

A Harvard Medical School Special Health Report

Improving Memory

Understanding age-related memory loss



In this report:

How memory changes with age

17 ways to promote memory health

Seven flaws of normal memory

Is it normal aging or dementia?

SPECIAL BONUS SECTION

Improve your everyday memory

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IMPROVING MEMORY

SPECIAL HEALTH REPORT

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Dear Reader,

Years ago, I saw a patient in the early stages of dementia. She still had moments of great clarity, and in one of those times she lamented, “I’m vanishing as a person.” Her words have stuck with me because they seemed like such a lucid description of the impact of dementia on an individual. In many ways, our memories shape who we are. They make up our internal biographies—the stories we tell ourselves about what we’ve done with our lives, the people we’ve loved, and those who have mattered to us. In short, our memories are crucial to our essence as human beings.

Memory also facilitates the practical side of life. Remembering how to get from your house to the grocery store or how to do the tasks that make up your job allows you to take care of your needs and the needs of the people you love. That’s what makes memory loss so scary and one of the most common fears of people as they grow older. In my work as a neurologist, I care for patients with cognitive impairment, many of whom have disorders like Alzheimer’s disease. To balance this activity, my research has focused on studying healthy cognitive aging. I have been investigating the differences in brain activity between older individuals with very well-preserved thinking and memory and those with more typical age-related difficulties. I also have been leading studies aimed at promoting brain health and enhancing memory function. My interest in these issues led me to accept the invitation to edit this Special Health Report.

There’s no getting around the fact that the ability to remember does change with age. Reassuringly, many of these changes are signs of normal aging, not dementia. However, now is a good time to commit to enhancing your brain and protecting it as much as possible from decline. One key is continually challenging the brain with new tasks that build what the experts call cognitive reserve—a reflection of the brain’s capacity to resist damage from disease or injury. Staying mentally active and learning new skills are good ways to do this. Although the connection may not seem obvious at first, keeping the rest of your body healthy is another fundamental way to preserve your memory. For example, exercise turns out to be among the best prescriptions for maintaining not only a healthy body, but also a healthy brain and a resilient memory.

In short, there are important measures you can take to protect your brain as you age. This report will show you 17 concrete steps for enhancing and preserving your memory, as well as numerous practical strategies for improving everyday recall. It will also answer common questions about memory, and it will provide you with important ways to help distinguish between normal memory changes and those due to disease. It will also help you understand why memory, at any age, is imperfect. Now, let’s get started.

Sincerely,

Kirk R. Daffner, M.D.
Medical Editor

Dr. Daffner would like to acknowledge Dr. Marilyn Albert and Dr. Aaron Nelson, the previous editors of this Special Health Report, who provided the foundation for the current presentation, and to thank the Wimberly family, the Muss family, and the Mortimer/Grubman family for their generous support.

Understanding memory

All your life, you've probably experienced times when your memory failed you—whether on a high school history test or an examination for a driver's license. (Exactly how many feet away from a fire hydrant do you have to park, anyway?) Even as a teenager, could you remember all the verses of a song, or was it only the chorus that stuck?

Memory is not perfect, no matter how old you are. True, some people have amazing memories. They recall details of events that have long since escaped you. But nature did not design the human brain—even theirs—for perfect recall of every detail in daily life. Just as you delete old emails on your computer to make way for new ones, the brain routinely prunes out unneeded information, making way for newer, more relevant memories.

Moreover, memories are not like snapshots that are taken and then stored in their entirety in one place in the brain. Rather, memories are encoded in a fragmented manner and distributed throughout different parts of the brain; these different pieces must be reassembled when you remember something, creating the possibility that you may reconstruct the memory imperfectly. Adding to all this uncertainty, memories of an event—even one you witnessed—can be heavily influenced by what other people tell you happened or by your own biases (see “Seven flaws of normal memory,” page 9). That's why eyewitness testimony is unreliable.

In short, it's normal to forget things. It's also normal to become somewhat more forgetful as you grow older. However, for some people, memory problems go beyond what is normal. Dementia (a serious decline in memory and thinking caused by Alzheimer's disease, damage to blood vessels that feed the brain, or a buildup



of abnormal proteins in the brain) can rob people of the ability to remember and think well enough to function independently. How can you tell whether your memory lapses are caused by normal aging or something more serious? There are some key differences, as noted later in this report (see “Memory problems: Normal aging or brain disease?” on page 39).

Unfortunately, there is no cure for dementia. However,

there are many steps you can take to improve normal memory and promote a healthy brain—including steps that will help you reduce your risk for developing dementia in the first place or at least delay its onset. This report will serve as your road map. But first, you need to understand just what memory is and how it works.

What is memory?

Memory refers to all that you remember, as well as your capacity for remembering. But not all memories are created equal. Some memories are meant to be retained for a short period and then discarded. For example, you remember the telephone number of the local pizza place only long enough to make the call. By contrast, memories that are more important—for example, the names of close friends and relatives, the multiplication tables, your phone number, and other information you use regularly—are kept in the brain's equivalent of long-term storage and can be retrieved at will. Certain kinds of information can be memorized only if you concentrate, whereas other kinds of memories, such as the faces of people you see regularly and the steps of simple everyday routines like brushing your teeth, are absorbed without conscious effort.

Researchers and neuroscientists have devised several classification systems to describe the various forms of memory. One major system relies on duration, making a distinction between short-term memories, which are fleeting, and long-term memories, which can persist for a lifetime.

Short-term memory

This is information that the mind stores temporarily, encompassing what you need to remember in the next few seconds or minutes. Short-term memories include, for example, the name of the person you just met fleetingly at a cocktail party (as well as what that person said), and the date and time of the appointment you just made and must remember only until you write it down.

One form of short-term memory is working memory, which enables you to manipulate information while holding it in short-term storage. For example, working memory comes into play when you remember prices at the supermarket while at the same time performing a computation with them so you can compare costs between different brands or quantities.

Short-term memories are supposed to be fleeting. They turn over at a high rate because new ones are continually replacing them, and there are only so many short-term memories you can keep in mind. Research shows that the average person can hold only about seven (plus or minus two) unrelated “bits” of information in mind at one time. That’s why it’s easier to remember a seven-digit phone number than a longer number such as the identification number on a driver’s license.

The relatively transient nature of your short-term memory is actually beneficial because it allows you to discard unnecessary information. Imagine what life would be like if you kept every short-term memory—the price of each dish you ordered from a Chinese restaurant, or what color tie your friend wore every day last week. Your mind would be so overloaded with trivia that you’d have trouble focusing on the things that really are important. It would be as if you kept all your junk mail and let it bury your personal letters, bank statements, and other important documents.

Short-term memory has another limitation. It is fragile and easily disturbed by interruptions. If you’re

Flashbulb memory

Memory researchers use the term “flashbulb memory” to describe a vivid memory of an unexpected, emotionally charged public event. The assassination of President Kennedy and the destruction of the World Trade Center are examples of compelling public events that became ingrained in the memories of many who witnessed them, either directly or through television. Flashbulb memories tend to include numerous minute details associated with your experience of the event—where you were standing, what you were doing, who was around you, and so on. It is likely that the combination of profound meaningfulness and emotional impact surrounding the event serves to inscribe it intensively in long-term memory.

Experts used to assume that flashbulb memories remained more accurate over time than ordinary memories, but research has shown that they are vulnerable to the same biases and distortions as memories of less dramatic events.

This theory has been corroborated in studies of different groups of people in the aftermath of the Sept. 11, 2001, terrorist attack. In a study in *The Journal of Experimental Psychology*, researchers questioned more than 3,000 people from seven U.S. cities about their memories of the event one week, 11 months, and 35 months after the assault. Participants answered questions about where they were, what they were doing, and how they felt when they first heard the news, as well as specific facts about the attack, such as the number of planes involved (referred to as event memory). The researchers found that the rate of forgetting was about 20% or more the first year and between 5% and 10% thereafter—a rate that’s similar to ordinary autobiographical memories.

trying to remember a phone number and someone walks into the room and asks you a question, chances are you’ll forget the number and have to look it up again. Shifting your focus of attention to answer the question overwrites the phone number, which was being held in short-term memory.

Long-term memory

Although most unimportant short-term memories quickly decay, the brain stores the important ones—those that are emotionally compelling or personally meaningful. That stored information is long-term memory. It is the total of what you know: a compendium of data ranging from your name, address, and phone number to more complex information, such as

the sounds and images of important events that happened decades ago. It also includes the routine information you use every day, like how to make coffee, operate your computer, and carry out all of the intricate sequences involved in performing your job or running your household.

Your long-term memory and short-term memory are not distinguished merely by how long the memories last. Another difference is the amount of information each memory system and its associated brain regions can handle. Although the brain can juggle only a relatively small number of short-term memories at a time, it can store an enormous number of long-term memories. Barring disease or injury, you can always learn and retain something new. Furthermore, long-term memories are less fragile than short-term memories, which means they're not lost when something interrupts your train of thought. Some types of previously learned long-term memories even tend to remain intact in the early stages of dementia, when people have trouble learning new information. This applies especially to procedural memory (see page 5).

Maintaining a long-term memory often requires that you periodically "revisit" it. Some memories that go unused for a long time fade or become distorted. Have you ever read a book that you loved, but years later found yourself unable to recall much more than the title? That's probably because you hadn't thought of the plot and characters in a long time. On the other hand, certain long-term memories are amazingly persistent, no matter how infrequently you use them. For example, many adults are surprised by their ability to remember minute details of their youth—an unjusti-

fied punishment they received, a fifth-grade science project, their first date. These events probably made a deep emotional impression at the time.

Interestingly, research demonstrates that although long-term memory is more durable than short-term memory, it is also changeable. For example, the way you remember your first romance can evolve over time in response to experiences and information you acquire years later.

Declarative (explicit) memory

Long-term memory can be divided into two categories—declarative memory and implicit memory.

Declarative memory, also known as explicit memory, is information that requires a conscious effort to recall. It is further divided into two subtypes—semantic memory and episodic memory.

Semantic memory is factual knowledge, such as the names of the continents, the color of your spouse's eyes, or what winter is. Much of the basic information you acquired during your school days falls into this category. In addition to being factual, semantic memory has another key characteristic: it is not bound to a specific point in time. You can't point to the exact moment when you learned that George Washington led the Revolutionary War, for example. And even if you can remember the specific day when you learned the multiplication tables or other facts in school, the timing isn't important to your knowledge of them.

Episodic memory contains the images and details of experiences you have had. Episodic memories are personal memories tied to specific times and places. The party you attended last weekend, the vacation you took last summer, and your children's birthday celebrations are all episodic memories. An episodic memory is more fragile than a semantic memory because it is more specific; it has a smaller network of associated connections in the brain. Throughout your lifetime, you've probably thought about George Washington being the first president of the United States a hundred or more times, in many different contexts—maybe during social studies class, then during a trip to see his historic house at Mount Vernon, or when you saw his head on a quarter or a

Types of long-term memory	
<p>DECLARATIVE, or EXPLICIT ▶ Requires conscious effort to recall</p>	<p>Semantic: General or factual information (Examples: <i>The year World War II started, names of colors, state capitals, the contents of this report</i>)</p> <p>Episodic: Personal memories (Examples: <i>Your wedding, your vacation, what you did yesterday</i>)</p>
<p>IMPLICIT ▶ Outside of conscious awareness</p>	<p>Procedural: Skills and procedures (Examples: <i>How to type, play golf, ride a bicycle, drive a car, brush your teeth</i>)</p>

QUICK QUIZ: WHICH MEMORIES WILL YOU FORGET?

You are 65 years old. You get in your car to drive to your sister's house in another town for Thanksgiving. The last time she made Thanksgiving dinner was five years ago, and it was your Uncle Ed's last holiday with the family. He died three months later. His new caregiver, Pat, had brought him to the dinner. That was also the Thanksgiving that your niece announced she was pregnant.

On this trip to your sister's, while thinking about your last visit, which of the following are you most likely to forget?

- A. To release the parking brake before setting the car in motion
- B. Your uncle's name
- C. The name of your uncle's caregiver
- D. The family's reaction to your niece's news
- E. The route to your sister's house
- F. To put the pumpkin pie you promised to bring in the car

Answer: If you have normal age-related memory problems, the correct answers are **C** and **F**.

Let's review:

- A.** The steps involved in driving a car are procedural memory, which holds up quite well with age.
- B.** If you have trouble remembering your uncle's name, this is a sign that something more serious may be wrong. You should consider having your memory checked by a doctor.
- C.** The name of someone you met only once several years ago is the type of memory that is less likely to be remembered. When you met Pat, you may have put the name into short-term memory, but it never made it into long-term storage. So you will not remember it five years later. Even if you did store the name, you haven't used it for so long that the memory of it has faded. If you saw Pat on the street, you would most likely recognize her but not remember her name. If she introduced herself, it would likely spark the memory and allow you to connect the name to the face.
- D.** Recollection of the interaction among the family members at the dinner is an example of episodic memory. Some types of episodic memory diminish with aging. But memories

of events that provoke emotion tend to endure. You may have more trouble remembering a mundane conversation you had with your cousin than the joyous news about your niece.

- E.** You could have answered E to the question and been right. This was a trick because there's not enough information in the question. If you visit your sister often, then you should remember how to get to her house. If you visit your sister often, yet get lost on the way to her house, this is a sign of a memory problem outside the realm of normal, and you should consider having your memory checked by a physician. If it's been five years since you drove there, you will likely need directions or a GPS. As you drive, though, you may find that you don't need as much prompting as you thought. You may see landmarks that jog your memory.
- F.** How could you possibly have forgotten the pie? There are several possible reasons for this lapse that have nothing to do with dementia. Distraction is an example. You may have been thinking about other concerns while packing for the trip. Perhaps the phone rang while you were loading the car. You chatted with a friend for a few minutes and then forgot that you hadn't put the pie in the car.

dollar bill. Episodic memories, on the other hand, are probably brought up in fewer contexts and less often.

Implicit memory

In contrast to declarative memory, implicit memory relies on information that is stored at the subconscious level. Though there are a couple of types of implicit memory, the only one that matters in this context is procedural memory.

Procedural memory allows you to hone skills and do routine things like getting dressed, without con-

sciously recalling previous experiences with the same tasks. How to ride a bicycle, write in cursive, tie your shoes, drive a car—each of these skills required effort and practice at one time, but once you mastered it, you were able to perform it without remembering how you learned it or the separate steps involved. When you take out your bike for a ride, for example, you don't think, "Okay, first I straddle the seat, then I put my left foot on the left pedal, and then I push off the ground with my right foot...." You just get on and go. It's as if your body does the remembering for you. ♥

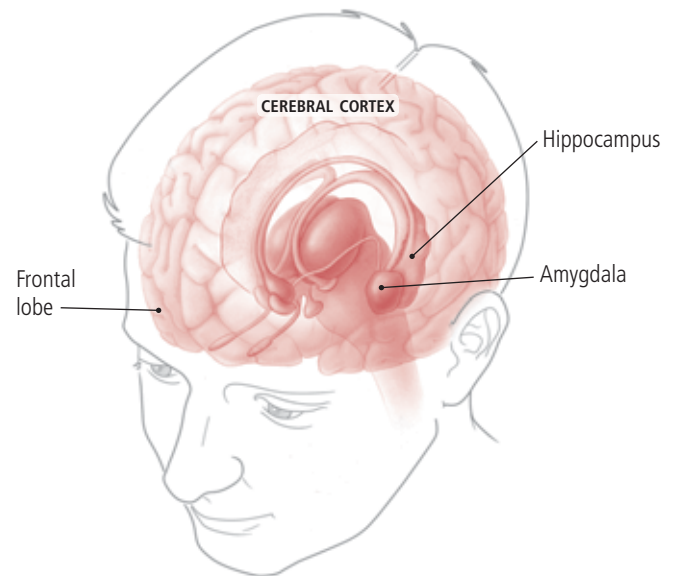
How memory works

You just saw a new movie, and you stored the memory of it in your brain, along with other information and events that you encountered today. But where, exactly, did it go? Is your brain's system for storing memories a “memory bank”—a single repository of all the sights, sounds, and facts that have made a strong enough impression for you to remember them?

The short answer is no. The memory of an event is not a single entity, like a book on a shelf. Instead, it is the aggregation of multiple streams of information from the various senses (sight, hearing, smell), filtered through your perceptions. Moreover, multiple regions of the brain are involved in the process of recording and preserving a memory (see Figure 1, at right).

- **The hippocampus.** Deep within the brain, a structure known as the hippocampus plays a key role in acquiring and consolidating new memories. The information that will constitute a memory is sent first to the hippocampus and surrounding structures. One of these structures creates what is called a hippocampal index, which catalogs the components of a memory so it can be re-collected and reconstructed later. The hippocampus is crucial for retrieving memories until they are put in long-term storage in other brain regions.
- **The amygdala.** Situated close to the hippocampus, the amygdala is the part of the brain that reacts to emotionally powerful information, tagging this information as important, so the brain retains it.
- **The cerebral cortex.** Once a memory is established, it is not stored in a single part of the brain, but distributed among pertinent areas of the cerebral cortex—the large, domed outer layer of the brain.
- **The frontal lobes.** These are essential for focusing attention (and ignoring distractions). Focused attention is important for acquiring new information, activating and retrieving stored memories, recollecting the source of information, and keeping track of the timing and order of specific events.

Figure 1: Anatomy of memory processing



Memories are not encoded like a photograph, but rather in fragmented, distributed pieces, which need to be reassembled to remember. The hippocampus, a crescent-shaped structure deep in the brain, and surrounding structures play crucial roles in memory storage. The amygdala reacts to emotionally powerful information. The frontal lobes enable you to focus attention long enough to encode new information. Long-term memory storage occurs in the cerebral cortex.

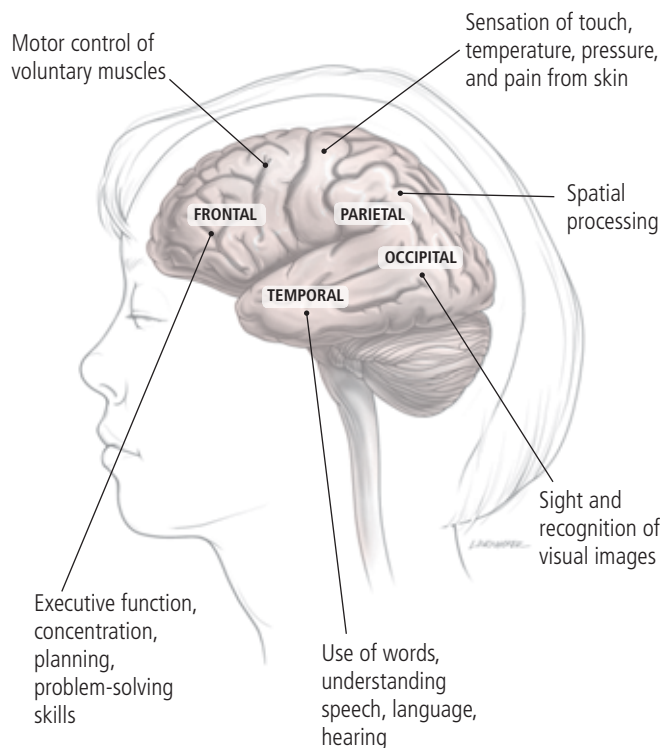
Where are memories stored?

