10 MYTHS AB THE BR

by Dr Trish Riddell

Recently, I asked the Kaizen community whether they could identify which of a group of statements were myths about the brain and which were supported by scientific evidence. I was overwhelmed with the response – thank you to all of you who took the time to reply. I thought it might be useful for the community to see my answers, and to find out what proportion of the group had the same answer as me. Why not jot down your own answers before comparing them with my answers below. I have also indicated for each question the percentage of people that disagreed with my answer:

1. We make no new neurones in our brain after we are born
2. Listening to Mozart does not make you smarter
3. There are left brain and right brain people
4. We only use 10% of our brains
5. Your memory can hold 7 + 2 things at a time
6. It's all downhill after 60!
7. We know what will make us happy
8. Our memories of past events in our lives are inaccurate
9. The reptilian brain controls our emotional responses
10. The adult brain is able to be changed

All myths are marked with check or cross marks, indicating whether the myth is true or false.

OUT AIN

10 | The adult brain is able to be changed

Our brains are designed as learning machines and two main mechanisms for learning have evolved. The first is called experience-expectant learning. The human infant brain creates 100% more connections (synapses) between neurones than are found in the adult brain. The original wiring of the brain is based on thousands of years of evolution and is the product of the unchanging environment over this time – things that can be expected in that environment are coded into the original connections we make in our brains (e.g. the ability to process language). Over the first years of life, the experiences of each individual child determine which synapses should be kept and which lost due to lack of use. So, connections that represent the sounds that we hear in our own language are kept, and those for other languages that we do not experience are lost. However, as we approach the appropriate number of adult connections, this mechanism for learning becomes less useful.

Therefore, not all learning can be based on the expectation that our environments will contain certain information. We have to have a means of learning about new technologies, new environments etc. So, in addition to using the loss of synapses as a means of learning, we also create new synapses to code novel experiences. This is called experience-dependant learning, and this is available throughout the lifespan. Learning results in strong connections within networks of neurones so that behaviours become habits. But, just as habits are learned through overuse, a new set of behaviours can replace old habits if they are used frequently and therefore develop equally strong networks of neurones. **An old dog can learn new tricks!**

25% thought this was false

9 | The reptilian brain controls our emotional responses

This seems to be a slight misinterpretation of the literature. I would agree that there is a more primitive, reactive, emotional system that responds in a characteristic way to emotional events, and then a more developed, proactive, system that can over-ride this in most circumstances to give us more control over our emotional responses. The problem is that what McLean defined as the reptilian brain contains no more than the brain stem and cerebellum which is responsible for highly stereotyped emotional responses (e.g. the aggression response that you see in an angry cat). What I think of as the reactive emotional brain is based more in the amygdala and structures at this level (which MacLean defined as the Limbic brain). The context specific, proactive emotional system is probably found in the orbitofrontal cortex which is one of the latest evolutionary areas to be developed in primates. This is the part of the brain that allows us to change our response to events that perhaps would have triggered strong and unproductive emotional reactions for us in the past.

50% thought this was true

8 | our memories of past events in our lives are inaccurate

In a series of studies, Elizabeth Loftus has demonstrated that it is possible to plant false memories. In one experiment, participants were given an individual booklet containing three true stories from childhood (verified by relatives) and one false story about being lost in a department store at about the age of 5 (an event which relatives confirmed had not happened). After reading the booklets, participants were asked to write what they remembered about each event, and, if they did not remember anything, to say "I do not remember this". This writing exercise was repeated on three occasions. Six of the 24 participants claimed to remember the false event on each occasion asked. As a result of a series of research studies, Elizabeth and her colleagues have been able to outline the circumstances under which false memories are produced. These include: social demands to remember (in this case by the experimenters), memory construction by imagining events when participants are having trouble remembering, and encouragement not to think about whether the imaginings are true or not. This reveals something about the nature of our memories – while we might think they are a true reflection of events, they can be modified by suggestion and so, over time, might become a mixture of memory and imagination.

