Introduction to neuroscience 01

Work has changed hugely but our brains have not, and therein lies the challenge. Organizations need their people constantly to adapt and change, collaborate, innovate and perform at their best. But our brains are not designed for 21st century organizational life: they think they are still out on the savannah, and for our brains the goal is all about survival. Given these constraints, those leading organizational change need to understand how the brain perceives and processes change, and what can be done to enable our brains to work at their best during times of uncertainty. This book provides insight on how to do that.

Why should organizations be interested in neuroscience?

Perhaps the question should be put the other way around: why wouldn't organizations be interested? Change is difficult. We know from experience that personal change isn't easy, from taking more exercise, eating more healthily, getting enough sleep, starting a new role, moving to a new location, to learning a new skill. It doesn't come easily to us. Organizational change is even harder: trying to persuade tens, hundreds, thousands and tens of thousands of people to change is a challenge. There probably isn't a single organization that has not been through change, be it the impact of globalization, restructuring, new technology, changing legislation or shifting customer expectations. Moreover, as many employees identify, and as we know from personal experience, it's not just the big change programmes that are difficult – it is the constant layer upon layer of small changes that gradually wear us down.

Despite this vast experience of change, industry and employee surveys tell us organizations could do better. Time and again industry reports reveal

how many change programmes fail to deliver the promised efficiencies and benefits. The focus on employee well-being is in part a recognition that it is in no one's interest in the long term to keep employees in a constant state of stress. It is clear that we can, and need to, get cleverer at helping organizations and people through change. Neuroscience can help us do this.

Neuroscience, the study of the nervous system including the brain, provides a new lens through which to look at change. There are different theories of change but there is something very appealing and practical about understanding how our brains deal with change and what would help them to become, and remain, resilient. Neuroscience helps us to understand ourselves and others better. For some leaders I work with, just having this new perspective on change and deeper understanding of people has been enough to make a significant difference to their ability and confidence to lead others through change. Understanding more about our brains, what drives them and what gets in the way, has helped both to guide their actions and build their empathy for others. Some of them will tell their stories later in this book.

So, neuroscience, as we'll explore in Chapter 3, helps to explain why we find organizational change difficult. More interestingly and more importantly, it provides clear guidance on what practical things we can do to help people through change (and that is the focus in the chapters in Part Two of this book). Although still in its infancy, it is already proving immensely useful in bringing to light what enables us to be focused, to learn and to perform at our best.

Part of the appeal of neuroscience is that it resonates with people's experience: it explains why we find uncertainty disturbing and distracting. It helps us realize that our reactions and emotions are 'normal' and people find this reassuring: there's nothing wrong with them, it's just the way our brains deal with change. It also underpins the intuitions of good organizational change practitioners and leaders: for example, that having a good relationship with a line manager is not just 'nice to have' but does make a real difference to us and enables us to think and work better. Neuroscience shows that this is not just a matter of opinion: there are biological reasons as to why we feel this way.

Another benefit is that although at one level neuroscience is complex, at another level it is relatively easy to apply. You don't need to be a neuroscientist. Nor do you have to wait for major culture change in your organization. Every leader, manager and employee can get on and apply it straight away. Nor does it necessarily require radical change: small actions can make a significant difference to our ability to focus at work. The learning can be

applied at a local level by each leader with their team, or at a macro level, right across the business. By understanding our brains and the way they function, we can work with the physiology, not fight it.

One more reason why organizations are finding neuroscience so useful is that it provides scientific evidence and a language which appeals to even the most sceptical of leaders. People I work with have said how useful it is when working with their leadership teams to be able to draw on science, to refer to research and evidence. This was brought home to me when I was working with a group of leaders in a bank who had some demanding targets to meet while employees were facing redundancy. During one session a banker commented 'I like this. It's not the usual psychofluff I get from HR and Communications. This is *science*.'

Why so much interest right now?

There's no doubt that neuroscience is coming to the fore. In both the United States and Europe, governments have committed large budgets so that we can better understand the brain. In the United States, The Human Connectome project is mapping the brain's neural connections. You can find out more at **http://www.humanconnectomeproject.org/**. Another example is The Wellcome Trust's and the Education Endowment Foundation's *Education and Neuroscience Initiative* in the UK which is evaluating the impact of education interventions that have been informed by neuroscience. One of the reasons there is so much interest right now is that we are just beginning to see neuroscience come out of the lab and into the workplace: we are just beginning to explore the practical applications.

For the majority of organizations, people's brain power is crucial. Many organizations and indeed many countries have moved away from agriculture and manufacturing. Their survival and success depend on people's ability to think, innovate, adapt and collaborate. Brain power is all they have.