For years, people believed that memories were kept in a single place in the brain. But over many decades of research, scientists realized that this assumption was wrong. In the 1980s, the development of functional brain-imaging technology gave scientists the tools to scan people's brains as they performed a variety of tasks, including remembering things. This enabled researchers to confirm that long-term memories are not stored in a single location that functions as a repository of information, but rather are widely distributed in networks throughout the brain, primarily

in the cerebral cortex—the outer covering of the two large hemispheres of the brain.

It might sound odd at first that memory storage is widely distributed, but this actually makes sense. The cortex is the most highly developed part of the human nervous system, containing about 20 billion neurons (nerve cells) that collectively function to integrate sensory information, control voluntary movements, and mediate thought processes. Different areas of the cerebral cortex process different kinds of information. For example, auditory information, including speech and other sounds, is processed initially in the temporal lobes, while the registration of visual images occurs in the occipital lobe at the back of the brain (see Figure 2, below). What these findings suggest is that a par-

Figure 2: Brain map



Different parts of the cerebral cortex of the brain specialize in different functions. Memories are stored in many parts of the brain, but some areas are more critical than others. To retrieve a memory, these areas of the brain must work in coordination with others. For example, the frontal lobes (important for planning and organization) work together with several brain regions in acquiring and retrieving visual, auditory, spatial, and other information.

ticular aspect of a memory will most likely be stored in a region of the cortex that specializes in processing similar information.

Therefore, the words of “The Star-Spangled Banner” would be stored in the language regions of the left temporal lobe, but the melody would be stored in the brain’s auditory cortex. And each memory is connected to many related memories. For instance, if you associate “The Star-Spangled Banner” with the American flag, that image might be stored in your occipital lobe, which processes visual information. Your memories are thus intricately broken down and cross-referenced, making your brain less like the shelves of a library and more like the Internet. Calling up memories is like searching the Web, with one or two words activating many hyperlinks.

But just how does the information that you encounter on a daily basis get filed away? Memory researchers have used a three-stage model to describe how the brain learns and remembers each bit of information:

- Stage 1: acquisition
- Stage 2: consolidation
- Stage 3: retrieval.

Impairment in any one of these three stages can result in a failure of memory.

How smoothly the process goes—which is to say, how well you remember—depends on many things. Genetics plays a major role. Studies of human intelligence suggest that approximately 50% of mental ability is genetically determined. It may be that some people are simply better at remembering than others because of a genetic predisposition for an excellent memory. But factors within your control are also important. Overall physical health, emotional well-being, stress level, and sleep quality exert a huge influence on how well you learn and remember.

Stage 1 | Acquisition

It’s common sense: for you to remember anything, your brain must first encode it. When new information is learned or acquired, it first takes the form of temporary pathways of nerve cell activity in the brain, as one neuron communicates with the next.

The location of these neuronal pathways depends on the nature of the information. For example, in most people, activities such as speaking and writing activate neurons in the left temporal lobe, which processes language, whereas studying a map activates neurons in the right parietal lobe, which processes spatial information.

When you've just learned something new, the neuronal activity that represents this newly acquired information is temporary, and the knowledge is part of your short-term memory. Most of this information will quickly fade away. The memories that endure will be those that were encoded most completely in the first place—the information that you paid the closest attention to when you learned it. When you have trouble remembering a piece of information, it's often because you weren't paying close attention when you initially encountered it. Memories that involve multiple senses as well as emotions are more likely to be retained.

Stage 2 | Consolidation

Let's say that you were paying close attention to the information you just heard and that it was effectively encoded in your brain. How does it become stored as a memory that you can recall in the future? For the information to become a long-term memory, its initial neuronal pathways must be strengthened. The strengthening process, typically referred to as consolidation, occurs over a period of time.

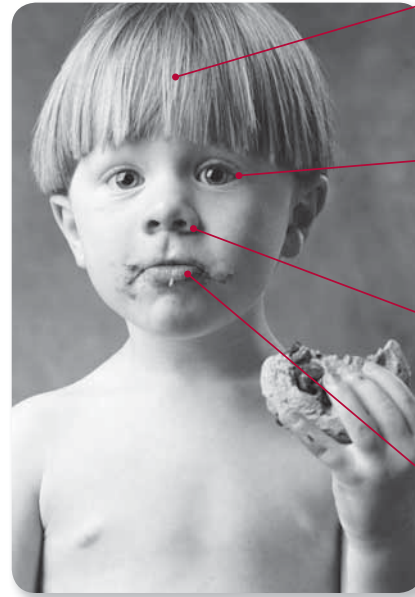
Consolidation of declarative memories

Several factors influence whether the hippocampus responds to the newly acquired information and gives the signal to store it as long-term memory. For example, you're more likely to retain new information if it relates to long-term memories you already have because the richer associations help you to store the information more deeply. You are much more likely to remember the names of the players on your local football team if you know something about football than if you don't follow the game at all.

Your brain also has systems for detecting things or events that are new or unusual and remembering them for future reference. Similarly, you are much

Figure 3: Remember grandma's cookies?

An experience that stimulates many parts of the brain is more likely to be remembered, particularly if it has an emotional component.



Emotion: Feelings of pleasure are processed by the brain's reward system, which includes the amygdala.

Sight: The eyes relay the image of chocolate chip cookies to the primary visual cortex in the occipital lobe.

Smell: Sensors in the nose pick up the sweet scent and convey it to the olfactory region of the cortex.

Taste: Sensory receptors on the tongue deliver the flavor of chocolate to the brain's gustatory area.

more likely to recall objects or events that affected you emotionally (see Figure 3, above). You can probably remember the images of the World Trade Center falling far more vividly than you can recall, say, a photo of a hotel where someone in the news happened to stay.

Consolidation of procedural memories

In contrast to declarative memory, the consolidation of procedural memories is not dependent on the hippocampus. Even people with amnesia, who have damage to the hippocampus, can form new procedural memories—that is to say, they can learn new skills through practice. Procedural memories, such as how to play a musical instrument, also tend to remain intact with aging. They even persist during the early stages of Alzheimer's disease. However, acquiring new procedural memories becomes more difficult with age because we process information more slowly.

Procedural memory is stored throughout the brain in regions that are important for coordinating movement or sequential processing, such as the frontal lobes, the cerebellum, and the basal ganglia.

Stage 3 | Retrieval

Retrieval is the act of recalling something. A memory is stored in the brain as a unique pattern of nerve cell activation. When you're not thinking about the memory, its neuronal pattern is inactive. To retrieve the information, your brain must reactivate the pattern. Similar memories have partially overlapping patterns of neuronal activation. Sometimes when you try to retrieve one bit of information, a similar memory comes to mind and blocks out the information you want (see "Blocking," page 10). For example, you may be trying to recall the name of Tom Hanks' first movie, but instead you keep thinking of the name of his most recent film.

Researchers have determined that it takes less than a second to reactivate a neuronal pathway holding simple, familiar information. They've found, for example, that when a young person sees a photograph and is asked whether it's familiar, it takes about a fifth of a second for the image to reach the visual system in the brain, a fifth of a second for the person to decide whether it's familiar, and another fifth of a second for the person to begin to nod.

If it always took just a fraction of a second to remember something, you wouldn't worry about your memory. But, of course, it often takes considerably longer. Even if your memory is perfect, it can take several seconds or more to recall complicated information. How long the process takes depends on how familiar you are with the information you're looking for. If someone asks you to name the third president of the United States, for example, and you're an American history teacher, you may be able to recall in an instant that the answer is Thomas Jefferson. Otherwise, your brain will activate neuronal pathways that process information related to the chronology of the presidents—the year when the United States was founded and the names of any early presidents that come to mind, for instance. In the process, you may feel that the answer is "on the tip of your tongue." If the neuronal pathway in your brain leading to the answer is still intact, you'll eventually retrieve it.

While this may be irritating, it is very common. Research shows that it happens to younger people as often as once a week and to older people with normal

memories two to four times a week. Frustratingly, you may recall the first letters of the name or just the first or last name before you remember the whole name.

Seven flaws of normal memory

Regardless of age, you're unlikely to have a flawless memory. People who can remember very long lists of numbers or recall the minutiae of their daily lives—right down to what they ate for lunch every day last year—are exceedingly rare. And frankly, such a memory can be a burden rather than a blessing. Memory, it seems, is inherently flawed—and in more ways than you might think.

Daniel Schacter, a professor of psychology at Harvard University, described the most common ways that normal memory fails us in his book *The Seven Sins of Memory*. Some of these memory flaws become more pronounced with age, but unless they are extreme and persistent, they are not considered indicators of Alzheimer's or other memory-impairing illnesses. They are simply the way that our brains work. The following is a brief summary of Schacter's seven memory "sins."

1 Transience

This is the tendency to forget facts or events over time. You are most likely to forget information soon after you learn it. However, memory has a use-it-or-lose-it quality: memories that are called up and used frequently are less likely to be forgotten. Although transience might seem like a sign of memory weakness, brain scientists regard it as beneficial because it clears the brain of unused memories, making way for newer, more useful ones. In this sense, transience is akin to cleaning the junk out of your closets or clearing the temporary files from your computer's hard drive.

Although everyone experiences transience of memory, it is extreme and debilitating in people with certain kinds of brain damage. For instance, people with amnesia that is caused by injury to the hippocampus have normal short-term memory, but they are unable to form new long-term memories. They forget information soon after they learn it. This is not the type of transience that normally affects people's memories.

2 Absentmindedness

This type of forgetting occurs when you don't pay close enough attention to the information you want to remember. You forget where you just put your pen because you weren't focusing on where you placed it. You were thinking of something else (or, perhaps, nothing in particular), so your brain didn't encode the information securely. Absentmindedness also involves forgetting to do something at a prescribed time, like taking your medicine or keeping an appointment.

One way to avoid this problem is to identify things that can serve as cues to remind you to do something. For example, if the doctor tells you to take your medicine at bedtime, you might use another regular bedtime activity as a reminder cue for medicine-taking. In this situation, you could link it to rinsing after toothbrushing, and use the same water glass to sip water to take your pills. Similarly, if you need to take your vitamins at breakfast, you could make a habit of putting the bottle beside your coffee cup at your place at the table so it provides a cue when you sit down to eat.

3 Blocking

Someone asks you a question and the answer is right on the tip of your tongue—you know that you know it, but you just can't think of it. This tip-of-the-tongue experience is perhaps the most familiar example of blocking, the temporary inability to retrieve a memory. Blocking doesn't occur because you weren't paying attention or because the memory you're looking for has faded from your brain. On the contrary, blocking occurs when a memory is properly stored in your brain, but something is keeping you from finding it.

In many cases, the memory block is a memory similar to the one you're looking for, and you retrieve the wrong one. This competing memory is so intrusive that you can't think of the memory you want. A common example is calling your older son by your younger son's name, or vice versa. Scientists call blocking memories "ugly sisters" because they're domineering, like the stepsisters in Cinderella. Scientists have used ugly sisters experimentally to block memories. In one such experiment, people were asked to pick out the definitions of uncommon words from a selection of possible definitions. When definitions that were

similar in sound or in meaning were given along with the accurate definition, more people had memory blocks than when unrelated ones were given.

Brain-imaging studies suggest how blocking might work in the brain. When a person is retrieving a memory, some regions of the brain become more active and others become less active. Some of the increased activation reflects inhibition of other regions. When the right regions are activated, this inhibition can work in your favor by keeping your brain from calling up irrelevant information. But when you call up an ugly sister by mistake, the brain regions that encode it may suppress the regions needed to retrieve the memory you really want.

Scientists think that memory blocks become more common with age and that they account for the trouble older people have remembering other people's names. But it remains unclear whether tip-of-the-tongue experiences are more common than other age-related memory problems. Increases in blocking have been linked to less efficient executive control mechanisms that help keep competing memories or words from interfering with the selection of the appropriate response. In any case, there's encouraging news about blocking. Research shows that people are able to retrieve about half of the blocked memories within just a minute.

4 Misattribution

Consider the following scenario: you're asked who "John Smith" is, and you remember quite clearly not only who he is, but also what he's done lately that's been in the news. Then you're asked where you learned these details. You think for a moment and reply that it was on the evening TV news. However, there was no report about John Smith on TV. Instead, you got your information from the friend you had lunch with yesterday.

Right memory, wrong source—that's one example of misattribution. Misattribution occurs when you remember something accurately in part, but misattribute some detail, like the time, place, or person involved. Another kind of misattribution occurs when you believe a thought you had was totally original when, in fact, it came from something you had



It's common to remember information, but forget exactly where you learned it. For example, you may think you heard it on TV, when you actually learned it from a friend you ate lunch with.

previously read or heard but had forgotten about. This sort of misattribution explains cases of unintentional plagiarism, in which a writer passes off some information as original when he or she actually read it somewhere before.

Misattribution happens to everyone. Usually it's harmless, but it can have profound consequences, particularly in the criminal justice system. In some cases, misattribution on the part of eyewitnesses is responsible for the arrest and conviction of individuals for crimes they didn't commit.

As with several other kinds of memory lapses, misattribution becomes more common with age. Age matters in at least two ways. First, as you age, you absorb fewer details when acquiring information because you have somewhat more trouble concentrating and processing information rapidly. Second, as you grow older, your memories grow older as well. And old memories are especially prone to misattribution.

5 Suggestibility

Imagine that you saw someone fleeing from a car as its antitheft alarm was blaring. You didn't get a good look at the thief, but another person on the street insisted that it was a man wearing a green plaid jacket. Later, when the police show you photos of possible suspects, you're confused until you see a man dressed in green plaid. Then you point to him.

Suggestibility is the vulnerability of your memory to the power of suggestion—information that you learn about an occurrence after the fact. Although little is known about exactly how suggestibility works in the brain, the suggestion fools your mind into thinking it's a real memory. Suggestibility can be the culprit in recollections that adults have of incidents from their childhood that never really happened.

6 Bias

One of the enduring myths about memory is that it works like a camera, recording what you perceive and experience with complete, objective accuracy. But even the sharpest memory isn't a flawless snapshot of reality. In your memory, your perceptions are filtered by your personal biases—experiences, beliefs, prior knowledge, and even your mood at the moment. Your biases affect your perceptions and experiences when they're being encoded in your brain. And when you retrieve a memory, your mood and other biases at that moment can influence what information you actually recall.

Bias can affect all sorts of memories, but among the most interesting examples are people's recollections of their romantic relationships. In one study, couples who were dating were asked to evaluate themselves, their partners, and their relationships—initially and then two months later. During the second session, participants were asked to recall what they had said initially. The people whose feelings for their partners and their relationships had become more negative over time recalled their initial evaluations as more negative than they really were. On the other hand, people whose feelings for their partners and their relationships had become more loving recalled their initial evaluations as more positive than they really were.

Although everyone's attitudes and preconceived notions color their memories, bias plays an especially bitter role in people prone to depression. These people tend to have what's called negative memory bias: they remember negative information better than positive information. Negative memory bias is an important risk factor for depression, which makes sense—constantly remembering the sad things that happened to

you more than the happy things is likely to sustain a depressed mood.

Researchers are looking into which parts of the brain are involved in negative memory bias and how it arises. Some theories suggest a problem with the interaction between the amygdala (which processes emotional memories) and the hippocampus (which processes factual ones). Another study implies that a small-sized hippocampus relative to the size of the amygdala might be to blame. These results make sense, implying that negative emotional memories take precedence.

One area of research that still needs to be probed is whether memory bias of any kind becomes more common with age.

7 Persistence

Most people worry about forgetting things. But in some cases people are tormented by memories they

wish they could forget, but can't. The persistent memories of traumatic events, negative feelings, and ongoing fears is another form of memory problem. Some of these memories accurately reflect horrifying events, while others may be negative distortions of reality.

Two groups of people are particularly prone to having persistent, disturbing memories. One group is individuals with depression. Research has shown that depressed people are given to ruminating over unpleasant events in their lives or mistakes that they believe they have made. Dwelling on such negatives also fuels a vicious cycle of increasing depression. The other group with persistent, unwanted memories includes people with post-traumatic stress disorder (PTSD). PTSD can result from many different forms of traumatic exposure—for example, sexual abuse or wartime experiences. Flashbacks, which are persistent, intrusive memories of the traumatic event, are a core feature of PTSD. ♥

How memory changes with age

Many people begin to notice changes in their powers of recall around the age of 50. Some of these changes are relatively predictable and differ from the memory impairment caused by dementia or other conditions that damage the brain. There are ways to tell the difference (see “Memory problems: Normal aging or brain disease?” on page 39).

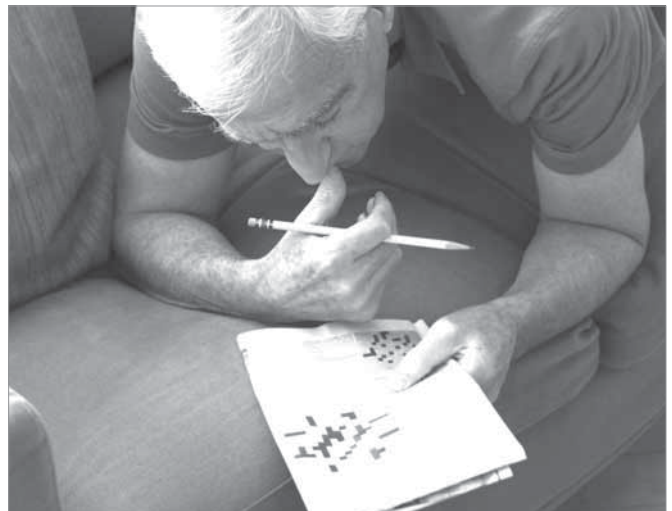
But just because your memory seems to be getting worse with age, that doesn't necessarily mean that age is directly responsible. Your memory can falter as a result of stress, fatigue, or being overloaded. Some memory difficulties may also be caused by medications, poor vision or hearing, sleep disturbances, or depression—in other words, things you can take steps to correct (see “17 ways to promote memory health,” page 24).

