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Remember: The Science of Memory and the Art of Forgetting

Made by Blinkist

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Maybe these blinks will inspire you to dig deeper, or maybe they're enough to start you thinking and then on to something new. However you read blinks, we hope they help you become an even brighter you.

What's in it for me? Learn all about the strengths and weaknesses of your amazing, fallible memory.

Do you remember where you put your car keys? Or, for that matter, where you parked? How about the name of that actor in that movie – what was his name?

Throughout the day, we experience memory lapses, and if you're over a certain age, these can hit with a bit of dread. We wonder, is this the beginning of our decline? Is dementia or Alzheimer's far off?

And yet we think nothing of having memorized tens of thousands of words. We recall specific instants from childhood in vivid color. We remember the lyrics of a pop song from decades past. For all its flaws and inconsistencies, the memory is truly amazing.

Through a survey of the latest research in neuroscience, these blinks explore the power, frailties, and function of the brain's memory systems.

In these blinks, you'll discover

- how you create, access, and shape memories;
- how and why you forget so much; and
- how to come to terms with and take advantage of both the strengths and weaknesses of your memory.

Memory is a physical thing triggered by attentiveness and generated through a process of encoding and consolidation.

Anything you perceive evaporates in about 15 to 30 seconds unless you get that information to the *hippocampus* – a deep brain structure that knits neural activity into long-term memory.

This is how that happens: When you're fully attentive in a moment of some action, your brain translates raw data from your senses into neural activity within the *prefrontal cortex*. This process is called *encoding.* From encoding, we move to *consolidation*, where the information passes from the prefrontal cortex into the hippocampus. Here, the neural activity is bound into a stable pattern. That pattern of neurons is now your memory of the moment. But what is "memory" and how exactly does it work? Well, there are three main types of memory functions you rely on in your

daily life: *semantic*, *episodic*, and *muscle* memory. The memories consolidated by the hippocampus fall into two categories, the semantic and the episodic, so let's start there.If you have a US penny in your pocket, go ahead, dig it out, hold it in your palm and give it your attention. You'll see that Lincoln faces right, the phrase *In God We Trust* arcs overhead, the year sits before his chest, and the word *Liberty* hangs by his shoulder.

As you look at the coin, this image of the penny is being encoded in the prefrontal cortex of your brain. Remember though that, if you want this memory to stick, it has to be consolidated in your hippocampus. So, study the penny. Pay attention to its details. If you do so repeatedly, the neural representation will eventually travel to the hippocampus of the brain where it'll be bound into a stable neural pattern, becoming your

long-term memory of the penny, ready to be activated on demand.

This sort of memory is what's called *semantic memory.* This type of memory comes about through studied repetition or repeated actions in your daily life. The barista at the cafe, for example, knows what the regulars order because she's heard it day after day.

By contrast, episodic memories are connected to a place and time. They're the impactful, surprising, and meaningful moments of your life that the brain has translated into stable neural patterns – events, like the first time you held your daughter, or shocking moments, such as a car accident.In the next blink, we'll take a closer look at these particular types of memory.

Our episodic memory may be powerful and vivid, but it's probably wrong.

If you're of a certain age you might remember January 28, 1986, when a space shuttle careened high in the blue sky over Florida and burst into a ball of flames. The explosion of the Space Shuttle Challenger left no survivors and was witnessed by millions on live television.

Twenty-four hours later, a pair of psychology professors at Emory University asked their students to jot down an account of what they were doing when they either witnessed or learned of the explosion.Two and a half years later, the professors followed up with the students and again asked for a personal account of that fateful January day. For almost every student, the memory had changed.

When the professors revealed to the students the discrepancies between their accounts of the day the Challenger exploded, some of the students insisted that their current version was correct and that the version they jotted down within 24 hours of the fiery launch was flat wrong. Surprised? Don't worry, this is perfectly normal.

The key message here? Our episodic memory may be powerful and vivid, but it's probably wrong.

