A DAY IN THE LIFE OF THE BRAIN
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A FEW PRELIMINARY REMARKS

Sometimes one book can change your life. Okay, that sounds a bit corny. And I'm not talking about the one you're holding in your hands either. But that's how it was for me. When I was in the eleventh grade at school, I had to give a presentation. It replaced a whole written exam, it had to be sixty minutes long, and I could choose not only the subject, but the topic as well. I wasn't used to having that much freedom. Somewhat desperately, I turned to my parents: what could I find that interested me enough to talk about it for a whole hour? My head was full of basketball, so much so that I sometimes trained seven days a week. That didn't leave much room for other passions.

The presentation could also be about a book, so I scoured my parents' bookshelf for inspiration. Reaching between Swedish crime novels and accounts of women's lives under the Third Reich, I pulled out a slim red-and-white volume entitled *Medicine for Education. A Way Out of the Crisis*.

"Have you read this, mum?" I called from the lounge. She hadn't. I opened it, began to read, and after twenty pages, I knew what the topic of my presentation was going to be. The book was about the findings of brain research and the frankly astounding fact that hardly any of this stuff seemed to have found its way into German schools. I read the book, gave the presentation – and suddenly basketball was no longer the be-all-and-end-all.

After that, I spent a good deal of my youth watching videos of a man in a polo-necked sweater explaining how the brain works. To this day, his voice still rings in my ears whenever anyone says the word “brain”: “Good evening, ladies and gentlemen. We are here to talk about YOUR BRAIN!” The author of the red-and-white book and the man in the videos was the neuroscientist and psychiatrist Manfred Spitzer. He has since become a rather controversial figure due to his persistent claims that smartphones are turning us into mentally deficient, overweight couch potatoes, which some regard as a bit of an oversimplification. But it was partly down to him that I started to read books on neuroscience and psychology, moved to Osnabrück to study cognitive science and completed a research project in Riga to find out whether Latvians perceive the colour grey differently from Germans because they are surrounded by so many drab facades. My paper was entitled *Ten Shades of Grey*, and the answer was: probably not.

The term “cognitive science” might not mean much to you in the abstract. In essence, “cognitive” simply means what goes on in your head whenever you think, remember, plan, decide, perceive, forget, say or imagine something, i.e. all the things you do on a daily basis, even when you think you're not actually doing anything at all. The word comes from the Latin *cognoscere*, meaning to recognise, find out or know. And that figures, as the purpose of cognitive science is to find out exactly how these processes work: how does a thought come about? How do we make decisions? Why do we remember things we don't want to remember, but forget what it was that we needed so urgently from the supermarket? I found this absolutely fascinating at the time. I still do.

Since developing this interest in the human brain, I have stumbled on some remarkable discoveries. One of these – and perhaps the most important – was summarised by the neuropsychologist Donald O. Hebb in 1949 in the oft-quoted maxim: "Neurons that fire together wire together."

What this means isn't immediately obvious, so here is the most useful image I know to help you grasp how the human brain works. Imagine you've just moved to a new town and want to cycle to work in the morning. On the first day, you have no idea which is the best way to go, so you tap your destination into the navigation app. It suggests a route, but there are lots of alternatives.

The first time you ride slowly, stopping at every crossroads to check the directions. It's quite an effort. But because you go the same way every day, it gets progressively easier. After a few weeks, you no long need the app. Your brain has stored the route, and you follow it automatically. At the same time, there are lots of other roads in the town that you never use. Because there is no traffic on these roads, they gradually become overgrown so that the road markings are no longer clear. (Okay, so I'm straining the metaphor a bit here, but it is only a metaphor!) If you suddenly have to take a new route, it feels like it did on day one: uncertain, slow, unfamiliar, laborious. You're lost without the app.

This is exactly how our brain works: the town is your brain with its neuronal networks, your daily cycle trips are the electrical signals, and the routes that you memorise over time are your synaptic connections. Routes that you use a lot become routine and hence steadily easier: a phenomenon commonly known as *learning*. Roads that you ignore grow rough and bumpy or disappear altogether. It's like the old adage: "use it or lose it".

But beware: the longer you stick to the same route, the harder it gets to start taking a new one, even if it's shorter. And the same goes for our brain. It likes ingrained habits. And getting rid of these is far from easy.

In this book, you will experience a whole day in the life of the brain. It begins in the middle of the night when you're asleep. You will dream, drink your coffee, have breakfast and walk (yes, *walk*) to work, where you will take part in meetings that don't involve brainstorming (this results in the worst ideas). After work you'll do a round in the gym, go for a drink with your best friend and reminisce about your first love. Once home, you'll spend more time on your phone than you meant to. Then you'll read a few more pages of your book and, finally, after an eventful day, drop off contentedly to sleep.

And me? My job will be to explain what's happening in your brain all this time. You will learn things you'll find genuinely useful for everyday life: how to control your dreams, why you can't concentrate in an open-plan office, what can really help you get more exercise, how to spend less time on your phone, why you and your friends laugh at the same jokes, why you get a blackout when you drink too much, why you don't sleep so well when you're stressed, and what you can do about it.

Needless to say, I haven't found all this out on my own. After my degree, I decided to become a journalist. But I continued to read books and studies on the brain and turned what I'd learnt into a newsletter and podcast. These are both entitled "The Life of Brain", and they form the basis for this book. But even more importantly, I couldn't have written these pages without the work of all the many scientists who spend their days attempting to answer the biggest – and smallest – questions concerning the human brain. The papers and books cited here can all be found in the chapter-by-chapter source index at the back.

