VINTAGE

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ABOUT THE AUTHOR

Shane O'Mara is Professor of Experimental Brain Research at Trinity College Dublin – the University of Dublin. He is Principal Investigator in, and was Director of the Trinity College Institute of Neuroscience, one of Europe's leading research centres for neuroscience. He is also a Wellcome Trust Senior Investigator and a Science Foundation Ireland Principal Investigator.

He is the author of two previous books, Why Torture Doesn't Work: The Neuroscience of Interrogation and A Brain for Business – A Brain for Life. He has also written many scientific papers, as well as for the newspapers and magazines.

He loves to walk wherever and whenever he can, with long urban walks in any walkable city a particular favourite.

@smomara1

www.shaneomara.com

Also by Shane O'Mara

Why Torture Doesn't Work: The Neuroscience of Interrogation

A Brain for Business: A Brain for Life

INTRODUCTION

What is it that makes us human? What quality is it that makes us different to all other living creatures? Language usually comes top of the list – it is a unique human capacity, without doubt.[1] Other species communicate with each other, and often do so flawlessly and elaborately, with call signs for food and danger, for example. But no other species has anything like human language, with its infinite capacity to carry meaning, content and culture.

We humans also use elaborate tools, and we train other humans in their use; moreover, our tool use evolves over time. But other species do use tools, albeit not with the variety and creativity that we do. Our unique human propensity to cook our food is often cited too: it is true that no other species cooks their food. Cooking gives us nutrients and sustenance from sources we couldn't otherwise use. But this begs the question – how do we gather and transport food for cooking? Another item usually on the list is the exceptional investment we make in our children and adolescents, raising and caring for them for extended periods – a commitment far greater than any other species makes.

There is, however, one entry often omitted from the list – something that is one of our major and singular adaptations (an alteration to our biology that aids our survival), one that is regularly overlooked in the popular mind. It is common to all of the adaptations just mentioned, as well as many more. This is our ability to walk, and especially to walk upright on our two feet, an adaptation known as 'bipedalism', freeing our hands for other tasks.[2] Almost all other land animals are quadrupeds – they walk on four limbs. Walking is a marvellous and seemingly simple feat, and it is a feat that robots have yet to emulate with anything like the fluidity of humans and other animals.[3]

Walking makes our minds mobile in a fashion denied other animals. The now (nearly forgotten) neurologist and phenomenologist Erwin Straus captured the sense of how intertwined walking is with our identity and experience in 1952, commenting that our 'upright posture is an indispensable condition of man's self-preservation. Upright we are, and we experience ourselves in this specific relation to the world.'[4] Our upright posture changes our relationship to the world, including, as we shall see, our social world.

Our close relatives, the chimpanzees, use an intermediate form of bipedalism, where they walk using a combination of their hands and feet. This adaption is known as 'knucklewalking', and it is not an especially efficient way of getting around.[5] Many birds also walk on land on two legs – but they do not walk with an upright spine.[6] Their spinal columns are not perpendicular to the ground with a mobile head on top. For humans, walking bipedally has involved dramatic modifications and adaptations across the whole length of our bodies, from the top of our head all the way to our toes.

What does walking on our two feet give us that makes us different? In evolutionary terms, bipedalism enabled us to walk out of Africa and to spread all over the world – to the far distant glaciers of Alaska, and the sun-baked deserts of Australia. It's a unique ability that has defined human history.

Walking upright has also given us all sorts of other physical advantages. Bipedal walking frees our hands, meaning we are able to carry food, weapons and children. Shifting locomotion to our feet, stabilising our balance along the spine and hips, has allowed us to throw stones and spears, to creep along and attack others with primitive stone axes, to gather up the stolen spoils of assault and combat, and to quietly disappear into the night. We have been able to carry our young – often over great distances – by simply putting one leg in front of the other. Walking upright makes our minds mobile, and our mobile brains have marched to the far horizons of our planet.