This chapter covers normal age-related changes.

Age-related changes in the brain

As you get older, certain characteristic changes take place. You are likely to experience delays in your ability to recall things, which explains why you have to rack your brain to remember a name or word that is familiar to you. It also becomes more difficult to divide your attention among more than one activity or source of information. You may find it difficult to focus your attention, getting more easily distracted than when you were younger.

Over time, changes take place in the brain that may account for these difficulties. Brain regions involved with memory processing, such as the hippocampus and especially the frontal lobes, undergo age-related structural and neurochemical changes. For example, the hippocampus shrinks in size. Some receptors (the lock-and-key structures on the surface of neurons needed for them to communicate with other neurons) may cease to function normally. The result is that as you age, it takes longer to absorb new information and to form



As you age, it may take longer to recall information, such as a name or a word that is familiar to you.

new memories. The loss of receptors and of neurons may also make it harder to concentrate.

These changes can undermine the encoding, consolidation, and retrieval of new information. Different kinds of memory can decline with age, including episodic memory (for example, which stock you sold last year from your retirement account), semantic memory (facts, such as the year World War I started), and spatial memory (such as the directions to a new location).

It's not just that you learn this sort of information more slowly; you may have more trouble recalling it because you didn't fully learn it in the first place. If you and your child or grandchild learn a new computer game together, chances are that the next day the child will remember more of the details of how to play the game than you do.

In addition, the ability to perform tasks involving attention and executive function declines with age. Executive function is a group of cognitive activities that involve the overall regulation of thinking and behavior—the higher-order processes that enable us to plan, sequence, initiate, and sustain our behavior

▶ Still sharp after all these years?

Sometimes, what appears to be a memory problem may simply reflect a slower processing speed. Comparisons of younger and older people's scores on memory, learning, and intelligence tests suggest that mental sharpness declines slightly with age. But whether such comparisons are valid is questionable because timed tests may favor the younger person. The older person's information processing is a little slower: in one study, elderly people took 20 to 40 milliseconds longer than younger people to detect gaps in circles. Thus, the lower scores of older persons may simply reflect a slowing of their responses.

People may require more time and effort to learn new information as they age, but once they've learned it, they retain it as well as younger people. In practical terms, slightly slower thinking is not necessarily a disadvantage. It may actually reflect more thorough reasoning and result in fewer mistakes.

toward some goal, incorporating feedback and making adjustments along the way.

When people of all ages encounter new information, they may all take in the big picture, but those who are older may not absorb as much detail. For instance, after listening to a presentation, a 25-year-old and a 75-year-old may both remember the overall subject and basic ideas, but the 25-year-old may be able to recall more of the specifics.

Reasons for encouragement

These changes may sound disturbing, but they are relatively minor and may simply represent slower processing speed (see "Still sharp after all these years?" above). In other words, age-related changes in the brain may slow down your learning and your recall, but they don't impair your ability to function effectively. Your ability to make sense of what you know and to form reasonable arguments and judgments is well-preserved. Moreover, the wisdom that you've gained from experience over the years remains unscathed.

In addition, you can compensate for the slow-down in information processing and diminished ability to concentrate by working harder to pay attention to any new information you are trying to learn. It's not

difficult. For example, try repeating the information several times in your mind or discuss it with friends (see "Focus," page 18). Willpower and effort can overcome a fair amount of age-related difficulty. In many instances, if you make the effort to learn something well, you'll be able to recall it as well as a younger person can. And consider this: while processing speed may become slower with age, the general amount of knowledge a person has continues to increase.

Not all memories slip

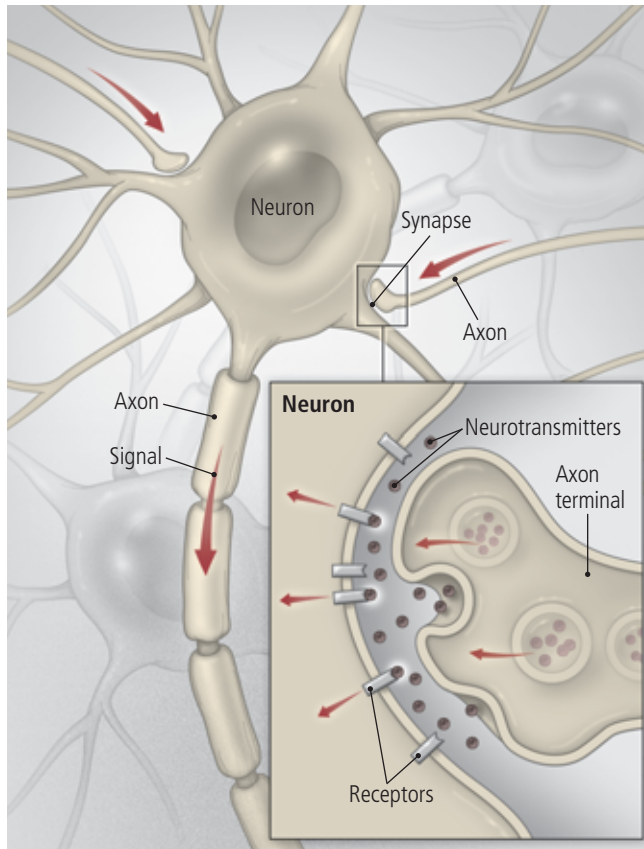
One of the myths surrounding the term "age-related memory loss" is that all forms of memory are equally affected. In fact, while some information may become harder to recall—and new memories may be harder to lay down in the brain—other memories will remain as accessible as ever. There is truth in the old saying that "you never forget how to ride a bicycle." Procedural memory—by which you remember processes and skills such as how to ride a bicycle, serve a tennis ball, or accomplish routine tasks—does not tend to fade with age.

Brain plasticity

While certain brain regions may take a hit from the aging process, the brain is also quite adaptable. The complex network of interconnected neurons through which it processes information is quite dynamic, changing constantly throughout life in response to everyday experiences—a phenomenon called plasticity.

For years, the scientific view of an adult's brain was anything but encouraging. Experts believed that, unlike other cells in the body, neurons did not regenerate. They thought that the brain produced new brain cells only early in life and that once you reached adulthood, the growth of new neurons ceased and existing neurons began to die off. You may have heard the oft-repeated "fact" that you lose 10,000 brain cells a day. The idea was that your brain was shrinking, and that could mean only one thing: as you lost neurons, you also lost some of your capacity to learn, think, and remember. Researchers now know that this neuron degradation is less pronounced than previously thought.

Figure 4: A wide web of memories



In order to recall a memory, you must activate a vast network of interconnecting brain cells called neurons (nerve cells). These brain cells deliver and permanently store messages along neural pathways, primarily in the cerebral cortex, the large, domed outer layer of the brain.

One brain cell communicates with another across a space called a synapse, by way of chemicals known as neurotransmitters. These neurotransmitters activate the receptors on the neighboring cell. Revisiting a memory strengthens the connections between brain cells that are responsible for maintaining that memory.

Not only do brain cells not die as rapidly as scientists once thought, but it may even be possible to grow a modest number of new neurons—a process known as neurogenesis. Nearly two decades ago, compelling evidence showed that human adults do sprout new neurons, even in the hippocampus. The significance of this is not entirely clear, and neurogenesis may be less important for memory than maintaining the connections among neurons—the neural pathways that are formed among brain cells as you learn new information or have experiences (see Figure 4, at left). Revisiting the information strengthens the pathways. In fact, any activities you engage in frequently—whether related to your job, your hobbies, or running a household—become more sturdily encoded.

The brain also has some capability to reorganize itself, shifting functions from one network to another, if a particular process starts to weaken. For example, some studies have found that the brains of older and younger adults may engage different brain regions to accomplish the same mental task. Scientists believe that this may be a mechanism of older brains to compensate for diminished function in the area normally used for that task.

The bottom line is this: New connections between neurons are formed as we learn information or take in visual images and other types of stimuli. The more we use the information, the stronger the memory. Even if some brain regions weaken, the brain may be able to compensate. For these reasons, stretching your mind with mentally challenging activities can improve your memory. ♥

Improving everyday memory

There are plenty of techniques that boost your ability to retain new information and skills. Doctors and other clinicians who work with people on improving their cognitive performance and memory have found these strategies to be effective. They aren't difficult to master. Indeed, many are simple things that you probably do already, but can benefit from doing more systematically. By investing some time to learn these skills, you can reap the rewards of a sharper, quicker mind.

These techniques fall into three general categories: organizational tools, behavioral strategies, and memory-enhancing techniques that make new information meaningful and relevant to you, thus making it easier to remember.

Organizational tools

Most people need to organize a multitude of facts each day: dates and locations of appointments, people's names and phone numbers, even where they left the car keys. Information that is well organized is much easier to learn and remember. There are many organizational tools, including time-honored ones such as address books and calendars. You can also get apps for smartphones and other electronic devices that remind you when it's time to do something.

It doesn't matter which tool you choose; what matters is that you use it consistently.

Here's a brief list of the types of information that people often forget and some organizational strategies to help you remember. Table 1, page 17, also contains a quick troubleshooting guide for ways to deal with common memory problems.

Belongings. Have a designated spot for your most important personal belongings (keys, glasses, handbag) and always put them there when you're not using them.

Meetings and appointments. Maintain a calendar (on paper or on an electronic device like a smartphone or tablet) in which you write appointments and important dates, and keep it with you at all times. For people who don't use

electronic organizers, some experts recommend a "memory notebook," which is a binder that has a weekly calendar and paper for writing down important information. Develop the habit of checking your organizer or notebook at least several times each day.

Daily tasks. In addition to listing your appointments, keep a list of the miscellaneous things that you have to do each day or week—people to call, items you need to buy, routine maintenance on your car or home, and so on. Keep those to-do lists in your electronic organizer or memory notebook.

Contact information. Keep your address book or electronic organizer up to date with the names and phone numbers of friends, relatives, and professionals or companies with whom you do business (bank, doctors, mechanic, etc.).

Vital information. Keep important documents like insurance papers and medical records in a file cabinet or other designated location. Record other vital information in your electronic organizer or memory notebook. You may want to list the medications you are taking and when to take them; your

Table 1: Common memory lapses and strategies to overcome them

WHAT YOU FORGET	HOW TO REMEMBER BETTER
Names	<ul style="list-style-type: none"> • When you meet someone for the first time, stop and take the time to register his or her name. Many times you may forget a name simply because you didn't notice it being said to you in the first place. • Use a new acquaintance's name in conversation. • Think about whether you like the name. • Think of people you know well who have the same name. • Associate the name with an image, if one comes to mind. For example, link the name Sandy with the image of a beach, and imagine Sandy on the beach. Use as much detail as possible—picture her in a bathing suit, on a beach that's familiar to you. • Write the person's name down in your memory notebook, personal organizer, or address book.
Where you put things	<ul style="list-style-type: none"> • Always put things you use regularly, such as keys and eyeglasses, in the same place. • For other objects, repeat aloud where you put them. • As you put an object down, make a point of looking at the place where you put it. • If you still don't think you'll remember, write down in your memory notebook or personal organizer where you put the object.
What people tell you	<ul style="list-style-type: none"> • Ask someone to repeat what he or she just said. • Ask the person to speak slowly; that way, you'll be able to concentrate better. • Repeat to yourself what the person said and think about its meaning. • If the information is lengthy or complicated (such as advice from your doctor), record it on your cellphone or a small voice recorder, or take notes.
Appointments	<ul style="list-style-type: none"> • Write them down in an appointment book, in a calendar that you look at daily, or in your personal organizer.
Things you must do	<ul style="list-style-type: none"> • Write them down in your personal organizer or calendar. • Write yourself a note and leave it in a place where you'll see it (for instance, on the kitchen table or by the front door). • Ask a friend or relative to remind you. • Put an object associated with the task you must do in a prominent place at home. For example, if you want to order tickets to a play, leave a newspaper ad for the play near your telephone. • If you must do something at a particular time (such as take medicine), set an alarm.

Adapted with permission from Winifred Sachs, Ed.D., Center for Cognitive Remediation and Treatment, Beth Israel Deaconess Medical Center.

medical history; names and phone numbers of your doctors, health insurance company, homeowner's insurance, and credit card companies; and work numbers of your closest relatives and friends.

Locations. Keep maps of your area and other places you visit regularly in your car or at home. Before going somewhere new or unfamiliar, check the map. Visu-

alizing where you are going can help reinforce your memory of the directions you may have written down. And just knowing that you have a map can help minimize any anxiety you may feel about getting lost. If you use a GPS, don't become so reliant on it that you fail to pay attention to where you're going. Otherwise you'll never memorize the routes.

Checklists. For procedures that you may have difficulty remembering from one time to the next (like using a digital camera), write the steps down and post them nearby.

Behavioral strategies

Certain behavioral strategies can help improve your ability to learn new information effectively and retain it over time.

Focus. Your ability to focus your attention and absorb information quickly declines with age and contributes to age-related memory loss. The slowdown in processing causes a bottleneck of information entering your short-term memory, reducing the amount of information that can be acquired and encoded into long-term memory. You can enhance your focus and attention by doing the following:

- When someone is talking to you, look at the person and listen closely. If you missed something that was said, ask the person to repeat it or to speak more slowly.
- Paraphrase what is said to make sure that you understand it and to reinforce the information. For example, if someone says, “We can see the movie either at Loews Theater at 7:30 or at the Paramount at 7:50,” you might respond, “Which would you prefer, 7:30 at Loews or 7:50 at the Paramount?”
- If you find that you tend to become distracted during conversations, try getting together with people in quiet environments, such as homes instead of noisy restaurants. When you do meet people at a restaurant, sit at a table near a wall. If your companions sit against the wall and you sit facing them, you’ll

be able to focus on them without having your attention wander to other diners.

You can improve your ability to focus on a task and screen out distractions if you do one thing at a time. Try to avoid interruptions. If someone asks you something while you’re in the middle of reading or working, ask if the person can wait until you’re finished. Don’t answer the phone until you’ve finished what you’re doing—let voice mail take the call.

Repeat. You will remember new factual information more effectively if you repeat it to yourself



Writing things down can help you remember them. It provides a written reminder and actually reinforces the memory.

or say it out loud. If someone gives you directions, for example, repeat them to the person to make sure that you got them right. Discussing newly learned material with a friend or colleague is another way to help reinforce it in your mind.

Ensure comprehension. The more thoroughly you understand new information, the greater the odds that you will remember not

only the general concept but also the details. You can improve your comprehension by rereading material, asking questions about it, and discussing it.

Make a note. How many times have you had a brilliant idea while getting ready for bed or standing in line and then forgotten it? Many people assume that if a thought is important enough, they will remember it. But this is unrealistic. When something significant occurs to you, write it down as soon as you can. The act of writing things down actually helps reinforce them in your mind, so you may not even need to refer to your notes to help jog your memory.

Before going to the doctor’s office, make a list of questions you want to ask or things you want to mention. Jot down other thoughts as they come to mind: ideas related to your job, possibilities for birthday and holiday presents, the names of restaurants you’d like to try or books you’d like to read, or movies that you didn’t see when they were first released. These are the sorts of ideas that often fade with time, but that you know you’ll want to remember.

Practice spaced rehearsal. Research on learning has shown that “spaced rehearsal” is more effective for long-term recall than “cramming.” In other words, you will remember something more effectively if you rehearse it once a

day for several days rather than all at once.

If you have trouble retaining complicated information—for instance, when you read an article, take a course, or start a new project at work—try using spaced rehearsal. Write down the main points of what you have just learned and then review your notes once or twice. Read them again the following day and then again the day after. Spacing out these study sessions gives your brain a chance to consolidate the information that you have learned and form a more durable memory of it.

Do small tasks first. It's only natural to turn your attention to the large, important tasks at hand and let the mundane tasks slide. The problem with this approach is that small tasks, like answering email messages, tend to pile up and then get forgotten. If you act on them quickly, you don't have to worry about remembering to do them later.

Be patient. One of the main reasons memory declines with age is that the brain processes information more slowly. Give yourself the time you need to absorb new information. Don't consider it a sign of personal failure that you need to slow down in order to learn something new.

Memory-enhancing techniques

You may have heard the term “mnemonics,” which refers to tech-

niques for remembering information. The name comes from Mnemosyne, the Greek goddess of memory. One mnemonic device is to think of a word that rhymes with a person's name so that you don't forget the name. Another is to come up with a sentence or phrase to help you remember something, such as “Every Good Boy Does Fine” for recalling E, G, B, D, and F, the notes that fall on the lines of the treble-clef musical staff.

Associations

When you learn something new, immediately relate it to something you already know. Making connections is essential for building long-term memories. What you're really doing is making the information meaningful, thus aiding your hippocampus in consolidating it. Making connections between new and old information also takes advantage of the older pattern of synaptic activation, piggybacking the new material onto an existing network.

Remember names by making associations with the first letters. For example, it's fairly easy to remember the National Aeronautics and Space Administration because it is familiar as the acronym NASA. You might try this technique with people's names, too. Let's say you meet someone named Louise Anderson. Her initials are L.A., an association that's easy to remember because it's already familiar as the abbreviation for Los Angeles.

Make associations to remember numbers such as access codes or passwords that you need to use regularly but, for security reasons, don't want to write down and keep in your pocket. For example, if you need to remember the number 221035 to get your voice mail: 22 could remind you of “catch-22,” and 10 might be your house number, while 35 was your age when your oldest child was born.

“Chunking” information

Another technique for remembering a long series of items is to regroup them—for example, so that a list of 15 things is organized into three groups of five. For example, when you do grocery shopping, think of the items you need by categories, such as dairy, produce, desserts, frozen foods, and so on.

Chunking is also useful for remembering numbers. Phone numbers are naturally chunked into the area code, local exchange, and remaining four digits. Let's say your checking account number is 379852654. Instead of memorizing it as a string of nine single digits, try grouping the digits into three triple-digit numbers: 379, 852, and 654. That way, you'll reduce the number of chunks of information you need to remember from nine to three.

Method of loci

This technique originated in ancient Greece and it is still one of the best ways to memorize complex or lengthy material, like speeches.

The idea is to link the main points of the material to specific locations so that thinking of those locations triggers your recall.

Here's how it works: First, think of a familiar route, such as your commute to work, and imagine traveling that route, noting the stores and other landmarks along the way. Next, pick out the main points in your speech or other information and relate each point in sequence to a landmark on your route. When giving your speech (or recalling the information), think about commuting to work and seeing the landmarks. The image of the landmarks will help you remember the points of your speech. It helps if you vividly picture the images of your route, and also vividly picture something from your speech in that place. For example, if one of the points in your speech deals with a publication your company just put out, picture that publication—the title page just as it looks in real life—on the doorstep of the coffee shop you pass every day.