Over the following pages I will touch on many specialist areas of brain research, each one of which could fill a whole book. But my interest lies – and always has done – in the bigger picture. Research has always fascinated me, but what fascinates me even more is what we can do with it. How can knowledge gained from what are often ultra-complex scientific set-ups be applied to our everyday lives? And that's exactly what this book is about.

One important thing to remember is that every brain is unique. There are small brains and large brains; some are quick and agile, others slow and dreamy. Some filter information like a sieve and others soak up every little thing like a sponge. Anyone who engages to any degree with modern neuroscience will soon come up against concepts such as ADHD, autism, hypersensitivity, dyslexia – in short, all the many forms of what is known as neurodiversity, which demonstrate how differently people perceive and process the world around them.

Now you may be wondering why, if this spectrum is so vast, I refer in this book to the brain in the singular rather than the plural? The answer is that my focus lies elsewhere. The aim of this book is not to categorise neurological differences. What I am concerned with here and now is the thing that unites us all: the astonishing malleability, adaptability and learning capacity of this tiny miracle inside our heads.

That said, science is seldom entirely free of ambiguity. Discoveries can be interpreted in different ways. Before we can reflect on what the results of scientific studies mean for our everyday lives, we need to understand them. Consequently, you won't find a single specialist term or process in this book for which I haven't tried to provide as simple an explanation as possible – as in the cycling image above. If you come across a word you don't quite understand, you are sure to find it in the glossary at the back.

A quick lesson before we start: For a long time, phenomena such as fear, desire or attention were attributed to a particular region of the brain – for example: "This is the amygdala: it is responsible for fear." You won't find me writing anything like that. Because there is a growing consensus in the research community that individual brain functions cannot be ascribed to a single region alone. It's like in football: scoring a goal is never the work of just one player. Except in the truly rare case where a player collects the ball from the goalkeeper, dribbles it past all their opponents to the penalty area and puts it in the back of the net. There is no region of the brain that collects the ball from the goalkeeper: thinking is a team sport. Here, the different areas work together at all times.

During the course of this book, you will gain a deeper knowledge of some regions of the brain with apparently complicated names, like “ventromedial prefrontal cortex”. Quite a mouthful! But once you know the basic structure of the brain, you will no longer be daunted by these. You can find a diagram of the brain and its various regions in the inside flaps of this book, so you can look them up as necessary.

Alternatively, you can simply use your hand. This is a trick I learned in similar form from the psychiatrist Daniel J. Siegel, and it serves as a rough guide to the structure of the human brain. It works like this: raise your hand with your palm facing towards you. The top of your forearm is your brainstem, which is what keeps you alive. It connects the brain with the spinal cord and controls basic bodily functions such as breathing and heartbeat. Now fold your thumb inwards so that it lies exactly in the middle of your palm. The tip of your thumb is your limbic system: this is deeply embedded in the brain and was long regarded as the engine room of your emotions. But the limbic system is not a clearly delimited area, and scientists now think that the corresponding regions communicate with areas all over the brain in order to generate your emotions.

Now fold your fingers down over your thumb. Together, they will form what is known as the cerebral cortex. This consists of four lobes on either side of the brain: the frontal lobe (directly behind your forehead), the parietal lobe (directly behind the frontal lobe underneath your crown), the occipital lobe (at the lower back of the head, right at the back of the skull) and the temporal lobe (at the side of the brain, roughly at the level of your ears). You can see exactly where the four lobes are located in one of the diagrams on the inside flap of this book.

By now, you should have made a fist with your hand. Turn it round and imagine there is a small ping-pong ball attached to the back of your fist at the level of your wrist. This is your cerebellum – what you might call the sports department of your brain: it helps with movement coordination and balance.

When describing regions of the brain, it is also common to specify which part of the region we are talking about. If I say, for example, that the "anterior parietal lobe" is activated during a certain action, I mean the front part of that region. If the rear part were active, I would say "posterior" instead of "anterior". You don't need to remember all these names: there is another diagram at the back of the book where the cardinal directions of the brain are labelled.

One further point: I will sometimes talk about nerve cells or regions of the brain being “fired”. This expression comes from neuropsychology and is used metaphorically. A nerve cell is fired when it triggers a so-called action potential – that is, an electrical impulse that is transmitted along its axon. An axon is the long, wire-like ending of a nerve cell which sends out electrical signals from the cell body, like a data cable telling the brain where to spark off the next idea. This action potential is an electrochemical discharge resembling an explosion – hence the term “firing”.

But before this starts to sound too much like a biology lesson, you can put your hand down again (if you haven’t already), and close your eyes for a moment. Because, as I said, the day you are about to experience begins in the middle of the night. Sweet dreams!

[…]

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9:00 A.M.: OFF TO WORK

Why your brain is not a computer

After breakfast, you're ready to go to work. You have showered, dressed, put on your shoes and slipped into your jacket. Now you're standing in the hall reaching for the car keys. Suddenly, you stop and slowly put the keys back on the dresser. Zipping up your jacket, you step briskly outside. Today the car stays home: you're walking to work! Okay, it's a bit of a trek – nearly two miles to the office. But that's no more than forty minutes at an average pace. And you can afford that much time.

For Martin Gommel, a fellow journalist at the independent news magazine *Krautreporter*, the 29th February 2024 began something like this: he got up an hour earlier than usual, shouldered his rucksack and struck out on foot from his home in Berlin-Kreuzberg at seven. It felt good to be among the early risers out and about at this unearthly hour. Looking out from the Schilling bridge over the river Spree after a mile or so, he noticed that the sun had not yet fully risen. After three and a quarter miles, he turned breathlessly into the Sredzkistrasse in Prenzlauer Berg and pushed open the door to the editorial office. At five o'clock, at the end of the working day, he took the same route home.