But the benefits of walking aren't solely confined to our evolutionary history – walking is hugely beneficial for our minds, our bodies and our communities. Walking is holistic: every aspect of it aids every aspect of one's being. Walking provides us with a multisensory reading of the world in all its shapes, forms, sounds and feelings, for it uses the brain in multiple ways. Walking together can be one of the best experiences of walking. Social walking – marching in concert and with purpose – can be an effective goad for real change in society. Walking is so vitally, centrally, important to us, at both individual and collective levels, that it should be reflected in the way we organise our lives and societies. Our public policymaking needs to fully embrace why walking makes us so distinctively human, and should feed in to our urban and suburban planning. I look forward to the day when physicians the world over write prescriptions for walking as a core treatment for improving our individual and aggregate health and well-being. In fact, GPs in the Shetland Islands have already started prescribing beach walks as a preventative treatment against maladies of brain and body.[7]

Throughout this book, we will celebrate the full sweep of human walking, from its origins deep in time, through how the brain and body perform the mechanical magic of walking, to understanding how walking can set our thoughts free, all the way to the most social aspects of walking – whether it's a four-ball in golf, a country ramble, or a march to try and change society. Along the way, we will draw the lessons to be learned and show the benefits for the individual and society. And these lessons are manifold, and easy to apply.

I will show how walking makes us social, by freeing our hands for tools, and for gestures – movements that allow us to signal meaning to others. Walking allows us to hold hands, sending out signals of exclusive romantic involvement; walking allows us to provide physical support to each other; marching in protest is a common feature of our free political lives, which is why the prevention of assembly and of marches is one of the first orders of an autocrat. Walking is good for the body, good for the brain, and good for society at large.

But the converse is also true. We pay the price for our lack of movement, whether it arises because of the environments we occupy, the design of our offices, or from just being idle and sedentary. I want to show in this book how imperative it is that we start walking again. Our brains and our bodies will be the better for it; our moods, clarity of thought, our creativity, our connectedness to our social, urban and natural worlds will all be the better for it. It is the simple, doable, personal fix we all need.

The emerging science is giving us a clear picture: regular walking confers enduring and substantial benefits on individuals, and on society at large. This book celebrates both the science of walking and the unalloyed joy of going for a good walk. I want to place an ostensibly simple behavioural change into a central position as the driver of positive psychological and physical well-being. It is an activity that almost everyone can engage in, and that comes naturally to us. Our brains and bodies are built for movement in our daily lives, in our natural and built environments: regular movement improves our thinking, feeling and creative selves in myriad ways, as well as improving our health.

It's time to get up and walk our way to a better life – go see the world as it is, and as only we humans can.

1.

WHY WALKING IS GOOD FOR YOU

We overlook at our peril the gains to be made from walking, for our health, for our mood, for our clarity of mind. Many of us live now in a deeply unnatural environment, where we spend long periods of the day sitting with our eyes focused on screens, perhaps a half-metre or so from our eyes. When we stand up, and then walk around and move about, our posture changes, with our torso and spinal column shifting to a single vertical axis from our head down through our back, and, through our legs and feet, contacting the ground. By contrast, when we sit, the weight of our body trunk is largely concentrated on the lower back, and in particular, on the coccyx, that little collection of bones that comprises our vestigial human tail.[1] The coccyx anchors a remarkable lattice of tendons and muscles extending across the spine and down the upper legs in particular, the gluteus muscles of the upper thighs, which are vital for walking. Little wonder that lower-back pain is one of the most common ailments in the developed world.

How silly, then, that the remedy – to regularly get up out of your seat and walk about – is so little understood or practised. Long periods of immobility also cause changes in muscle: fatty deposits build up in leg muscle, and, as we age, we lose muscle mass in part because of our immobility ('sarcopenia'). There are many other changes too: our blood pressure changes, as does our metabolic rate (the rate at which we burn energy). But when we stand up, things suddenly change in brain and body: we become 'cognitively mobile', our minds are in movement, our heads swivel, our eyes dart about. Our brain activity changes when we move about, with electrical brain rhythms that were previously quiescent now engaged and active. We become more alert, our breathing changes, and our brains and bodies are readied for action. The French philosopher Jean-Jacques Rousseau commented that 'I can only meditate when I am walking. When I stop, I cease to think; my mind only works with my legs.'[2]

Here's a walking memory of mine: I'm at a student conference in Belfast during the dreary and seemingly never-ending 1980s. I take a long walk up the Malone Road, past Queen's University into the centre of town. I pass through the numerous security cordons. Young soldiers with serious weapons are patrolling the city, looking in shopping bags for bombs and guns, talking nervously to each other in English accents. There's plenty of tension in the air. The Loyalist politician Ian Paisley's campaigning against the Anglo-Irish Agreement is a constant backdrop, as are the terrible atrocities, the many bombings and murders. The city is alive, though. A city is hard to kill.

