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memory

the brain,
the mind, and
the past

DANIEL L.
SCHACTER

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—Mark Pendergrast, *Philadelphia Inquirer*

Searching for Memory



The Brain, the Mind, and the Past

DANIEL L.
SCHACTER

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For my mother, Harriet

Great is the power of memory, a fearful thing, O
my God, a deep and boundless manifoldness; and
this thing is the mind, and this am I myself.

—Augustine, *The Confessions of Saint
Augustine*

“I know it can’t’ve *been* like that, but that’s what I
remember.”

—Pat Barker, *Regeneration*

As I used to say to my clients, “Memory is life.”

—Saul Bellow, *The Bellarosa Connection*

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THE SEEDS OF THIS BOOK were sown in 1975, when I worked as a research assistant for Dr. Herbert Crovitz at a Veterans Administration Hospital in Durham, North Carolina. There I tested brain-damaged patients who were utterly incapable of remembering new information for more than a few seconds. One man conversed easily when we first met and seemed more or less like anyone else. But when I left the room and returned several minutes later, he had totally forgotten we had ever met. Startled and intrigued by such dramatic disorders, I developed a deep and enduring interest in memory that I have pursued for the past two decades.

I have had much help along the way. Herb Crovitz ignited my interest in memory, and Endel Tulving nurtured it during my years in graduate school and ever since. I have been fortunate to work closely with many fine psychologists and neuroscientists during the past two decades. For their contributions to research described in this book, I am indebted to Marilyn Albert, Nat Alpert, Barbara Church, Lynn Cooper, Tim Curran, Elizabeth Glisky, Peter Graf, Joanne Harbluk, John Kihlstrom, Bill Milberg, Morris Moscovitch, Mary Jo Nissen, Michael Polster, Scott Rauch, Eric Reiman, Cary Savage, Endel Tulving, Anne Uecker, Mieke Verfaellie, and Paul Wang—to name only some of my collaborators. I have received pointers and advice concerning phenomena and issues addressed in these pages from numerous colleagues, including Steve Ceci, Mary Harvey, Jake Jabobs, Eric Kandel, Michelle Leichtman, Elizabeth Loftus, James McGaugh, Richard McNally, Roddy Roediger, and Larry Squire. The members

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My greatest debt is to my family, Susan, Hannah, and Emily, the source of my most vital memories.

INTRODUCTION

Memory's Fragile Power

IN GABRIEL GARCÍA MÁRQUEZ'S epic novel *One Hundred Years of Solitude*, a strange plague invades the small village of Macondo, causing the inhabitants to lose aspects of their memories. The symptoms develop in stages. Each villager loses the ability to call up childhood recollections, then the names and functions of objects, later the identity of other people, and finally "even the awareness of his own being."

A silversmith, frightened when he cannot come up with the word *anvil* to describe the tool he has always worked with, frantically goes about placing written labels on every item in his home. Inspired by the method's seeming success, José Arcadio Buendía attempts to label everything in the village:

He . . . marked the animals and plants: *cow, goat, pig, hen, cassava, caladium, banana*. Little by little, studying the infinite possibilities of loss of memory, he realized that the day might come when things would be recognized by their inscriptions but that no one would remember their use. Then he was more explicit. . . . *This is the cow. She must be milked every morning so that she will produce milk, and the milk must be boiled in order to be mixed with coffee to make coffee and milk.*¹

Distressed at the thought of a life of endless labeling, Buendía makes a heroic last attempt to save the memory of the villagers: he

tries to develop a memory machine that will store written entries of all the experiences and knowledge accumulated in each person's life. After devising fourteen thousand entries for the machine, mercifully, Buendía is freed from this nightmare by a stranger who cures him of the plague. With a cure comes the full restoration of his memory. Only then does he recognize the stranger as an old and dear friend.

The novel dramatizes a world without memory: a world in which even close friends and family members seem like strangers; a world in which symbolic forms of communication are useless, and most of the tasks on which society depends cannot be performed; and, perhaps most tellingly, a world in which our sense of personal identity and self-awareness is stripped away. The narrator in Saul Bellow's *The Bellarosa Connection*, who runs a memory-improvement institute, sums it up for his clients: "Memory is life."²

Yet, except for those annoying moments when memory fails or when someone we know is afflicted with memory loss, most of us are barely aware that just about everything we do or say depends on the smooth and efficient operation of our memory systems. Stop and think for a moment about what is involved in just one simple task: arranging to meet a friend at a restaurant. For starters, you must be able to bring to mind your friend's name and phone number as well as the information needed to execute the call. Then you must use your memory of voices to identify the person who answers the phone as your friend. Throughout, to hold up your end of the conversation and to understand what is being said to you, you must constantly access an internal dictionary of words, sounds, meanings, and syntax. At some point you must search through memories of visits to restaurants, or recommendations of new ones, in order to determine which restaurant would be a good choice. You must be able to call up details of your friend's personality, special interests, and anything else that will contribute to harmony and avoid provocation or confrontation. Later, you must call upon knowledge and skills that remind you how to get physically from here to there. Finally, you must be fully aware of what else is going on in your life so that you do not schedule the meeting for a time when you already have something planned.