The reason I know this in such minute detail is that he wrote about it and I was the one who edited the article. Martin is the magazine's mental health correspondent. The fact that he wrote in that capacity about walking is no coincidence.

It was February 2024 when Martin started this routine, and he has stuck to it ever since, only taking the U-Bahn in heavy rain. Describing his walks to and from work every day, he writes: "Suddenly I am flying. The world around me drifts by and I feel light. I glide along, closing my eyes for a moment. My arms and legs move effortlessly, I forget my body and am one with the moment. Poplars rustle, and a refreshing head wind wafts around my shoulders. Time stands still. I breathe in fresh spring air and look out over the Berlin skyline." Today, he says he can't imagine life without his walk to work: "It sounds dramatic, but I have to say: walking has changed my life. I feel fitter, healthier and more focused." There are good reasons for this. Some of them have nothing to do with walking in itself, but with being out in the fresh air.

And now I'd like to make a deal with you. If your workplace is less than three miles away and it isn't raining on your next working day, try doing the trip on foot just this once. If you absolutely hate it and feel worse than usual, fair enough. Feel free to write to me and complain about my lousy idea. No one's forcing you to repeat something you don't like. But one morning won't kill you. And there are an incredible number of good reasons to at least give it a try.

You may remember the COVID pandemic. Bit of a hot potato, I know, and not exactly something people like to be reminded of. It was a peculiar time in many ways. And one of its peculiarities was that we walked everywhere. You couldn't meet your friends and siblings indoors, so you would go for a walk with them instead in the local town, village or woods. "Going for a stupid walk for my stupid mental health", the cynics called the new trend. But it's true: spending time in nature relieves stress and improves memory, attention and concentration. Why is this? And what can we do if we spend most of our day indoors?

In cognitive science, the human brain is often compared to a computer. This comparison has obvious weaknesses, however, and a single exercise will demonstrate how unlike a computer your brain is. Or can *you* solve this maths problem?

What do you get if you multiply 97.367 by itself 5000 times?

Don't know? Tut, tut! Okay, nowadays you could do it using the calculator on your phone. But let's say it's 1946. The Apple co-founder Steve Jobs wasn’t even born. Be honest: could you do that sum in your head? Thought so.

In February 1946, Arthur Burks and his research team at the University of Pennsylvania opened their doors to the public, promising big news. They were ready to present to the world the ENIAC, the “Electronic Numerical Integrator and Computer” – the first machine capable of performing such complex calculations instantaneously. The ENIAC weighed nearly thirty tons and required around 18,000 electron tubes and 7,200 diodes consuming 150 kilowatts of electricity. It took more than 200,000 work hours to build. And, as so often, the men involved in the project hogged the limelight. Arthur Burks – alongside the two physicists John Presper Eckert and John Mauchly – was indeed a central figure in the development of the ENIAC. But the majority of those involved in programming this gigantic device were women.

When Burks announced that the ENIAC would solve the above problem, the reporters in the room were apparently bent over their notepads. “Watch closely in case you miss it”, he warned as he pressed a button. Before the reporters could even look up, the job was done and the result appeared on a punch card retrieved on the spot by Burks. *Voilà!* The inventors gave their machine a few more problems to solve, and the audience was blown away.

The ENIAC was a milestone not only in computer research but also for our understanding of ourselves as human beings. Because scientists and the public initially insisted on comparing the ENIAC to the human brain. It was a “robot brain” or a “brain machine”. It wasn’t long, however, before the tables were turned, resulting in what is probably the most influential comparison in the history of neuroscience: the brain is like a computer!

This idea was popularised as early as 1958 by the Hungarian mathematician, physician, information scientist and economist John von Neumann in his study *The Computer and the Brain*. He was convinced that the brain was like a flesh-and-blood computer: a self-contained information processing machine enclosed in the skull, just as the ENIAC was enclosed in its locked room. It had gigabytes of working memory and megahertz of processing speed. This metaphor assumes intelligence to be something that is sealed inside the skull, governing how well humans can think. And because it is sealed in, it works according to a simple model: it receives input from the outside world and uses it to generate output. The brain is the hardware and intelligence the software.

But is this correct? As the scientist Matthew Cobb wrote in *The Guardian*: "By viewing the brain as a computer that passively responds to inputs and processes data, we forget that it is an active organ, part of a body that is intervening in the world."

Frédéric Vallée-Tourangeau is a professor of psychology at the UK's Kingston University who is researching the extent to which cognitive processes, rather than taking place in isolation in the brain, are assisted by tools, social interactions and physical surroundings. In his words, "thinking with your brain alone – like a computer does – is not equivalent to thinking with your brain, your eyes, and your hands."

Over the years, pioneers of the philosophy of mind have come up with many different metaphors. One of these was the idea that the brain is like a muscle. Like the biceps, it could be trained, and your intelligence would improve the more you trained it. This would presumably make school a kind of fitness studio for your grey matter.

A more recent comparison is with the internet. The brain is a network, has a decentralised control system, operates at astonishing speed and stores information. But almost all comparisons that attempt to describe the workings and function of the brain and human intelligence have one thing in common: they assume that the brain is the only entity responsible for thinking. Consequently, they don’t provide any real insights into how to make us humans think smarter in our everyday lives.