When I cast my mind back over this walk on my first visit to Belfast, I remember that I walked past the much-bombed Europa Hotel. I then walked east toward Botanic Avenue, and then took a long loop back around the streets and roads to the rear of the Europa Hotel. Why this route? Just because I could; that's what being on foot does for you. It's early Saturday afternoon, the weather is grey, and there's a hint of rain in the air. Wandering about, I accidentally find myself walking on Sandy Row, the Loyalist epicentre of Belfast. The murals are amazing, and a little frightening, to someone from the sedate and peaceful south. I walk quickly on, eventually connecting with the Lisburn Road, and finally find my way back to where we students were all staying on the Malone Road. Here, in Belfast, a walk is a walk into a past that is still present; as the old maxim has it, 'the past hasn't even passed'.

Wrapped up in this little personal journey are many of the elements of the hidden story of walking: mental time-travel to recall details, reminiscences about a walk, orientation and successful navigation through an alien urban environment, the little frisson of fear that still comes to me when I remember the security cordons and the murals. We now know that the brain systems relating to all of these functions are in constant communication and support each other's functioning. And, crucially, these brain systems are not perfect. My memory has tricked me a little. It has simplified the route, and left out significant details. I remember Botanic Avenue as being almost opposite the Europa Hotel. It's not, as a look at a map tells me. Botanic Avenue is at an acute angle that runs on to Great Victoria Street, which is actually where the Europa Hotel is. And, weirdly, I have excised most of the detail about the relative location of Sandy Row and the Europa Hotel. I remember Sandy Row as more or less directly behind the Europa. It's not: Sandy Row is further south than that. I am left to imperfectly recall the gists of locations, places, things; I do not possess a faithful video recording somewhere in my brain of the route I took all those years ago.

This is the key point underlying our episodic and event memories: they are imperfect, gist-like, extracting meaning, focusing on certain salient points, and ignoring others.[3] There is more information out in the environment than our mobile minds can capture, and more than we need to know. How we move, what we look at, who we talk to, what we feel as we move: these are central components of our experiences. They might enter into our recall and be laid down as traces in our brains. We are not disembodied brains travelling through space and time: we feel the ground beneath our feet, the rain on our face; perhaps peering into the unknown, but in doing so we are extending our range of experiences of this complicated world. And all the while we are silently creating memories of where we have been, and making maps of the world we have experienced.

It's possible to demonstrate the brain-changing power of simply getting up and walking about. A straightforward experiment called the 'Stroop' task – devised by American psychologist John Ridley Stroop[4] – is used to test 'cognitive control', in other words, the ease or otherwise with which you can direct and control your attention and thinking. The Stroop task is a colour-and-word identification task with a twist. Participants are presented with lists of colour names (red, green, blue, black, etc.). These are printed either in the same colour (for example, the word 'red' printed in red) or in another colour (the word 'red' printed in green). Participants are asked to, as quickly as they can, name the colour of the printed word. Typically, when the printed word and the colour it names are congruent, response times are rapid and accurate. By contrast, when the printed word and the colour it names are incongruent, response times are much slower.

Often, Stroop-task performance is impaired under dual-tasking conditions. For example, a participant might be asked to engage in the colour naming, while simultaneously monitoring sentences played through earphones, and listening out for a particular word or phrase which they must identify by pressing a button. The Stroop effect is very reliable and easy to detect; it is often explained as requiring the paying of selective attention to certain aspects of the visual stimulus, while actively suppressing attention to other (automatic, attention-grabbing, prepotent) aspects of the visual stimulus, and then selecting and making the appropriate response.

But what happens if you add movement into the mix? The experimental psychologist David Rosenbaum and his colleagues at Tel Aviv University wondered if merely standing up might have an effect on Stroop performance.[5] They found, over a series of three experiments, that when a participant is standing up, the Stroop effect for incongruent stimuli – where performance should be slower – is, in fact, faster than is normal compared to when they are seated. It is as if the mere act of standing mobilises cognitive and neural resources that would otherwise remain quiescent. Moreover, recent studies show that walking increases blood flow through the brain, and does so in a way that offsets the effects of sitting around.[6] Regularly interrupting prolonged bouts of immobility through the simple act of standing up changes the state of the brain by calling on greater neurocognitive resources, constituting a call to action as well as a call to cognition.