As we've just learned, our brains go through a few steps translating sensory data into neural activity, which in turn is consolidated into a stable pattern that we can store away and recall when needed. At each step, however, the memory is vulnerable to inaccuracies.

First, while our attention can capture an incredible amount of sensory information, it can't catch everything. We're limited by our perspective and

guided by our interests and expectations. Then, as we translate the sensory data into neural activity, our beliefs and biases again play a strong hand. Finally, in order to distill that neural activity into a stable, retrievable pattern, we edit creatively. We omit some details and add others under the influence of our imagination, assumptions, and the suggestions of others.

After this point, the memory goes into storage. If left untouched, the neural connections that make up the memory physically recede. Gaps appear. We forget.

Retrieving the memory doesn't preserve its accuracy either. We recall the neural pattern and fill in the gaps with invented information. What's more, we reinterpret the remembered moment in the context of our present circumstances. We create a narrative to jibe with our current

opinions and mood, effectively reshaping yesterday for today.

Each time we remember, we rewrite and save the amended version, and the previous version is gone. Our latest version of memory feels real to us because it's the only version we have.

Muscle memory is a unique and vital form of memory that you create in your motor cortex through repeated practice.

Whether the penny becomes a semantic memory formed through repetition, or a detail in an episodic memory of a meaningful moment, that memory lives in the hippocampus. However, one extremely important kind of memory – muscle memory – resides somewhere else entirely.

The key message here is: Muscle memory is a unique and vital form of memory that you create in your motor cortex through repeated practice.

When Henry Molaison was a young boy, he fell from his bicycle and fractured his skull. A few years later, he began to have seizures. The seizures grew more severe until, at age 27, he agreed to allow a surgeon named William Scoville to perform experimental brain surgery.

Dr. Scoville removed Henry's hippocampus.

The seizures subsided, but relief came with an awful price. Without the hippocampus, Henry could no longer form long-term memories.

Henry retained another sort of memory, though, that lives in part of the brain called the *motor cortex.*

When you execute a deliberate physical movement, like pressing a finger down on a piano key or jumping from the ground to clear a hurdle, neurons in the motor cortex send a message down the spinal cord and into your muscles. So every time you press the piano key or clear a hurdle, you activate those neurons in the motor cortex. The connections between them grow stronger, and the neural pathway becomes stable. With practice, you activate the pathway with greater ease, and after a while, you can retrieve this

so-called muscle memory without conscious thought.

For example, a researcher, whose name and face Henry could never recall, taught him a method of drawing where, instead of watching directly, he could only observe his drawing hand through a mirror. In essence, his brain had to guide his hand in reverse.

Mirror drawing required new pathways through Henry's motor cortex. To him, each session felt like the first time, but the pathways strengthened with repetition, and he learned to control lines flowing from his pen.

Because muscle memory does not rely on the hippocampus, Henry could continue to develop new physical skills without it.

Forgetting, though frustrating, is healthy, necessary, and even helpful.

There was a man who couldn't forget anything . . . ever. His name was Solomon Shereshevsky, and for over three decades, psychologists tested him with long and meaningless lists of words and numbers. Throughout, his memory never faltered.

Rather than a sort of superpower, Shereshevsky came to view his memory as a burden. His mind was full of information, much of it useless, and sorting through it all was a never-ending task. On top of it all, like anyone else, Shereshevsky experienced things he'd rather forget.

He'd imagine setting fire to these unwanted moments, but, sadly, these memories wouldn't turn to smoke and ash. Shereshevsky simply couldn't forget.

The key message here is: Forgetting, though frustrating, is healthy, necessary, and even helpful.

For the most part, we forget by default. We decide in the moment that whatever's in front of us isn't worth paying much attention to. We're able to do that because of our *working memory*. It registers the sensory data of our present environment and moments, and helps us make sense of one instant to the next. But, while our working memory is essential, it's temporary. For example, on your routine commute home, it'll let the now-familiar information pass; the billboards, the bridges, the other cars. If nothing distinctive happens, you'll arrive home without any noteworthy recollection of the journey.

