MOVE!

The New Science of Body Over Mind

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Introduction

'Just come in and move however your body wants to …'

This is the moment I have been dreading all day. It's 7.30 p.m. on a Wednesday and I have come to a village hall in Surrey, England, for what I've been told will be an evening of mind-altering free-form dance.

The young man on the door takes my money and encourages me inside. It's dark, apart from a few candles and fairy lights, but I can just make out a middle-aged DJ with a bleached crew cut and harem pants, spinning what probably comes under the banner of gentle tribal beats. One woman is rolling on the floor, while another is wafting around chasing imaginary butterflies. Then two of them start hugging. At which point my body tells me very clearly that it would like to move, as quickly as possible, back through the door.

I don't, and as the evening progresses, my body gives up the fight and starts to move. As the drums build towards a climax, the DJ murmurs 'let go' into the mic. Suddenly, as if he flicked a switch, I notice that I'm no longer moving my legs: they are moving me. My feet are hammering the floor at an alarming rate, as my head shakes from side to side and my arms flail in circles. I couldn't stop if I wanted to, and I feel unleashed, alive, free.

It was my first foray into the world of how movement

can radically affect the mind, and it was something of an eye-opener. I'll be honest: getting high on life like this isn't my usual kind of thing at all. My thing is more about sitting quietly, reading, thinking and writing about the peculiarities of the human mind – trying to get my head around why people think the way we do, and what science can tell us about how we might overcome the many mental and emotional glitches – from a lack of focus to anxiety and depression – that seem to come as part of the deal.

But then one day it occurred to me that my mind seems to work best when my body is on the move, and I started to wonder why. What is it about going for a long walk that unravels tricky scientific concepts in my head and helps a jumble of ideas finally coalesce into sentences? Why does an hour of yoga make me feel calm and in control, no matter what challenges the rest of the day holds? And why does jumping around to music in the kitchen make me feel so damn happy?

A spell of sitting and reading later, it transpired that I wasn't the only one asking these questions. Scientists working across a huge variety of disciplines, from neuroscience to cell biology, from exercise physiology to evolutionary biology, have started to investigate how bodily movement affects the mind and are just beginning to tease apart the physiological mechanisms that explain why. What they are finding is potentially game-changing scientifically and, given the way most of us live our lives these days, profoundly important for our overall health and well-being.

It shouldn't be news by now that most of us aren't moving anywhere near enough, myself included. After walking the dog for an hour in the morning, my working day mostly

involves sitting at a desk and moving no further than the kitchen for multiple cups of tea. If he's lucky, the dog gets another wander through the woods, and on some days I do yoga, but more often than not weekday evenings involve yet more sitting, followed by eight hours in bed. Statistically, my life isn't all that unusual. The average modern adult spends 70 per cent of their life sitting or lying completely still; we move around 30 per cent less than our counterparts in the 1960s. Children spend up to 50 per cent of their free time sitting around, and that's before you factor all those hours bent over a school desk.[1] Elderly people, unsurprisingly, clock up even more hours of stillness, spending up to 80 per cent of their waking day barely moving a muscle.[2]

There are good reasons why we, as a species, have chosen the way of the sloth. First, it's comfortable. And second, we have spent most of the past century inventing technologies that make movement unnecessary. Unlike almost all of the other creatures on the planet, we are now in a position where we barely need to shift our bodies to find food, stay entertained or even find mates. Most of it can be done sitting down and occasionally moving our thumbs.

Yet while we (stiffly) pat ourselves on the back for having the brains to make this happen, we are missing something important. The brain evolved not for us to think but to allow us to *move* – away from danger and towards rewards. Everything else, from our senses to our memories, emotions and ability to plan ahead, was bolted on later to make these movements better informed. Moving is at the heart of the way we think and feel. If we stay still, our cognitive and emotional abilities become seriously compromised.