We perform these feats of memory naturally, even though the tasks require the virtually perfect operation of memory-retrieval systems with processes so complex that even the most advanced computer would not be able to carry out the assignment as easily and effectively as we do. Now consider that we rely on these systems to perform similar feats countless times each and every day of our lives.

Like other biologically based capabilities, memory is generally well adapted to such everyday demands of life, because it has evolved over countless generations in response to the pressures of natural selection. A foraging animal who can remember locations where food has been found has an important survival advantage over a competitor with less accurate recall; an inhabitant of the jungle who can recognize quickly the signs of a dangerous predator stands a better chance of escape than a competitor with slower or foggier recognition processes. Indeed, we can guess that many features of memory survived the rigors of evolution precisely because they helped animals and people survive and reproduce; any memory system that consistently produced serious distortions would not be likely to survive many generations.³ While far from perfect at meeting all human needs, our own memory systems do a remarkably good job of handling the staggering variety of demands we place upon them.

Yet memory's reputation has been tarnished lately. We hear disturbing reports of false traumatic memories in therapy patients. We read strange stories of people who vividly recall alien abductions. And we learn that scientists have come up with simple ways to induce some of us to remember clearly events that never happened!

Does this suggest that as accurate as memory is in most situations, it is less consistently reliable than we once believed it to be? Or that its reliability is conditional, highly accurate in some situations or under some conditions—perhaps when our well-being or even our survival is at stake—but less so in other circumstances? Or that it is highly reliable in allowing us to recall a general sketch of moments from the past, but much less reliable in its recall of specific detail?

We've all had firsthand experience with memory's imperfections. I once asked a colleague how long it had been since he shaved his beard. He replied in bewilderment that he had always been clean-shaven. Each of us had perfect confidence in his own memory, yet the two were in conflict. Likewise, all of us have had the uncomfortable experience of being unable to pull up a word or a name we once knew well, failing to recognize a face that ought to seem familiar, or drawing a blank when a friend reminds us of something we supposedly did together. Why is it, we may ask, that trying to remember the past is sometimes like trying to capture a darting phantom? Is this evidence of the imperfection of evolution? Or, rather, of the side effects of its advantages? Imagine having immediate access to everything you ever knew or experienced. Is protection from the chaos that would

result the price we pay for the occasional inability to retrieve information we need or want at the moment?

Researchers studying memory have begun to grapple in earnest with these and other equally intriguing questions about how we remember the past. For example, to study emotion, researchers often ask their subjects to call up the saddest or happiest moment of their lives. Remarkably, it has been observed that the act of remembering sad episodes can bring people to tears within moments, and remembering happy incidents can induce an almost immediate sense of elation. Why does memory have such power in our lives?⁴

To begin to answer the questions I've raised, we must first try to understand what memory is. Twenty years ago, when I first entered the field of memory research, it was fashionable for cognitive psychologists to compare memories to computer files that are placed in storage and pulled out when needed. Back then, nobody thought that the study of memory should include the subjective experience of remembering. We now believe with some degree of certainty that our memories are not just bits of data that we coldly store and retrieve, computerlike. Artists and writers, of course, have long been aware of the importance of subjective experience in memory, and I am often struck by their prescient comments about what memory has meant to them in their creative work.

For instance, in Matthew Stadler's novel *Landscape: Memory*, the story's protagonist, Maxwell Kosegarten, starts to paint a landscape he saw several years earlier. The painting develops slowly, over time, as Maxwell retrieves and explores his memory again and again. As he paints, he confronts the discrepancy between the view of memory as a static reproduction and what his own experience is telling him. He writes:

if my memory ought to be an accurate replica of the original experience, if that was so, my painting was hopelessly inaccurate. It was a bad painting of a fuzzy memory. But I preferred to think that memory is never frozen, nor should it be. My painting was a successful rendering of the dynamic memory that had simply begun with the original event. . . . My painting, I figured, was so very accurate in its depiction of this memory that it would inevitably look wrong when compared to the original model.⁵

Philosophers and writers have sought to penetrate memory's mysteries for centuries, and scientists have struggled with remembering

and forgetting for more than one hundred years. For much of this time, progress has been slow, but the study of memory has undergone dramatic changes during the past couple of decades, some even revolutionary. Most important, we have now come to believe that memory is not a single or unitary faculty of the mind, as was long assumed. Instead, it is composed of a variety of distinct and dissociable processes and systems. Each system depends on a particular constellation of networks in the brain that involve different neural structures, each of which plays a highly specialized role within the system. New breakthroughs in brain imaging allow us to see, for the first time, how these specific parts of the brain contribute to different memory processes.