Change is speeding up – we only need to look back at the last 20 years or so to see how much change there has been and how quickly new changes have arrived. Facsimile machines have come and more or less gone; videos have almost disappeared. The devices and means we have to communicate and share information would have amazed us 30 years ago. Successful organizations need to be able to adapt swiftly.

In short, here are 10 reasons why neuroscience matters to organizations:

1 We need to change the way we manage change in organizations: by understanding the brain, we can do this better.

2 Neuroscience brings a new lens through which to look at and understand people and what motivates them.

3 At long last, neuroscience brings scientific evidence to leading people, change management and employee engagement, proving they are not 'soft'.

4 It resonates and underpins the instincts of successful leaders; it builds confidence as to what to do to support people through change.

5 Performance: neuroscience is all about what helps our brains to perform at their best.

6 It's practical and can be relatively easy to implement.

7 When we understand how our brains work, we can work with the physiology, not fight it.

8 It's useful at the macro and micro level: from how to plan change in an organization to how to organize your day to allow your brain to think at its best.

9 There is a greater focus on well-being in organizations, physically, mentally and emotionally: organizations owe it to their employees to understand what will help keep their brains and minds in a better state.

10 It provides science and evidence and these can be very persuasive to sceptical leaders.

Key moments in the history of neuroscience

Neuroscience is very much in the news in the 21st century, but it's not new. For thousands of years, people have wondered what the purpose of the brain is. Here are a few of the key milestones and characters who have contributed to our learning.

The pioneers of neuroscience

The ancient Greeks were interested in the role of the brain but held widely differing views. Some believed that the brain was the seat of the soul but that it had nothing to do with thinking; they believed that thought was in the heart. The logic was that the heart was seen as the source of blood, and if you lost blood, that was the end of life and of thinking. Aristotle thought

the brain's task was simply to cool the blood. The Egyptians seem to have placed little value on the brain: although they preserved the body for the afterlife, they scooped the brain out of the head and discarded it.

Several ancient Greeks made a significant contribution to our knowledge. In the 5th century BC, Alcmaeon of Croton found a connection between the eyes and brain (probably the optic nerve) and so began to establish a link between the brain and mental activity. In around 400 BC, the physician Hippocrates of Kos recognized that epilepsy and madness were disturbances of the brain. Hippocrates also identified that a cut on one side of the brain caused a spasm on the other side of the body. This is what we now recognize as lateralization of brain function: that the left side of the brain controls the right side of the body and vice versa. Around the 3rd century BC, Erasistratus identified what we now know as motor and sensory nerves from the body to the brain. The Roman physician and anatomist Galen (129–199 AD), an important figure in ancient science, noted the impact of a brain injury on mental activity.

Like the Greeks, it seems that the ancient Chinese and Indians also placed greater significance on the heart as the organ ruling over feelings and sensation. Texts exist that show that the Indians noted mental disorders as a consequence of head injuries. The Chinese suggested that different emotions were spread across the internal organs, with the spleen being important to consciousness, the liver to anger, the kidneys to fear and the heart to happiness (Finger, 1994).

The views of the Greeks are important as they influenced so much of what people in Europe thought until the Renaissance. Understanding was moved along by Leonardo da Vinci whose work included the dissection of the brain of an ox. In the 17th century, René Descartes played a role too. Descartes distinguished between the mind and the body: he made explicit that the bodily functions of the brain are completely separate from the mystical qualities of the soul: this freed people to think about the practical functioning of the brain without fearing what religious authorities might say.

Phineas Gage

In September 1848 Phineas Gage was working near Cavendish in Vermont. He was the well-liked and capable 25-year-old supervisor of a group of men working on the new rail line. They were blasting through rock when Phineas decided that he would take care of pouring gunpowder into a deep and

narrow hole that they had drilled into the stone. He rammed a long iron rod to tamp down the gunpowder but a spark was accidentally ignited and the tamping iron, which was over a metre long and over two centimetres wide, blasted upwards. It hit Phineas just below his left eye and went through the top of his head and landed some 50 metres away. Amazingly, Phineas survived and he made a good physical recovery. However, his personality completely changed. From being a good worker and an even-tempered man, he became unreliable and unpredictable. He could no longer work at his job and his marriage broke down. John Harlow, one of the doctors caring for him, wrote, 'He is fitful, irreverent, indulging at times in the grossest profanity (which was not previously his custom) manifesting but little deference for his fellows, impatient of restraint or advice when it conflicts with his desires, at times pertinaciously obstinate, yet capricious and vacillating, devising many plans of future operation which are no sooner arranged than they are abandoned… he was "no longer Gage".'

The incident was disastrous for Phineas, but his accident demonstrated that certain parts of the brain influence both our behaviour and our very personality.