As well as improved cognitive control, it's clear that walking confers many, many other benefits. We all know that it is good for our heart. But walking is also beneficial for the rest of our body. Walking helps protect and repair organs that have been subject to stresses and strains. It is good for the gut, assisting the passage of food through the intestines.[7] Regular walking also acts as a brake on the ageing of our brains, and can, in an important sense, reverse it. Recent experiments asked elderly adults to participate in thrice-weekly, and relatively undemanding, walking groups.[8] In the regular walking group, over the course of a year, the normal ageing of the brain areas providing the scaffolding for learning and memory is somewhat reversed in the walkers, by perhaps about two years or so. An increase in the volume of these brain areas was also found; this is quite remarkable in itself, suggesting that the act of regular walking mobilises plastic changes in the very structure of the brain, strengthening it in ways similar to how muscles are strengthened when worked.

One way of interpreting the literature on ageing and walking is straightforward: you don't get old until you stop walking, and you don't stop walking because you're old. Lots of regular walking, especially if conducted at a high tempo, with an appropriate rhythm, forestalls many of the bad things that come with ageing. Walking is also associated with improved creativity, improved mood, and the general sharpening of our thinking. Periods of aerobic exercise after learning can actually enhance and improve recall of the previously learned material. Reliable, regular, aerobic exercise can actually produce new cells in the hippocampus, the part of the brain that supports learning and memory. Regular exercise also stimulates the production of an important molecule that assists in brain plasticity (known as brain-derived neurotrophic factor, or BDNF).[9] The phrase 'movement is medicine' is correct: no drug has all of these positive effects. And drugs often come with side effects. Movement doesn't.

When walking in the beautiful Glendalough valley once, I felt the thrumming of many running feet. I stopped, and was treated to the sight of four or five red deer running through the glen. It was late autumn, breeding season, and I could hear the stag roaring and calling. This is something else walking does for you: you see, smell and feel things as they are, not through a windscreen at speed. Walking allows you to confront the personal, instead of insulating you from it. Like many people, I also drive, and I always take the train to work. But walking is special to me as a form of transport. Walking allows me to walk it off, whatever *it* is. Walking clears my mind, allowing me to think things through. Natural movement brings with it experiences and demands on the body and brain that do not arise from other types of movement. Cars, bicycles, trains and buses all divorce you in different ways from the environment, you are mechanically propelled, sometimes insulated behind glass, travelling too fast, worried about crashing, trying to find that new song on the radio. There is a peculiar passivity to it: you are sitting, yet you are moving at speed. This can never be true of walking: one foot must go in front of the other until you get there, under your own steam. You make your own way, and experience the world close at hand, at your own speed, in your own way.

But, how do we know that walking has all these multifarious benefits for our minds, bodies and quality of life? What's the evidence? The evidence is extensive and, as we will see in the course of this book, shows that walking enhances every aspect of our being, from our physical health, to our mental health, to our social lives and beyond.

*

This may seem an obvious point, but when we're walking our brains are in motion too. In fact, as we shall see, we evolved as a mobile species: we walk about, we move, we seek new sources of information from the world. In other words, we are not just brains locked in a skull, we are minds in motion – we are 'cognitively mobile'. The study of how we think, how we reason, how we remember, how we read, how we write, is known as the study of cognition. Typically, the scientific investigation of cognition occurs in a laboratory, using carefully controlled experiments and a range of methods and tests that measure cognitive abilities.

Almost anything that moves in a reliable and consistent way can probably be measured somehow. The movements made can be various and manifold. They might be the pattern of eye movements that a person makes: where they look, and for how long, at particular locations on the screen can be captured; the rapid flickering of increases and decreases in pupil size might be measured; the electrical responses of the brain might be analysed; reaction times might be assayed; how much the person fidgets in the experimental chair ascertained. And, in the latest generation of experiments, participants might perform these complex tasks while lying in a brain-scanning machine, which uses a variety of advanced methods to measure and to localise activity in the brain associated with the performance of a particular cognitive task.