Sure enough, as we make ourselves comfortable, the

cracks in our collective psyche are beginning to show. Our increasingly sedentary lifestyles have been linked to falling IQs,[3] a vacuum in new creative ideas,[4] a rise in antisocial behaviour[5] and an epidemic of mental illness that is affecting people of all ages and from all walks of life.[6]

Studies suggest that both self-esteem and pro-social behaviour tend to be lower among people who spend more time sitting,[7] and that sedentary time is linked to a greater risk of anxiety and depression. Although it isn't clear which comes first, the sitting or the depression, physical activity is well known to be helpful in relieving symptoms of both conditions, so it stands to reason that a sedentary lifestyle is not ideal for anyone at risk of, or already dealing with, mental health issues.

Cognitive skills, too, take a hit when we sit. Being sedentary for long periods is the enemy of focused attention, memory and planning ability and puts an unnecessary lid on our creativity. A recent study of young Finnish schoolchildren found a significant relationship between the amount of time spent sitting and achievement in standardised maths and English tests over the course of two years, particularly among boys.[8] The rot sets in at an early age, and if we do nothing about it, sitting still becomes a lifelong habit.[9]

It also makes us old before our time. In studies, middle-aged people who spent more than two or three hours per day sitting in the car or in front of the TV were found to lose their mental sharpness significantly faster than those who were more active. We also know that regular exercise can reduce the lifetime risk of dementia by 28 per cent.[10] By one recent estimate, as many as 13 per cent of Alzheimer's cases worldwide can be traced back to a sedentary lifestyle.

By another, reducing sitting time by a quarter could prevent more than a million new diagnoses worldwide. It doesn't matter how you cut the numbers, the message is the same: move more, and your brain will thank you in the long run.

Given our collective propensity for lolling around, it is perhaps more alarming than surprising that our sedentary ways may be affecting IQ at a population level, making humankind as a whole just a little bit less smart. IQ scores had, until recently, been rising by an average of 3 points per decade, for as long as people had been taking IQ tests and in countries all over the world. The trend is named the Flynn Effect, after the New Zealand-based psychologist James Flynn, who first documented it back in the 1980s.[11]

Soon afterwards, however, from the mid-1990s onwards, the Flynn Effect started to slow down, and by the early 2000s the trend was running in reverse, at the rate of a few points per decade.[12] Some observers explained this with the controversial claim that less intelligent people tend to have more children, which over time could have diluted national averages.[13] Others suggested that an increase in global migration was to blame, because incoming foreigners didn't quite understand the questions.[14] A recent study from Norway, though, shows quite clearly that neither of these – let's be honest, offensive – explanations holds water. By tracking IQ scores of young men from the same family over several decades, researchers found that IQ scores were declining within families across different generations. This means that it can't be down to changes in genetic fitness – evolution doesn't work that fast, and certainly not for complex traits such as intelligence, where variation is explained not by one gene but many. It is much more

likely that the changes can be explained by changes in the environment.

Or, perhaps, by the way we choose to use it.

A lack of movement isn't the only change in our lifestyles in recent years, but there is no doubt that the descent to seatedness is an important social change that has been creeping up on us for some time, and not only in the pampered West. A study from 2012 compared the amount of physical activity involved in work, leisure, home life and travel in the US, UK, China, India and Brazil from the 1960s onwards. Everywhere they looked, physical activity was on a downturn – and not only in leisure time but all the time. The fastest declines were in China and Brazil during the 1990s. These were mostly accounted for by changes at work and home, as physical labour gave way to office work and home appliances made daily chores less of a workout. Only India seemed to be bucking the trend, at least in 2012, but sedentary time had already shown signs of rising there too.[15]

The gym is not enough

If you're the kind of person who diligently hits the gym every day, you are probably feeling pretty smug right now. But there's a catch: exercise – at least the way we currently think of it, as something to do in earnest between long periods of sitting – is not the way to turn things around. Brain imaging studies show that there is a correlation between the thickness of brain regions involved in memory and the amount of time a person spends sitting, regardless of whether or not they also do high-intensity exercise at some point during the day. And while mood and focus do spike briefly after

a period of exercise, overall it doesn't matter if you go for broke for an hour in your lunchtime spinning class. The effects of sitting still for the four hours either side of lunch don't go away.