But even when you *do* pay close attention to a moment, there's still no guarantee that you'll make a memory. Remember the penny? Was the word

Liberty by Lincoln's shoulder or by his chest? If you don't recall, don't freak out. You extracted the meaning from that blink and decided, on some level, that knowing the layout of a penny is useless. And it is. Those neural connections have begun a well-reasoned decay.

We can also forget on purpose, which can also be healthy and helpful. Though it may be difficult, we can avoid the real-world cues that trigger an upsetting memory, and with effort and practice, redirect our thoughts elsewhere. Consequently, with time, the neural pathway of that upsetting memory fades.

For those with post-traumatic stress disorder, getting off that neural circuit is markedly more difficult. The traumatic episode insists itself into the present. Unable to ignore the trauma, some people with PTSD have made progress by taking advantage of the creative license we use in retrieving memories.

They repeatedly recall the trauma on purpose, but each time, they visualize a better ending in the hope of overriding the trauma.

The promise of rewriting traumatic memories recalls a method Solomon Shereshevsky found later in life.

The man who remembered everything would draw what he wanted to forget as a meaningless scrawl on a blackboard in his mind's eye. He'd then wipe the board clean. Shereshevsky persisted with this imagined cleansing, and at last, he began to forget.

Our ability to remember to do something later is thoroughly unreliable.

Classical musicians possess incredible memories. They routinely memorize tens of thousands of notes in sequence, each to be played with its own subtle timing and pressure.

Yo-Yo Ma, the world-renowned cellist, surely ranks high among these memory masters, and yet on one night in the fall of 1999, he forgot his cello – a $2.5 million instrument – in the trunk of a New York City cab.

Whether exhaustion, stress, or distraction contributed to Ma's lapse in memory, his failure to remember to check the trunk and hoist out his cello before it sailed away into Manhattan traffic, speaks to an important facet of the human brain.

The key message here is: Our ability to remember to do something later is thoroughly unreliable.

This sort of memory is called *prospective memory*. Prospective memory is a memory of an intention; a message to a future self, which, by nature, is so flaky that it's better understood as a sort of forgetting.

We forget lots of things, like buying milk on the way home, picking up the dry cleaning, or canceling the free trial for that streaming service. And while these can cause some inconvenience, they are, on the whole, benign.

This isn't always the case, though. Between 2008 and 2013, for example, US surgeons forgot to retrieve 772 surgical instruments from the insides of their patients before sewing them closed.

So in response to our propensity for forgetfulness, especially when the stakes

are high, you're better off using external memory aids. Checklists, for example, are now best practice amongst surgeons, and a nonnegotiable requirement for commercial pilots.

Writing down a to-do list and making a routine of going through it, is a great memory aid. Combine the list with the calendar on your smartphone or computer, set alerts and alarms, and be specific about what needs to be done.

If you have a physical cue, place it where you can't miss it. For example, if you need to bring wine to a friend's dinner party, plunk the bottle down right in front of your door. After all, Yo-Yo Ma wouldn't have forgotten his cello if it'd been blocking the door of the cab.

Your capacity to learn and recall information is both remarkable and shoddy.

At 69 years old, a retired engineer named Akira Haraguchi performed a mind-blowing feat. Without any external reminders, he recited pi – that mysterious mathematical constant – to 111,700 digits.

No, Haraguchi is not a memory savant. He isn't some kind of mathematical genius. In most ways, his brain is, in fact, just like yours.

Think of it this way. You've likely achieved a feat similar to Haraguchi's recitation of pi. For instance, like many adults, there's a strong chance that you can understand, spell, and pronounce as many as 100,000 words. That's pure information, memorized. It's a mind-blowing achievement!

But how are you able to do that, and still manage to forget so much, so often? Haraguchi, for example, confessed to forgetting his wife's birthday.

The key message here is: Your capacity to learn and recall information is both remarkable and shoddy.