Paul Broca and Karl Wernicke

Just a decade later in 1861, Paul Broca, a French neuroanatomist and anthropologist, examined the brain of a dead man. The man's name was Leborgne but he had been nicknamed 'Tan', as over two decades his ability to speak had reduced to the stage where all he could say was 'Tan', although his other mental abilities were intact. Broca's examination showed that Tan had a lesion on the left side of his frontal lobe, and Broca deduced that this had had an impact on Tan's reduced ability to speak. This area is now known as Broca's area and we will refer to this again in Chapter 8 on communication and storytelling. In 1876 Karl Wernicke, a German physician and psychiatrist, noted that not all communication problems were a result of damage to Broca's area. He found another area on the left of the brain that, when damaged, limited people's ability to understand language. This part of the brain is now known as Wernicke's area.

As a side note, in a study by Pujol *et al* (1999) 96 per cent of right-handed people were shown to have language in the left hemisphere, whereas only 76 per cent of left-handers have communication on the left; 14 per cent of left-handed people have bilateral activation and 10 per cent showed dominance in the right hemisphere.

World War One (WW1)

World War One (WW1) also helped to develop our knowledge. Much of what we have learned about the brain stems from people's misfortune – when things have gone wrong through natural causes or because parts of it have been damaged or destroyed. WW1 marks a point when medicine had become sophisticated enough to prevent some soldiers dying of head wounds, enabling them to live but with mental, emotional, behavioural or personality disorders.

'HM'

Just as Phineas Gage never expected to feature in the history of neuroscience, nor did Henry Molaison, better known as 'HM'. HM was born in 1926 and he developed a very severe form of epilepsy – so serious that he could not work or lead a normal life. So in 1953, when he was 27 years old, HM underwent an operation to relieve the epilepsy. This involved removing certain parts of the brain, including the hippocampus. This operation had been conducted before, but on previous patients only one side of the brain was operated on. HM's epilepsy was so severe that the surgeon decided to remove parts on both sides of his brain. The result was devastating; so much so, that this procedure has never been repeated. For HM, after the operation, was incapable of forming new 'explicit' memories: he was trapped in the present. This meant that he could not remember people he had met since the operation. One of the researchers working with him related how she had to reintroduce herself each day and, even if she left the room just for a short while, when she returned he would have forgotten that they had ever met. He was able to retain memories for about 30 seconds and then they were lost.

As for memories formed before he had the operation, Henry retained some but not others. He had lived through World War Two (WWII) and could remember facts about it, but he began to lose autobiographical memories such as his experience at high school. We might think of past memories as being similar, but HM showed that the brain processes the recall of semantic memories, eg facts, in a different way from the recall of episodic memories such as unique events from our personal lives. From HM we have learned that the retrieval of autobiographical memories requires the hippocampus.

HM did retain the ability to form some new memories: 'motor tasks', ie any task that involves learning new skilled movements (as opposed to facts).

For example, HM was asked to learn how to trace between two outlines of a star: he improved considerably each time he was asked to perform the task, although he could not recall ever having done the task before.

HM unwittingly taught us the role of parts of the brain, in particular the hippocampus in creating and retrieving new memories.

Technology

In more recent years our knowledge has advanced again thanks to technology. X-rays have been around since the early 20th century. Newer machines, such as Functional Magnetic Resonance Imaging (fMRI) scanners, do not use X-rays and so are considered safer. They enable scientists to look at the brain as we are involved in tasks. fMRI measures changes in blood oxygen concentration; it uses the fact that oxygen is carried by haemoglobin, and the amount of oxygen carried affects the magnetic properties of haemoglobin. fMRI has helped neuroscientists to identify that a range of brain areas might be activated by a specific task. fMRI shows that if the nature of a task is changed slightly, eg reading words rather than hearing words, different parts of the brain are activated.

Technology is moving on again as it becomes more mobile: tools such as electroencephalography (EEG) caps measure electrical activity on the surface of the brain and enable research to take place outside the lab and while people are performing tasks in the workplace.

Caveat

Misinterpretation

There is a lot of hype, over-interpretation and misinformation out there; 'neurononsense' is one of the kinder ways of describing it. One example of this is an Op-Ed article in the *New York Times* in 2011 called 'You love your iPhone. Literally.' The researcher, who worked for a branding agency, put 16 participants into an fMRI scanner and looked at which parts of the brain were activated when they saw or heard an iPhone. Amongst other things, the researcher claimed that, because the insular cortex was activated, 'The subjects' brains responded to the sound of their phones as they would respond to the presence or proximity of a girlfriend, boyfriend or family member'.