In fact, you could argue that binge-exercising is missing the point of movement entirely. In her book *Move Your DNA*, movement guru Katy Bowman makes exactly this point. She says that exercising in short bursts, or to target certain muscles, is a bit like taking vitamin supplements to try and offset an unhealthy diet. It may help, but it's never going to make you truly healthy, and it will probably leave you hungry for what she calls 'nutritious movement'. Bowman doesn't delve all that deeply into how movement affects the mind, but I would argue that movement nutrition is at least as important for our mental, cognitive and emotional health as it is for our physical well-being. Moving our bodies in certain characteristically human ways connects us to the equally fundamentally human ways that we think, feel and make sense of the world that's both around us and within.

This is a theme that I'll return to in a few pages' time. For now, though, the important thing to know is that, as a society, we're not moving enough, and what little we are doing we are mostly doing wrong. That's the bad news. And here comes the good: it doesn't matter what you want to do with your mind. Whether you want to learn better, slow brain ageing, spark new ideas or just feel more in control of your mental health, there is almost nothing that moving more – and in particular ways – can't help you to achieve. Body movements can serve as a short-cut to changing the ways we think and feel.

This is a big deal: contrary to received wisdom, thoughts

don't only come from inside our heads, and thoughts are not the only routes to emotions. Some kinds of body movement help to reduce inflammation – a modern-day scourge linked to everything from depression to chronic pain. Others hijack the brain–body stress pathways in ways that help dial down feelings of anxiety and instil a visceral sense of confidence. Others change the way that electrical information flows through the brain, directly affecting our mental state. Move right and the body becomes an extension to and an equal partner of the brain – not just the meat suit that carries it around.

I say this with confidence because many scientists are changing the way they think of the body and its relationship to the mind. After many years in which science cast the body as an understudy in the story of our mental lives, it has finally landed itself a starring role. For decades the mind has been thought of as being run exclusively by the brain, sitting high and dry in the head while the squelching, churning, pumping and filtering activities of the body managed the dirty business of keeping us alive. Now, though, we now know that, unglamorous as they may seem compared with the electrical fizzing and whizzing of the brain, our bodily functions are just as much of a key component in what makes us tick.

As we'll see in the next section, the dirty business of keeping us alive actually involves a huge amount of communication between the body's various organs, the pipes and wires joining them up and the bodily fluids that swoosh around and between them. This communication provides a constant backing track to our lives, directing our thoughts and colouring the way we feel.

In this new view the brain has a different, although no less important, role. According to the influential psychologist Guy Claxton, rather than being the master controller and arbiter of our every thought and decision, it instead acts as a kind of 'chatroom' that hosts the body–mind conversation that makes up our mental life. Here, he says, 'swarms of factors can come together and, through communication, agree on a plan'.[16] The brain is not so much the boss as a facilitator, bringing the key players to the table and allowing everyone to be heard and to come up with a collective plan of action.

'Action' is the important word here because that's where the link to movement comes in. The power of movement is that it allows us to hack into this body–mind chatroom and changes the tone of the conversation for the better. The overall aim of this book is to reveal some of these emerging dials and levers and how they work, using the best, most up-to-date science that we have.

In the pages that follow I'll meet not only the scientists who are investigating the physiological, neural and hormonal connections that link body and mind but also the many inspirational people who are putting the theory into practice and proving its worth in real life. From a psychologist who overcame illiteracy with the help of dance to an ultra-marathon runner who outpaced his demons, and from a neuroscientist who has found out he was wrong about Pilates to a stuntman who is helping kids backflip their way to better mind control, there is no shortage of people who are living proof of the movement solution. Science provides the data, but these people provide the inspiration to make a few simple changes that really can improve your life.

