2-2 A brain of two halves

2-2a The structure of the brain

If you are not too squeamish, imagine you have lifted the top off someone's skull and pealed back a thin protective membrane (see Figure 1). You are now looking down on the brain sitting in a pool of liquid. You have probably heard the phrase ‘grey matter’ and one of the first things you would see is that the outermost layer of the brain is indeed slightly grey in colour. It also has many dips and folds.

You would also notice that the brain is divided into two halves or hemispheres with the division running from the front to the back of the brain.

These two hemispheres are joined together by a bundle of approximately 200 million nerve cells that pass messages between the two hemispheres. This connecting bundle of cells is called the **corpus callosum**.

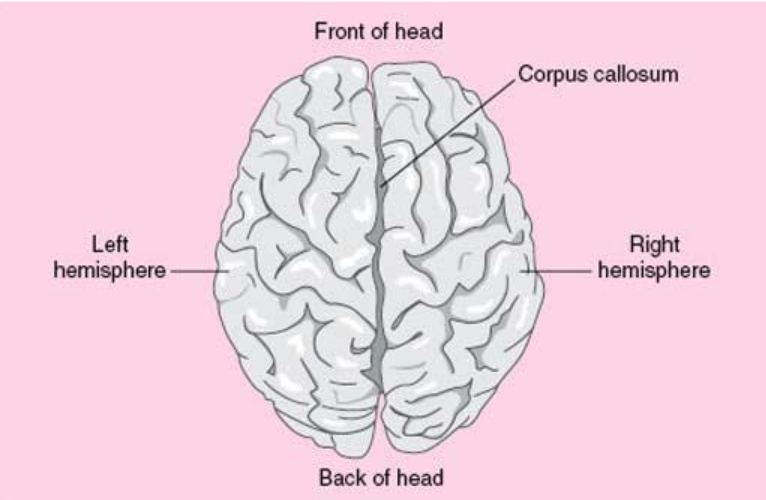

Figure 1 Looking down on the brain

Although these two hemispheres look the same, so they have a similar structure, there are differences in the way they function so they control different responses. For example the left hemisphere controls and receives information from the right side of the body and the right hemisphere controls and receives information from the left side of the body.

The two hemispheres may also differ in the extent to which they control certain functions such as producing speech, daydreaming or recognising someone's face. Some functions may be more under the control of one hemisphere, so that hemisphere will dominate the other. Other functions may be shared equally by both hemispheres. For example our speech area is usually located in the left hemisphere except in some, but not all, left-handed people who may have areas controlling speech on both the left and the right hemisphere. Conversely both hemispheres play a role in vision although it is the right hemisphere that receives information from the left visual field and the left hemisphere that receives information from the right visual field.

You will have noted from the mention of left-handed people above that not all brains are organised in the same way. Another finding in this area is that males, especially right-handed males, have greater left hemisphere dominance for speech than females. If a man suffers damage in the speech area of his left hemisphere this will have a greater impact on his speech compared to a woman who has suffered similar damage.

However, bearing in mind that there will be some differences between people in the way that their brains are organised, we do have a range of evidence that suggests that generally the two hemispheres are dominant in different areas. The left hemisphere dominates for speech, writing, mathematical ability, logic and analysis. The right hemisphere dominates for **perception**, **spatial ability**, musical and artistic abilities, imagery and dreaming. The right hemisphere also seems to be more emotional and negative compared to the positive and rational left hemisphere.

Evidence to support the proposal that one hemisphere may dominate the other for a particular function, or **hemispherical specialisation**, has come from a number of sources. In this section you will consider what has been learned through research with people who have had an operation that splits the left hemisphere of the brain from the right hemisphere of the brain.

2-2b The story of the split brain patients

A surgical procedure that cuts through the corpus callosum has provided evidence to support the different specialisations of the left and right hemispheres of the brain. This procedure is used very rarely and always as a last resort when someone has frequent and major epileptic seizures that do not respond to drug treatment. The frequency and severity of their epileptic fits is very disabling and their quality of life is poor. The attacks can even be life threatening. In these patients epileptic activity would start in one area of the brain and then spread across the corpus callosum to all areas of the brain. By cutting these connections between the two hemispheres epileptic activity is contained in one hemisphere only. The operation usually leads to a significant decrease in the frequency and severity of the seizures without any apparent interference in normal functioning.

Early researchers were puzzled by the fact that people who had undergone this operation did not show any noticeable changes in behaviour, personality or their scores on intelligence tests despite such extensive surgery. In fact they wondered what the purpose of the corpus callosum was if you could cut through it with so little effect. However careful testing by

Roger Sperry (1968) and colleagues did uncover behaviour that was far from normal. This work was to gain him a Nobel Prize for Medicine in 1981.

Sperry et al, devised a number of split brain experiments using people who had had split brain surgery as participants and comparing their responses to people who had not had this surgery. In one experiment the split brain participant was blindfolded and given objects to explore with their left hand. Information from the left hand goes to the right hemisphere but speech is generally controlled by the left hemisphere.

Participants were unable to tell the experimenter the name of the object they were holding in their left hand even though they could obviously recognise the object because they would make appropriate gestures with it. For example, if the object was a key they would hold it out as though putting it in a lock and turn it. Because the right hemisphere does not talk and could not transfer information to the left hemisphere the object cannot be named. However as soon as the participant touched the object with the right hand they were able to name it instantly.

In another experiment the participant would sit at a table with a screen in front of them. They would be asked to place their hands round the sides of the screen so that their hands were hidden from view. They would then be asked to fix their eyes on a spot in the centre of the screen.

Figure 2 A split brain study

A word is then flashed onto one side of the screen very briefly (approximately one tenth of a second). The word has to be flashed very quickly so that the participant does not have time to move their eyes and the information will only go to one of the brain hemispheres.

When a word is flashed on to the left-hand side of the screen the information will go to the right hemisphere of the brain. The information cannot be passed to the talkative left hemisphere so the participant cannot tell the experimenter what the word was.

However the participant can use their left hand to explore a pile of objects behind the screen and easily pick out the object that corresponds to the word that has been flashed up. They still won't be able to tell the experimenter what the left hand is doing as sensory information from the left hand is going to the silent right hemisphere only. Also they can't find the right object with their right hand as the right hand is controlled by the left hemisphere and the left hemisphere did not see the flashed word.

In split brain experiments the techniques used will limit information to one hemisphere only and the person behaves as if they have two separate brains with each hemisphere appearing to operate with no conscious awareness of what is happening in the other hemisphere.

Of course in everyday activities split brain people can operate normally because they can move their eyes and make sure that incoming information is available to both hemispheres. Occasionally odd behaviours do occur, especially in the early days after surgery. A patient might find that they are buttoning up a shirt with one hand and unbuttoning it with the other hand or that their left hand suddenly closes a book that they were engrossed in.