One of the most frequent and maddening failures in memory occurs, so to speak, at the tip of the tongue.

Say you're reaching for the name of that famous surfer. You know, that one famous surfer. It begins with an *L*.

It's not Lance Armstrong. He's the cyclist. But it's a name like Lance Armstrong, so much like Lance Armstrong that the name Lance Armstrong keeps diverting your attention back to Lance Armstrong and away from the neural path of the name you're looking for, which, by the way, is Laird Hamilton.

If you Googled it, that's fine. There's no evidence that looking up elusive info weakens your memory.

Names often fall prey to tip-of-the-tongue glitches because they're abstract.

Here's an illustration. If you saw a man and learned that he was a baker, you're more likely to remember *that* bit of information rather than if you'd learned that his name was Baker.

That's because Baker, the surname, carries no meaning in itself, no story, no sensory data, no object for your brain to take hold of. But baker – the profession – is rich with associated smells, tastes, textures, and more.

In fact, Haraguchi used the memory's preference for the meaningful and tactile in his memorization of pi. He transformed each abstract digit into a syllable and each syllable into a word. When he strung them together, the

digits of pi told Haraguchi a long, unusual, and memorable story.

The weakening of memory with age is a frustrating but natural phenomenon. But Alzheimer's Disease? That's something else entirely.

For many of us, a common lapse in memory looks something like this: You walk into a room, but come to a halt. Looking around, you wonder: Why did I come in here?

Or perhaps you experience the following a few times a day. You're heading out the front door when suddenly you stop short and slap your pockets. No, not there. Check inside your coat. Where did you leave your keys?

As we get older, say past 50 or so, we notice these lapses more and more, in part because they occur more often, but also because they can arrive with a pang of dread. As we rummage through drawers, looking for our car keys, we wonder: Am I losing it?

Here's the key message: The weakening of memory with age is a frustrating but natural phenomenon. But Alzheimer's Disease? That's something else entirely.

As we get older, memory declines. The semantic memory suffers even more of those tip-of-the-tongue glitches. More gaps appear in our episodic memory, that gallery of lived experience. And the already-flaky prospective memory, that to-do list in our heads, becomes even more unreliable.

All of this is normal and largely due to the slowing speed of our brains, the aging of neurons and their connections, and a diminishing capacity to pay attention.

Alzheimer's Disease, on the other hand, seems to have a more singular source: the buildup of proteins in our brains into what are called *amyloid plaques*.

The buildup of amyloid plaques starts in the hippocampus and then moves on to the parts of the brain that help us navigate space and solve problems. These plaques can accumulate for over a decade before triggering the cascade of neural failures known as Alzheimer's Disease. And due to Alzheimer's route through the brain, the memory lapses caused by the disease are of a different character than those of normal aging. Someone with Alzheimer's doesn't merely lose their keys; they're likely to hold their keys in their hand and wonder what they're even for.

While the aging of the brain is inevitable and the consequences of Alzheimer's are brutal, there's good news on both fronts. In our final blinks, we'll explore how you can optimize your memory in the face of these challenges.

A healthy, engaged lifestyle will not only mitigate Alzheimer's but can help you resist the normal weakening of your memory.

Over the course of two decades, a team of Alzheimer's researchers followed the lives of 678 elderly catholic nuns. The researchers conducted all manner of physical and cognitive tests, and as each nun died, she left her brain to the team for autopsy.

The researchers discovered, as they would amid any group of older brains, some evidence of amyloid plaque, that trigger of Alzheimer's. Interestingly, even though they also recognized the shrinkages and tangles that go along with the disease, many of these same nuns showed no signs of the disease in life.

The key message here? A healthy, engaged lifestyle will not only mitigate

Alzheimer's but can help you resist the normal weakening of your memory.

The researchers theorized that through years of formal education, active social lives, meaningful work, and mentally stimulating hobbies the nuns were continually building new neural connections. Consequently, when amyloid plaques shut down a neural pathway, these resilient brains had alternate neural routes to stave off the onset of dementia.