There are two principal methods of brain imaging. The first and by far the most popular is magnetic resonance imaging (MRI), which comes in two principal flavours: functional (thus, fMRI) and structural (sMRI). MRI is a medically safe, non-invasive procedure that allows you to (in principle) see the brain at work with details down to the millimetre. The other major brain-imaging tool is positron emission tomography (PET), which involves the injection of radioactive tracers into the blood, and mapping their uptake in differing brain regions during differing tasks. PET is a technique with comparatively poor spatial localisation, compared with MRI, and is a little unpleasant, especially if you have a needle phobia. PET has found specialised uses particularly in the development of new drug treatments for brain and other disorders. MRI, by contrast, does not involve any injections, and offers much greater localisation in terms of structure and function. MRI and PET have allowed us an unprecedented view of the brain at work – and especially of the human brain at work.[10]

Let's now imagine you are asked to participate in an fMRI experiment. You are placed on the bed of the MRI scanner, and slowly inserted into the bore at the centre of the machine. First up, an sMRI: a picture of multiple slices through your brain, to check that there are no abnormalities or other problems present. Assuming this goes smoothly, you will then be instructed in the task you will perform in the fMRI. Here, you will first gaze at a small cross on a screen (this is called eye fixation), and then you will be asked to perform a task. Keeping to the theme of this book, this task might be a spatial navigation task. You might have a joystick, and you have to find your way around a complex three-dimensional maze. We can predict, based on what we know from experiments on rats and on humans, that we will see a very high degree of activity in the hippocampal formation, as well as activity in brain regions involved in motor movements. How do we show there is activity in the hippocampal formation, specific to the task, and not to other aspects of the task? Here is where control experiments are absolutely essential. Often, a subtractive logic is employed: task-irrelevant activity is subtracted from the task of interest. You might ask the subject to move the joystick according to a verbal instruction, but not while exploring the maze, so that they are engaged largely in visuo–motor behaviour.

This laboratory-based, experimental approach has been remarkably powerful. It has allowed us to test and extend the standard model of human cognition. However, it does come with certain limitations. The particular limitation we concern ourselves here with is our ability to measure what it is that goes on in the brain while the brain is moving around, when the mind is mobile 'in the wild', as it were. The experimental psychologist Simon Ladouce and his colleagues at Stirling University argue (correctly, in my view) that our understanding of cognition has progressed more slowly than it could or should have done, because past and current generations of psychologists and neuroscientists have not studied mobile minds and brains with the intensity that perhaps we might have done.[11] To be fair to legions of experimenters, this has occurred of course because putting the lab into the wild is difficult. Studying the actions of the mind in motion can be done, but it is not easy. Realistically, to study cognition in the wild requires taking what is best of laboratory practice and somehow making lab instruments mobile so that we can measure what it is that people think, say and do while they are walking about.

The latest generation of mobile technologies are becoming well known to us all and these can be adapted and used to capture behaviour while we are out and about. Many, if not most, of us now have smartphones. These usually now come equipped with apps to measure the number of steps, speed of walking, our diet and many other things besides. Expanding on these and other technologies allows us to capture more of what the brain is doing when cognition is mobile. Smartphones have proven to be particularly useful. Participants can be pinged at different times of the day and they can be asked what they are doing, how they are feeling and what it is they are planning to do, among other questions. This is known as 'experience sampling'.[12]

While there are indirect ways of studying how walking changes the brain, specifying and understanding the underlying mechanisms can be more difficult. Relating these changes to the activity of these brain cells, circuits and systems to overall cognition and behaviour is more difficult still. However, we do now have the beginnings of an understanding of how walking affects activity in the brain. In turn, we are now starting to understand how walking changes the brain in order to prepare for action.

Imagine for a moment being a cat, sitting and waiting for your prey. There's a rat nearby which, in turn, is moving about looking

A 2011 experiment was able to roll back the years, allowing us to see what his body might have looked like and how it would have changed because of this nomadic lifestyle. Researchers studied how a sixty-two-year-old, reasonably active male adapted and responded to walking the long trail across the Alps. The unnamed Italian man walked 1,300 kilometres of the Via Alpina over the course of three months.[16] Before starting, he reported to the laboratory where he was measured from tip to toe. Measures were taken of all of the critical aspects of his bodily functioning: his breathing capacity, his muscle strength, how lean his body was, the various components of his blood, and a whole variety of other measures. He was then equipped with a mobile physiological laboratory that he carried with him. This laboratory in miniature consisted of instruments in a rucksack, along with tools to allow him to repeatedly take and measure his own blood chemistry. The portable devices allowed the researchers to develop a picture of our modern Ötzi's ongoing adaptation to his prolonged mountainous trek.

