Introduction

This chapter explores what memory is and how it works – which is crucial to understand if you’re going to succeed in your studies. Examining what happens when lasting memories are made is the first step towards using your brain at its brilliant best.

Key topics

- Why memory affects everything you do
- The power and potential of your brain
- Learning to learn
- Different kinds of memory
- What’s special about studying
- How your memories are stored
- Where the memory-making process begins

Key terms

Neurons; synapses; procedural, semantic, episodic, autobiographical and prospective memory; study; hippocampus, cerebellum and amygdala; declarative learning; the ‘holographic brain’ theory; short-term, long-term and working memory

Meet your memory

To succeed as a student you need to get to know your memory: the complex set of systems that has such a dramatic influence on everything you do. It’s no good writing off your memory as faulty, trying to get by without it, or suddenly deciding to use it the night before your big exam. You need to have a quality, lasting relationship with your memory and it can be your greatest ally - but only if you know what it is, why it’s so important and how you can exploit it in every area of your studies.
From the outset you need to have a sense of how phenomenally complicated memory is, but also a clear picture of the very straightforward things you can do to use it to maximum effect.

**Memory is everything**

You are the sum of your experiences: without them, you just wouldn’t be you. Everything you think, say and do relies on memory.

On the most basic, physical level, your survival depends on an instinctive routine of heartbeats, lung breaths, chemical reactions. Your system remembers to keep you alive. Other things you’ve learnt to do and now remember without thinking: balancing, walking, using your hands and fingers, carrying out countless tasks and techniques that have become embedded in your memory and happen automatically. You’ve learnt to use language, in your silent thoughts and out loud, remembering the complex ways in which letters and sounds combine to make words, what things are called and what they mean, and how to use at least one language system to communicate with yourself and others. Language has helped you to build up a rich knowledge of the world: the people, things and places around you, along with all the information you’ve gathered about life in general and the specific fields you’ve studied.

Your memory is active every second, coping with the present moment, updating your knowledge as things change, accessing your stores of

**Memory power**

In your brain you've got around a hundred billion nerve cells, *neurons*, each with around 7,000 connections to others around them. Some aspects of the brain are streamlined and simplified as the years go by, but yours still has as many as 500 trillion *synapses*, the pathways between cells that give you all the physical capacity you need for a lifetime of rich, interconnected memory-making. More than just the most complex bit of you, your brain is the most intricate mechanism of all. It may account for only 2 per cent of your bodyweight but it needs 20 per cent of the oxygen in your blood, so it works hard. The wrinkled, spongy, moist, grey lump between your ears holds 100,000 miles of blood vessels and the electricity it uses could light a 10-watt bulb.
past experiences – and looking into the future to create ‘memories’ for things that haven’t even happened yet. This book is about doing more with your memory, but you need to begin by celebrating its power right now. You’ve learnt a miraculous amount already, you recall much of it flawlessly and you’re constantly adding new information into the intricate, infinite storage system we call memory.

**Memory and learning**

Your brain is built to learn. You’ve already used it to store vast amounts of information about your experiences, using all your senses to create personal memories, teaching yourself about the world and how you can operate in it and gathering detailed knowledge and understanding from a range of sources.

Your first teacher was experience itself, the information gained directly through your senses. Then, as your thinking developed, you learnt to learn in a more abstract way, taking hold of ideas, linking new concepts with things you already understood and making sense of the world by forming connections. As your abilities with language improved you were able to access deeper levels of meaning. From simple number skills you made increasingly complex discoveries about maths. Every new learning experience became a building-block for the next. All your life you’ve gathered details, facts and figures, but you’ve also discovered the importance of patterns, rules and systems, building your scientific knowledge and understanding, gaining a sense of the bigger picture of history, geography, economics … of the past, the present and the possibilities ahead … equipping yourself to cope in any discipline – and adding every new bit of learning into the vast, multi-layered, interconnected collection that is your memory.

Your DNA, your experiences and the ways in which you’ve used your brain have all contributed to the memory you have today; or, rather, to the memories …
Different types of memory

Procedural memory is remembering how to do things. Once gained, skills can feel like second nature - but getting there can be tough and you need to know how to make the most of all the help you get along the way: how to study, learn, practise and master a range of procedures and techniques.

Semantic memory means your knowledge of the world: vast, but far from perfect. Retrieving key details can be difficult and adding to your mental database is particularly challenging when the information is abstract or fragmented, hard to understand or a struggle to engage with - and that’s so often the case with the material you have to study.

Episodic memory is your collection of experiences and events, including personal, autobiographical memory. Some moments are much easier to recollect than others and the accuracy of all of them can be questionable to say the least, thanks to the interplay between memory and imagination. But these memories can be intense and powerful and they can be used to remember absolutely anything: equations, dates, languages, quotations, essays, systems ... You can imagine yourself into close contact with everything you need to explore, understand and remember. You can combine instinctive memory principles with conscious, controlled learning.