38% thought this was true

7 | We know what will make us happy

You probably have experience of this in your own, or your family's, life. Think of something that you really thought you wanted, and quite quickly received. Then think whether your expected happiness corresponded with your actual happiness. Or think of something that a child said they really wanted for Christmas or a birthday, and remember how long it was played with before it was superseded by a new toy or pastime. Research by Daniel Gilbert and his team suggests that we are very poor at imagining the consequences of both happy and sad events. We over-estimate both how unhappy we would be if something bad happened (in reality we bounce back very much quicker than we expect) and also how happy we will be if something good happens (the happiness lasts for a much shorter time than we expect). In fact, we can maximise our happiness through anticipation! We are happiest just before we receive something that we have wanted for some time. Think how that might save on the shopping bills!

38% thought this was true

6 | Its all downhill for the brain after 40 (or 50 or 60)

While it is true that working memory for facts decreases with age, and that we do slow down a little, the picture for the ageing brain is not all bleak. Laura Carstensen, a professor at Stanford University has theorised that some differences in memory between younger and older adults arise from a difference in temporal focus. Young adults who feel that their lives will stretch on indefinitely focus on saving as much factual information as possible since this is likely to benefit them in the future. In comparison, older adults have a more restricted sense of their future and so concentrate on emotional well-being. Laura's group have shown that manipulating this sense of time by either telling older people to imagine that a new drug has been invented that will expand their healthy life by 20 years, or by testing young people immediately after a disaster that increases their sense of mortality, reduces the memory differences between young and old people. In addition, older people attend to and remember more positive than negative events, and have better emotional well being than younger people. Again, this difference can be decreased by manipulating expectations of longevity. Thus, while there are some deficits in the ageing brain, the picture is definitely not all negative – in fact, it becomes increasingly positive with age!

8% thought this was true

5 | Your memory can hold 7 + 2 things at a time

This "fact" is based on one of the most highly cited papers in psychology "The magical number seven, plus or minus two: Some limits on our capacity for processing information" published in Psychological Review in 1955. In this paper, he described studies that estimate the number of categories of a single dimension of sound (e.g. tones) or space (e.g. locations) that can be identified accurately as about 7 (though this ranged from 5 to 10 depending on the nature of the category). He also described experiments that suggested that the number of chunks of information that we could remember immediately after hearing them was about 7 (again with a range from about 5 to 10). Since 7 appeared in both estimations, he tested to see whether these were limited by the some aspect of human brains (i.e. that the number 7 was a "magical" representation of some human neural capacity). He showed quite clearly that these were not dependent on the same mechanism and so that 7 was not magical. Indeed, subsequent research suggests that memory span varies depending on what is being remembered (7 for digits, 6 for letters and 5 for words) so even the number of things we can remember is not described by the magical number 7.

40% thought this was true

4 | We only use 10% of our brains

This myth is thought to have developed as a misinterpretation of a statement by the famous 19th century psychologist, William James. He was very careful to note that he thought it unlikely that the average person used more than 10% of their intellectual potential. This has transmogrified into the statement that people use only 10% of their brains. Studies of patients who have damage to their brains has failed to identify a single part of the brain which does not have a function. Similarly, fMRI studies have located different functions within each and every part of our brains. We also now know that, when a part of the body is amputated, the part of the brain that controlled the missing body part is taken over by neighbouring body parts – so even bits of the brain that lose connections are re-used. There is a good reason for this – the brain consumes 20% of the oxygen we use despite being only 2-3% of our body mass. It would be highly unlikely that evolution would have created an organ which is so resource intensive and then allowed 90% of it to go unused!