In this book I identify and discuss different types of memory that enable us to hold information for brief periods of time, to learn skills and acquire habits, to recognize everyday objects, to retain conceptual information, and to recollect specific events. Acting in concert, these memory systems allow us to accomplish the tasks of our day-to-day lives while also supplying our intellect and emotions with ideas and feelings from the past that allow us to act with purpose and live rich emotional lives. But memory involves more than just our remembrance of things past. As we have come to learn that memory is not one single thing, we've opened up a whole new world of implicit, nonconscious memory that underlies our abilities to carry out effortlessly such tasks as riding a bicycle or playing a piano, without having to direct each movement consciously every time we attempt the task. Many of us think of this type of memory as being stored in our fingers, but new research is uncovering that specific brain systems are involved in the nonconscious effects of the past on the present.

We now know enough about how memories are stored and retrieved to demolish another long-standing myth: that memories are passive or literal recordings of reality. Many of us still see our memories as a series of family pictures stored in the photo album of our minds. Yet it is now clear that we do not store judgment-free snapshots of our past experiences but rather hold on to the meaning, sense, and emotions these experiences provided us. Although serious errors and distortions occur relatively infrequently, they furnish significant clues about how we remember the past because they arise from, and provide a window on, some of the fundamental properties of our memory systems.

One especially important such property is that we cannot separate our memories of the ongoing events of our lives from what has happened to us previously. Imagine that for a set time period, two people

were tied together so that each could witness only what the other saw, read only what the other read, learn only what the other learned, and have only the emotional experiences the other experienced. Unless these two people were identical personalities with identical pasts, their memories of the time period could be vastly different. What has happened to us in the past determines what we take out of our daily encounters in life; memories are records of how we have experienced events, not replicas of the events themselves. Experiences are encoded by brain networks whose connections have already been shaped by previous encounters with the world. This preexisting knowledge powerfully influences how we encode and store new memories, thus contributing to the nature, texture, and quality of what we will recall of the moment.

Not surprisingly, these insights and others have taught us much about the vulnerability of memory—why our recollections are sometimes predisposed to corruption by suggestive influences, and how we sometimes distort the past for no immediately apparent reason. And we are beginning to understand why some memories have the power to induce us to cry, to laugh, or to tremble. We are still far from being able to say that we have a complete picture of how human memory works, but after centuries with little success, we are starting to find places for many pieces of the puzzle.

One reason for the emerging synthesis is that students of the brain and the mind, after years of going separate ways, have come together to develop an integrated approach that has transformed the study of memory: cognitive neuroscience. A mere two decades ago, the study of memory was carried out by separate tribes of cognitive psychologists, clinicians, and neuroscientists. Cognitive psychologists studied memory in the laboratory, but showed scant interest in the world of memory outside the lab and little or none in the brain.

Clinicians—psychologists, neurologists, and psychiatrists—described fascinating disorders of memory, but were unfamiliar with the elegant techniques used by cognitive psychologists to dissect memory. Neuroscientists studied memory by removing particular parts of animals' brains and then observing the effects. Most of them hardly noticed the findings and ideas of cognitive psychologists or clinicians.

In the 1980s, cognitive psychologists began to emerge from the confines of the laboratory. Some studied memory in everyday life, adding a new richness to their work. Others began to test patients with memory disorders, bringing their vast arsenal of experimental

tools to bear on understanding baffling cases of amnesia. Clinicians interested in memory loss drew increasingly on the techniques and theories developed by cognitive psychologists, and used new methods for visualizing the brain, such as magnetic resonance imaging (MRI), to provide precise characterizations of brain damage in their patients. At the same time, neuroscience made stunning progress, facilitated by technical breakthroughs that allowed increasingly refined explorations of the brain and by the development of powerful new theories using neural networks. More and more neuroscientists began to relate their findings with rats and monkeys to human memory. And during just the past few years, new functional neuroimaging techniques, such as positron emission tomography (PET scanning), have allowed us to see the brain in action while people remember. Cognitive psychologists, clinicians, and neuroscientists are all now contributing to pathbreaking neuroimaging research that is providing a novel window on memory and brain. A synthesis has emerged during the past two decades that is exciting and vast in scope.

I decided to write this book because I believe it is time to tell the tale from the perspective of someone who has been part of it. For much of my career I have attempted to link cognitive psychology, clinical observations, and neuroscience into a cohesive approach to understanding memory. Here I try to paint the big picture of memory as I have come to see it.