The loci that you use can also be rooms in your home, which you can imagine walking through sequentially, maybe starting at the front door and walking whatever path you normally take through the house. As you picture your path, mentally drop images from your speech along this route.

The SQ3R Method

SQ3R stands for Survey, Question, Read, Recite, and Review. This five-

step method is particularly effective for mastering a large volume of technical information from a textbook or professional document.

Survey the material by reading through it quickly. Concentrate most on the chapter headings and subheadings, as well as the first sentence of each paragraph, to get an overview.

Question yourself about the main points of the text. The more provocative and interesting your questions, the better able you will be to mentally organize the material when you re-read it.

Read the text carefully for comprehension, keeping in mind your questions from the second step. Don't take notes or underline yet—doing so at this stage can actually interfere with your comprehension by interrupting the flow of information.

Recite what you have just read, either to yourself or to someone else. Speaking out loud helps deepen your understanding of the material. Now is also the time to take notes.

Review the text, as well as your notes, a day or two later. Now, think critically about the information: does it support or contradict other information you know about the subject? Go back to your questions from step two. Can you answer them? Do any questions remain? Review the text quickly several more times over the next several days or weeks to help your brain consolidate and store it.

Professional memory training

You can go it alone and teach yourself techniques for strengthening your memory. Or you can get professional memory training. Some medical centers offer memory training programs in which people meet every week or so to learn memory-enhancement techniques, then practice them as homework. Another alternative is to attend a series of individual sessions with a clinician who specializes in memory and other cognitive problems, such as a psychologist, occupational therapist, or speech pathologist. Such a specialist can recommend specific strategies for the types of memory problems that affect you (see “Phyllis's story,” page 21).

Do memory training programs work? Studies on the effectiveness of memory-enhancement programs have found some benefit.

One study demonstrated the potentially enduring value of an organized training program for cognitive enhancement. For this study—called Advanced Cognitive Training for Independent and Vital Elderly, or ACTIVE—2,832 adults ages 65 to 94 were divided into four groups. Participants in three of the groups attended 10 training sessions—one group received training in memory, another in reasoning ability, and the third in speed of processing. The fourth group received no training and served as a comparison group. Each of the

PHYLLIS'S STORY: The benefits of memory coaching

"I used to have a sharp memory," says Phyllis, 58. But then she started having trouble remembering all sorts of things. She'd forget where she left her glasses and her keys. She'd forget the details of conversations. Formerly an avid reader, she had trouble retaining information that she'd read.

Her doctor recommended that she see a therapist who specializes in helping people devise strategies and systems to improve everyday memory function. At her first session, the therapist asked Phyllis to tell her specifically what she'd been forgetting, then proposed a strategy for each type of memory lapse. Once a month, Phyllis met with the therapist to discuss how well the strategies were working and to fine-tune them as needed.

For example, the therapist suggested that Phyllis put her glasses and keys in the same places whenever she came home. On the occasions when she had to leave them somewhere else, the therapist told her to say out loud where she was putting them. For example, if the phone rang as she was coming in the door and she rushed into the kitchen to answer it, she would say, "I'm putting my keys on the kitchen table."

To remember information from conversations, the therapist helped Phyllis learn how to paraphrase during the course of the conversation. Restating the information in her own words would reinforce it in her mind.

To improve concentration while reading, the therapist recommended creating a place in her home just for reading that was free of distractions. Phyllis also learned how to make a brief written note summarizing the key aspect of each section of the material she was reading.

Phyllis feels that most of the strategies have proved to be extremely helpful. She still struggles to concentrate on what she's reading, although she's doing better than before she started seeing the therapist. Now that her last memory-coaching session is over, the most encouraging improvements are that she can almost always find her keys and glasses and follow the details of conversations. "I feel my memory is nearly back to normal," she says.

training groups improved in the cognitive area that was trained. For example, the memory group showed enhancement on tests of memory. Follow-up studies demonstrated that these improvements lasted many years. However, no improvement was ever found in mental functions that were not specifically trained. Ten years after the study began, the participants in each of the three training groups reported that they had less decline

in their ability to engage in daily activities (for example, preparing meals, handling finances, shopping, housework, driving) than those in the comparison group.

Another study found that older adults improved their memories after a six-week program that included memory training, physical activity (daily walking or swimming), stress reduction, and a healthy diet high in antioxidants. The study participants were 94

people living in retirement communities, with an average age of 81. The researchers tested the participants' memories at the beginning, middle, and end of the study, and found that over all, the people's memories had improved. The participants also felt their memories were better. An important limitation of the study was that there was no control group to which the researchers compared the subjects who received the memory training and lifestyle intervention.

The four memory techniques used in the study were based on those found in the book *The Memory Bible: An Innovative Strategy For Keeping Your Brain Young* by psychiatrist Gary Small, an author of the study. The techniques were taught sequentially, and participants were expected to practice each skill at home the week it was taught, according to clinical neuropsychologist Karen Miller, the lead author of the study. These are the four techniques they learned:

- **Look, snap, connect** is all about paying attention, since you can't remember what you don't notice in the first place, and then using visualization to solidify the memory. *Look* refers to slowing down and noticing what you want to remember, such as the fact that you parked your car in section 3B of the parking garage. *Snap* means taking a mental snapshot of the item. That could be a literal image of the parking garage sign, though you'll prob-

Can computer brain-training games save your brain?

You probably know teenagers who spend large amounts of time riveted to various electronic devices playing games. In recent years, a new crop of electronic games has come on the market. These are aimed at middle-aged and older adults worried about their memory. Companies like Nintendo, Posit Science, Lumosity, and even AARP have made computer brain-training games big business. But do they work?

The quick answer is this: be wary of outsized claims about computerized brain-fitness programs. The jury is still out on whether these programs can live up to marketing promises. There is good evidence that these programs can improve your ability to perform the specific tasks in the program—for example, remembering a list of unrelated items. But whether this translates to helping overall memory is still under investigation. So, you'll get good at playing the computer game, but this may not help you remember the name of an acquaintance or find your car keys.

That said, a couple of small studies have found that a few specific computer programs may extend the improvement to other domains of memory and thinking. Bear in mind that these results are preliminary and must be replicated in larger studies to be considered valid.

A program called Project:EVO appears to help people improve their ability to multitask, something that becomes more difficult with age. A study published in *Nature* in 2013 found that the 46 older adults (ages 60 to 85) who played the game



Brain-fitness programs can be fun, but beware of outsized claims. They may teach a specific task, but they don't necessarily help overall memory.

became better multitaskers, and they also had a boost in cognitive skills that weren't directly related to the game. Working memory (temporarily holding information in mind and manipulating it) and the ability to sustain attention also improved. The gains in memory remained six months after the end of the study.

In a study of 23 adults (ages 60 to 70), published in *Neuroimage*, the Cogmed Working Memory Training program was shown to improve working memory and also positively affected episodic memory and the ability to sustain attention. In one part of the study, participants who underwent training could carry out

a working memory task more efficiently, relying on less brain activity to attain the same performance level.

However, these studies have some limitations. None of them compare one program to another or to other types of mental challenges, such as learning a new language or taking up a musical instrument. Moreover, the competitive features of a program and the person's desire to get his or her money's worth from buying the software (some of which costs nearly \$400) might influence the results. It is also worth noting that so far there is no evidence that any of the commercially available training programs prevents or delays the onset of Alzheimer's disease or any other form of dementia. So try a computer program, if you like. It certainly won't hurt (except maybe in the wallet). But no single computer program can replace the benefits of staying physically, mentally, and socially active throughout life.

ably be more likely to remember a more elaborate image, such as that of three bumblebees (representing the 3B section you parked in). *Connect* involves connecting the image and the thing you want to remember—in this case, the three bees and section of the garage where you

parked. So you could imagine the bees in your car. Then when you pause to remember where you parked after coming back to the garage, you'll likely draw up the image of the three bees buzzing in your car.

- **The story method**, used by many memory researchers,

expands on Look, Snap, Connect. It is helpful when you need to remember many items, such as a list of things to do. In this case, you assign each item a visual image to represent it in the story, and then you make up a story with those images in it. Say you have to buy a present for

your wife after work, then get your dog groomed, then pick up your daughter from dance class, and then call your mother in Florida. You might picture a present buckled into the front seat of your car. Then, as you're driving the familiar route to the store, you picture your wet and soapy dog running out in front of the car. Chasing after it is your daughter, dressed in a tutu. Next, a pile of Florida oranges rains down on your car. When you go to remember what to do, you tell yourself the story you created, remembering each errand one by one.

- **The categorization technique** consists of taking groups of

objects and chunking them into categories so you can remember them more easily. For example, if you have a list of items to get at the grocery store, you can remember them in groups such as bread, dairy, fruits, etc. When you get to the store, you can shop for the items one category at a time, since that's how you memorized them.

- **Face/name association** addresses the common problem of forgetting the name of a new acquaintance. This technique links the name with something prominent about the person's looks. For example, if Carlos has a big nose, you might think of a car parked on his nose. Or

if Christine has curly hair, you might think of Christmas ornaments hanging from her curls.

If you are considering a memory-enhancement program, choose one that is run by a health professional with specialized training in cognitive rehabilitation. Beware of memory-enhancement programs that use computer games as a one-size-fits-all means of strengthening your memory (see "Can computer brain-training games save your brain?" on page 22). People with memory problems that are substantial enough to interfere with their daily lives are most likely to benefit from individual treatment, where their particular needs can be identified and addressed. ♥

17 ways to promote memory health

As you get older, certain aspects of memory normally slow down, but that does not mean you are powerless to protect your brain as you age. In fact, there is a lot you can do.

Certain lifestyle measures—such as exercising regularly, reducing stress, and getting a good night's sleep—can produce noticeable improvements in memory and mental function or at least help you maintain your current abilities. Looking toward the future, however, it's also a good idea to protect your brain from injury and other assaults that can damage your memory and increase your risk for dementia. This chapter will cover both types of measures.

Unfortunately, there is no pill with true memory-enhancing qualities, though makers of various herbs, vitamins, and other supplements would like you to think there is (see “Ginkgo: A no-go for memory,” page 30, and “What about vitamins?” on page 29). But if you follow the recommendations in this chapter, they will do more for you than any so-called memory pill.

1 Exercise

Physical fitness and mental fitness go together. In fact, engaging in regular aerobic exercise (meaning any exercise that speeds up your heart rate and breathing) can help you achieve both of the goals listed above—that is, improving your memory now and reducing your risk for dementia later. People who exercise regularly have better mental function than those who do not exercise, and they experience less of a decline in memory over time.

Exercise appears to help memory in numerous ways, enhancing the ability of the brain to adapt and compensate for age-related decline. For example, physical fitness seems to slow the normal age-related shrinkage of the brain. Studies have found that physically active older adults have greater brain volumes over all than those who are less fit. This seems to translate to maintaining higher levels of mental function longer.

Of particular significance, exercise may actually boost the size of the hippocampus, a brain structure important for memory that typically shrinks as a person ages. For example, a study published in *Proceedings of the National Academy of Sciences* found that people who underwent exercise training for one year increased the size of the hippocampus about 2%. By contrast, study participants who were assigned to a stretching program had a 1.4% shrinkage of this vital structure.

In part, these beneficial effects may be the result of increased levels of a compound called brain-derived neurotrophic factor (BDNF). BDNF promotes the growth of neurons (nerve cells) in the brain and strengthens the connections between brain cells. Exercise also encourages the formation of new blood vessels in the brain. And it reduces your stress levels and improves your sleep—two measures that help memory in additional ways (see “Manage your stress,” page 26, and “Get a good night's sleep,” page 27).

Perhaps less obvious, exercise also promotes brain health by helping other parts of the body. For example, it helps maintain a robust cardiovascular system, which ensures a good supply of oxygen-rich blood to the brain. It also helps reduce the risks for type 2 diabetes, high cholesterol, high blood pressure, and strokes—problems that can lead to brain-damaging cardiovascular problems, including strokes, and increase the odds of developing dementia. A six-year study, published in *Annals of Internal Medicine*, of 1,740 people ages 65 and older found that people who exercised more than three times a week had a lower risk of dementia than their sedentary counterparts.

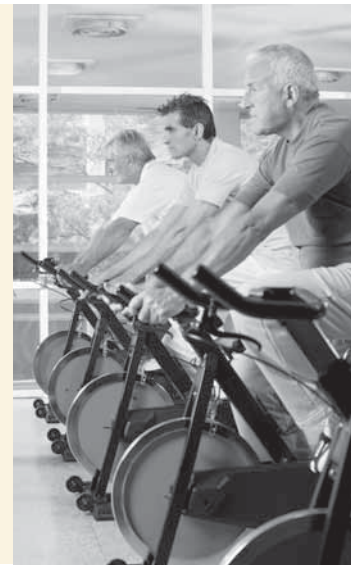
What you can do: Researchers don't know precisely how much exercise is needed for good brain health, but one thing is clear—you only reap benefits if you exercise on a regular basis. You can't exercise for a week or two and consider it done. The available research suggests that the exercise needn't be extreme, but should be moderately vigorous. (See “Exercise recommendations

Exercise recommendations for older adults

If you're 65 years of age or older, are generally fit, and have no limiting health conditions, you can follow the guidelines listed below, which will deliver benefits for your body as well as your brain. If you have a health condition that limits your activity, do as much as you are able to do comfortably and safely. Always check with your doctor before starting an exercise program.

The Physical Activity Guidelines for Americans from the U.S. Department of Health and Human Services recommend this combination:

- Two hours and 30 minutes (150 minutes) of moderate-intensity aerobic activity (e.g., brisk walking) every week. If you're very fit, you can substitute one hour and 15 minutes (75 minutes) of vigorous-intensity aerobic activity (e.g., jogging or running). Or, try an equivalent mix of the two. In general, two minutes of moderate activity equal one minute of vigorous aerobic activity.
- Muscle-strengthening activities on two or more days a week that work all major muscle groups (legs, hips, back, abdomen, chest, shoulders, and arms). Allow 48 hours between sessions.



for older adults," above, for the federal guidelines.)

A formal exercise program is best. If you're just starting, you can find helpful guidance on building a well-rounded program in another Harvard Special Health Report titled *Starting to Exercise* (see "Resources," page 48). But any physical activity is better than none, so try to build more activity into your daily routine. Here are some examples:

- When possible, walk instead of driving.
- Set aside time each day for exercise—for example, a brisk half-hour walk around the neighborhood.
- Use the stairs instead of the elevator.
- Exercise at home, possibly with an exercise DVD.
- Plant and tend a garden.
- Take an exercise class or join a health club.
- Swim regularly, if you have access to a pool or beach.
- Learn a sport that requires modest physical exertion, such as tennis.

2 Keep learning

Like exercise, continuing to challenge your mind throughout life can get you closer to both goals of improving your memory and lowering risk for later decline. Some studies have shown that people who have more years of education preserve their overall mental function longer and have a lower risk for developing dementia than those with fewer years of education. Scientists believe that intellectual enrichment and learning stimulate the brain to make

more connections. As a result, the "educated brain" may possess a greater reserve of cognitive ability—a deeper well, so to speak—and be able to sustain more loss of neurons. But if you failed to get an advanced degree when you were in your 20s, that doesn't mean it's too late for you. A lifelong habit of learning and engaging in mentally challenging activities seems to keep the brain in shape. A study published in *JAMA Neurology* in 2014 found that people maintained better memory and thinking abilities in later life if they had higher levels of formal education, had held mentally stimulating jobs earlier in their lives, or engaged in higher levels of non-work-related mental stimulation in mid- to late life. Additional studies have found that people who regularly engage in mentally stimulating activities—such as reading, writing, playing board games, playing musical instruments, and gardening—in midlife have a lower risk of developing dementia later.

Researchers are still trying to unravel the ways that mental stimulation may help maintain a healthy brain. But in animal studies, environmental enrichment has been shown to increase the expression (activity) of genes involved with memory.

What you can do: Exercising your brain with challenging activities is believed to stimulate communication between brain cells. Some ways of stimulating your mind are obvious—for example, doing crossword puzzles, reading, participating in a book discussion group, playing chess, or taking classes. However, the

most beneficial activities may be ones that challenge your brain in entirely new ways—for example, learning a new language or taking up a new musical instrument.

You don't have to go to great lengths or spend a lot of money to find mental stimulation. Mental challenges also come from the unexpected occurrences that take you out of your daily routines and make you think. If you're still working, chances are that you get some of these curveballs thrown at you from time to time. But if you aren't working and your time is largely unscheduled, you may need to actively seek out novel experiences and learning opportunities. Planning day trips or longer vacations, meeting regularly with friends, going to the theater or to museums, or just making a point of varying your routine can help keep your mind active and engaged. You can also try cooking new recipes, joining a club, or learning a new art or craft.

3 Stay socially active

Some research suggests that older adults who are socially engaged have better memory and other cognitive abilities, and may even be at a lower risk for dementia, compared with those more socially isolated. A study of 3,610 people between the ages of 24 and 96 looked at the relationship between participants' mental function and their level of social contact based on how often they talked on the phone to friends, neighbors, and relatives. The researchers found that the higher the individual's level of social interaction, the better his or her mental function; this result was found across all age groups.

There are several ways social engagement may benefit your memory. Social interaction often goes hand in hand with intellectual stimulation. Carrying on conversations not only exposes you to new information, but also forces you to frame your thoughts in different ways. Social relationships can also provide support during stressful times, reducing the damaging effects that stress can have on the brain.

What you can do: Reach out to others. Social support can come from relationships with friends, relatives, or caregivers, as well as from a religious community or other organized group. You can even tackle two brain-boosting options at once by joining a walking group or finding an exercise buddy.

4 Manage your stress

Stress can impair memory in more ways than one. Stresses of everyday life, like deadline pressures or arguments with family members, can cause you to expend mental resources managing the anxiety and distress. When you reduce and manage these stressors, that frees your mind for other memory and mental tasks.

In addition, stress can trigger the body's natural "fight or flight" reaction, which occurs in response to a perceived threat. To protect itself, the body releases stress hormones, including cortisol and epinephrine (also known as adrenaline). These hormones prime your body to respond to a physical danger by either running or standing your ground. Energy-boosting glucose is released into your bloodstream to fuel your muscles. Your heart pounds and breathing quickens to deliver oxygen and nutrients to those muscles. Sharpened senses, such as vision and hearing, make you more alert. Platelets become stickier, so clots can form more easily to minimize bleeding from potential injuries. Immune system activity picks up.