Rather than a computer or a muscle, then, a much better metaphor for the human brain is perhaps the altogether different one suggested by the science writer Annie Murphy Paul: that of a magpie. As she explains in her book *The Extended Mind*, magpies use a remarkable variety of materials for their nests. Practically anything they can find: not just twigs, branches and moss, but fishing line, plastic, spoons, forks, jewellery and bicycle chains. And our brain works in a similar way. Everything around us – our own bodies, our environment, technology, other brains – has an impact on our brain and hence on our thinking. More than that: all this is *part* of our thinking. Or, as Annie Murphy Paul writes: “For one thing … [thought is] an act of continuous assembly and reassembly that draws on resources external to the brain. For another: the kinds of materials available to “think with” affect the nature and quality of the thought that can be produced. And last: the capacity to think well – that is, to be intelligent – is not a fixed property of the individual but rather a shifting state that is dependent on access to extra-neural resources and the knowledge of how to use them.”

What she means by this is that, whereas a laptop will work equally well whether it is used in the office or in the park or at home, the brain is strongly affected by the environment in which it operates.

How nature alters your brain

When you go outdoors, it has a direct impact on your brain and your thinking. To take an example: in one study, researchers from Finland and Australia investigated how walking in the countryside affects relaxation and attention. The study consisted of two field experiments conducted in very different environments. One was a walk in a Finnish forest – a fairytale setting with tall pine trees, a soft forest floor and fresh air. This walk was enjoyed by 127 test subjects, while another 119 took a walk in a municipal park – a very different experience, with grassy expanses, footpaths and an urban soundscape. The participants had to walk approximately two to four miles entirely at their own pace. Different groups were subject to different conditions. Some were given tasks to complete as they went; these were specially designed to increase their attention or their connection to their environment (such as mindful awareness of nature). Other were given no particular instructions and simply walked, listening to the sounds of nature and enjoying the time out.

Afterwards, the participants were tested on three different levels. First, their mood was studied by asking them how they felt – whether relaxed or stressed, for example. Then they were asked how refreshed they felt. Finally, they took a special test to measure their sustained attention. The results were as follows: after the walk, all participants felt better, although it turned out to be nature itself that had the biggest impact. In terms of attention, there was a noticeable difference, with those who had performed nature-related tasks showing a greater improvement. Clearly, active engagement with nature can have positive cognitive effects. Lastly, those who had felt more stressed at the beginning benefited most from the walks. Both park and woodland settings appeared to be particularly good for recharging the batteries.

For another study, researchers at the University of Michigan asked students to walk for around fifty minutes, once in a natural and once in an urban environment. Each participant completed the two walks at a week's interval.

The researchers tested the participants' working memory both before and after the walk by asking them to listen to sequences of numbers and repeat them back in reverse order. These sequences consisted of three to nine numbers, becoming progressively longer. To make their memory work even harder, they had to complete a further task immediately before the walk. Those who had walked in the natural environment scored twenty per cent higher in the subsequent tests. This shows that it also matters *where* we walk – something to remember next time you're planning an outing with family or friends!

You don't even have to go outdoors to enjoy the positive effects of nature, however. Imagine you're sitting at your laptop in a windowless room. In front of you is an incredibly boring concentration test that involves clicking repeatedly on numbers displayed on the screen – a task that requires quick reactions and constant attention. Before long, you notice your mind wandering. Your concentration has gone out the window.

This was (literally!) the experience of 150 students who took part in an experiment at Melbourne University. After completing a demanding round of an attention task, the participants were allowed to take a break. But not just any old break. One half of the group were allowed to look out of the window for forty seconds at a green roof with grasses and meadow flowers waving gently in the breeze – in other words, something beautiful.

The other half spent their forty seconds looking at a drab concrete roof – grey, flat, motionless. Not so beautiful. Afterwards, the test continued with a concentration task. Here, the students who had looked at the green roof made significantly fewer mistakes than the other group. Their reactions were quicker, more consistent and more attentive than those of their colleagues who had simply stared at concrete. What a difference forty seconds can make!

Sometimes I have phases when my thoughts go round in circles. Perhaps it's the same for you. I think back to past decisions, and whether I did the right thing. Or forward to future situations and conflicts that haven't even happened yet but which potentially might, and how trying it would be if they did because I would have to rack my brains for a solution. Thinking about fictional conflicts is not only no fun: it also gets you nowhere. Especially when they don't actually materialise. I could have saved myself so much worry if only I'd stopped brooding. Now and then – when I'm feeling particularly sensible – I go outdoors and spend an hour amongst nature, and it nearly always makes those imagined conflicts feel less threatening.

Research conducted in the last few years has shown that getting out into the fresh air really does help against brooding. A research team from Portugal set out to discover what effect a thirty-minute walk in a municipal park would have on people who normally live in an urban environment.

The set-up was extremely simple: two groups of healthy participants, both walking for thirty minutes – one amongst greenery, the other in a concrete urban landscape. Afterwards, their mood and tendency to brood was tested. The results were clear: only the first group had significantly fewer negative thoughts. But why is this so? To find out, the team performed a so-called mediation analysis – a bit like a psychological onion skin model – and identified two central mechanisms. One is a sense of awe: a mixture of greatness, wonder, humility and fascination. The kind of feeling that overcomes you when you look at the sea or a mountain landscape. The researchers discovered that the more awe the test subjects experienced on their walk, the less their negativity – and hence the less they brooded. Secondly – quite apart from the awe factor – improved mood alone served to reduce the tendency to brood. This shows that nature doesn't help directly against brooding, like popping a pill: it simply puts us in a different emotional state – less me, more world. And that's often just what we need when we're in a mental rut.