Prospective memory is one of the hardest sorts of memory to control: remembering things that are yet to happen, like appointments, birthdays, jobs to do. It’s vital for good organisation, time management and efficient working, so it’s a crucial element of successful study.

So what is study?

Where does studying fit in with all the ways you’ve been building your brain since before birth? A collection of different memory skills, it’s clearly a very specialised form of thinking and learning, with its own challenges and rewards. Think about the place it occupies in your overall ‘education’. Consider all the memory-building that’s gone on before you ever thought about studying anything and reflect on the learning experiences that have contributed most to your understanding - of the world and of yourself. As you prepare to take a fresh approach to learning, think about the aspects of your memory that might benefit you most in all the study you do.
**Born to learn**

The things you know now are a combination of organic learning and targeted study, which will be true for the rest of your days. You’ve chosen to read a study-skills book, so it’s likely that this current stage of your life is geared towards focused, strategic learning. But you need to explore the way your memory works for *everything*, because the best techniques for studying and exam-taking are simply extensions of core memory principles - the things you’ve been doing successfully since before you were born, whether you knew what you were doing or not.

**More than life-long learning**

Experiments have shown that babies in the womb can learn sequences of sounds. They react to music they heard pre-birth and they seem to get a head-start on counting if they’ve been played repeated patterns of notes: one beep, two, three ... Our brains are built to spot sequences and to use patterns to structure memories, and it’s just one of the many instinctive techniques we can use when we have something very specific to learn.

**Time travel**

Try this quick experiment. Think of a powerful memory from your childhood: a particular moment that sticks in your brain. Concentrate on the images you see in your mind's eye, but also consider any other senses that connect you to this piece of the past: maybe the taste of party food, the smell of the countryside, the feel of a piece of clothing, the sound of the ocean ... Then try to describe the moment in words: on paper, out loud or just in your head. When and where did it happen? Who was there? What was going on? More details may spring to mind and you might well be able to connect this memory to others. It’s a jigsaw piece in a huge puzzle and, for some reason, this one is still clear in your mind while others have faded. You can’t remember every childhood day, so why is this one so clear?

It’s likely that strong feelings helped to create a lasting memory, positive or negative. *I was so excited that morning, but I’ll never forget how scared I was when the clowns came on.*
Sense impressions will have strengthened it and help you to recall
the details now. *The smell of cut grass always takes me straight
back to that afternoon.*

Understanding is important, too, even if you haven’t got the whole
story. *I must have been six, because that was the year we went
to France and I’m sure the park where we had our picnic was in
Paris …*

Some of the details may be faulty, especially if you’ve rehearsed them
many times, but it’s a powerful recollection of bits, so many interwoven
strands, so many chains of connection – and it’s important evidence of
the way your memory works, when it works well.

To make this memory you took in the moment through your senses –
or at least parts of it. Many bits went straight in and out and weren’t in
reach for long enough to become memories, but some did, were held
on to, mixed with other pieces of information and kept alive for the
time it took to be stored as memories. You’ve gone back to them in
your mind many times since to embed them (and probably to change
them subtly over the years), but these details are still accessible,
provoking feelings, delivering facts, inspiring ideas … and connecting
with many of the memories that were made before and since.

Be a memory detective

Think about a powerful memory from your past, exploring all the
details you can remember – then check your accuracy by looking in
diaries, finding old photographs and films or talking to other people
who were there. Notice the sorts of things that you remember
correctly, but also the ways in which even strong personal memories
can be faulty. Your imagination plays tricks on you, memories often
change as time goes by – and this is really important to know because
it’s going to be a vital part of your memory training. You’ll be learning
how to create imaginative memories for anything and everything.
You’ll find out how to ‘trick’ your brain into remembering.
Memory: fact or fiction?

Real and imagined experiences can become very blurred in the brain. There's a fine line between what actually occurred and what you invented. Scans have shown that two-thirds of brain activity is the same whether something really happened or not and it's an aspect of memory that has huge implications for study. What if you could learn to create powerful memories, with as much impact as real experiences, to help you remember everything you needed to know?

Choose to confuse?

Think of a time when you said, ‘I don’t know if I dreamt it, but …’ What about the phrase: ‘Did I imagine it, or …? We say these things because we really do get confused between dreams, flights of fancy, imaginative ideas - and real-life events. Consider how similar these memories can seem. Have you ever thought about making the most of this confusion: designing memories specifically to support your studies?

When you want to make your memory work - in particular, when you're researching, studying and revising - you can tap into your most powerful, most natural memory-making processes. When you know how to turn anything into a lasting memory you can add in all the strategies for keeping memories alive, connecting them to others, retrieving and applying them whenever you want ... and you have a powerful approach that can be turned to any learning challenge.

So what has to happen for an experience to become a memory? Not everything makes it to long-term storage, so how do you start choosing what you want to remember?