33% thought this was true

3 | There are left brain and right brain people

Most myths are based on some truth, and this is no exception. Clearly, the two halves of the brain have evolved to perform different functions. On balance, the two sides of our brain are much more similar than they are different. However, in order to increase our brain's potential, we have evolved so that some tasks are performed preferentially with brain tissue located in one half of our cerebral cortex. Thus, for instance, our language production centre, Broca's area, is in the left frontal lobe. However, not all language abilities are confined to the left hemisphere, and our right and left hemispheres communicate with each other, so we have only relatively better language function in the left hemisphere. Similarly, the right hemisphere processes complex spatial patterns relatively better than the left. So performance in a particular task in most people can be slightly better or faster in one hemisphere than the other – but it is not exclusively processed in only one hemisphere. The corpus callosum allows information to pass quickly between the hemispheres so that information is shared.

What does this say about training that purports to increase right or left hemisphere function? A study by the U.S. National Academy of Sciences concluded that, while training could enhance different styles of learning (logical vs intuitive), this was not as a result of improvement in function of the left or right hemispheres respectively. Improved functioning in both hemispheres contributed to any changes seen.

25% thought this was true

2 | Listening to Mozart does not make you smarter

I have to admit to being a fan of Mozart, and even sometimes listening to this when I am working. However, I do not do this on the chance of being made smarter! The original research into the Mozart effect was conducted by Gordon Shaw and Frances Rauscher at University of California, Irvine. They tested the spatial reasoning of a group of college students before and after listening to 10 minutes of Mozart Sonata for two pianos in D Major. They found that the students showed short term improvement in spatial reasoning. Attempts to replicate even this very modest finding have failed (a good summary of studies can be found here).

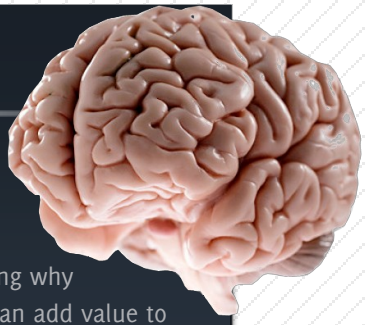
13% thought this was true

1 | We make no new neurones in our brains after we are born

Our neural networks control our behaviours, our emotions, our memories. As adults, much of our behaviour is fixed (though not unchangeable) and so creating lots of new neurones throughout the brain is unnecessary. Most of the change we require can be accomplished by creating new synapses (connections) between neurones that already exist. However, each new memory that we keep requires electrical activity in a set of neurones. It might be possible, therefore, that we could run out of neurones to store new information and therefore would not remember new experiences as we grew older. This problem is overcome by creation of new neurones in the one part of the brain where we need them most – the hippocampus. This part of the brain is responsible for keeping an address book of where each of our memories is stored. We know that creation of these new neurones have important functions – you might remember a time when you were very stressed and found it difficult to retain new information. We make fewer neurones in the hippocampus when stressed or depressed. However, the good news is that there is a simple condition in which we make more new neurones – when we exercise. And, this creates more new neurones than we lose when we are stressed. So, if you want to keep a healthy body and hippocampus, go and have some exercise.

8% thought this was true

Conclusion



I was surprised that there were some people that still believed every one of these myths about the brain. And I was encouraged that most people now know that we can make new neurons and most know that it is not all downhill after 60 (though I wondered how much of this was wishful thinking!).

Clearly, however, there is a need for more expert advice in this field. I have put together a short video (watch here) explaining why I think knowing about the brain can add value to everyone's life.

ABOUT THE AUTHORS

Dr. Trish Riddell is a chartered psychologist and chartered scientist with an active research interest in neuroscience. She holds a BSc in Physiological Sciences from the University of Glasgow, and obtained a Masters degree in Quantitative Methods Applied to Physiology from Imperial College before going to University of Oxford to complete a doctorate in Physiological Sciences. On leaving Oxford, she worked at the City University of New York, conducting research and developing courses in neuroscience for undergraduates and graduates of this University and also for the prestigious Columbia University. Since returning to the UK she has continued her research and teaching career pursuing her passion for neuroscience and is an internationally renowned research scientist. She run courses on the brain for people at all levels of their journey of discovery (http://www.kaizen-training.com/events).