Really? Many academics were quick to respond. The insula does respond to emotions. In fact as many as one-third of neuroimaging studies are said to show activation in the insula. It can be triggered by positive emotions but the primary function attributed to the insula is disgust, not love. It responds to disgusting tastes and images, or when we see something we think is morally wrong. It responds to pain. This is one of many examples of misinterpretation: it is dangerous to assume that because a brain region can be activated by, for example, love, that activation there always means that the participant is feeling love.

This is by no means an isolated case of over-claiming for neuroscience. The areas of marketing and advertising seem to be particularly prone to overexcitement. In an advertising film for a fast car, the manufacturers stated that scans showed that it is almost as exhilarating to drive their car as to fly a fighter jet. They said that they had proved this by asking the driver to wear an electroencephalography (EEG) cap and showed that the driver's levels of a chemical called dopamine (a neurotransmitter linked to positive experiences that we will refer to later) had risen to almost those of someone flying the jet. There's a major flaw in this argument: EEG caps measure electrical activity in the brain and can't measure dopamine.

There is a great deal of enthusiasm – understandably so – for trying to identify what happens in people's brains before they decide to buy a product. If only we could put people into a brain scanner and see which messages will convince them to buy, what a difference that would make. The well-known saying, 'Half the money I spend on advertising is wasted; the trouble is I don't know which half' would no longer be true. But we are not there yet.

It's early days

Despite identification of parts of the brain going back thousands of years, neuroscience is still in its infancy. There is still a huge amount we do not know, and possibly some things we will never know, such as 'the hard problem' of neuroscience: how does a lump of tofu-like substance inside our heads give rise to the mind and to consciousness?

The 2014 Nobel prize-winning work of Professor John O'Keefe, Director of the Sainsbury Wellcome Centre for Neural Circuits and Behaviour and Professor of Cognitive Neuroscience in the Department of Cell and Developmental Biology, Division of Biosciences at University College London (UCL), changed our understanding again. The hippocampus is

a part of the brain very much associated with memory (as HM's story illustrates) but Professor O'Keefe's work showed that the hippocampus is not just about memory but also about spatial orientation. His work together with that of May-Britt Moser and Edvard Moser demonstrated that the hippocampus has a role as the brain's positioning system, an internal GPS so to speak. Each of these discoveries shifts our understanding and causes us to think again about assumptions we have made about the brain.

The lab is not the workplace

Much neuroscience research is still done in a lab and, to point out the obvious, the lab is not like the world of work. In an article in 2015 (**http://ideas.ted.com/how-scientists-make-people-laugh-to-study-humor/**), Sophie Scott, Deputy Director of UCL's Institute of Cognitive Neuroscience, discusses the challenges she faces in researching communication and, in particular, laughter: laughter is not an easy thing to create in a scanning machine. So, we also need to be aware that much research is done in a lab which is a very specific and peculiar environment. In addition, often research participants are inside large machines, such as fMRI scanners, which are very far from the typical workplace. Moreover, there might be biases because of where the research is done (the richer countries in the world) and the participants (often university students). However, this is changing as technology develops and becomes smaller, more mobile and more portable.

This book

What we know and understand about the brain is constantly changing. That said, there are areas of knowledge that are now well established and that the great majority of neuroscientists would agree on. In this book, I have, by and large, kept to well-researched and well-established areas.

About this book – how will it help?

This book is all about helping those responsible for leading change to have a better chance of doing so successfully. Change is speeding up and there is

more and more pressure on leaders and managers to do it quickly and to do it right first time.

In part, this book is about sharing understanding and providing a new lens through which to look at people and change. For some people just understanding more about the brain and how it perceives the world is useful and is enough. But applied neuroscience is also very practical and small actions can make a big difference. The book is a balance of science, practical examples, personal stories and questions to help the reader plan change from a brain-friendly perspective. These first three chapters provide context and a foundation for the rest of the book. The chapters in the second part each focus on an aspect of organizational change, share some of the science that helps us to understand what is going on, and set out some very practical things we can do to help. It's a book that you can read from cover to cover and/or dip in and out of, as you choose.

Summary of key points from this chapter

- Work has changed significantly but our brains have not: they are not designed for the 21st century workplace.
- Organizational change is ubiquitous but we are still struggling to do it well.
- Understanding our brains and how they deal with change means that we can work with the physiology, not fight it.
- Neuroscience provides a lens through which we can better understand ourselves and others.
- It provides science and evidence which can be very persuasive.
- Although at one level it is complicated, it can be translated into practical actions that make a difference.
- Neuroscience is still in its infancy, but an interest in our brains is not new.
- Until the arrival of tools such as fMRI scanners and EEG caps much of our knowledge stemmed from the damaged brain.
- Neuroscience is the subject of much hype, especially in the areas of marketing and advertising, and we do need to tread with caution.

References and further reading

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