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Introduction

Metacognition refers to thoughts about one's own thoughts and cognitions (Flavell, 1979). Although the term itself may seem mysterious, metacognitive acts are common. For instance, take some time to answer two questions. First, when was the last time you failed to recall someone's name, but were absolutely sure you knew the name? These frustrating events, called tip-of-the-tongue states, happen a lot and may increase in frequency as we grow older (Schwartz, 2002). They are metacognitive in nature because you are having a thought ("I'm sure I know the person's name") *about* a cognition (in this case, your thought is "that the person's name is *in your memory*"). Second, when was the last time you decided to write down lengthy directions, or perhaps even brief ones, and how often do you make a list of groceries to buy at the market? In such circumstances, you may realize that there is little chance of remembering important information, so you naturally rely on external aids—for example, lists, PalmPilots, or even other people—to ensure that you won't forget. Understanding the limits of your own memory also is a form of metacognition because it concerns your beliefs and knowledge *about* memory. What may also be evident from the rather common events illustrated above is that metacognition is not a single concept, but it is multifaceted in nature.

To illustrate further the facets of metacognition, consider the following scenario involving a college student who is preparing for an examination in Introductory Psychology on the biological basis of behavior.

> Linda is diligently studying the *Introductory Psychology* textbook in her dormitory room, when her roommate turns on the TV. Realizing that the distraction

will make it harder to memorize and understand the important facts, she grudgingly walks down to the study lounge. After securing the most comfortable couch, she continues studying by attempting to memorize the major parts of the brain. In doing so, she judges that in fact she knows most of them well, except that she keeps forgetting the lobes of the cerebral cortex. Thus, instead of spending more time on the other parts of the brain, she decides to invest her energy on the stubborn cortex. After repeating the lobes to herself multiple times, she still believes she won't remember them. To overcome this difficulty, Linda uses a simple strategy that she had learned from Mr. Bennett, her chemistry teacher in high school, which is to make up a meaningful phrase using the first letter of each lobe. With some diligent thinking, she comes up with "French Teachers Prefer Olives" to remember the *F*rontal, *T*emporal, *P*arietal, and *O*ccipital lobes. After finishing the chapter, she also realizes that she doesn't quite understand how neurons communicate, and regardless of how hard she tries, she cannot seem to grasp the differences between action potential, resting potential, and graded potential. To cut her losses in wasted time, Linda decides to wait until the next class to ask some of her friends how neurons work.

This scenario illustrates three facets of metacognition that have been investigated extensively in the field: metacognitive knowledge, metacognitive monitoring, and metacognitive control. The definitions of these terms and other key concepts are presented in Table 1.1.

Metacognitive knowledge pertains to people's declarative knowledge about cognition. Declarative knowledge is composed of facts, beliefs, and episodes that you can state verbally (i.e., recall from long-term memory) and hence are accessible to conscious awareness (Squire, 1986), such as remembering that "dogs bark" or that "most cars have four wheels." By extension, metacognitive knowledge includes those facts and beliefs *about* cognition that you can state verbally. These facts may be general (e.g., "People who use images to learn lists of words often remember more than people who do not use images") or more specific (e.g., "I have difficulties solving Sudoku puzzles"). Linda demonstrated metacognitive knowledge when she recognized that distractions in the environment—for example, voices from the television—could interfere with her learning of classroom materials. Although Linda showed savvy knowledge about her cognition, metacognitive knowledge also may include incorrect beliefs. For instance, many students believe that studying the evening before an examination—popularly referred to as "cramming"—is an ideal way to retain new information, whereas decades of research indicate that spacing study of the same materials over longer intervals is a much more effective way of learning. Of course, if you haven't got it by the night before, by all means cram; what you learned might not last long, but if you are lucky, it will get you through the exam.

Table 1.1 Definitions of Important Concepts Relevant to Metacognition

Concept	*Definition*	*Examples*
Cognition	Symbolic mental activities and mental representations	Learning, problem solving, reasoning, memory
Metacognition	Cognitions about other cognitions	See examples in text
Metacognitive knowledge	Knowledge about a kind of cognition	• Knowledge about how learning operates • Knowledge about how to improve learning
Metacognitive monitoring	Assessing the current state of a cognitive activity	• Judging whether you are approaching the correct solution to a problem • Assessing how well you understand what you are reading
Metacognitive control	Regulating some aspect of a cognitive activity	• Deciding to use a new tactic to solve a difficult problem • Deciding to spend more time trying to remember the answer to a trivia question

Metacognitive monitoring refers to assessing or evaluating the ongoing progress or current state of a particular cognitive activity. To investigate metacognitive monitoring, researchers often ask experimental participants to explicitly judge a cognitive state. In Linda's case, monitoring was evident when she judged how well she had learned the major parts of the brain, and when she realized she did not understand how neurons communicate. Of course, if her judgments were inaccurate, she may have found herself in trouble. That is, if Linda actually *under*estimated how much she had learned, she may have spent too much time studying course materials that were already well learned and hence robbed herself of the opportunity to study materials that were less well-learned. Perhaps worse, she may have judged that she really knew the material well, and that she would remember it during the exam. Thus, if this judgment overestimated how much she had learned, Linda may have ended up with a poor grade, even though she was absolutely sure she understood all the material.

