage of your general knowledge of the area, and choose a route that seemed to minimize the distances. This would probably also arrive at the same answer (the shortest route). The key difference is that the heuristic only really works well if you have a rich knowledge base to draw upon when making the inferences and generating solutions. And as will be discussed in subsequent chapters, although heuristics might be more efficient, because they are based on specific knowledge, they might produce an incorrect solution if the underlying knowledge base contains false or incomplete information. The reliance on heuristics has long been thought to be a source of cognitive errors (Tversky & Kahneman, 1973, 1974), although more recent work assumes that heuristics are a sign of adaptive cognition (Gigerenzer, Hertwig, & Pachur, 2011). Both of these perspectives will be covered in later chapters on problem-solving and decision-making.

Incomplete or incorrect knowledge

It may seem fairly obvious, but a major source of errors in thinking is an imperfect or incorrect knowledge base. In a sense, this underlies many of the cognitive heuristic errors as well. Consider a very straightforward example: a student is struggling to solve an algebra problem for her homework. If she remembers the correct algorithm, or correct example, the solution should eventually come. However, if she remembers the wrong algorithm, an incorrect example, or can't remember an example at all, the problem will be much more difficult to solve. In general, thinking is more difficult when you are thinking about something that is in an unfamiliar domain. Thinking is more difficult when you are trying to solve a problem that is really novel. Later in this text, in the chapter on problem-solving, we will discuss general strategies for solving problems in cases where the knowledge base is incomplete. At the other extreme, experts are characterized by a very rich and extensive knowledge base. This rich and extensive knowledge base helps experts to solve problems more quickly, make diagnoses more quickly, and make optimal decisions more efficiently.

There are many other examples of how incorrect or incomplete knowledge can affect the thinking process. For example, the general tendency to make judgements and decisions on the basis of information that is available in memory is known as the **availability heuristic** (Chater & Oaksford, 1999; Tversky & Kahneman, 1974). In other words, people tend to make decisions on the basis of the information they have immediately available in consciousness or that is immediately retrievable from memory. More often than not, this heuristic will lead to correct decisions. After all, we have evolved to trust our own memories. However, events that are perceived as being more frequent because of high salience or recency will skew our judgements. People routinely overestimate the likelihood of

serious injury due to things like shark attacks, terrorist attacks, aeroplane disasters. These events are tragic when they occur but still occur with very low frequency. However, often the tragic nature of these events leaves them more salient in memory over other mundane events of higher frequency, such as vehicle accidents. As a result, our memory about low and high frequency events is skewed, and this skewed memory representation results in a bias. This bias results in overestimating the occurrence of low-frequency events.

Later in this book, we will cover other types of cognitive errors and bias. In many ways, these errors are a major source of insight into the thinking process. It is also important to note that despite these errors, most people arrive at reasonable conclusions and make good decisions. Herbert Simon, the influential cognitive scientist and artificial intelligence researcher, refers to this as **satisficing** (Simon, 1957). Simon argues that a cognitive system designed to seek optimal performance is likely to be impossible, and certainly undesirable, for most applications. If optimality is difficult or impossible to achieve, then a cognitive system designed to seek optimal performance will fail. A more adaptive approach, one that largely describes human cognitive abilities, is one which seeks a good enough outcome but not a perfect outcome.

THEORETICAL APPROACHES TO THE STUDY OF THINKING

I started this chapter with a reference to Descartes. Interest in understanding thinking goes back much farther than that. Philosophers, theologians, psychologists, and physicians, as well as the average person, have all spent time trying to understand how we think, what we think about, and why we have the thoughts that we do. Since this text is on the psychology of thinking, we will not spend much time discussing the earlier, less psychological accounts. In addition, because this is a book from the cognitive psychological tradition, we will start with early work that directly influenced the cognitive tradition. This does not mean to undermine or negate any of the important work on the role of unconscious motivations in thinking that are associated with the psychoanalytic approach developed by Sigmund Freud. One could easily argue that Freud's work was influential in bringing about a consideration of the complexity of human thought. Furthermore, as we consider what is sometimes known as the "dual process" approach, it may be worth noting some higher-order similarities between the Freudian model of personality (with an emphasis on conflict between fast, intuitive behaviours and slower, higher-order cognitive processes to keep them in check) and the role of a fast, intuitive system versus a slower, deliberative system in thinking and cognition. I am not suggesting that the dual process approach to cognition is analogous to Freudian theories, but rather that both are attempting to describe the same underlying systems of thought.

The Gestalt approach

As discussed above, it is important to understand some of the historical and theoretical developments that led up to our current understanding of human thought. One of the more well-known of these earlier approaches is the **Gestalt approach**. This was one of the primary approaches to the study of thinking in the early part of the twentieth century. The Gestalt approach arose in Germany and was a counter to the **Structuralist** approaches of the same era. Most of us know about the Gestalt laws of grouping. These are perceptual laws that all centre on the idea that humans are biased to perceive whole objects, rather than parts. For example, the **Law of Proximity** states that feature or figures that are near each other will tend to be perceived as belonging to a common object. Likewise, the **Law of Similarity** states that elements or features in a group of objects are perceived as belonging together if the objects are similar to each other. Note that these laws are primarily descriptive, and although they serve as good rules of thumb for describing our perceptual preferences, they have generally been criticized for lacking scientific rigour and for failing to provide sufficient explanatory power. Figure 1.1 shows some basic examples. Although most of these show simple perceptual grouping laws, these laws also suggest a reliance on whole-object perception. By this view, the mind is not a "blank slate" but is designed in such a way as to process information and deal with representations – processed information and representations are the objects of study in the psychology of thinking. And of course, many of the ideas do live on in the contemporary principles of aesthetics and design.