Once again, you don't necessarily have to go outside to benefit from this. Another research team used photographs instead of actual walks. Fifty-eight test subjects were asked to imagine they were about to give a presentation to a critical audience. Although this may sound fairly harmless, it is a classic social stressor. And that was the whole idea: the participants were meant to experience pressure and self-doubt. Next, some were shown a slide show with nature shots, others one with cityscapes, and a third group nothing at all. The interesting thing in this case was that, while the nature slides failed to reduce brooding to any real extent, they had measurable impacts on the emotions. People felt more of a sense of getting “away from it all”. And that is precisely the value of this study: it shows that simply contemplating the beauty of nature can provide a mental mini-break, even if it doesn’t directly curb the tendency to brood.

All these positive effects of nature are not only observable in small groups of test subjects, however. In a study from 2019, researchers analysed data samples from just under a million Danes. The results showed that the greener the place a person spends the first ten years of their life, the lower their risk of mental illness later on. People who had grown up in the least green environments had an up to 55 per cent higher chance of developing a psychological disorder than those whose early years were spent in the greenest locations.

Why is nature so good for the brain?

As you can see, the idea that nature is good for us is not some esoteric invention, but a well-established neurobiological and psychological phenomenon. The question is, why? Is there some kind of logic to it? To date, a whole set of theories have evolved to explain this effect.

The perhaps most famous of these comes from what is known as the attention restoration theory. This was developed by Rachel and Stephen Kaplan, who have spent decades studying environmental psychology. According to them, our attention works like a resource: you can use it, but not endlessly. This is something you notice when walking through a town or city: faced with honking car horns, flashing adverts, bicycle bells and building sites, your brain is constantly having to filter what is important, and that takes energy.

Nature acts upon our senses in a different way. The light falling through the leaves, the wind rippling the grass – none of this requires any decision, evaluation or reaction from us. Rachel and Stephen Kaplan call this "soft fascination". Nature engages your attention without any effort on your part, thus giving your brain a breather.

The second explanation has to do with stress regulation and was developed by the American environmental psychologist Roger S. Ulrich. As we have seen, the body is programmed to react instantly in dangerous situations – with a sophisticated system of stress hormones, nerve signals and bodily reactions. This can be a problem if the reaction becomes permanent, and your brain constantly thinks it has to sound the alarm.

And this is precisely where nature comes to the rescue, according to Ulrich. Because the sight of greenery, the sound of rustling leaves, contact with the earth, light, air – all these things appear to tell your brain: “All is well. You are safe.” A deep-rooted biological “all clear” signal, you might say. But why? Presumably because our ancestors lived in this kind of environment for millennia. A quiet forest meant food, protection, survival. Our brain is not just a thinking organ: it is also a survival organ. And when you find yourself in surroundings that your brain deems safe, your inner stress level falls – something that offices, waiting rooms, cramped apartments and harshly lit supermarkets won’t do for you.

The third explanation is also the most fundamental. It is based on the assumption that we humans have an innate bond with nature. The evolutionary biologist Edward P. Wilson called this concept “biophilia”: a love of life, nature, all that grows and is alive. Why? Because our brains evolved amid nature. For the majority of human history we were hunter-gatherers. We foraged in forests for our food, drank from rivers, sheltered in caves. Our senses, our nervous systems, our decisions – all these things evolved outdoors. And that means that your brain is not made for computer screens, neon lighting and honking cars. It's made for forests, birds, wind and, occasionally, silence.

Today, when you walk through a meadow, smell a campfire or spot a squirrel, it evokes memories in your brain that are older than any childhood experience. These are evolutionary memories. And that's why it feels so good to be amongst nature. Because it's familiar, even if you weren't brought up on a farm.

Thus, study after study comes to the conclusion that time spent in the natural world has a positive effect on our thoughts. But does nature also have a healing effect? One study conducted in a hospital in Philadelphia investigated whether it makes a difference if patients can see trees from their beds. This study was published back in 1984 in the journal *Science*, and is regarded as one of the most influential in the field of architectural and environmental psychology. I just love the results: people whose rooms looked out onto trees were proven to need fewer painkillers, suffer fewer side-effects and spend less time in hospital than those whose rooms overlooked a brick wall. The nursing staff also made fewer negative notes on the emotional state of those patients with the greener outlook. This experiment paved the way for the concept of "healing architecture", which seeks to improve wellbeing and recovery through the design of health care facilities. And in a further study of 2025, its results were not only confirmed but further expanded.

A research team led by Max Steininger at the University of Vienna's Department of Cognition, Emotion and Methods in Psychology investigated whether this positive effect only occurs when patients looked at nature in real life, or whether simply watching nature videos was sufficient. The test subjects were shown nature scenes while inside the MRI scanner, and the researchers then compared their effect with that of videos of urban landscapes and interiors. At the same time, the participants were subjected to artificial pain stimuli by applying electric shocks of varying intensity to the backs of their hands which they had to assess in terms of intensity and unpleasantness. It sounds mean – and it is – but it was for a good cause: the participants reported less pain after watching the nature videos. And their brains confirmed this, with the scans showing a clear reduction of activity in the regions responsible for bodily pain processing.

The nature videos didn't only affect mood, however (that is, the emotional evaluation of pain), as is often the case with placebos. They also changed what Max Steininger called the "early, raw sensory signals of pain". And they were roughly half as effective as painkillers. In other words, nature appears to exert a direct influence on the way the brain processes pain information – even before conscious evaluation begins.

In short, we don't even need a real forest floor under our feet or real birdsong in our ear: nature films are evidently enough to trigger the healing effect of nature. Perhaps this marks the beginning of a rethink of our approach to pain management: fewer pills, more trees. So next time you're ill and in pain, it may indeed be worth sitting back and finally watching that documentary on the North Sea that you recorded ages ago.