This physical reaction can help us sprint out of the path of an oncoming bus or fight an assailant. But in today's world, the sources of perceived threats have multiplied (financial problems, a heavy workload, a distressing medical diagnosis). In the short run, this reaction is helpful, giving you increased energy and focus. But when your cortisol level remains high for too long, it can harm brain structures vital to memory, including the hippocampus.

What you can do: There's no one-size-fits-all strategy for reducing stress. You have to find strategies that work for you—whether taking a brisk walk, listening to music, talking to a friend, or engaging in a relaxing activity, such as gardening, knitting, or meditating (see "Try meditation," page 28). A handful of small studies have investigated the effects of yoga on memory. For example, a 2014 study found that participants who did eight weeks of Hatha yoga improved on tests of working memory when compared with a group that engaged in an eight-week program of stretching and strengthening exercises.

Dr. Herbert Benson at Harvard Medical School has been a leading figure in the field and coauthored

the Harvard Special Health Report *Managing Stress*, which includes dozens of strategies for tamping down your stress levels (see “Resources,” page 48).

If you can't lower your stress level on your own, you might benefit from counseling. Some research indicates that it may not be the actual stressors in your life that cause problems so much as your *perceived* level of stress.

5 Get a good night's sleep

People who don't sleep well at night tend to be more forgetful than people who sleep soundly. A good night's sleep is essential for consolidating memories (see “Sleep, perchance to remember,” below). Sleep may aid memory in another way as well—by lowering levels of stress hormones. Stress hormones decline during the first few hours of sleep, which experts believe may free up the hippocampus to consolidate memories. Recent research has also suggested that the brain clears out toxins during sleep, and this may have implications for your risks of developing dementia. In studies with animals, levels of a toxic protein called beta-amyloid that is associated with Alzheimer's disease were found to rise during wakefulness and fall during sleep. Changes in time spent sleeping alter the rates at which beta-amyloid accumulates.

Although people vary in their need for sleep, six hours appears to be the minimum that most older adults need to ensure adequate daytime alertness and memory function. Getting consistently good-quality

sleep can reverse sleep-related impacts on thinking and memory. But some people have difficulty getting enough sleep. With age, people become more prone to sleep disorders. These make it harder to get adequate sleep, and they can contribute to a general decline in mental function.

The most common sleep disorder is insomnia. Unfortunately, many medicines used in the treatment of insomnia can also impair memory and general cognitive function, so it's best to avoid long-term use of sleep-inducing medications. Instead, try the sleep tips described below for reducing insomnia.

Another sleep disorder is obstructive sleep apnea (OSA), which can lead to memory impairment if not treated. People with OSA have short pauses in breathing that can disrupt sleep with hundreds of “mini-awakenings” each night. More than 18 million American adults have sleep apnea, with more men than women being affected by it. It becomes more common with age, affecting at least one in 10 people older than 65. It is often associated with loud snoring. If you have OSA, treating the problem appears to improve some aspects of cognitive function.

What you can do: The following practices can help reduce insomnia:

- Establish and maintain a consistent sleep schedule and routine. Go to bed at the same time each night, and wake up at the same time each morning. A set sleep routine will “train” you to fall asleep and wake up more easily.

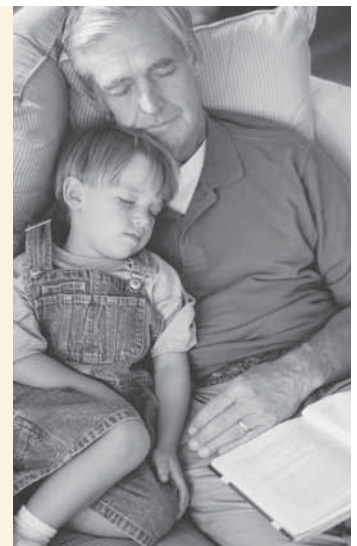
Sleep, perchance to remember

Why does sleep make a difference to memory? One theory suggests that changes in brain activity during two phases of sleep—slow-wave sleep and rapid-eye-movement (REM) sleep—are important for memory consolidation.

Research with rodents showed that during slow-wave sleep, the pattern of activity in the hippocampus was very similar to the pattern that appeared earlier when the animals were engaged in learning something. This finding suggests that during slow-wave sleep, the hippocampus “replays” the recently acquired

information to strengthen the neuronal patterns that were activated during the acquisition phase. This replaying of the learning scenario is the key component of the consolidation process.

Research has also revealed that during REM sleep—the phase of sleep when dreaming occurs—there is increased activity in the cortex. Some scientists now think that dreaming is one of the ways in which the brain strengthens the neuronal pathways that encode memories.



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- Use the bed only for sleep and sex.
- Plan to do your most vigorous exercise early in the day. Exercising in the hours immediately before bedtime causes physiological changes that may interfere with sleep. Exercising in the morning, on the other hand, enhances your alertness when you need it most—at the beginning of the day.
- Avoid coffee and other sources of caffeine (e.g., chocolate, many soft drinks, some brands of pain relievers, many types of tea) after midmorning.
- Avoid excessive napping during the daytime. Prolonged napping can disrupt your natural sleep cycle and prevent you from feeling tired enough to fall asleep at night.
- Don't take sleeping pills unless nothing else works. If you do take a prescription sleep medicine, work with your doctor on using it effectively, but only on a short-term basis, because sleep medications can be habit-forming. In addition, like sleep deprivation itself, sleeping pills can cause memory loss.
- Try drinking warm milk before bedtime. Milk contains tryptophan, a chemical that may help you relax. Some people find this helps them feel sleepy.
- Don't try to sleep if you're not tired; otherwise you'll set yourself up for tossing and turning. If you're still awake after about 20 minutes in bed, get up and read awhile to help yourself relax.

6 Try meditation

Meditation can boost your memory in multiple ways. It improves your ability to focus, even when things around you are chaotic—thus improving attention, which is crucial for memory acquisition. It helps reduce stress, counteracting the harm of chronic high levels of stress hormones on your brain, including the hippocampus, which can shrink under a steady onslaught of cortisol. And there is a third way it may help. According to a study of mindfulness meditation, published in *JAMA Internal Medicine* in 2015, it can improve your ability to get a restful night's sleep.

In mindfulness meditation, you pay attention to what you're experiencing from moment to moment, without drifting into thoughts about the past or concerns about the future, and without analyzing (or making judgments about) what is going on around

you. Researchers at Massachusetts General Hospital in Boston and the University of Massachusetts Medical School in Worcester have found that this practice alters regions of the brain associated with memory, awareness of self, and compassion. A study of 48 college students, published in the journal *Psychological Science* in 2013, found that those who engaged in mindfulness meditation four days a week for two weeks improved working memory and reading comprehension and reduced mind wandering. Moreover, they increased their score on the reading comprehension section of the Graduate Record Examination (GRE) from 460 to 520, on average. Those in the comparison group had no increase in GRE score.

For some people, the benefits of meditation relate to stress reduction. In one study of 34 adults ages 65 and older with high anxiety-related stress, eight sessions of a mindfulness-based stress reduction program lessened the severity of their anxiety and improved their performance on a memory test—they were better able to recall a paragraph when asked about it later. The study was published in the *International Journal of Geriatric Psychiatry* in 2014.

What you can do: Numerous books, videos, and workshops are available to learn the techniques of meditation. In particular, Jon Kabat-Zinn, a longtime scholar on the science of meditation, is well-known for his books and guided mindfulness meditation programs (see “Resources,” page 48).

If you experience persistent sleep problems, consult your physician so that you can identify the specific issues and get the necessary treatment.

7 Eat a Mediterranean-style diet

The Mediterranean diet—which features whole grains, fruits and vegetables, and healthy fats from fish, nuts, and oils—is famously good for the heart and circulatory system. That may be why it also appears to lessen the risk of developing memory problems later in life. “What’s good for the heart is good for the brain,” according to the Alzheimer’s Association.

One study, published in the journal *Neurology* in 2013, looked at the eating habits of more than 17,000 people with an average age of 64 and found that those who most closely followed a Mediterranean-style diet

were 19% less likely to have impaired mental function. Other observational studies have suggested that people who adhere to Mediterranean-type diets have lower rates of both mild cognitive impairment (see page 40) and full-blown dementia.

One component of the Mediterranean diet—fish (which contains omega-3 fatty acids)—may be particularly beneficial. Evidence that supports the connection between brain health and omega-3s includes data from the Framingham Heart Study. This study revealed that people with initially higher blood levels of the omega-3 fatty acid docosahexaenoic acid (DHA) had lower rates of dementia over a period of nine years.

Other components of the diet have also been shown to reduce dementia risk. For example, eating unsaturated fat—which includes fish oil as well as most vegetable oils—reduces risk, according to some

studies. In one study, which looked at a subset of the famed Women’s Health Initiative, 482 women ages 60 and older were observed for three years. The women who consumed the most monounsaturated fat (found in foods such as olive oil and avocados) showed significantly less memory decline than those who ate less monounsaturated fat. In the highest consumption group, monounsaturated fat made up more than 13% of dietary calories.

Eating a lot of fruits and vegetables can be especially beneficial because many are good sources of vitamins and other nutrients that may protect against diseases and age-related deterioration throughout the body.

What you can do: If you want to try a Mediterranean-type diet, here are the basics:

- Increase your consumption of fresh fruits and vegetables. Half your plate should contain produce.

What about vitamins?

Consuming adequate amounts of vitamins and minerals is essential for overall health, including brain health. But there is no convincing evidence that taking vitamin supplements at doses higher than the Recommended Dietary Allowance (RDA) improves memory in the short term or protects against dementia in the long term.

B vitamins. In the realm of memory and cognition, you want to be sure you are getting the RDA of the B vitamins—especially B₆, B₁₂, and folic acid. A vitamin B₁₂ deficiency, in particular, can cause disorientation and confusion. Vitamin B₁₂ is found in meat, poultry, seafood, dairy products, and eggs. You can prevent or treat a vitamin B₁₂ deficiency by eating these foods or taking supplements. About 6% of people ages 60 and older are deficient in vitamin B₁₂, and nearly 20% are borderline deficient. Older adults produce less stomach acid than younger people, which makes it harder for them to metabolize this vitamin from food sources. People who complain of memory or thinking difficulties should have a blood test to rule out a vitamin B₁₂ deficiency, since it is often treatable.

Vitamin D. Some studies have found that low levels of vitamin D can impair mental function. And vitamin D deficiency is common. For example, a study published in the *Journal of the American Geriatrics Society* in 2014 of over 2,700 adults ages 70 to 79 found that 68% of them had vitamin D levels less than 30 ng/mL (30 to 74 ng/mL is considered normal). Those with lower vitamin D levels had lower scores on tests of mental function than those with higher vitamin D levels. Other studies have found a possible connection between low vitamin D levels and increased risk for dementia.

In theory, you can meet most, if not all, of your vitamin D requirement with exposure to the sun on the arms and legs for about 10 to 15 minutes a day. (You should always wear sunblock on the face and hands to avoid the skin-aging effects of ultraviolet radiation.) Sunlight penetrates the skin and converts a naturally occurring substance into the form of vitamin D that can be used by the body as a nutrient. However, in the northern latitudes, it can be difficult to get enough sun exposure, especially in the winter. Moreover, few foods naturally contain vitamin D, the main exception being fatty fish (salmon, mackerel, and tuna). Milk and some juices are fortified with vitamin D. That leaves supplementation as the best route. Try to get 800 IU a day.

Vitamin E. Vitamin E has several beneficial properties that could theoretically promote brain health and reduce the risk of dementia. Its antioxidant properties could protect against injury from the toxic byproducts of metabolic activity—namely, harmful molecules called “free radicals.” Vitamin E also may increase blood flow by preventing cells in the blood called platelets from sticking together. Vitamin E is found in nuts, olive and other oils, and fruits and vegetables like tomatoes, broccoli, and avocados.

Unfortunately, no study has shown that taking vitamin E improves cognitive abilities in healthy people or reduces the risk of dementia in people who have mild cognitive impairment. Moreover, taking vitamin E supplements has not been shown to diminish the likelihood of heart disease and may even slightly increase the risk of death.

- Limit red meat and avoid processed meat entirely. Fish, poultry, and beans are better protein sources.
- Choose whole grains—such as whole-grain bread and brown rice—over highly processed grains.
- Use olive oil or another type of vegetable oil in cooking.
- Snack on nuts (such as walnuts or almonds) instead of potato chips, ice cream, or candy bars.

It may be tempting to continue eating a basically unhealthy diet (full of saturated fats and containing few fruits and vegetables) and supplement this with vitamins and fish oil capsules. But that will not have the desired effect (see “What about vitamins?” on page 29).

8 Maintain a healthy weight

Maintaining a healthy weight, particularly during middle age, can help reduce risks of dementia. However, roughly one-third of Americans are obese, meaning that they have a body mass index (BMI) of 30 or higher. (To calculate your own BMI, go to www.health.harvard.edu/BMI.) Being obese leaves you more prone to a host of medical problems, including dementia. Particularly risky is having so-called central obesity—the classic “spare tire”—in middle age. In addition, people who are obese face a higher risk of heart disease and diabetes—two conditions that have also been linked to memory impairment and a higher risk of dementia. Though maintaining a healthy weight throughout middle age is clearly beneficial, researchers are investigating

whether you can derive the same benefits if you’re overweight to start with and then lose weight.

A few small studies of people who are severely obese and undergo weight-loss surgery have demonstrated improved memory and cognition after the procedure. In one study, published in *The American Journal of Surgery* in 2014, 50 people who had weight-loss surgery showed improvements in attention, executive function, and memory that lasted up to three years after the surgery. Whether people can achieve these improvements with less dramatic, nonsurgical weight loss—and whether this translates to decreased risk for dementia—are questions under study.

What you can do: You’ve heard it over and over—consume fewer calories. That generally means eating more vegetables and fruits and less processed food, especially processed food products that are high in saturated fat and refined sugar and flour. Replacing calorie-dense foods like cookies and donuts with low-calorie foods like produce both fills you up and reduces your caloric intake. The number of calories you need each day depends on your sex, age, and level of activity (see Table 2, page 31).

You may be consuming too many calories, and from the wrong foods. But don’t try to make major alterations too quickly. The foods you eat, how you prepare them, and how often you eat become habits. And habits are very hard to change. You also probably like the foods you’re eating. If you replace foods you like with foods you don’t like, you will quickly go back to your old unhealthy habits. So, as you slowly

Ginkgo: A no-go for memory

Ginkgo biloba, an extract from the nuts and leaves of the maidenhair tree, has been widely touted as a memory booster. But the popularity of this supplement is more of a testament to the power of marketing than to any measurable brain benefits from ginkgo, according to a large body of research.

Ginkgo biloba has been tested in dozens of studies involving both healthy

people and those with mild to severe cognitive impairments. The findings have been disappointing. A study published in *Human Psychopharmacology* analyzed results from 28 studies that looked at the effects of ginkgo on memory, executive function, and attention in healthy adults without dementia. They found no measurable positive effects on any of the three types of mental function.

Taking ginkgo has not been shown to reduce risk for Alzheimer’s disease or other causes of dementia. And it is of no help for people with dementia. A review by the Cochrane Collaboration, an international group of independent experts, evaluated 36 studies testing ginkgo biloba in people with cognitive impairment or dementia and concluded the evidence of any benefit for the extract was “inconsistent and unreliable.”

Table 2: How many calories do you need each day?

This table shows roughly how many calories a person of average weight needs to consume each day to maintain his or her current weight. If you want to lose weight, you will need to take in fewer calories. If you weigh considerably more, these give you targets to slowly work toward.

	AGE	RELATIVELY SEDENTARY	MODERATELY ACTIVE	ACTIVE
Women	31 to 50	1,800	2,000	2,200
	51 and over	1,600	1,800	2,000–2,200
Men	31 to 50	2,200	2,400–2,600	2,800–3,000
	51 and over	2,000	2,200–2,400	2,400–2,800

Source: Dietary Guidelines for Americans, 2010.

increase the amount of fruits and vegetables you eat, be sure to pick ones that you enjoy.

If you find it difficult to change your diet, consider consulting a dietitian or nutritionist. They can guide you to an overall healthier way of eating and suggest foods and methods of preparation you haven't thought of. You may find that healthy foods you scrupulously avoided are actually not bad if prepared in a different way.

9 Manage your medical conditions

Conditions that have been linked with heart disease—including high blood pressure, high cholesterol, and type 2 diabetes—have also been linked to memory problems. Moreover, they can increase your risk of suffering brain-damaging strokes and dementia or cause memory problems to appear at an earlier age (see “Lessons from the Nun Study,” at right).

High blood pressure. Adults with high blood pressure (hypertension) are more prone to memory impairment than people with normal blood pressure. Moreover, people with hypertension experience memory loss that is more severe than that suffered by individuals who don't have hypertension. These differences hold true regardless of age.

High blood pressure also increases risk for dementia, especially when it is present in midlife. It likely does so by accelerating atherosclerosis, the buildup of plaque in the arteries that impairs circulation. A reduction in circulation can slow blood flow to the brain, which can harm the cells of the brain. Even worse, if blood flow to one area of the brain is stopped, brain tissue in that area can die. Each episode of dam-

age—which is actually a tiny stroke—affects a small area of the brain, and symptoms may not be apparent until a critical amount of tissue has been destroyed. This is a form of vascular dementia, which is a well-recognized cause of memory loss in older people.

High blood pressure is generally easy to treat with a healthy lifestyle and, if necessary, medication. Low-

Lessons from the Nun Study

The Nun Study, an ongoing research project begun in 1986, seeks to understand the hows and whys of aging and Alzheimer's disease. It features a unique population of 678 retired Catholic sisters, all of whom agreed to donate their brains at death. The unprecedented wealth of information available about the sisters' personal and medical histories, combined with the relative uniformity of their lifestyles, allowed researchers to tease out some of the medical and social factors that put an individual at risk for developing dementia.

One of the most significant findings has been the understanding of how cardiovascular factors interact with Alzheimer's disease pathology. When an autopsy is done on the brain of a person who had Alzheimer's disease, two distinctive features are found—clumps of material called plaques between cells and twisted fibers called neurofibrillary tangles inside cells. In the Nun Study, the women who seemed to fare the best cognitively were those whose brains, when autopsied, showed little evidence of stroke, even if they had plaques and tangles consistent with moderate Alzheimer's. From this, researchers conclude that a healthy brain has reserve capacity it can draw on to maintain normal functions even when Alzheimer's disease is present. On the other hand, when the brain is compromised by cardiovascular disease, dementia symptoms appear at an earlier stage.

ering blood pressure reduces your risk for heart attacks and other forms of heart disease. It also appears to reduce your chances of developing dementia.