In search of memory

For centuries, scientists have been hoping to ‘find’ memories stored away somewhere in the brain and to discover the precise processes that got them there. Unfortunately, it hasn’t proved to be quite as simple as that. The more closely we explore it, the more complicated the human brain appears. It’s possible to lose whole sections of your brain and still be able to think and learn. Some mental functions are
clearly located in particular areas, but individual memories can be spread to different places and even simple thinking tasks involve activity across the brain.

**Mapping the mind**

It seems that our memories are formed and stored all over the outermost layer of the brain, the cerebral cortex. The four lobes have their own specialties: the frontal lobes, for example, are vital for short-term learning and the coordination of memories, retrieving details from the past and making plans for the future; and autobiographical memory relies strongly on the temporal lobes. Beneath the cortex ...

- **the hippocampus** transfers memories from short- to long-term status and it’s vital for ‘declarative’ learning – information you can communicate – and for memories involving shape and space
- **the cerebellum** is involved in storing procedural memories and motor skills: robust learning that’s accessible without conscious thought
- **the amygdala** is central to remembering and processing emotions and plays a key role in laying down long-term memories.

**Holographic memory**

Imagine a hologram: one of those three-dimensional images captured on a two-dimensional surface. If a hologram is broken into pieces, each bit still holds the original image, just a smaller, weaker version – and this quirk has given rise to a theory called ‘the holographic brain’. What if, like a hologram, your brain stores memories everywhere and nowhere in particular? Can you imagine memory as a complex assembly process, rather than just a collection of stored data? Perhaps we should stop looking for individual memories in particular places and start drawing on the connective, collaborative power of the whole brain – celebrating memory as much more than the sum of its parts.
Survival strategies

Memory is clearly a very complex process. Once stored successfully, memories can last a lifetime in a richly interconnected data store. We're good at taking in information, but what happens next is much less straightforward. You could easily be told a mathematical formula, read the name of a figure from history or watch a construction technique being demonstrated, then lose the information instantly, the details passing in and out of your head and disappearing for ever. In fact, your brain is designed to disregard much of the information it encounters, otherwise your excellent senses would overload it with details that have nothing to do with your survival and success. But, as your own autobiographical memory proves, plenty of things do survive the passing moment and stand the test of time. Understanding why this happens has to be a key step towards studying well.

Short-term v. long-term memory

Many different things affect how well something is remembered in the long term, such as:

- your commitment to learning
- the importance you place on the subject matter
- how often you study it
- the ways you're able to use it
- the things you do to keep it fresh.

But none of the above means anything if the information doesn't even make it over the first hurdle, doesn't even stay within reach beyond the passing moment.

In memory research, ‘short-term’ now means very short indeed; and not just a slightly weaker form of long-term memory but a different thing altogether. Information can be held for a few moments, but then lost for good - unless something happens to transfer it into longer-term storage. Simply seeing or hearing something doesn't guarantee that we'll still have access to it even a few seconds later. We all know that from bitter experience, but it doesn't stop many students trying to learn in the most passive ways - and then wondering why so little of it sticks.
The life of a memory

Your sense organs detect details, get them inside your head and then the information is held on a very temporary basis in what we now call ‘working memory’. After that, some of it gets transferred to more lasting storage, ‘long-term’ memory, from where it can be accessed for a long time to come: for a lifetime, potentially, if the right things are done to keep it secure.

Using your memory well means understanding how it works in the short and long terms. As the next chapter explains, you need to take control of studying from the very start: from the moment you meet information that you want to explore and remember.

Practical tips for getting to know your memory

Spend some time thinking about the different types of memory: procedural, semantic, episodic, prospective. For each of these headings, pick a particular ‘example’ memory that comes to mind: learning to ride a bike; all the sporting terms you know; your last holiday; the tutorial you need to go to tomorrow. Consider how these collections of information have been built into your brain, how securely they’re fixed, how easy they are to access and how they ‘feel’ when you bring them to mind.

Choose an event that’s happened recently - one that you’ve had no particular reason to think about since. Then go through your senses one by one (sight, hearing, taste, touch, smell) and see how much each one helps you to access the memory. Start focusing on the way senses activate memories, learn about the ones that will be most useful to you - and highlight the ones you’ll need to develop.

As well as your experience of long-term learning, start thinking about your short-term memory skills. Get a friend to read out the following sets of numbers to you. After each burst of information wait ten seconds and then repeat as much of it as you can from memory. What’s the longest set that you can learn like this? How long do you think this learning will last? Can you feel yourself doing anything instinctively to hold on to the information?
And now …

1.1 Pick a personal area of expertise, from education, sport, leisure or social life, and think about how well your memory has helped you to absorb vast amounts of information and learn complex skills. Start noticing and celebrating the power of your memory.

1.2 Whenever you think about an episode from your past, focus on the many layers of information that make a memory. Get used to exploring memories from different angles and through a range of senses and begin to understand how one memory triggers many others.

1.3 Think about your day-to-day studies. Be honest: how much is your memory helping you and in what ways does it let you down? As you learn more about memory, in all its forms, start spotting the places where it could have the biggest impact on your success.