While the perceptual laws of Gestalt psychology have mostly been superseded by more sophisticated theoretical approaches, Gestalt psychology also emphasized several approaches to thinking and problem-solving which influenced subsequent theories of thinking. For example, Max Wertheimer, who was one of the founders of the Gestalt school, considered two broadly

Examples of Gestalt Laws

Proximity   Similarity   Closure

Common Fate/Motion   Good Continuation
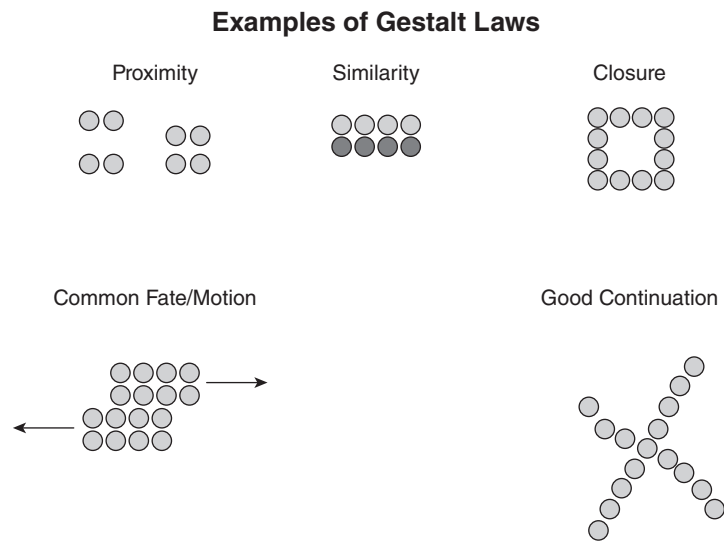
Figure 1.1 An example of some of the Gestalt laws of grouping. According to the Gestalt view, we tend to perceive whole objects and show a preference for grouping similar things together.

ation

of external and internal events as internalized **mental representations**. There is no set, agreed-upon definition of what a mental representation is, but for our purposes we should define a mental representation as a stable state of activation within a cognitive/neural system that corresponds to an event, object, or idea. Birthday parties, cats, and vaccines are all things in the world. When I think about them, I generally think about them in the same way each time. It is a stable representation. My representation for cats consists of memories and images of my own cat, knowledge about where cats come from, feelings of affection, and likely these are all activated when I think of cats. By this definition, then, thinking is the process by which these internal representations are manipulated. As a result, many of the cognitive accounts of that era emphasized the notion of **symbolic processing**. More contemporary accounts tend to rely less on the idea of mental symbols and the advent of model cognitive neuroscience has allowed theorists to understand thought as a process of changing states of activation, rather that purely symbolic processing. Indeed, many modern self-help and motivational texts routinely refer to "thinking and the brain" or how to "help your brain make better decisions".

Dual process account

Within the field of cognition devoted to thinking, reasoning, problem-solving and decision-making, a long-standing tradition in psychology and in the cognitive sciences is the notion that some cognitive process are fast, somewhat effortless, and not tied to consciousness and that other cognitive processes are slower, more effortful, and more closely tied to consciousness. Although this has taken many forms, the primary version of this theory is known as the **dual process account** or **dual systems theory**. Both terms have been used in the literature. The more common term is the dual process account. In this text, I may use both, though I will usually use dual process. Within this dual process account, the constituent subsystems are almost always referred to with the label "system", thus each of the two systems makes up the dual systems in the dual process account.

The dual process theory assumes that there are two cognitive and neuropsychological systems that underlie the thinking process. Evans (2003, 2008) refers to these as **System 1** and **System 2**, and suggests that these systems differ in terms of evolution, structure, and function. Other theorists have used other terms to describe the two systems, such as **holistic** and **analytic** (Evans, 2003, 2008; Evans & Stanovich, 2013; Nisbett & Miyamoto, 2005; Nisbett, Peng, Choi, & Norenzayan, 2001; Norman & Brooks, 1997; Sloman, 1996). These distinctions can be semantic, but these various descriptions do not always overlap perfectly. In this book, I use the System 1 and System 2 designation as it is the most well-known. Readers should consult Evans (2008) for a comprehensive and critical review of these theories, and I cover the topic in greater detail in Chapter 8.

Most theorists regard System 1 as a cluster of structures and functions that may operate with relative autonomy, and the functions and behaviours ascribed need not interact with other systems. System 1 is generally described as relatively fast, unconscious, independent of general intelligence or working memory ability and operates via associative mechanism. System 1 is also described as the more primitive system. This means that it relies on neural structures that are evolutionarily primitive (e.g., lower cortical structures). As such, System 1 is thought to be shared by humans and non-humans alike.