The insights discussed so far in this chapter only go half-way to explaining why you should walk to work in the mornings. Being outside is good for us. But so is walking itself: at least, if you compare it with driving or travelling on a packed underground train.

This was confirmed by a survey of 713 commuters in Sweden's three largest cities. The team conducting it found that satisfaction with the daily commute contributes to overall happiness. Walking or cycling to work resulted in a higher level of satisfaction among the test subjects than driving or travelling by public transport.

A major reason for this is the movement involved. Walking at an easy pace requires a surprising number of muscles to work together in order to ensure efficient and stable forward motion. Your leg muscles do the bulk of the work: the front upper thigh muscles – the quadriceps – stretch and stabilise the knee, while the rear upper thigh muscles propel your leg forwards and support the forward drive. At the same time, your calf muscles serve to raise your heel so that you push off gently from the ground, while your front shin muscle lifts your foot to prevent you from tripping. Your glutes also play a crucial role, with the gluteus maximus, the largest gluteal muscle, enabling you to power yourself forwards, and the smaller ones keeping your pelvis stable while your weight is on one leg. They are assisted in this by the hip muscles, which bring your leg forwards in the swing phase, while the adductors on the inside of the upper thigh serve to keep your legs in a straight line.

In a word: walking is far more complex than sitting passively on a commuter train. A review conducted back in 1999 noted that even one-off physical activities such as a brisk thirty-minute walk can improve mood and sleep quality, and that people who are more physically active are highly likely to be positive about their mental wellbeing. Another reason for this is that, if you drive or commute to work by train, you are automatically spending less time in natural light. If you were to spend ninety minutes walking back and forth to work, it would therefore make a big difference. And perhaps you wouldn't need the vitamin D pills so many of us take in winter either.

Most of us know instinctively that daylight is good for our wellbeing. But light can also reduce the likelihood of having to take antidepressants. One cohort study involving nearly half a million adults in England investigated the mental health effects of spending time outdoors in the daylight. The researchers used questionnaires to gather data on mood, lifestyle and other health-related aspects. They concluded that people who are exposed to daylight for longer periods have a lower risk of suffering from depression and needing antidepressants. And if that isn't a reason to at least give walking to work a go, then I don't know what is. Deal?

How your body sends you signals (that you're not consciously aware of)

The positive effects of walking are thus partly down to the movement itself. How exercise affects your cognitive ability and wellbeing is described later in this book. To me, the interaction of mind and body is one of the most fascinating aspects of all research into the human mind. In cognitive science, cognition is said to be "embodied", meaning that thought, perception and consciousness are not generated solely in the brain, but through a close interaction with the whole body and its environment.

This idea goes back to the 1980s. In their book *Philosophy in the Flesh*, cognitive linguist George Lakoff and philosopher Mark Johnson demonstrated that even abstract concepts are often derived from bodily experience. When we say things like “the summer lies ahead of us” or “my best years are behind me”, we are thinking of time literally as movement through space. The future is in front of us, the past behind us – just like when we are walking. Other examples are expressions such as “a warm-hearted person”, “to give someone the cold shoulder” or “a frosty atmosphere”, in which social proximity or distance is perceived in terms of temperature.

Decades before that, the phenomenologist Maurice Merleau-Ponty likewise argued that consciousness is *always* embodied. Today, Antonio Damasio is regarded as one of the leading neuroscientists in this field. With his theory of “somatic markers”, he provided empirical evidence that our decisions are guided by physical states. Numerous researchers have since developed this concept and reached the conclusion that thought is not just an output of the brain, but a product of the whole organism, including the body.

This sounds philosophical – and it is. To help you understand what it means for your everyday life – and why these discoveries tell you so much about how to improve your concentration and make better decisions – I need to quickly tell you a rather distasteful story.

A few months ago I woke up with a grumbling in my stomach. I propped myself up against the wall behind the bed and reached for my phone, but the screen was a blur. My stomach continued to gurgle. I blinked several times but my vision didn't get any clearer. Beads of sweat formed on my forehead. Something wasn't right. I'll spare you further details. I had picked up some sort of tummy bug. The question was: where? Was it at the Mexican restaurant where I'd eaten sweet potato tortillas with a good friend the night before? Or was there something wrong with the beer I had drunk afterwards at the pub quiz night where I'd been so scandalously robbed of victory? (How was I supposed to know what the song *Major Tom* sounds like played backwards?)

No. It wasn't that. It was the Mexican. There was no way of knowing if it was the tortillas, but my body's signals were clear. As soon as I thought of the sweet potatoes I felt queasy again. I had the sort of feeling in my stomach that I could no longer ignore. Besides, since I began studying the interaction between brain and body I have grown much more sensitive in general to the many subtle signals my body sends me. Because our body knows what to watch out for far more often than our brain is willing to acknowledge.

The above-mentioned neuroscientist Antonio Damasio demonstrated in a famous study of the 90s how much our body influences our decisions, long before our brain kicks in. In the so-called Iowa Gambling Task, he got test subjects to play a card game in which they could win or lose money by selecting from four card decks. Two of these decks were “good” – moderate winnings, moderate losses. The other two were “bad” – high winnings, but even higher losses. After selecting around fifty cards, most of the test subjects realised that two of the decks were disadvantageous to them. But it only took around ten cards for a clear pattern to emerge in their physical reaction: as soon as they approached one of the bad decks, their skin conductance response (SCR) – that is, the electrical conductivity of the skin, which is affected by minimal amounts of sweat – rose measurably. Their bodies had understood that the deck in question was a bad bet long before they became consciously aware of it.

