

Memory and Belief

It is good to be able to speak to you all in assembly again, after a long break due to the use of this Hall for exams. I hope that if you took an exam here that it went well. If it did, it was in part because you were able to combine your natural intelligence with information retained in your memory. That whole revision process was in actual fact a process of training your memory. But of course memory is even more important to us than simply doing well in exams. We are able to function as we do because of the complex way our brains process the world – our beliefs – and the way the brain stores information about the world - memory.

Let us begin with memory. Although we all rely on it every second of every day, we know so little about it. Where and how are memories stored in the brain? Why can we remember some things but not others? Why do some people have better memories than others? What, exactly, *is* a memory?

First we have to get rid of the idea that there is a single thing called memory. In fact it is a very complicated thing. We need to realise that there are different types of memory.

Short-term memory, or working memory, stores a small number of memories for a limited period of time. It seems that we struggle to store more than about seven short-term memories at a time. These memories only last for a few seconds.

Short-term memory is very important to you. How intelligent you are is limited by the capacity of your short-term memory – the bigger your short-term memory, the smarter you are. The other factor in defining how bright you are is how quickly you can process information.

Then there is long-term memory. We don't know how memories get from the short-term memory to the long-term memory. But when the memories are stored in the long-term memory they can last a lifetime, accessible by an effort of will or surprising us when we come across something our brains associate with the stored memory.

You might think that this explanation of memory is complicated enough. But the real picture is even worse than that. Recent research has divided long-term memory into at least four forms of information processing. Short-term memory has fragmented into six different components.

So your memory is very complicated. But we are getting close to understanding it. And when we do, imagine the consequences! Then, you will be able to choose to have any memory you want. Do you want to learn to speak French fluently? Then buy the microchip, plug it into the socket behind your ear and 'remember' all the grammar and vocabulary you need. Do you want to 'remember' how to drive a car or fly a helicopter? Another microchip will give you the skills. You might even find yourself enjoying memories of a wonderful holiday that you have never actually been on.

But what about beliefs? We are defined by our beliefs just as much as by our memories. I suppose that we can define a belief as ‘those things I think are true, but I’m not sure enough about them to call them knowledge.’

The brain is central to forming beliefs. Let’s imagine that you open the door of your house and see a friend who tells you that you have won a big prize. I think you will be amazed to find out what happens in that fraction of a second.

1. You see the person’s face, recognise it and therefore ‘believe’ you know who he is. Activity in the part of your brain called the fusiform cortex, especially in the right side of the brain, allows this to happen. Without it you would not have the ability to recognise a face, or even see ‘faces’ at all.
2. Having recognised the face, you form the belief, based on your long-term memory of faces and facts, that he is your friend. If you had damage to your perirhinal and perihippocampal cortices, you would be unable to do this.
3. You are not yet sure whether this is a hoax or not (your friend has an odd sense of humour). So you take another moment to study his face. You form the belief, based on such factors as tone of voice, the look in his eye, body language and a thousand other indicators, that he is trustworthy and means what he says. To do this, and to spot untrustworthiness, you have used the part of your brain called the amygdala.
4. Your friend then tells you that you have won a big prize. But he doesn’t call it a big prize – he uses the word ‘jackpot’. To remember the meaning of the word you have to use different brain processes to the ones used for remembering faces. This will lead you to believe that you have won some money, rather than some kind of a pot. To do this you have used yet another part of your brain – your superior and middle temporal gyri, mostly on the left side of your brain.
5. Your friend then hands you a piece of paper, which he invites you to read by pointing at it. You understand the gesture through the use of your anterior cingulate cortex and regions of your frontal and temporal lobes.
6. You read the paper and see your name, followed by a pound sign, a one, and six zeros. In order to form the belief that this is a cheque for one million pounds you needed to do some processing in your left parietal lobe.

That whole process would have taken a fraction of a second and would have led to your almost instantaneous reaction – whether to shriek, jump up and down or burst into tears. But in that fraction of a second you used your long and short term memories, many different kinds of mental processing and ten different parts of your brain.

Sometimes we think of our minds as pretty simple, because the experience of using them is not very difficult. But we shouldn’t forget that behind the user-friendly

conscious part of our brain is an incredibly complicated machine with thousands of interrelated areas, each using billions of neurons. Perhaps we should all give thanks that our brains don't break down as often as they might, under the circumstances.

And a final thought to carry through the day: your brain is by far the most complicated thing on the planet. In fact, you have the extra-ordinary gift of having the most complex object in the known universe sitting between your ears. And that remains true, no matter what happened in the exams. Let us give thanks for our brain and resolve to respect it, and use it in the best way in the week ahead.