Ultimately, whether you are looking for more brain power, to feel more connected to others or just more in control of your life, the message from all corners of science is coming through loud and clear: this is no time to be sitting around.

1

Why We Move

That which we call thinking is the evolutionary internalisation of movement.
Rodolfo Llinás

Nothing in biology makes sense except in the light of evolution.
Theodosius Dobzhansky

Some days, the life of a sea squirt sounds almost idyllic. After a brief swim around the ocean while it's young and still has the energy, the tadpole-like larva finds a rock with a view and settles down for a rest. Once attached, it sets about developing into its adult form, a blob with two tubes. There it will sit for the rest of its life, gently sucking in water through one tube and blowing it out of the other like a small, rubbery bagpipe.

There's a high price to pay for this lifetime of relaxation. In its larval stage a sea squirt has a simple brain and a basic nerve cord that runs along the length of its tail. It uses these to swim around, searching for a good spot to live, and to co-ordinate its movements to get there. Once attached, though, glued firmly to the rock by its head, the sea squirt digests

almost its entire nervous system, never to make a decision again.

The curious case of the disposable brain tells us something about why we have a nervous system at all. And, before we get to the 'how to' aspects of body movement over mind, it's worth considering why the many body–brain pathways came to exist. The distinguished Colombian neuroscientist Rodolfo Llinás used the sea squirt to make the case that animals originally evolved brains not so that they could *think* but so that they could *move* – away from danger and towards where the living is easier, making informed decisions as they go. Movement, Llinás reasoned, is simply too dangerous to attempt without a plan.[1]

Sea squirts represent a snapshot of a time in evolution when life was experimenting with whether a nervous system was any more likely to make you survive the rigours of existence. Nervous systems are expensive to run – our own brains gobble up 20 per cent of our body's entire energy budget despite accounting for only 2 per cent of our body weight. For the sea squirt, the answer was that the investment was worth it for as long as it was on the move, but thereafter, not so much. And when movement is no longer necessary, thinking is surplus to requirements, so the whole system goes in the recycling.

Since this period of evolutionary dithering, most species of animals have opted not only to keep a brain throughout the entirety of their lifespan but also to invest heavily in its architecture. Thinking and movement have been evolving in lockstep ever since. The human brain is by no means the pinnacle of the process of brain development – each creature's brain is, after all, uniquely adapted to its own way of

life – but in terms of investment it is certainly an extreme example. Our brains contain three times as many neurons as our closest living relatives the chimpanzees. In fact, with 86 billion neurons with over 100 trillion connections between them, the human brain is the most complicated object we have ever encountered.

Explanations of how we got this way generally concentrate on our cortex, the wrinkly outer layer of the brain, which is disproportionately large in humans compared with other apes. The wrinkles are actually a product of its size: as the cortex expanded, adding more and more processing power, the only way it could fit into the skull was to repeatedly fold in on itself. Other species with a smaller cortex, such as dogs, cats and chimpanzees, have far fewer folds and wrinkles than us. Some, including mice, rats and marmosets, don't have any at all – their brains are as smooth as raw, skinned chicken.

Some think that our cortex enlarged to cope with the challenges of finding new ways to think – keeping track of our complex social lives, for example, or predicting where the next meal might show up and working out how to catch it. Then, once we used our big brains to work out how to cook, they got even bigger, because cooking allowed us to extract more calories from our food. All of this added up to an unusually large cortex that allows us to plan, to mentally travel back and forward in time and to come up with ideas for things that have never existed before.

That's a good synopsis as far as it goes, yet it totally ignores the influence of movement. A new theory adds this vital detail into our origin story, linking the evolution of forward thinking not to abstract computations inside the

head but to a growing evolutionary pressure to come up with new ways to move. In this view, the origin of our most impressive mental tricks can be traced even further back in our evolutionary history, to a time before humans existed, when our even more distant ancestors needed to find new ways to get around.