And the good news here is that it is never too late for anyone to start walking, even over long distances. Despite being reasonably fit, our modern-day Ötzi had never taken a journey on foot of this length and duration before, yet the measurements showed that his body adapted quickly and easily to the rigours of the journey, including overcoming the effects of mild oxygen starvation at altitude. (The Via Alpina varies between 0 and 3,000 metres above sea level; altitude sickness usually happens above 1,500 metres, where oxygen levels drop to 84% of the oxygen available at sea level. By 3,000 metres, oxygen levels drop to 71% of the oxygen available at sea level.)

There were positive changes in virtually every single measured area of his functioning. His body mass index – often used to determine obesity – declined by about 10%. On the other hand, his percentage of measured body fat fell dramatically, by about a quarter in total, as a result of the continued exercise of the journey. (Need to lose weight? Don't go to the gym; go for a really, really long walk. And do it in nature, over a period of days to weeks. It will be far more beneficial to you.)

Overall, our modern-day Ötzi walked just over 1,300 kilometres in sixty-eight days – about 19 kilometres a day – although there

image
not
available

day. A smartphone really can be your personal, individual lab in your pocket.

Smartphone penetration has increased dramatically in all societies and across all income groups, in both the developed and developing worlds. This almost total smartphone penetration now allows the capture of both individual-level walking data and country-level walking data, with high precision, over long periods of time. This is perfectly illustrated by the size of data sets now available; for example, computer scientist Tim Althoff and colleagues at Stanford University created a data set consisting of 68 million walking days captured from 111 countries, involving 717,527 people, aged from their mid-teens to their mid-seventies.[20] This is what the phrase 'big data' actually means: a vast lake of data, made of up almost uncountable drops of data gathered from hundreds of thousands of people.

After performing a variety of data checks and data clean-ups, they ended up with a final data set comprising 66 million walking days from 46 countries, involving 693,806 people. They were also able to capture age, body mass index (BMI), and gender, and went on to use this data set to build up a picture, at the country level, of patterns of activity regarding human walking. Additionally, they were able to use another data set from the US, which analyses – across a variety of measures – the walkability (or otherwise) of 69 US cities, from across the whole of the US. Importantly, as we will see in Chapter 5, some of these cities are from the same geographic locale, are similarly affluent, and have similar demographics, but show great differences in levels of walking, depending on the walkability of the city. They found huge variations within and between countries for the number of steps taken by individuals in each country. The best predictor of obesity, as measured by body-mass index (BMI), is not the absolute number of steps taken by individuals within any country, but rather the inequality in the number of steps taken within a country between males and females.

All sorts of interesting details came out of this study. For example, males walk more than females at all ages, from the mid-teenage years through to the seventies. On the other hand, females on average have lower BMIs than males. BMI, however, increases on average for lower activity levels. The average person in their walking's essential and intrinsic virtues and rewards. The poet I return to, time and again, is T. S. Eliot. I find Eliot's poetry has a cadence and rhythm that are remarkable, especially if read aloud. His great modernist poem 'The Love Song of J. Alfred Prufrock' (1915) is a journey on foot, and a journey through states of mind. It is a poem set to the rhythm of a long urban walk, undertaken uncertainly as evening falls. The opening lines are an invitation to walk the city:

> Let us go then, you and I,
> When the evening is spread out against the sky
> Like a patient etherized upon a table;
> Let us go, through certain half-deserted streets,
> The muttering retreats
> Of restless nights in one-night cheap hotels
> And sawdust restaurants with oyster-shells

Eliot extends an invitation to an unspeaking, and unseen, other to walk with him in the late evening, to explore on foot the low areas of the city. The journey on foot is essential to the cadences of the poem. Eliot does not ask the unseen other to cycle with him, to take a cab with him, to travel in the train with him. It is an invitation to walk.

Walking promises types of experience denied other forms of transport, no matter how attractive they might be. There will be the sights, conversations, the sounds of others, the smells of the lonely, window-ledge pipe-smokers who will be seen at 'dusk through narrow streets'. The feeling is one of Eliot having a conversation with himself whilst walking. There is a blurring of interior and exterior worlds, while Eliot, as Prufrock, walks uncertainly along. The poem is a notable, though oblique, tribute to walking and wandering in the urban and social worlds; the walking tempo carries you along through an imagined evening.

As Eliot says, 'Let us go', and explore now the wonder that is walking: all of it. The science, the history, the complex interactions of bone and muscle and nerves, stumbling, ambling, mooching, wandering, traipsing, strolling, tramping, striding, stepping. Our journey will take us from ancient Africa, to the mechanics of movement, into the innermost recesses of the brain as it maps the

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