Metacognitive control pertains to regulating an ongoing cognitive activity, such as stopping the activity, deciding to continue it, or changing it in midstream. Linda's study behavior illustrates each of these forms of metacognitive

control. She decided to stop studying the parts of the brain that she judged were learned well and instead focused just on the more difficult lobes of the cortex. In this case, she used monitoring to make a decision about how to allocate study time. To remember the lobes of the cerebral cortex, she controlled her studying by switching from a more passive rehearsal strategy to a more active strategy involving the generation of a meaningful phrase, in this case, that "French Teachers Prefer Olives." Metacognitive knowledge is important here in that she used her knowledge about strategies in the hope of overcoming her difficulty in memorizing important concepts.

Although this discussion and the corresponding definitions in Table 1.1 will be useful in grasping each of the concepts alone, a more analytic understanding about how they are related to one another and to cognition itself will prove important as well. Figure 1.1, which has been adapted from Nelson and Narens' (1990) influential article on metacognition, is a general framework about the relationship between metacognition and cognition. This framework includes two related levels, the meta-level and the object-level. The object-level can be viewed as the ongoing cognitive processes of interest, such as attention, learning, language processing, problem solving, and so forth. The meta-level also contains *a model* that is a person's understanding of the task they are performing and the ongoing cognitive processes that are engaged while they complete the task. This model is partly informed by people's monitoring of their progress on a task, but it also may be informed by their metacognitive knowledge. For instance, Linda may have constructed a model of her studying that included her goal to learn all the important biological concepts in the chapter she was studying as well as her belief that the best way to meet the goal was to study in a quiet environment and with effective study strategies.

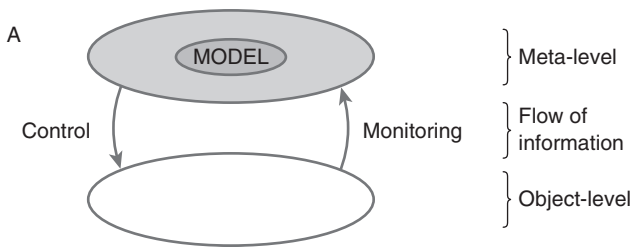

Figure 1.1 A framework relating metacognition (meta-level) and cognition (object-level) that gives rise to monitoring and control processes.

SOURCE: Adapted from Nelson, T. O., and Narens, L. (1990). Metamemory: A theoretical framework and new findings. In G. H. Bower (Ed.), *The psychology of learning and motivation* (Vol. 26, pp. 125–173). New York: Academic Press.

The interplay between the meta-level and the object-level defines the two process-based activities of metacognition—monitoring and control (for a generalization of this framework to more than two levels, see Nelson & Narens, 1994). In terms of this framework, metacognitive *control* is exerted whenever the meta-level modifies the object-level—more specifically, information from the meta-level acts to influence the ongoing activity at the object-level. Controlling the object-level, however, provides no information about the ongoing states of the object-level. Accordingly, you must monitor those object-level activities so that you can update your model of them (Nelson & Narens, 1990). In Figure 1.1, this process is metacognitive *monitoring*, which involves the flow of information from the object-level to the meta-level. This flow of information acts to update the model based on what is happening at the object-level. Examples of monitoring and control are presented in Table 1.1.

To help illustrate how this framework operates, Nelson and Narens (1990) offered a metaphor based on a telephone handset, which we expand upon here using a more contemporary example. Imagine that a friend calls you on the cell phone because she is excited to tell you about a movie that she just saw. Think of yourself as the meta-level and your friend as the object-level. Your goal is to understand your friend's message, and your model of this task may include numerous beliefs, such as that you probably won't understand your friend if you are both talking at the same time and that your friend hates being cut off while she talks. As you listen on your cell phone, you receive a flow of information from your friend as she speaks to you. Using the concepts from Figure 1.1, you are *monitoring* the ongoing message from your friend. At the same time, you can ask your friend to repeat anything you did not understand or hear well, or if you decide that you don't want the punch line of the movie ruined, you can ask your friend to talk about something else, or even hang up on her. In this way, you are controlling the conversation in the hope of meeting your own goals, and more specifically, what you are monitoring—the ongoing dialogue from your friend—is being used in the service of controlling the conversation. Of course, in terms of the framework in Figure 1.1, the object-level is not external to you—as in this example—but instead refers to any one of many cognitive processes that you could be monitoring and controlling.

Our leading scenario involving Linda also poses a mystery that we will explore in more depth throughout this book, namely, "How can people both think and think about themselves thinking at the same time?" That is, how can Linda both study and think about her studying as she is doing so? According to the framework in Figure 1.1, people become aware of their thinking when information from object-level thought processes is *represented*

by the meta-level. The idea is that we can think about our thinking—or monitor thinking—by developing a higher-order representation (or model) of what cognitions are operating at the object-level. This particular answer to our question is similar to those posed by other philosophers and cognitive scientists (e.g., Rosenthal, 1998; Schooler, 2002). This framework is powerful because it is general: Any particular cognitive processes could be the object of meta-level processing. As important, the framework itself poses many empirical questions that will be explored thoroughly in this book, such as, How do people monitor ongoing thought processes, such as learning or problem solving? Is such monitoring accurate or does monitoring provide a distorted picture of people's cognitive activities? How is monitoring used to control ongoing cognitive activities, and when people control cognition, do they do so in an effective manner?