Twenty-five million years ago the common ancestor that we share with other apes split off the evolutionary tree from the monkeys. These early apes lived in the trees like their monkey cousins but were bigger, heavier and clumsier and were in constant danger of falling from the branches. Their solution to this problem was quite sensible: to spend more time bearing their weight on their hands, holding on tightly to branches above in situations where smaller monkeys might have been able to balance. This strategy worked well, and over millions of years (and some shoulder modifications) slowly evolved into an ability to brachiate – swinging arm over arm in the trees at speed, as gibbons do today.

Brachiation is a complicated way of moving. According to the evolutionary anthropologist Robert Barton, of Durham University, it requires more than just a vague plan of action to stand any chance of getting from A to B safely. Staying safe while swinging through the trees requires an ability to link movement to an understanding of the consequences of your actions at speed – *I put my hand here, swing and reach … that one won't hold my weight, so I'll grab here* and so on – which means being able to formulate and adapt a plan on the fly. In a paper published in 2014 Barton put forward his idea that the development of the extra brain circuitry needed to support this new skill not only led to an improvement in our ancestors' physical

gymnastic skills but also set the stage for our impressive mental gymnastics.[2]

The circuitry that is in charge of these kinds of super-fast movements is found not in the wrinkly cortex but in the cerebellum – the small, cauliflower-like region that, in diagrams at least, looks as if it's dangling from the bottom of the rest of the brain. At about the time that the early apes started swinging through the trees, the cerebellum started expanding, becoming disproportionately large compared with the cortex. This trend continued through the evolution of the great apes and accelerated in the branch that led to us.

The way the cerebellum is built seems to have made this expansion a fairly straightforward process. While the rest of the brain's wiring looks a bit like the organised chaos of an old-fashioned telephone exchange, the cerebellum is more like a well-kept vineyard, with neat rows of neurons linked with super-fast input and output wires. That means that another 'module' can be replicated and then bolted on fairly quickly, at least on an evolutionary timescale.

Until recently this finding would have raised a huge 'so what?' in evolutionary biology circles. The cerebellum had long been known to be specialised for fine-movement control. It shouldn't have been terribly surprising that the cerebellum would expand to support a complex new movement skill.

Then in the late 1990s and early 2000s the view of the cerebellum started to change. It was gradually becoming clear that what the cerebellum does for movement it also does for thinking and emotional control. Brain imaging experiments and tracing of neurons throughout the brain revealed that many of the evolutionarily newer cerebellum

'modules' wire up to the frontal parts of the cortex, which are in charge of planning and forward thinking and help to fine-tune our emotional reactions. In fact, it turned out that only a small portion of the human cerebellum connects to the movement-generating parts of the rest of the brain. The rest specialises in thinking and feeling.

Barton's theory is that, when brachiation tied together movement, forward planning and potentially fear of falling from a great height, it set us up for all manner of sequential thinking, from understanding the rules of language and numbers to building simple tools, telling stories and working out how to get to the moon and back. It's tempting to speculate that it may also underlie the sensations that accompany some of our less successful social interactions: swinging and falling is certainly how it can feel when a conversation suddenly takes a turn for the worse.

The ability to think sequentially is particularly useful for skills that require not only fine sensory motor control but also a capacity to work out a sequence of actions that will lead you to your goal – central to the ability to knit a scarf or think through a series of moves in chess. It could also explain how chimpanzees can work out the sequence of movements that will allow them to adapt a twig to fish for termites. 'Our capacity to work out how to achieve a goal by stringing together a sequence of actions is kind of the basis of our causal understanding of the world,' says Barton.

Blame the ancestors

Twig technology aside, the other great apes haven't done a great deal with their expanded forward-planning skills.