High cholesterol. Like high blood pressure, high cholesterol levels appear to increase risk for memory impairment and dementia years down the road. There's more than one form of cholesterol. Low-density lipoprotein (LDL) cholesterol is considered the "bad" form of cholesterol because it can build up in the walls of arteries and lead eventually to heart attacks and strokes. High-density lipoprotein (HDL) cholesterol helps to clear excess cholesterol from arteries, and is therefore considered the "good" form of cholesterol.

Having high LDL cholesterol levels in midlife has been shown to raise risk for later developing mild cognitive impairment (see page 40) or dementia. It's not clear whether high cholesterol leads to memory loss only through increasing the risk of stroke, or whether the crucial factor is excessive LDL or insufficient HDL. There is some evidence that the generation of harmful amyloid proteins in the brain (which are present in people with Alzheimer's disease) might depend on cholesterol.

Diabetes. Several large studies have documented links between diabetes and decline in memory and thinking. People with diabetes are at greater risk for mild cognitive impairment, vascular dementia, and Alzheimer's disease. Scientists think that many factors link diabetes and dementia. People with diabetes have chronically high blood sugar levels, especially if the disease is not well controlled. This may damage small blood vessels in the brain. In addition, high blood sugar depresses the function of the hippocampus, which, as noted earlier, acquires and consolidates new memories.

Many people with diabetes have high cholesterol levels, high blood pressure, or both. This too may contribute to the higher risk for dementia faced by people with diabetes.

There is some evidence that better control over levels of sugar in the blood is associated with improved cognitive functioning.

Metabolic syndrome. Some doctors call metabolic syndrome the "most common condition you've never heard of." It affects almost 50 million Americans, yet many of them don't know it. Metabolic syndrome isn't

just one condition; it's a combination of problems. You have it if you have three or more of the following:

- high blood pressure
- excess belly fat, meaning a waist size of 40 inches or more for men, or 35 inches or more for women
- high triglycerides, a kind of blood fat often checked with cholesterol levels
- low HDL cholesterol
- high fasting blood sugar.

Metabolic syndrome puts you at greater risk for a host of problems, including strokes, diabetes, and a fatal heart attack. A study published in the journal *Neurology* suggests that problems with memory and thinking be added to that list. The observational study found that of the 7,087 French people ages 65 and over who took part in the study, about 16% had metabolic syndrome. Over the four years of the study, those with metabolic syndrome were 20% more likely than the other participants to experience a decline in overall cognition. When researchers analyzed the various components of metabolic syndrome, they found that people with high triglycerides and those with low HDL had the greatest declines in memory and thinking. Full-blown diabetes was also associated with declines.

What you can do: Ideally, you want to keep your blood pressure, cholesterol levels, blood sugar levels, and weight within the normal range throughout life. That means blood pressure below 120/80 mm Hg, total cholesterol below 180 mg/dL, blood sugar levels below 100 mg/dL before eating and below 140 mg/dL two hours after eating, and BMI between 18.5 and 24.9. Several lifestyle practices, including a number of



A Mediterranean-style diet, with plenty of fresh vegetables and fruits, may help ward off Alzheimer's disease. Fatty fish such as tuna that are high in omega-3 fatty acids (particularly DHA) seem especially helpful.

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measures already discussed, can help you.

- Exercise regularly. This helps to reduce blood pressure, lower LDL (bad) cholesterol, and raise HDL (good) cholesterol, and it can help keep blood sugar levels under control.
- Eat a healthy diet that's rich in vegetables and fruits to help control both your blood pressure and cholesterol levels. One option is the Mediterranean diet (see "Eat a Mediterranean-style diet," page 28). Another is the DASH diet (named for the Dietary Approaches to Stop Hypertension trial). Like the Mediterranean diet, the DASH plan emphasizes fruits, vegetables, and whole grains. It includes low-fat or nonfat dairy products, lean meats, fish, poultry, nuts, and beans. It is high in fiber and low to moderate in fat (see Table 3, below).
- Limit salt intake to help control your blood pressure. Your body needs a small amount of sodium to function normally. But most of us consume too much, mostly in the form of salt. Most people ages 2 to 50 should consume less than 2,300 mg of sodium a day. But if you are over age 51, are African American, or have high blood pressure, diabetes, or chronic kidney disease, the limit is less than 1,500 mg. If you're eating packaged foods, read food labels for sodium content and choose foods with lower amounts. If you're cooking from scratch, you can control the amount of sodium you add. Try reducing the amount, and soon your

palate will adjust. You can also compensate for reduced salt by using salt substitutes or adding herbs and spices.

- Reduce stress to help keep your blood pressure under control. Blood pressure fluctuates throughout the day in response to a variety of factors, including stress and anxiety. (See "Manage your stress," page 26, for suggestions on coping with stress.)
- Avoid cigarettes. This is important for many reasons. Among smoking's many harmful effects, it raises blood pressure and increases the risk of heart disease and stroke. (See "Don't smoke," page 37, for tips on how to kick the habit.)

10 If you drink alcohol, do so moderately

Drinking too much alcohol on a regular basis increases the risk for memory loss and cognitive decline. People with alcoholism have difficulty performing short-term memory tasks, such as memorizing lists. Another type of memory loss associated with alcohol use is Korsakoff's syndrome, a form of dementia in which severe amnesia comes on suddenly and dramatically as a result of long-term vitamin B₁ (thiamine) deficiency combined with the toxic effects of alcohol on the brain. The memory loss of Korsakoff's syndrome is permanent about a quarter of the time, but it can be reversible to some degree in most cases, especially if it is caught early. Other alcohol-related memory problems may be reversible if the person sharply cuts down on drinking and eats a healthy diet.

Even moderate drinking can negatively affect memory in the short term. Your ability to remember and think clearly are impaired while under the influence of alcohol. In addition, alcohol consumption can disrupt sleep (which is important for consolidating memories) and may contribute to depression.

That said, some studies have linked moderate drinking with a reduced risk of dementia over the long term. Moderate consumption means no more than two drinks a day for men and one a day for women.

Some studies suggest that red wine in particular (as opposed to other forms of alcohol) may have an especially salutary effect, possibly because of resvera-

Table 3: The DASH diet

TYPE OF FOOD	SERVINGS ON A 2,000-CALORIE DIET
Grains and grain products (include at least three whole-grain foods each day)	7 to 8 per day
Fruits	4 to 5 per day
Vegetables	4 to 5 per day
Low-fat or nonfat dairy foods	2 to 3 per day
Lean meats, fish, poultry	2 or less per day
Nuts, seeds, and legumes	4 to 5 per week
Fats and sweets	limited

rol, a compound found in the skin of red grapes that has garnered attention as an anti-aging compound. Alcohol may be memory-protective because of its antioxidant properties and the fact that it decreases the risk of non-hemorrhagic stroke.

What you can do: Many questions remain about the relationship between alcohol and memory. If you do not currently drink alcohol, the study findings should not be interpreted as a reason to start. If you do enjoy a cocktail or glass of wine, keep it moderate. Clearly it's better to forgo alcohol altogether than to over-imbibe.

11 Treat depression

The relationship between depression and memory loss is complex. Depression can be a cause as well as an effect of memory dysfunction. Severe, ongoing, and untreated depression can make people forgetful by interfering with their ability to concentrate and process information. This is particularly true in older adults. In fact, doctors coined the term “depressive pseudo-dementia” to describe older adults with severe memory impairment linked to depression. Once the depression is treated, the person's memory can often return to the level of function that existed before he or she was depressed.

Depression that occurs for the first time in an older adult may also be an early symptom of dementia. Thus, older people who develop late-life depression need to be closely watched. There are key differences in the memory loss experienced by people suffering from depression alone and people experiencing depression in conjunction with Alzheimer's. In people with depression alone, mental function usually fluctuates with mood. When mood improves—usually in response to treatment with medication, psychotherapy, or both—mental function generally improves as well. By contrast, someone with Alzheimer's disease will continue to have impaired cognitive functioning even when the depression lifts.

Depression has another possible effect on mental function: it seems to put people at risk for later dementia, particularly Alzheimer's disease and vascular dementia. The reason for this is not entirely understood.

What you can do: Depression goes beyond occasionally feeling sad or blue for a couple of days, which

is normal. If the feelings last and are intense enough to interfere with daily life, you probably have depression. There are several signs and symptoms of depression. According to the National Institute of Mental Health, they include

- persistent sad, anxious, or “empty” feelings
- feelings of hopelessness or pessimism
- feelings of guilt, worthlessness, or helplessness
- irritability, restlessness
- loss of interest in activities or hobbies once pleasurable, including sex
- fatigue and decreased energy
- difficulty concentrating, remembering details, and making decisions
- insomnia, early-morning wakefulness, or excessive sleeping
- overeating, or appetite loss
- thoughts of suicide, suicide attempts
- aches or pains, headaches, cramps, or digestive problems that do not ease even with treatment.

If you have any of these symptoms, seek help from a mental health professional, such as a social worker, psychologist, or psychiatrist. These professionals can provide counseling and possibly antidepressant medication. Your primary care doctor can refer you to a mental health professional.

12 Get your hearing tested

It makes sense: if you have trouble hearing something, you're bound to have trouble remembering it. It's not that you forgot, but rather, you never heard the information in the first place.

In addition, the struggle to hear something that sounds garbled requires the brain to work harder and possibly use resources at the expense of other functions. One study found that adults with mild to moderate hearing loss remembered fewer of the items from a list of 15 spoken words than did adults with good hearing. The researchers concluded that the extra effort involved in trying to hear the words diverted brain resources from acquisition and consolidation of memory. Hearing loss is a remarkably common problem, particularly in older adults.

What you can do: Periodic hearing tests should be part of routine medical care. Hearing loss is highly

treatable. Hearing aid technology has improved greatly in recent years; if you tried a hearing aid in the past and didn't find it helpful, consider trying again. Successful use of a hearing aid may require several follow-up visits to the hearing aid specialist, who will fine-tune and adjust the device for your needs.

13 Have your thyroid hormones checked

The thyroid gland secretes hormones that control metabolism, the rate at which the body burns energy. When the thyroid doesn't function properly, it can release too much or too little of these hormones, making the metabolism run too fast or too slow. Either problem can interfere with learning and memory, but in a different way.

- **Hyperthyroidism**, which causes an abnormally fast metabolism, can make people feel confused.
- **Hypothyroidism**, which causes an abnormally slow metabolism, can make people feel sluggish, sleepy, and depressed.

Research on animals shows that changes in thyroid hormone levels cause physiological changes in the hippocampus. Research also shows that when thyroid disorders are treated, people's memory problems diminish.

What you can do: If you suspect thyroid issues, ask your doctor for a simple blood test to check your

levels of thyroid hormones, as well as thyroid-stimulating hormone. Treatment can be as straightforward as taking pills containing synthetic thyroid hormone. Note that the role of other supplemental hormones is very much in question (see "Do estrogen and testosterone affect memory?" below).

14 Review your medications

Many over-the-counter and prescription drugs have side effects that can scramble thinking and dim memory. Older people tend to be more sensitive to these effects. Moreover, older people often take multiple medications. Although one drug alone may not cause problems, the cumulative effect of several drugs may impair memory and thinking.

Popular over-the-counter drugs with these side effects—often listed on the label as dry mouth, blurred vision, and confused thinking—include the antihistamines brompheniramine (found in Dimetapp, among others), chlorpheniramine (found in Chlor-Trimeton, Triaminic, and many others), and diphenhydramine (best known as Benadryl). Doctors sometimes recommend that people take diphenhydramine to help them fall asleep. (In fact, diphenhydramine is also the main ingredient in many over-the-counter sleep aids, such as Compoz, Somnex, and Unisom, as well as Tylenol

Do estrogen and testosterone affect memory?

In addition to thyroid hormones, other naturally occurring hormones can affect memory and overall cognitive function. In particular, research has focused on the sex hormones estrogen and testosterone.

Estrogen

Many women experience trouble with memory during menopause, when their levels of estrogen fall sharply. Fluctuating and declining estrogen levels can cause hot flashes and sleep disturbances and may also be to blame for memory problems.

Some studies suggest that estrogen protects neurons, which might explain a connection with memory. If that's true, you would think that hormone supplements should protect against age-related memory difficulties. However, a number of studies have revealed the opposite, casting doubt on estrogen's promise for preserving memory. Ongoing research is looking into whether different forms of estrogen given at different times may prove beneficial. One study of medical records of female members of the Kaiser Permanente health maintenance organization found that women who took hor-

mone replacement therapy only at midlife (about age 48) had a 26% lower risk of developing dementia later, whereas those who took the hormone supplements only later in life (about age 76) had a 48% higher risk. More research is needed before any recommendations regarding hormone replacement and memory can be made.

Testosterone

Men with high levels of testosterone have better visual and verbal memories than men with low levels. However, the value of testosterone supplementation in older men is controversial. Testosterone supplements have drawbacks—they can increase the risk of some kinds of cancer and may also raise the risk for stroke and for vascular dementia. In addition, the type of testosterone and the amount (if any) that should be given as a treatment for memory problems still needs to be established.

Table 4: Medications that may affect memory—and possible substitutes for them

IF YOU TAKE ASK ABOUT SWITCHING TO ONE OF THESE DRUGS
amitriptyline (Elavil) or doxepin (Sinequan)	a wide range of alternatives, depending on your reason for taking a tricyclic antidepressant (neuropathic pain, depression, etc.)
captopril (Capoten)	a different ACE inhibitor
cimetidine (Tagamet)	a proton-pump inhibitor, such as esomeprazole (Nexium), lansoprazole (Prevacid), or omeprazole (Prilosec)
cold or allergy medication containing brompheniramine, chlorpheniramine, or diphenhydramine	loratadine (Claritin) or another non-sedating antihistamine
oxybutynin (Ditropan) or tolterodine (Detrol, Detrusitol)	darifenacin (Enablex), solifenacin (Vesicare), or trospium (Sanctura), which are anticholinergic but more selective for the bladder
paroxetine (Paxil)	another SSRI, such as fluoxetine (Prozac) or sertraline (Zoloft), or a drug from the SNRI class, such as duloxetine (Cymbalta) or venlafaxine (Effexor)

PM.) But if it causes you mental confusion, try non-drug approaches to improving sleep instead (see the tips under “Get a good night’s sleep,” page 27).

Among prescription drugs, the prime culprits include certain ones used to treat depression, such as amitriptyline (Elavil) and nortriptyline (Aventyl, Pamelor); overactive bladder, such as oxybutynin (Ditropan, Urotrol, and other brands); and heartburn, such as cimetidine (Tagamet).

These medications share a common mechanism: blocking the neurotransmitter acetylcholine, which is why they are known as anticholinergic drugs. Certain drugs used to treat Alzheimer’s disease, such as donepezil (Aricept), have the opposite effect—they *boost* levels of acetylcholine in the brain—so it makes sense to steer clear of anticholinergics when possible. One study reported that the use of medications with anticholinergic activity was linked to a more rapid decline in the cognitive performance of older adults who had been studied an average of 7.8 years.

What you can do: If you’ve noticed any kind of confusion or thinking problems since starting a new medication, ask your doctor about a possible substitute, which is often (but not always) possible. For some people, especially older adults, medications (both prescribed and over-the-counter ones) can cause clouded thinking and memory, even if you’ve taken them for a long time without any problem. If you notice a marked deterioration in your memory, review your medications with your physician to identify a possible culprit,

even if you’ve taken these medications for a long time. For some potential alternatives to drugs with anticholinergic actions, see Table 4, above.

15 Say no to recreational drugs

People who use certain recreational drugs are likely to have problems with memory and related cognitive functions—not only while they are under the influence, but also for weeks after the drugs’ immediate effects wear off.

There’s no question that recreational use of marijuana produces short-term problems with thinking, working memory, and executive function. Marijuana’s active chemical, THC, causes its psychoactive effect by attaching to receptors in brain regions vital for memory formation, including the hippocampus, amygdala, and cerebral cortex.

There’s debate about whether long-term use of marijuana (either for medical or recreational purposes) produces persistent cognitive problems. Although early studies of recreational users reported such difficulties, the studies had design problems. Typically they compared long-term marijuana smokers with people who had never used the drug, without controlling for characteristics such as education or cognitive functioning. These factors might play a part in determining who chooses to smoke marijuana long-term and who never tries it, as well as who might be most at risk for thinking and memory problems later on. That said, studies suggest that although overall cognitive ability remains

intact, long-term use of marijuana may cause subtle but lasting impairments in executive function.

Memory impairment is also a side effect of habitual cocaine use. Cocaine users score lower than nonusers on tests of working memory and recall of long-term memories. Deficits are apparent on tests of verbal memory, even after users have abstained from cocaine for 45 days.

What you can do: One of the worst things you can do to your memory is to use recreational drugs. It is unclear how much of the memory impairment can be restored by quitting, but at the very least, quitting can prevent further damage.

16 Don't smoke

Current smokers have a higher risk of Alzheimer's dementia than former smokers. In one large and racially diverse study, researchers found that people who had smoked more than two packs of cigarettes a day at midlife had more than double the risk of developing dementia in old age when compared with nonsmokers. But here's the good news: people who had stopped smoking by midlife and those who had smoked less than half a pack a day had a risk of dementia similar to that of people who had never smoked.

Smokers also have a greater degree of age-related memory loss and other memory problems. A meta-analysis of 19 studies involving a total of more than 26,000 participants found that smokers showed a greater yearly decline in cognitive scores compared with nonsmokers.

No one knows whether smoking directly impairs memory or is merely associated with memory loss because it causes disorders that contribute to poorer brain function. Smoking increases the risk for vascular diseases, stroke, and high blood pressure, all potential causes of memory impairment and dementia.

What you can do: Regardless of the exact nature of the link between smoking and memory loss, if you smoke, it pays to quit. Research shows that people who stop smoking have less mental decline than people who continue to smoke. Of course, quitting isn't easy.

Cigarette smoking is a very difficult habit to break. First and foremost, it requires motivation. But just

Another reason to stay heart- and brain-healthy

High blood pressure, high cholesterol, and smoking all make clogged arteries more likely. If the problem becomes serious, a surgical procedure called coronary artery bypass may be needed. Some people who undergo this type of surgery experience memory loss and problems concentrating for a while after the operation. One study found that about half of the people who underwent bypass surgery had trouble remembering things or thinking clearly immediately afterward; approximately six months later, about one in four people continued to experience such problems. Why this happens is not clear.