Throughout this book, we will describe key experiments and debates that have arisen in response to these, and many other, questions and mysteries about metacognition. In this brief introduction, we have defined some concepts that will appear throughout this volume. We conclude by describing the chapters and main sections of the book, and as important, we also provide suggestions on how to work your way through them.

Chapter 2 describes some of the historical origins of metacognition. Certainly, a metacognitive approach to psychology has not always been in good standing, especially during the peak of the behaviorist movement when many psychologists criticized using introspective methods to investigate the mind and even dismissed the need for the concept of consciousness in psychological science. In this chapter, we describe how modern metacognitive research has responded to early criticisms and give a brief overview of some events relevant to the rise of metacognition. We also introduce some of the pioneers of metacognition—such as John Flavell and Joseph Hart, among others—who were vital in promoting and shaping this area. Chapter 2 will be useful to those who want to become scholars of metacognition, although it is not essential for understanding subsequent chapters.

In the remainder of the volume, we review research that has sought to answer a variety of core questions about metacognition, some of which we introduced above. The book is separated into three major sections, each including a set of chapters on more focused topics. In each chapter within a section, we highlight issues and experimental data that have driven programs of research within an area. Although the massive amount of research conducted in each area precludes an exhaustive review in any chapter, we have attempted to touch upon a wide range of work by highlighting both seminal and cutting-edge research. As important, we discuss special topics and current mysteries in boxes throughout each chapter. The latter boxes document

unresolved mysteries that new researchers in the area may find intriguing and exciting to explore, such as, "Do drugs impair your monitoring accuracy?" and "I'm in a tip-of-the-tongue state: How do I cure it?" Most chapters will introduce you to some of the influential leaders in the field, most of whom are still dedicated to pursuing programs of research aimed at solving mysteries in the field.

In Section 1, Basic Metacognitive Judgments, we entertain questions about how people monitor and control their memory, learning, and retrieval. In fact, much of this book examines issues that pertain to the metacognitive processes of memory—or metamemory—because the bulk of theoretical work relevant to monitoring and control processes has been conducted in this area. In Section 2, Applications, we discuss how metacognitive research has been applied to other tasks that are relevant to important real-world activities. These include the quality of eyewitnesses' confidence in memories of a crime as well as how metacognitive techniques have been used to improve student scholarship in educational settings. In Section 3, Life-Span Development, how metacognition develops and changes across the life span is of central interest. Monitoring and control processes are largely the focus of the first two sections, whereas in Section 3, we consider metacognitive knowledge in some detail, because it is here where scientists have wondered whether people's developing knowledge of cognition is a cause of cognitive development itself.

The chapters can be read in almost any order, although you may benefit by reading some before others. Because Chapter 3 describes the methods and analyses that have been used heavily in many disciplines in the field, we recommend reading this chapter before reading the others within that section or the chapters on Law and Eyewitness Accuracy, Childhood Development, or Older Adulthood. The remaining chapters can mainly be read independently of the others. With that said, our aim was to produce a volume in which each chapter builds upon issues and ideas within the previous ones, so paging through this volume chapter by chapter will likely lead to the most coherent and certainly most complete understanding of the principles of metacognition.

DISCUSSION QUESTIONS

1. In this chapter, the relationship between monitoring and control was illustrated with a metaphor involving two people speaking on cell phones, with one individual representing the meta-level and the other representing the object-level. Name as many different ways that the listener could *control* the input of this message. On one hand, why does this metaphor not actually represent a truly metacognitive system? On the

other hand, what metacognitive monitoring and control processes may be occurring within your own mind as you have a conversation with a friend? How might your inner metacognitive processes influence how you interact with your friend during this conversation?

2. Read the following sentence, and take a moment to reflect on how well you understand it: "The horse raced past the barn fell." If you are thinking, "I don't understand that sentence a bit," then you are similar to many others. Strangely, the sentence is grammatically correct. Here is a paraphrase to make it clearer: "The horse that was raced past the barn fell." Now, monitor your comprehension of this sentence. Any better? So, for comprehending sentences, people have some ability to monitor their understanding. Put differently, we are somewhat able to monitor the ongoing cognitive process of comprehension. Can you think of any cognitive processes that you would not be able to monitor? Why? (Just in case you still are concerned about the barn, the horse is the one that did the falling.)

CONCEPT REVIEW

For the following questions and exercises, we recommend that you write down the answers on a separate sheet in as much detail as possible, and then check them against the relevant material in the chapter. (For the reason why this trick will help you evaluate how well you have learned these concepts, see Dunlosky, Rawson, & Middleton, 2005.)

1. What is metacognition?
2. What is metacognitive knowledge?
3. Explain metacognitive monitoring and provide some examples of monitoring.
4. Explain metacognitive control and provide some examples of control processes.