From this, Damasio concluded that the body is like a silent early warning system. It detects patterns before our mind can even begin to decipher them. And it signals this to the brain via a raised heart rate, perspiration, nausea, tightness in the chest or facial flushing. What we often call a “gut feeling” is not, therefore, irrational. It is preconscious knowledge, encoded in physical states. Damasio calls these responses “somatic markers”:

emotional experiences stored in the body which help us to make decisions in a flash when there is no time for complex analyses.

But how exactly does this work? How does the body communicate with the brain? An important concept in this context is that of "interoception" – the brain's ability to perceive the internal signals of the body. These include our own heart rate, breathing and the fullness of the lungs or stomach, as well as more subtle states such as the feeling of thirst, pain, nausea or exhaustion. In Damasio's experiment, the test subjects exhibited these signals well before they cottoned on to how the game worked.

For a long time, interoception was regarded as a niche topic. Today, we know it plays a central role in our emotional experience, our self-regulation and even our capacity to understand other people. The British neuroscientist Sarah Garfinkel has conducted some particularly detailed research into this phenomenon. She has shown, among other things, that people who are better at detecting their heartbeat accurately also show more sensitive emotional responses: they have a "higher interoceptive sensitivity." In one of her best-known studies, Garfinkel discovered that the most accurate judges of their own heartbeat are, in addition, more emotionally stable. Here she distinguishes between the two concepts of "interoceptive accuracy" and "interoceptive awareness". By interoceptive accuracy, she means the objective ability to correctly detect body signals, the heartbeat being one of these. Interoceptive awareness, on the other hand, is the ability to judge whether or not you are good at interpreting your own body signals. Garfinkel discovered that this ability plays a major role: the higher the test subjects scored in this respect, the lower their risk of developing symptoms of anxiety. So good body awareness seems to go hand in hand not just with emotional awareness, but also with effective emotional regulation. In other words, if you have a better understanding of your body, you are more in touch with your feelings and are thus better able to regulate them.

The feelings you experience aren't simply the signals your body sends, however: those signals first have to be turned into emotions by your brain. We owe this insight to Lisa Feldman Barrett, who has spent years working on the question of how emotions are generated. According to her theory, feelings are not objective "raw" stimuli from the body, but a product of the *interpretation* of those stimuli – just like the brain's reading of the outside world as described in Chapter Two. Feelings, then, are an interpretation of the body's signals in light of our experiences, our values and our internal models of the world. If your heart suddenly starts racing, you could be thinking: "I'm over the moon!" Equally, you could be thinking: "Ohhh shit. I'm having a panic attack!" Physiologically, both these thoughts often have the same input (palpitations). The important thing is what your brain makes of them.

To help you understand this, it's worth taking a look at the two most important interlocutors involved in interpreting body signals. One of these is the vagus nerve. You know the one I mean: it runs like a data highway between your belly, heart, lungs and brain, and sends twice as many signals upwards as it does downwards. In other words, it's not just a case of the brain controlling the body: the body is at least as busy telling the brain what to do. According to studies, people whose vagus nerve is good at switching between activation and deactivation are better at regulating their emotions, better at coping with pressure, and even more socially engaged.

The second interlocutor is the so-called insula, an area deep inside the brain which plays a key role in processing interoceptive stimuli. It is here that many of the signals from the body – such as heartbeat, stomach fullness and breathing – converge. The activity of the insula appears to determine how in touch we are with our inner states, and how intensively we react to them. People with a more active insula report more intense emotions, for example. At the same time, imaging studies show that the insula often overreacts in people with anxiety disorders, interpreting bodily states such as palpitations or tightness in the chest as a threat.

This means that trusting your gut feeling isn't just about listening to your body: it's about having an intelligent conversation with it. And the better you know how reliable your internal perception really is, the easier it is for your brain to read it correctly.

And this brings us back to my earlier gastric episode. My body signals were so clear that they are etched in my memory. To this day I feel a slight queasiness when I think of that Mexican restaurant. Shame: I really liked it. My body, on the other hand, not only reacted, but learned. It conditioned a response before my conscious mind could intervene. And that's the thing about interoception: it works faster than any amount of thinking. And sometimes better, too.

In a world where many of us spend our days sitting down and are often only aware of our bodies as a vehicle for getting us from A to B, we lose touch with these internal signals. We function instead of feeling. But interoception is something that can be practised and improved. One way to do this is to try and concentrate on your breathing, so that you really feel the air flowing in through your nose, your chest rising and your belly contracting. This may sound banal, but your brain will be working flat out. And it will even change, as a team led by the neuroscientist Norman Farb discovered.

The researchers invited two groups to the laboratory. One completed an eight-week-long mindfulness course, as used in stress reduction programmes. The other group did nothing at all. Or rather, it served as the control group. Afterwards, all participants underwent an MRI scan, during which they were told to pay attention to their breathing. But not just anyhow: they had to consciously notice how their own body felt with every in- and outbreath.

In those who had completed the course beforehand, the MRI scan showed significantly more activity of the front insula, that is, in the interoceptive centre. Participants who had learnt to practise mindfulness were better able to detect their internal signals. The training caused the brain to change.

If you practice body awareness on a regular basis, i.e. noticing your heartbeat, breathing and body tension, your brain gets better at it. You become more sensitive to signals that are otherwise drowned out by background noise. And the effect is not insignificant: those who know what their body is trying to tell them often make better decisions (think of Antonio Damasio’s card players!), are more emotionally stable and can react more quickly when something is wrong.

So next time you don't know what to do, and are unsure whether a person is good for you or a project right for you, try checking in with yourself for a moment: what is your body telling you? It may have figured out the answer long ago.