So, an important lesson here is to challenge yourself mentally and socially. Seek out new experiences. Try learning a new language or a musical instrument. Crossword puzzles, while stimulating, won't do the trick.You could also get some sleep. The underslept brain, as we all know, struggles to pay attention. Also, without seven to nine hours of rest, the hippocampus can't properly stabilize and store away the memories of the day.

What's more, a habitual lack of sleep sharply increases the risk of Alzheimer's disease.

Chronic stress, the sort of stress that doesn't go away, is another risk factor for memory loss. If you have an abusive boss, mounting debt, or some other stressor that comes at you day after day, your brain will flood with stress hormones and exhaust its ability to form and retrieve memories. Under these circumstances, the hippocampus shrinks.

Of course, you avoid chronic stress when you can, but if you can't readily ditch one of these toxic stressors, look into meditation and practices of mindfulness, gratitude, and compassion. These help in reducing blood pressure and anxiety, lower stress hormones, and are associated with promoting a big, healthy hippocampus. And so although these practices effectively deal with the intangible, they have real-world effects.

Beyond a healthy lifestyle, you can use methods and tricks to optimize your memory.

If you had to guess, which are you more likely to remember: the number 105799, or Albert Einstein kicking a bagel?

As we've learned, memory has a loose grip for abstractions like numbers. But for images and stories memory has a far tighter hold.

In 2006, science journalist Joshua Foer used the brain's preference for visuals and narrative to compete in the USA Memory Championship. Foer created a code that translated digits into people, actions, and objects. 105799, for example, might then become Einstein kicking a bagel.

It was his first year in the competition, and he won.

The key message here is: Beyond a healthy lifestyle, you can use methods and tricks to optimize your memory.

While we're unlikely to match Foer's memory, his approach shows us that certain mnemonic techniques can work. First, he paid attention. To swing the doors of the working memory wide open, you've got to clear away distractions and focus on the emotional, sensory, and factual information before you.

Second, make it visual. If you're jotting down something you need to remember, add a doodle and highlight the key information in pink. If you meet a man named Baker, don't stop at picturing him as an actual baker in a white apron – put him on a mountain of Danishes with a faceful of flour!

Another tip for getting a memory to stick is to make it meaningful and personal. Create a story about the

information. Better yet, make it about you. That way you're not only exploiting the brain's love of narrative, you're tapping into the all-too-human tendency for self-involvement.

Also, repeat, repeat, repeat. If it's raw data you need to recall, quiz yourself. Wait a while and quiz yourself on that data again. If it's a skill involving physical movement, those piano scales, for example, or those track and field hurdles, nothing beats repetition. Do it again and again and burn those neural pathways deep through the motor cortex.

Finally, as our blink on prospective memory advised, use external aids. Make lists. Create detailed alerts on your phone. Put the wine bottle in front of the door. You don't have to worry that externalizing your memory with a search engine, calendar app, and physical cues will lead to a weaker mind. There's no evidence for that. Simply take advantage

of technology and the physical world because your brain, while impressive, needs all the help it can get.

Final summary

The key message in these blinks:

Your capacity to remember data, the moments of your life, and all that you've learned to do is incredible. Your brain translates the world into neural activity, and through some mixture of surprise, meaning, and repetition, you create long-term neural patterns that you can recall for years to come. Yet, as impressive as your memory is, it comes with some wild inconsistencies and frustrating failures. Fortunately, you can learn to accept and even appreciate its fallibility, and guard against the worst of memory's decline.

Actionable advice:

Eat brain healthy.

Beyond an enriching mental life and the best of memory tricks, try what's called the MIND diet. The MIND diet fuses the

Mediterranean diet with the DASH diet, which is scientifically geared to lower hypertension. The MIND diet consists of plenty of vegetables, leafy greens, berries and nuts, olive oil, whole grains, beans, and fish. Several studies have shown this diet can cut your risk of Alzheimer's in half.

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