But my goal in writing this book goes beyond describing the new synthesis in memory research and relating some of my own discoveries and ideas, to include consideration of a puzzle that many of these findings highlight. Memory, that complex and usually reliable asset, can sometimes deceive us badly. Yet even though memory can be highly elusive in some situations and dead wrong in others, it still forms the foundation for our most strongly held beliefs about ourselves. A head-injury patient I once interviewed who had lost many treasured memories felt that he had also lost his sense of self. He became so obsessed with the missing pages of his past that he could think or talk of little else.

“I can’t review my life,” he kept telling me.

This important duality—memory’s many limitations on the one hand and its pervasive influence on the other—is at the heart of this book because it is central to understanding how the past shapes the present. I refer to it as fragile power, and it has affected increasing numbers of us in recent years. An intense controversy has exploded in therapy settings, courtrooms, and the popular media as people claim,

with passionate conviction, to have recovered long lost memories of sexual abuse during childhood. Are some of these allegations based on illusory “memories” created, rather than uncovered, in psychotherapy? We have also seen a steady parade of child care workers and others convicted for abusing young children. Did these children really experience the horrors they report, or did repeated questioning create memories of events that never occurred?

Memory’s fragile power is evident in other sectors of society, too. As the aging population lives longer, more and more families are affected by the corresponding increase in cases of Alzheimer’s disease. Here, the devastating progression of memory disorder highlights both our extraordinary dependence on memory and its remarkable sensitivity to changes in brain function. And in perhaps the most poignant example of all, fifty years after the horrors of the Nazi killing grounds, so-called revisionist groups have attempted to recast society’s collective memory of the Holocaust by dismissing the recollections of survivors and questioning the mountains of factual evidence and footage of the most despicable event of modern times.

These examples remind us that trying to understand memory’s fragile power is not just an exercise in intellectual curiosity; it is also essential for understanding some of the most compelling issues of our times. In this book I relate insights from modern memory research to these and other important manifestations of memory in our day-to-day lives. Chapter 1 examines subjective experiences of remembering. It was once believed that remembering a past experience is merely a matter of bringing to mind a stored record of the event, but recent research has overturned this persisting myth. We will see how even the seemingly simple act of calling to mind a memory of a particular past experience—what you did last Saturday night or where you went on your first date—is constructed from influences operating in the present as well as from information you have stored about the past.

In chapter 2 I explain some of the fundamental processes that give rise to our memories. I will show how understanding the nature of encoding can help us to fathom the spectacular feats of memory of a long-distance runner who could recall long strings of digits and an autistic savant who had an extraordinary ability to remember visual patterns but little else. I will illustrate the complexities of the retrieval process when I introduce a brain-damaged boy who could recall his recent experiences through writing but not talking. And we will see how PET scanning studies are beginning to alter our thinking about how the brain accomplishes encoding and retrieval. I have taken part

in some of this research and will report the latest developments from the cutting edge of an exciting frontier.

Chapter 3 examines how we construct our autobiographies from fragments of experience that change over time. We will see that memories are not stored in any single location in the brain, as some researchers used to believe, nor are they distributed throughout the entire brain, as others contended. Different parts of the brain hold on to different aspects of an experience, which are in turn linked together by a special memory system hidden deep within the inner recesses of our brains. New conceptions of autobiographical memory will help us to make sense of what happened to a brain-damaged man haunted by a delusional memory that he is still fighting World War II, and provide insights into the experiences of a novelist who told the story of her life to a dying daughter.

How accurate are the tales we tell about our lives? In chapter 4, I explore the relation between memory and reality and consider what happens when the connection between the two is severed. Accumulating evidence suggests that we are usually correct about the general character of our pasts, but are susceptible to various kinds of biases and distortions when we recount specific experiences. We are especially prone to misremembering the source of our memories, as in the story I relate of a woman who confused a man she had seen on television with the man who had raped her. Studies of patients with neurological damage have begun to reveal what parts of the brain allow us to sort out memories of actual events from fantasies or imaginings.

We have also learned important lessons from brain-damaged adults who have lost large chunks of their pasts—some because they cannot form new memories, others because they can't retrieve old ones. In chapter 5 we will see that studies of these amnesic patients have led to an idea with profound implications: memory is not a self-contained entity, as many researchers once believed, but instead depends on a variety of different systems in the brain.

The study of amnesic patients has also helped to open up the previously hidden world of *implicit memory*—when past experiences unconsciously influence our perceptions, thoughts, and actions. When I first began doing research, psychologists studied *explicit memory* for recent experiences by asking people deliberately to recall or recognize words or other materials they had been shown a few minutes earlier. But in the early 1980s, a series of stunning experiments showed that people can be influenced by recent experiences even when they are unable to recall or recognize them explicitly. As we will see in chap-

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