Some research suggests that biological processes involved in coronary artery disease also contribute to brain injury and cognitive decline—raising the possibility that it is the underlying vascular disease, and not the bypass procedure, that contributes to most cognitive problems.

Researchers continue to look into this issue. In the meantime, if you are preparing for a bypass operation, talk with your surgeon ahead of time about what strategies are available to minimize the chances of post-surgery memory and thinking problems. After the operation, tell your doctor about any problems with attention or concentration you may be having.

Source: National Heart, Lung, and Blood Institute.

wanting to quit is often not enough. Many people need help. Cigarette smoking is both physically and psychologically addicting, and both of these aspects must be addressed. Quitting smoking usually requires a combination of counseling, social support, and some sort of nicotine replacement or other drug therapy. Start by deciding to quit. Here are some specific strategies:

- Set a firm quit date.
- Remove all cigarettes and ashtrays from your home, car, and place of work.
- Tell family and friends and ask for their support.
- Use some form of nicotine replacement (patch, gum, or lozenge).
- Talk to your doctor about other medicines that may help you.
- Call 800-QUIT-NOW (800-784-8669) to find the quit line in your state.
- Find counseling (individual, group, or telephone) that you are comfortable with.

To break the smoking habit, you'll probably need to come up with new approaches to handling stress. A counselor or fellow smokers who are quitting can help you come up with new coping skills that don't involve smoking. At least at first, it's best to minimize time spent with smokers.

Addiction to the nicotine contained in cigarettes can be very difficult to overcome. Several forms of nicotine replacement are available to help ease the transition. Nicotine products are available in skin patches, gums, and lozenges, which can be obtained without a prescription. Nicotine can also be delivered in inhalers and a nasal spray. To obtain these forms, you will need to have a prescription from your doctor.

Aside from nicotine, a few other drugs have been shown to help people quit smoking. These include bupropion (Zyban) and varenicline (Chantix).

If you try to quit smoking and don't succeed, don't be discouraged. Try again. Many people fail at their first attempt to quit smoking. Consider trying a different technique to find what works for you.

17 Protect your brain from injury and toxins

Head trauma is a major cause of memory impairment and appears to be a risk factor for future development of dementia (see "Head trauma," page 43).

Physical force isn't the only source of brain injury. Lead, mercury, and other chemicals present in homes and workplaces can cause memory loss and

poor concentration. Lead poisoning can result from drinking contaminated tap water and breathing in lead dust generated by the deterioration of lead paint in homes built before 1978, when it was outlawed. Carbon monoxide fumes leak from malfunctioning household furnaces and are spewed from automobile exhaust systems. Mercury and other toxic substances are found in some paints, dyes, and inks used in artwork. Still other sources of toxic exposure are pesticides used in home gardens and farms, darkroom chemicals, and chemicals used in metalwork and woodwork.

What you can do: You can reduce the risk of head trauma by using the appropriate gear during high-speed activities and contact sports. Wear seat belts when you ride in motor vehicles. Car accidents are by far the most common cause of brain injury, and wearing seat belts reduces the injury risk. Wear a helmet when bicycling, riding on a motorcycle, in-line skating, and skiing.

Reduce your exposure to toxic substances by taking sensible precautions. Before using paints, solvents, and pesticides, read the labels for safe handling. Test your home water supply and use a water filter to eliminate lead, if necessary. Avoid sanding, scraping, and otherwise disrupting lead paint on older homes. If you do plan to remove lead paint, hire a government-approved contractor for this work. Have your car and furnace serviced regularly to minimize carbon monoxide emissions. ♥

Memory problems: Normal aging or brain disease?

It's common to become somewhat more forgetful as you age. The question is, how can you tell whether your memory lapses are within the scope of normal aging or are a symptom of something more serious?

The changes associated with normal aging may make life frustrating at times, such as when you can't remember the name of someone you just met or have difficulty concentrating. But they don't interfere with your ability to go about your daily life. By contrast, people with dementia have a loss of memory and other mental function severe enough to impede their ability to function independently at home, socially, and at work. The source of the dysfunction often is some type of injury to the brain that goes beyond normal changes. For a variety of reasons, neurons, neural

networks, and brain regions are damaged to the point that they fail to function effectively.

Neuroscientists and physicians have identified some key differences between normal memory lapses and those that occur with dementia (see Table 5, below). For example, word finding can become problematic for everyone. You know the word or person's name you want to recall; you just can't quickly retrieve it (it's on the "tip of your tongue"). With normal forgetfulness, the information is not lost. It may require some context, a reminder, or even time, but you should remember it. For a person with dementia, the word is usually lost for good. People with Alzheimer's disease often can't name common objects. They also forget names, and not just the names of acquaintances.

Table 5: Normal aging or dementia?

Physicians often use information like that summarized in this table to help differentiate between normal aging and dementia.

▼ NORMAL AGING	▼ DEMENTIA
<ul style="list-style-type: none"> • The person remains independent in daily activities. • The person complains of memory loss but can provide considerable detail regarding incidents of forgetfulness. • The individual is more concerned about perceived forgetfulness than close family members are. • Recent memory for important events, affairs, and conversations is not impaired. • The person has occasional difficulty finding words. • The person does not get lost in familiar territory, but may have to pause momentarily to remember the way. • The individual operates common appliances even if she or he is unwilling to learn how to operate new devices. • There is no decline in interpersonal social skills. • Performance on mental status examinations is normal relative to the individual's age, education, and culture. 	<ul style="list-style-type: none"> • The person is critically dependent on others for key daily living activities. • The person complains of memory problems only if specifically asked and cannot recall instances when memory loss was noticeable. • Close family members are much more concerned than the individual is about incidents of memory loss. • Recent memory for events and ability to converse are both noticeably impaired. • The person makes frequent word-finding pauses and substitutions. • The person gets lost in familiar territory while walking or driving and may take hours to return home. • The person cannot operate common appliances and is unable to learn to operate even simple new appliances. • The person may lose interest in social activities or exhibits socially inappropriate behaviors. • Performance on mental status examinations is below normal in ways not accounted for by educational or cultural factors.

Source: Adapted from the American Medical Association's *Diagnosis, Management and Treatment of Dementia: A Practical Guide for Primary Care Physicians*.

They often can't remember the names of their relatives and other people they know well. Depending on the severity of the disease, a person with dementia may be unable not only to retrieve the names of people, but also to recognize who they are.

Some causes of serious memory impairment are reversible. For example, certain medications can cause memory problems, and stopping the medication will restore mental function (see "Review your medications," page 35). But many causes of dementia, like Alzheimer's disease, are permanent. The following are some examples of conditions that prevent neurons from functioning normally, causing a variety of mental impairments, including memory loss.

Mild cognitive impairment

People with mild cognitive impairment (MCI) have either memory loss, decline of other mental functions, or both, which are more persistent and severe than what is considered normal for their age, but are less severe than what is found in people with dementia. MCI has two major subtypes: amnesic (when memory is impaired) and nonamnesic (which affects other types of cognitive functioning, such as language, attention, or spatial processing). If a person has impairments in both categories, he or she would fall into a category known as multi-domain MCI.

In addition to being more severe than normal age-related memory loss, MCI is also different in terms of the kind of information a person forgets. With normal memory loss, people tend to forget things that aren't terribly important to them—the name of a casual acquaintance, for example, or to go to a dental cleaning. With MCI, a person may not be able to learn and retain important new information, such as the record of a favorite sports team, the outcome of important political events, or the plans of close friends or family members.

When taking memory tests, people with the amnesic type of MCI have more trouble remembering the details of pictures they've seen or paragraphs they've read just a few minutes earlier. Their memory difficulty is comparable to that of someone with very mild Alzheimer's disease. But on tests that measure

other mental functions, such as their ability to keep the details of routine activities straight, people with this type of MCI perform as well as healthy people and much better than people with Alzheimer's. The critical difference between someone with MCI and someone with dementia is that in the person with MCI, the impairment in mental function does not yet substantially interfere with day-to-day functioning.

MCI becomes more common with age, affecting 14% to 18% of people over age 70. For some people with MCI, cognitive function continues to worsen. In these cases, MCI is regarded as a transitional state between normal cognitive function and dementia. However, not everyone with MCI progresses to full-blown Alzheimer's. Some even go back to having normal cognitive function. If MCI remains stable or reverts to normal, it most likely is because of a condition such as depression, a sleep disorder (like obstructive sleep apnea), medications that interfere with cognition, or a medical condition. This means that MCI is a "nonspecific" diagnosis that is often, but not always, linked to Alzheimer's.

To diagnose MCI, a physician will ask about your medical history and will refer you for neuropsychological or cognitive testing (see "When to see a doctor," page 45). The determination of whether a person's social and occupational functioning remains intact—the crucial factor differentiating MCI from dementia—depends on a clinician's judgment based on input from the person and loved ones.

The symptoms of amnesic MCI include

- a subjective sense of failing memory, preferably backed up by another person such as a family member (for example, the person reports being very forgetful, or that his or her memory is much worse than in the past)
- memory impairment (for age and education) as determined by testing
- essentially normal general cognitive function
- no substantial difficulties carrying out activities of daily living
- no dementia.

Getting diagnosed with MCI can be frightening, especially because it is associated with a significant increase in the risk of developing dementia, particu-

Amnesia: Memory loss caused by injury or trauma

Amnesia is the inability to form new memories or, in some cases, to remember existing ones. Amnesia occurs when key structures of the brain—such as the hippocampus, which is essential for encoding memories—don't function properly. Some types of stroke, concussive injury, chronic alcoholism, disruption of oxygen supply, or certain kinds of infections such as viral encephalitis can cause amnesia. It is also a common side effect of electroconvulsive therapy used to treat major depression, although the effect is typically temporary.

People with amnesia don't forget everything, and they can retain their general level of intelligence. They have a normal attention span and can form short-term memories lasting perhaps a few minutes, if not distracted. Their procedural memory—which covers well-established skills such as driving a car or brushing their teeth—remains intact, because retention of these skills doesn't depend on the hippocampus and surrounding brain structures. The breakdown occurs with acquiring new long-term declarative memories, which often depend on the hippocampus.

People with anterograde amnesia are unable to form new long-term memories after an injury or the onset of illness.

People with retrograde amnesia have difficulty retrieving previously learned information, memories that had been acquired before the onset of the condition that caused the amnesia.

The duration of amnesia depends on the cause. If the disruption of brain function is temporary (as in a blow to the head that causes a concussion), most of the lost memory will be restored, although memories formed just before and soon after the injury occurred may be lost forever.

There is also a rare condition called transient global amnesia (TGA). TGA refers to a brief period of time (usually hours) during which a person is unable to retain new information and tends to ask questions repetitively. After recovering, she or he does not remember the events that occurred during that period. TGA is not related to later development of a more serious memory disorder such as Alzheimer's disease, although the precise cause of the condition is uncertain. Emotionally or physically stressful events such as intense physical activity, sudden immersion in hot or cold water, sexual intercourse, or medical procedures can trigger an episode. TGA tends to be more frequent in people who get migraines. Certain drugs and medications can also produce TGA-like episodes.

larly Alzheimer's disease. About 1% to 2% of the general population over age 65 develops dementia every year, but among those with MCI, it's 10% to 15%.

Dementia

Dementia is a brain disorder that results in a decline in memory and thinking that interferes with the ability to go about daily activities. There are several causes of dementia, including Alzheimer's disease. Although memory loss is a common symptom of dementia, memory loss by itself does not signify dementia. With dementia, people lose their cognitive abilities to the extent that they are unable to carry out normal activities and relationships. They may also experience personality and behavior changes such as agitation and delusions. Following are short summaries of the different causes of dementia.

Alzheimer's disease

Alzheimer's disease is the leading cause of dementia, accounting for 60% to 80% of all dementia cases. It becomes more common with age, although it can

occur before age 60. The impairments in memory and thinking of Alzheimer's disease trace back to the production of two detrimental substances in the brain—amyloid plaques and neurofibrillary tangles. The plaques and tangles damage neurons, ultimately causing neurons to die in brain regions essential to memory and thinking. Eventually, plaques and tangles and the loss of neurons extend into other areas of the brain.

For most people with Alzheimer's disease, worsening problems with memory are the most prominent early symptom, accompanied by impairments in judgment, problem-solving, language, interpretation of visual images and spatial relationships, mood, and personality. Behavioral and psychological problems can also occur.

The ability to form new memories usually goes first with Alzheimer's disease. Short-term memory is impaired, but long-term memories remain for a while. Although people with Alzheimer's are frequently able to recall events from many years ago, they have profound difficulty acquiring new memories. That's partly because the hippocampus, which plays a central role

in memory encoding, is particularly vulnerable to the damage from Alzheimer's. A person with dementia may ask a question, get an answer, then ask the same question a few minutes later.

One type of memory that tends to hold up pretty well in people with Alzheimer's disease is procedural memory. They often can perform many routine tasks (such as brushing their teeth). This is because procedural memory is supported by different brain systems than declarative memory (which, for example, is used to remember the name of an object).

Many people who have a relative with Alzheimer's disease worry about their own chances of developing it. The role of genetics in Alzheimer's disease is complex. For the most part, certain genes raise the risk that you will get the disease, but this does not mean you definitely will. Some combination of genes and environmental factors likely must interact to initiate the events that lead to Alzheimer's. For a very small percentage of people (those with early-onset Alzheimer's disease), their genetic makeup does cause the disease.

Vascular dementia

Another common cause of dementia, vascular dementia refers to cognitive impairment that stems from damage to blood vessels that feed the brain (see Figure 5, at right). These vessels may become narrowed or blocked. Many factors, including high blood pressure and high cholesterol, may contribute to this damage.

Brain cells, like tissues elsewhere in the body, need a constant supply of oxygen to live; they get this oxygen from the blood. When blood flow is interrupted during a stroke, some brain cells die. Dementia symptoms can develop after a stroke. Even "silent" strokes—those that cause few or no obvious persisting symptoms affecting movement or the senses—can damage brain tissue and increase the risk for cognitive decline and dementia. People who experience strokes due to blockage of the small vessels in the brain also exhibit a more rapid decline in memory test performance as well as in overall intellectual functioning.

Mixed dementia

Dementia is very often the outcome of more than one underlying disease process. The most common mixed

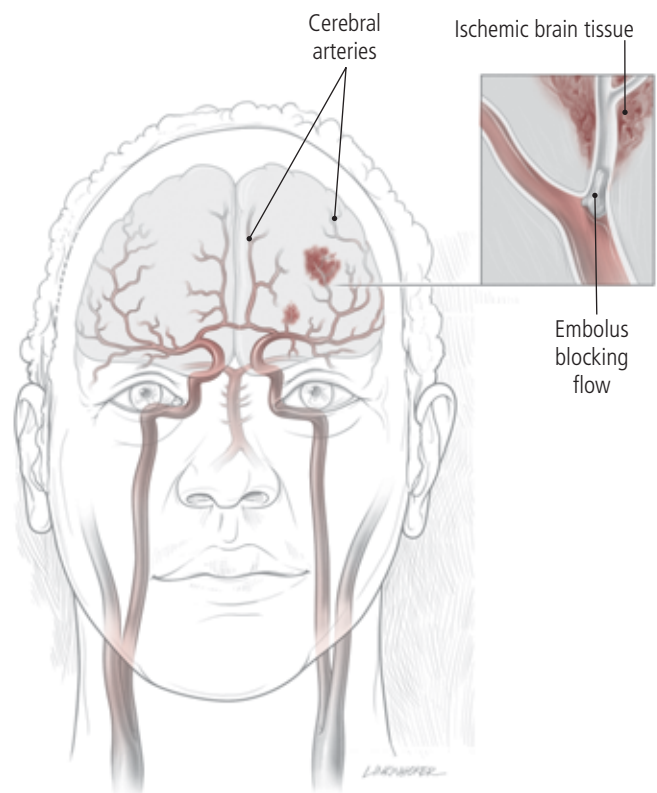
dementia involves a combination of Alzheimer's disease and vascular dementia. In fact, it has been estimated that over 40% of people with Alzheimer's disease also have vascular dementia. But other mixed dementias, such as a combination of Alzheimer's disease and Lewy body dementia (see below), are also seen.

Other types of dementia

Several other brain disorders may also lead to dementia.

Dementia with Lewy bodies. This progressive form of dementia stems from a buildup of abnormal proteins called Lewy bodies in brain cells that control cognitive functions and movement. According to the Lewy Body Dementia Association, this type of dementia affects 1.3 million Americans. The cognitive symptoms include problems with executive func-

Figure 5: What happens during an ischemic stroke



Ischemia refers to an insufficient supply of blood to an organ. Most strokes—about 87%—are so-called ischemic strokes, which are caused by the blockage of an artery that feeds the brain. Many of these ischemic strokes are caused by emboli, blood clots that travel to the brain after forming elsewhere, typically in the heart or aorta.

Recognizing dementia

Although people in the earliest stages of dementia often sense that something is wrong, the illness eventually deprives them of the insight necessary to understand their problems. So it's usually up to a family member or friend to recognize the symptoms.

If you suspect that someone you know has dementia, arrange for a medical evaluation. Making a diagnosis of dementia requires a thorough examination by a physician. A quick dementia screening instrument developed by researchers from Washington University in St. Louis has been used to determine whether a person experiencing memory problems should have a more extensive evaluation. It involves asking whether there has been a change in the last several years in the following eight areas:

- problems with judgment (such as problems making decisions, bad financial decisions, problems with thinking)
- less interest in hobbies or activities
- repeating the same things over and over (questions, stories, or statements)

- trouble learning how to use a tool, appliance, or gadget (such as a computer, microwave, or remote control)
- forgetting the month or year
- trouble handling complicated financial affairs (such as balancing a checkbook, income taxes, paying bills)
- trouble remembering appointments
- daily problems with thinking, memory, or both.

If you or a loved one has experienced a change in two or more of these, you should discuss this with your physician. Many forms of dementia are not reversible, but early detection provides an opportunity to minimize other medical conditions that may bring out severe dementia symptoms earlier than they might otherwise show themselves. It also allows family members more time to come to terms with the illness and to plan for long-term care. While Alzheimer's medications bring only a moderate, temporary improvement in symptoms, they may be most helpful early on. And other symptoms commonly associated with dementia, such as depression, can also be addressed.

Source: The Eight-Item Informant Interview to Differentiate Aging and Dementia, commonly known as the AD8, can be found in full at www.knightadrc.wustl.edu. It is a copyrighted instrument of Washington University, St. Louis, Mo. All rights reserved. Used with permission.

tion, attention, processing speed, visuospatial abilities, and memory. People with this form of dementia often experience varying levels of alertness, sleep disturbances, visual hallucinations, and mild motor symptoms of Parkinson's disease.