What kinds of behaviours rely on System 1? When you make a decision with your "gut" it might be a decision that is based on System 1. For example, consider two people who live on the same floor of an apartment building. They may see each other every few days, as each arrives home from work or errands. Initially, neither person may extend a greeting to the other, but at some point (days or week later), one of the persons says "hello" to the other. That is, after many silent meetings, one person makes the decision to greet the other. What thought process led to the decision to extend the initial greeting? Although it is possible that the greeter deliberated about this every morning, weighing the costs and benefits of a greeting and trying to maximize the benefit of saying "hello", a more likely alternative is that the greeting just felt appropriate at that time. After a number of uneventful and silent encounters, the greeter felt that the second person was safe, friendly, or otherwise deserving of a greeting. Put another way, it is probably hard for the greeter to put into words why he or she chose to say "hello" to the other person. It probably just felt right. But behind the right feeling, there is likely to be a whole catalogue of observed behaviour, memories, and associations that helped to tip the scale in favour of a greeting. This catalogue of behaviour is the underpinning of System 1.

When you make a more conscious, deliberative decision, it might be thought to involve System 2 processes more heavily. For example, I recently purchased a new vehicle (not new, but a three-year-old vehicle that was new to me). My current vehicle at the time was an 11-year-old Honda Pilot, and there were a number of problems that were worrying me. I took the car to a dealership for an estimate for several different repairs and the estimate was extensive. I then considered how much I was willing to spend to repair the vehicle and how much longer I thought I might want to drive an 11-year-old car. I reasoned that a newer, similar vehicle might be a better option, and although I had not planned to buy a new car that day, I quickly made a list of costs and benefits, pros and cons, and contacted my wife for a quick discussion. Although there were probably aspects of System 1 reasoning, the decision-making process was one that required a slower, more deliberative approach, a consideration of many outcomes and scenarios, the careful and explicit weighing of evidence, and a conscious decision. This is System 2 thinking.

The dual process approach, though intuitive, has received some criticism as well. In a recent review, Evans and Stanovitch (2013), who are proponents of the dual process approach, outlined what they consider to be some of the primary criticisms and concerns with this theory. For example, one problem is that dual process theorists have offered multiple and vague definitions. At various times they have been referred to as implicit/explicit, associative/rule-based, intuitive/reflective, conscious/unconscious. Individually, these descriptions and dissociations might be workable, but collectively they become more problematic. It is unlikely to be the case that all System 1 behaviours are equally uncontrolled, unconscious, associative, implicit, and intuitive. A second common criticism is that the proposed groupings have not been well aligned. That is, the features for behaviours that are thought to belong to one system are not always observed together. Many researchers have suggested that what might seem like evidence for two separate systems or processes is equally compatible with the view that thinking behaviour operates on a single continuum. In other words, what seems like evidence for a separate System 1 is simply behaviour that is carried out at the less flexible, less conscious part of the thinking continuum.

Aims and scope of this text

A primary goal of this textbook is to provide readers with an overview of the history of the psychology of thinking and also a survey of current psychological accounts of the thinking process. The psychology of thinking is a topic that extends much of the information that is typically covered in an undergraduate introductory course on cognitive psychology. In order to provide an overarching structure, I have grouped the topics and chapters into broad themes. The first theme concerns the **organization of human thought**. For example, a core aspect of how people think involves the comparison of existing states, stimuli, or precepts with past experience. These mental comparisons form the basis of the thinking process, and they involve the computation of the **similarity** (Chapter 2) between mental representations or concepts. This theme also encompasses the structure of mental representations. I have included a chapter on **knowledge representation** (Chapter 3) and a chapter on **concepts and categories** (Chapter 4). This theme also includes a chapter on the interaction between **language and thought** (Chapter 5). This idea goes back to the Sapir–Whorf hypothesis in the middle of the twentieth century and continues to be of interest to psychologists, anthropologists, and linguists.

Each chapter is meant to be able to stand alone, but the theme that holds them together is that these representations and concepts, bound by similarity and shaped by language, are the basic units of thought.

A second theme is general **thinking and reasoning**, and several chapters will be devoted to how and why people engage in reasoning. Reasoning is at the core of the

psychological study of thinking and this text will explore **inductive reasoning** (Chapter 6) and **deductive reasoning** (Chapter 7) . I have also included a chapter that covers the influence of **motivation and mood** on thinking (Chapter 8). This chapter also includes a longer and more detailed description on the **dual process approach**.

A third theme deals with the **behavioural outcomes of thinking**. In other words, the topics and chapters comprising Section 3 attempt to answer questions about the how we use our knowledge, concepts, and reasoning ability to make decisions and affect cognitive and practical change. Chapter 9 covers the psychology of **judgement and decision-making**. In this chapter I cover basic heuristics, probability estimation, and theories of decision-making. Chapter 10 covers **problem solving**, and includes a section on creativity as well. I conclude with a chapter on **expertise** and expert-level thinking, which includes a discussion of the formal expertise of chess, science, and medicine (Chapter 11).