Why you should move more at work

The walk to work has cleared your head. Of course, you could have done without that downpour half-way to the office. But at least you're wide awake now. On arrival, you take off your things, sit down in front of the screen and set to work. At first, you have no problem concentrating. But after two hours you feel a twinge in your back. You just can't seem to get comfortable today. And as you sit there, you think back to your school days and wonder how many hours of learning time you must have spent sitting still on your chair.

The answer is: too many. According to a survey by the Institute for Sports and Sports Science at the University of Heidelberg, children and young people spend an average 10.5 hours a day seated. This can make school a real ordeal for some children, as I found out when talking to parents about their children for an article in *Krautreporter*.

One father contacted me and told me about his daughter Antonia. After just three months in the first form, she had lost all interest in learning. Yet she had been really looking forward to primary school. All children go through phases like this, her father thought. But the phase continued. After two more weeks, he attempted to find out what was wrong. “The reason was simple”, he said. “Antonia hated having to sit still so much at school”. The family asked for a meeting with her form teacher. After a few minutes, the matter was sorted: the fact that Antonia needed more exercise at school was no problem. Now she is allowed to change seats during lessons if she wants to. She can work standing up. And if she feels the urge for more exercise, she can put her hand up, ask to go to the toilet and run up and down the stairs instead. “That changed everything”, Johannes said. Now Antonia has rediscovered her enthusiasm for school. And she enjoys learning, too.

From a neurological perspective, the practice of only allowing children to move about at break times (apart from PE lessons) is plain bonkers. And the fact that adults then carry this idiotic rule over into their working lives and often end up sitting motionless in front of their screens for eight hours a day makes no sense either. As we have just seen, thinking is closely connected to body signals. So it’s only logical that the body sends different signals when in motion than when sitting still on a chair. The idea that the

45-minute units of thinking time at school are best completed while rooted to the spot just goes to show how little we as a society understand about the thinking process. Yet we know what a lack of exercise can lead to: diabetes, high blood pressure and cardiovascular disease. Almost one child in six in Germany is overweight or obese. According to the Robert Koch Institute, this rises to one in five in eleven to thirteen-year-olds. The damage caused by sitting still is not immediately obvious, but has long-term effects. And then we wonder why we have such bad backs as adults! Yet physical education is a fixture of the school curriculum, in fact it's a subject in its own right. According to a survey of German schoolchildren in 2019, the average time spent on PE per week was just 2.6 hours. Compared with the average 10.5 hours per day (!) that a child spends sitting down, that is a ludicrously small amount.

But in many jobs we adults, too, spend most of the day seated. For a study published in 2017, Christine Langhanns and Hermann Müller from the Justus-Liebig University Gießen asked groups of volunteers to solve a series of maths problems in their heads. The test subjects had to perform this task in one of three positions: reclining on a sun lounger, sitting on a bike saddle or standing. They could either move a little, remain relaxed (but without moving too much) or stand stock-still. The participants' cognitive load was measured throughout the task by means of a brain scanning technique known as fNIRS. This stands for functional near-infrared spectroscopy – a method in which near-infrared light is used to determine the activity of the brain by measuring changes in the blood's oxygen content. The results showed that the test subjects' cognitive load rose considerably when they were told to "stand still". This instruction increased brain activity in the same area that was involved in solving the maths problems: the prefrontal cortex, which is important for performing intellectual tasks such as calculation and for controlling our impulses. Consequently, this region was no longer able to concentrate fully on the maths exercise while the test subjects were standing still.

Earlier in this book I described how positive the effects of walking can be on our wellbeing. But what happens if people have to perform concentration exercises and impulse control tasks at the same time? In another study, the test subjects had to do precisely that. For this purpose, they wore a portable NIRS brain scanner, which measures activity in the prefrontal cortex – a region of the brain instrumental in governing attention, self-regulation and planning. The results showed a substantially improved performance in cognitive tasks even during the walk itself – at least in the case of exercises requiring quick, clear decisions, such as the classical "go/no-go" task, in which the participant has to respond instantly to cues or consciously withhold their response. The researchers also noted increased activity in the prefrontal cortex at these precise moments – a sign that the brain was more alert, more coordinated and better regulated during movement.

Even more interestingly, this effect didn't occur with all types of movement. When the test subjects walked slowly or below their individual threshold pace, the effect was measurable, but moderate. As soon as they began to up the level of exertion, the positive effect actually lessened. In other words, we think best when our bodies are moving in a steady, rhythmic gait, as in a brisk walk, and not when we are going full pelt.

This is, of course, no coincidence. It makes evolutionary sense: we need to be more alert when moving around than when simply sitting still in a small dark cave (and I'm not talking classrooms or offices here). Why movement is so conducive to thinking has not yet been fully established, but there are a few possible explanations. According to the movement coach Christian Andrä: "When we move our bodies, it gets the blood flowing and increases the supply of nutrients, which improves the function of the whole organism. And that goes for the brain too. Movement increases the blood flow through the brain and optimises the oxygen supply. So doing more regular exercise makes it work more efficiently." A series of neurotransmitters are released which increase the efficiency of information transfer in the brain and promote the growth of nerve cells (more on this later, when we get on to the subject of sport).

In short, walking to work could be just the beginning. If you really want to capitalise on your body's decisive role in the thinking process, you should build movement into your working day as well. This is no easy feat, given that hardly anyone does. At the *Krautreporter* editorial office, I get up at regular intervals, walk across the room and remind my colleagues that we need to move more. Some stay put because they're busy working on a text, but a few always get up and join me in a group fidget. It just needs someone to take the initiative.

[END OF SAMPLE]