Parkinson's disease dementia (PDD). For dementia to be termed Parkinson's disease dementia, the person must have had Parkinson's disease for one year or more before the dementia came on. In PDD, like in Lewy body dementia, symptoms include impaired attention, impaired visuospatial function, problems retrieving information, and difficulties with executive function. Dementia is very common in people with Parkinson's disease, though just how common is hard to say. Studies suggest that close to one-third of people with Parkinson's disease suffer from some form of dementia.

Frontotemporal dementia (FTD). This group of diseases causes neurons in the frontal and temporal lobes of the brain to die. The symptoms depend on the part of the brain affected, but the most common signs include extreme changes in behavior and personality,

such as inappropriate behavior, a lack of inhibition, euphoria, or—in contrast—apathy. Other forms may affect language or movement. It is sometimes misdiagnosed as a psychiatric disorder or Alzheimer's disease, but tends to occur at a younger age than is typically seen with Alzheimer's, usually from the mid-50s to the mid-60s. Of those with FTD, 20% to 40% have a family history of dementia, suggesting the illness often has a genetic component.

Head trauma

A blow to the head that is strong enough to cause a concussion—a brief alteration of consciousness—can also impair memory. The blow can damage brain cells, or it can stretch or tear the axons, the fine filament “tails” of the neurons. Most people who suffer mild concussions recover their memories and other mental functions completely within a few hours or days.

More severe head trauma, such as an injury sustained in a high-speed collision, frequently destroys brain tissue and injures nerve fibers throughout the

brain. This type of damage is permanent. People who sustain multiple injuries from concussion—boxers and football players, for example—appear to be prone to later development of dementia and other brain disorders. There's also evidence that repeated concussions raise the risk of chronic traumatic encephalopathy, a serious and progressive condition. Symptoms can include alterations in mood (depression, suicidal thoughts, anxiety, apathy), cognition (impairments in memory and executive function), behavior (impulsivity, aggression), and motor function (gait, balance, tone).

There is a growing awareness of reduced cognitive function caused by sports activities that involve impacts to the head that can result in repetitive con-

cussions. These include football, soccer, lacrosse, and ice hockey. Many professional organizations, universities, and secondary schools in the United States have put into place concussion prevention and management guidelines. Prevention is clearly the best medicine here, but if you or someone you love does get a concussion, it's important to follow your doctor's orders when it comes to rest and rehabilitation.

Other neurological disorders

Among the many illnesses that interfere with brain activities—including memory—are multiple sclerosis, epilepsy, brain tumors, Huntington's disease, Creutzfeldt-Jakob disease, and late-stage AIDS. ♥

When to see a doctor

If you're concerned about your memory, or if people close to you have noticed some worrisome trends, see your doctor for an evaluation. Because memory loss can be a symptom of many different medical problems, it's important to identify the cause and begin treatment as soon as possible. In some cases, addressing a medical disorder or treating an emotional problem can lead to improvements in memory. For instance, people with depression or sleep disorders often find that treating those conditions improves their memory function or at least prevents further decline.

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The first step

Most often you would begin with a consultation with your primary care physician. Because this doctor knows you and your medical history, he or she is in a good position to relate your memory symptoms to medical conditions you have had or medications you are taking. But don't expect to walk out of your doctor's office with a definitive diagnosis. There is no single test that can pinpoint the cause of memory loss. The diagnostic process often requires a mental and physical examination, a variety of tests, and, depending on the results, monitoring over a period of several months or even longer.

Expect your doctor to ask you a lot of questions about your memory. For example:

- How long have you been having problems?
- Did the trouble come on gradually or suddenly?
- What sorts of things have become hard to remember?
- Are your difficulties preventing you from doing everyday activities like cooking or paying the bills?
- Are you taking any prescription or over-the-counter medications?

These questions help the doctor narrow down the possible causes of your memory loss. For example, the doctor will need to know whether you are taking any

medications that might have a known association with memory impairment. If your memory loss came on relatively quickly—and occurred shortly after taking a drug that is known to affect memory—then the diagnostic process may focus on that drug. Depending on the medication, the doctor may ask you to stop taking it or may prescribe a different drug to see whether your memory improves.

Because certain emotional and medical conditions can affect memory, the doctor will review your medical history, ask you about new symptoms and illnesses, perform a physical exam, and possibly order blood tests. The doctor will measure your blood pressure and blood sugar to look for hypertension or diabetes. If you have one of these conditions, your doctor can make sure that it is properly controlled, either with medication or through lifestyle adjustments, such as a modified diet. Your doctor may also check your blood and urine for signs of kidney or thyroid problems. The doctor may ask whether you've been under a lot of stress lately or if you've been feeling blue, because stress and depression can cause memory impairment as well as loss of interest in previously enjoyable activities. If depression is an issue, your doctor may refer you to a psychologist or a psychiatrist for further evaluation and treatment.

To reach a clear diagnosis, the doctor may need you to track your symptoms for several months, and so may ask you or your spouse to keep a record of your symptoms and then return to the office after that period. He or she can then determine if the symptoms are improving, staying the same, or getting worse.

If your doctor suspects you may have dementia, he or she may refer you to another health care provider who specializes in the assessment and care of people with cognitive impairment and dementia. Specialists include neuropsychologists, cognitive neurologists, geriatric psychiatrists, neuropsychiatrists, and geriatricians.

Neuropsychological testing

If your symptoms warrant a more comprehensive evaluation, your physician may refer you to a neuropsychologist, a doctor with expertise in the relationship between cognitive performance and brain function. Neuropsychologists typically use a battery of paper-and-pencil tests of mental abilities to evaluate your cognitive function. The tests assess attention, memory, executive function, language, and spatial ability. The doctor may also use tests or questionnaires to gauge your mood.

The neuropsychologist will interpret and analyze the test results in light of your age, level of education, and other variables that influence cognitive ability and memory capacity, as well as in the context of your medical history and other diagnostic studies. That way, he or she can determine if the findings suggest a specific type of disorder or if they reflect normal age-related changes in cognitive function. The following are the kinds of tests that are used:

Testing attention. Failure to pay close enough attention is one of the primary reasons people fail to learn new information—they never absorbed it completely in the first place. There are many tests that can be used to assess attention. As one example, the neuropsychologist might read you a sequence of numbers and then have you repeat back as many as you can remember.

Testing memory. Memory testing usually requires that you listen to or view some information and answer questions about it or reproduce it immediately

afterward, and then again 10 to 30 minutes later. Some memory tests entail learning and remembering visual information, such as a picture that you are asked to study or a design you are asked to copy. The neuropsychologist might also test your long-term memory by asking you questions about your personal history or factual information you may have learned in the past, comparing it to information gathered from medical records or other sources.

Testing executive function. Executive function is the umbrella term for the high-level mental functions that involve the overall regulation of thought and behavior, such as control over multitasking, maintaining focus on a task, inhibiting impulses, planning, initiation, reasoning, and problem solving. You use such functions even when doing simple things like following a recipe. These abilities often become impaired early in the course of Alzheimer's disease.

Executive function is also important in appreciating the subtle, implicit rules that guide social interactions—for example, exhibiting normal consideration for others and the motivation to engage with them. People who are having difficulty in this area are often unaware of the problem; family members may be the first to notice a personality change. These types of problems with executive function are usually not assessed through testing but rather through direct observation and discussion with family members.

Testing language. Language functions include the abilities to express yourself through speaking and writing and to understand what another person is saying or what you are reading. The neuropsychologist may ask you to name common objects or pictured items. Problems with naming and word finding can be early symptoms of Alzheimer's disease. You may be asked to follow instructions as a way of determining if you understand what's being said. You may also be asked to read a brief paragraph, repeat phrases, or describe a picture in writing.

Testing spatial ability. Spatial ability includes analyzing visual information such as shapes, faces, and routes between locations on a map. Because the right side of the brain plays an important role in analyzing spatial information, people who are having difficulty with this type of function may have a condi-

tion that has damaged the right hemisphere, such as a stroke. Spatial ability tests include drawing and copying designs, solving maze puzzles, and putting blocks together to construct a specific pattern.

Brain-imaging tests

A magnetic resonance imaging (MRI) or computed tomography (CT) scan produces a structural image of your brain. These imaging methods provide the most definitive method of identifying certain causes of memory problems, such as a stroke, brain tumor, or subdural hematoma (a collection of blood under the surface of the skull). All of these conditions can injure the brain, producing neurological and cognitive symptoms. Treatment for these conditions can lead to improvement, particularly if they are detected early.

For people suspected of having dementia, an MRI or CT scan may be done to rule out other possible causes of memory and thinking problems or to look for shrinkage in certain brain areas that would indicate the possibility of Alzheimer's disease. A relatively new type of brain-imaging test known as amyloid PET scanning can detect amyloid plaques—one of two hallmarks of Alzheimer's disease in the brain—but by itself it is not enough to diagnose Alzheimer's. The FDA has approved the use of amyloid PET scanning, but it is not yet covered by Medicare or private health insurance.

Treatment

The treatment for memory loss depends on the cause. Sometimes it's as simple as treating an underlying disorder, such as depression or thyroid dysfunction, or discontinuing a medication like diphenhydramine (Benadryl). There is currently no approved prescription medication for treating normal age-related memory loss.

There are some FDA-approved medications for Alzheimer's disease, but they are not cures. They are somewhat effective in temporarily reducing the symptoms. So far, no drug has been proven to prevent or reverse the damage done by Alzheimer's.

Cholinesterase inhibitors. The drugs in this class work by raising the levels of acetylcholine, a

neurotransmitter that's important for memory and learning, in the brain. They are rivastigmine (Exelon), galantamine (Razadyne), and donepezil (Aricept). The cholinesterase inhibitors work by blocking an enzyme that destroys acetylcholine, which presumably makes more acetylcholine available in the brain.

All of these drugs show similar benefits in treating the symptoms of Alzheimer's disease, but they are only moderately effective. People taking these medications are less cognitively and functionally impaired, and the differences can be measured over the course of several years. This slowing of the progression of symptoms may enable people with Alzheimer's disease to maintain independence for a longer period and reduce caregiver burden, among other benefits. A review of 29 studies found that these drugs might also ease some of the neuropsychiatric symptoms of Alzheimer's, such as depression, anxiety, and apathy.

Side effects of these medications are primarily gastrointestinal symptoms, including nausea and diarrhea. They have also been known to cause slowed heart rate, fainting, vivid dreams, and muscle discomfort. Donepezil, an extended-release formulation of galantamine (Razadyne ER), and the rivastigmine patch are the most convenient of the drugs because they are taken just once a day, whereas standard galantamine and rivastigmine are taken twice a day.

There is no evidence that any of the cholinesterase inhibitors are effective for preventing the development of dementia in people with MCI.

Memantine. Memantine (Namenda) is FDA-approved for treating moderate to severe Alzheimer's disease. It is an NMDA-receptor antagonist, which blocks glutamate, a neurotransmitter, from attaching to NMDA receptors in the brain. Too much glutamate stimulating these receptors can damage neurons and synapses, leading to memory loss and problems with other brain functions.

As with cholinesterase inhibitors, memantine usually provides only a modest benefit that might be apparent for six months or less. Research studies disagree about whether taking memantine with a cholinesterase inhibitor provides additional benefit beyond taking each separately. ♥

Resources

Organizations

Alzheimer's Association

225 N. Michigan Ave., 17th Floor
Chicago, IL 60601
800-272-3900 (toll-free)
www.alz.org

This nonprofit organization supports research on treatments for Alzheimer's disease and provides information and support to families. The association has local chapters throughout the United States.

Dana Foundation

505 5th Ave., 6th Floor
New York, NY 10017
212-223-4040
www.dana.org

The Dana Foundation is a private organization that supports brain research and educates the public about neuroscience through free publications.

National Institute of Mental Health

6001 Executive Blvd., Room 8181, MSC 9663
Bethesda, MD 20892
866-615-6464 (toll-free)
www.nimh.nih.gov

This branch of the National Institutes of Health is a source of information on depression, anxiety, and other mental illnesses that may contribute to memory loss.

National Institute of Neurological Disorders and Stroke

NIH Neurological Institute
P.O. Box 5801
Bethesda, MD 20824
800-352-9424 (toll-free)
www.ninds.nih.gov

This branch of the National Institutes of Health posts information on Alzheimer's disease, mild cognitive impairment, and other neurological disorders on its website, including the latest findings on drug treatments.

National Institute on Aging

Building 31, Room 5C27
31 Center Drive, MSC 2292
Bethesda, MD 20892
301-496-1752
www.nia.nih.gov

This branch of the National Institutes of Health conducts research and publishes information on aging and health.

Books

The Alzheimer's Prevention Program: Keep Your Brain Healthy for the Rest of Your Life

Gary Small, M.D., and Gigi Vorgan
(Workman Publishing Company, 2012)

This book shows how to strengthen memory, avoid everyday lapses, and reduce risk factors for dementia.

Chicken Soup for the Soul: Boost Your Brainpower

Marie Pasinski, M.D.
(Chicken Soup for the Soul Publishing, 2012)

This book provides practical tips and medical advice for improving memory, along with motivation stories.

Harvard Medical School Guide to Achieving Optimal Memory

Aaron P. Nelson, Ph.D, M.D., and Susan Gilbert
(McGraw-Hill, 2005)

This easy-to-understand guide explains how to know if you have a memory problem, discusses factors that can impair memory, and offers tips to optimize your memory.

Keep Your Brain Young: The Complete Guide to Physical and Emotional Health and Longevity

Guy McKhann, M.D., and Marilyn Albert, Ph.D.
(Wiley, 2002)

The book offers strategies for improving memory and maintaining brain health.

Mindfulness for Beginners: Reclaiming the Present Moment—And Your Life

Jon Kabat-Zinn, Ph.D.
(Sounds True, 2012)

This book invites the reader to explore and experiment with formal meditation practices and the cultivation of mindfulness in everyday life.

Harvard Special Health Reports

The following Special Health Reports elaborate on various points that were mentioned briefly in the chapter "17 ways to promote memory health," starting on page 24. They can be ordered online at www.health.harvard.edu or by calling 877-649-9457 (toll-free).

A Guide to Coping with Alzheimer's Disease

Scott M. McGinnis, M.D.
(Harvard Medical School, 2014)

A Plan for Successful Aging

Robert Schreiber, M.D.
(Harvard Medical School, 2014)

Controlling Your Blood Pressure: What to do when your doctor says you have hypertension

Randall Zusman, M.D.
(Harvard Medical School, 2014)

Diabetes: A plan for healthy living

David M. Nathan, M.D.
(Harvard Medical School, 2014)

Hearing Loss: A guide to prevention and treatment

David Murray Vernick, M.D., and Ann Gentili-Stockwell, M.A.
(Harvard Medical School, 2013)

Improving Sleep: A guide to a good night's rest

Lawrence Epstein, M.D.
(Harvard Medical School, 2013)

Managing Your Cholesterol

Jorge Plutzky, M.D.
(Harvard Medical School, 2014)

Reducing Sugar and Salt: Strategies for minimizing risks to your health

Teresa Fung, Sc.D., R.D.
(Harvard Medical School, 2012)

Starting to Exercise

Lauren Elson, M.D., and Michele Stanten
Harvard Medical School, 2015)

Thyroid Disease: Understanding hypothyroidism and hyperthyroidism

Jeffrey R. Garber, M.D.
(Harvard Medical School, 2015)

Understanding Depression

Michael Craig Miller, M.D.
(Harvard Medical School, 2013)

Glossary

acetylcholine: A chemical neurotransmitter that plays a role in attention, learning, and memory by helping brain cells communicate with each other.

acquisition: The first step in memory formation, in which the brain absorbs new information.

amnesia: A condition caused by brain injury or illness and characterized by an inability to form new long-term memories or to remember earlier ones.

amygdala: A brain structure with strong connections to the hippocampus and other structures of the limbic system that is vital to emotional arousal and the formation of long-term memories.

axon: A long filament-like projection of a neuron that conducts electrical signals away from the neuron cell body (nucleus) to other cells.

cerebral cortex: The outer layer of gray matter surrounding the cerebrum that carries out all aspects of higher brain function including thought, memory, sensation, and voluntary movement.

cognitive function: All of the brain mechanisms involved with thinking, reasoning, learning, and remembering.

cognitive reserve: The capacity of the brain to use alternative neural pathways or thinking strategies in response to neurological injury from conditions such as Alzheimer's disease.

consolidation: A key phase in memory formation, in which the brain transforms newly acquired information into long-term memories.

cortisol: A hormone released by the body in response to physical or emotional stress. High levels of cortisol can damage the regions of the brain that are crucial to memory function.

declarative memory: Memory for facts (semantic memory) and for events (episodic memory); also called explicit memory.

dementia: A progressive decline across multiple cognitive domains, resulting in impairment of everyday function.

encoding: A multistage process by which sensation, perception, or thought is transformed into neural representations that can be stored in memory.

executive function: A group of cognitive activities that involves

the overall regulation of thinking and behavior; the higher-order processes that enable us to plan, sequence, initiate, and sustain our behavior toward some goal, incorporating feedback and making adjustments along the way.

frontal lobes: Regions located in the front of the brain that play a major role in executive function.

hippocampus: A seahorse-shaped structure situated within the limbic system deep in the brain that has a central role in memory processing.

limbic system: A network of brain structures crucial for regulating emotions. The hippocampus, one of the structures that make up the limbic system, is instrumental in memory formation.

magnetic resonance imaging (MRI): A noninvasive diagnostic radiology procedure that uses magnetic fields to form images of the brain and other internal anatomical structures.

mild cognitive impairment (MCI): A condition characterized by the loss of cognitive function—usually memory—that is more severe than is normal for a person's age, but without obvious impairment in activities of daily living.

neuron: A nerve cell found in the brain, spinal cord, or nerves that transmits information to and from other neurons.

neurotransmitter: A chemical substance that relays signals from one neuron to another.

positron emission tomography (PET): A nuclear medicine imaging technique that uses differences in energy metabolism in different areas of the body to produce an image of functional processes in the brain or other organs.

procedural memory: The long-term memory of skills and procedures, or "how-to" knowledge.

retrieval: The act of recalling previously learned information; it involves the reactivation of particular nerve cell pathways that encoded a given piece of information.

synapse: The junction between two neurons, across which chemical neurotransmitters carry messages.

working memory: A type of short-term memory process that involves temporarily storing and manipulating information.



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