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managing alzheimer's and dementia care

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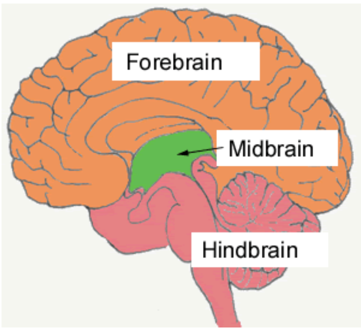
The brain and the behaviour



Source: mynextbrain.com/blog/?page_id=110

Alzheimer's disease is a degenerative condition associated with a progressive loss of nerve cells or neurons. The disease gradually pervades most areas of the brain. However, the evolving patterns of damage can vary greatly between different individuals. As a result, each person with the disease may have a complex set of difficulties and experiences, which are peculiar to them. This information sheet explains which areas of the brain are largely responsible for which skills and abilities and how the changes in behaviour, memory and thought we see in people with Alzheimer's may be a direct result of the way the disease has affected the brain.

The brain consists of three main sections: the hindbrain, the midbrain and the forebrain (see figure 1). The hindbrain and midbrain are mainly concerned with basic life support functions such as blood pressure and respiration.

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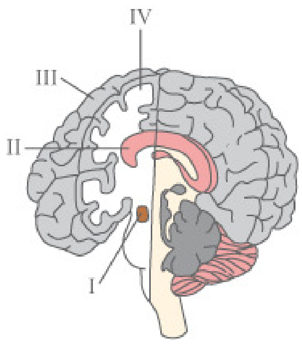

Source: www.brainandnerves.com/.../Our-amazing-brain-/

The cerebral cortex

The most important part of the forebrain is the cerebral cortex, a thin shell covering the surface of the forebrain. This thin layer is tightly crumpled and folded to increase its surface area. As a result the cortex alone contains an astonishing ten thousand million brain cells (the 'grey matter'). Beneath this densely packed cortex lie bundles of fibres) (the 'white matter') which transport information around the cortex and to other brain regions (see figure 3)

The lobes

To help us describe the different parts of the brain, the forebrain has been divided up into four sections or 'lobes' which are shown in figure 2. The **occipital lobe** is located at the back of the brain and deals primarily with visual information from the eyes.

The **parietal lobe** lies in the upper rear portion of the brain and is concerned with information about spatial relationships and structure. The **temporal lobe** lies beneath the parietal lobe and is involved in memory. Finally, the **frontal lobe** can be thought of as our executive and management centre. We shall discuss the functions of each lobe in more detail later.

The hemispheres

The brain is also physically divided into two halves or hemispheres, left and right. The hemispheres are not entirely separate – they are connected by a large bundle of fibres which allows them to talk to one another. While these hemispheres look almost identical from the outside, one hemisphere is usually dominant over the other. In all right handed people and the majority of left handed people, it is the left hemisphere which is dominant.

Lateralisation literally means that the left side of the brain best performs some functions, while others are mainly supported by the right side. In the human nervous system, the left hemisphere controls the right side of the body and the right hemisphere controls the left side of the body. Not all functions are so equally shared though. For example, language tends to be a function of the dominant hemisphere of the brain (usually the left side).

Information is also represented in a **map-like** ordered fashion within the brain. For example, the motor cortex, which sends movement instructions to the muscles, is organized so that parts of the body which are physically close (eg. hand and wrist) are controlled by groups of cells, which are also near to one another (see figure 3). Keeping related information in one place in the cortex helps to keep the amount of wiring between cells to a minimum and so saves on space.

It would be a considerable understatement to say that the structure of the brain is complicated. However, by studying behaviour and cognitive abilities in people with both healthy and damaged brains, scientists have been able to determine the principle functions of different brain areas. We look here at how the four lobes of the brain contribute to our experience of the world, starting at the back of the brain with the occipital lobe.

The occipital lobe

Although the eyes are the source of visual information about the world around us, it is actually the brain, which does most of the hard work. The eyes convert sensory information about light into electrical impulses, but these are passed to the brain for interpretation. This division of labour means we have to distinguish between acuity and perception.

Visual acuity – the ability to see small objects – is achieved by the workings of the eye itself.

Perception is achieved by the occipital and parietal lobes with information about colour, shape and movement being processed separately by the occipital cortex before it is passed on to the parietal lobe for combination into a complete 3D picture of the world.

As a result, someone may have difficulty seeing what an object is, despite both eyes being in perfect shape. However, it is still necessary to maximise their eyesight (for example, with correct prescription spectacles) so that the brain has as much information to work with as possible.

The parietal lobe

The functions of the parietal lobe are somewhat more diverse, and there is a significant difference between the dominant and non-dominant sides.

Dominant parietal lobe

The dominant parietal lobe (usually the left half) can be thought of as being concerned with things we have to put together into an order or structure. So tasks such as reading and writing (which require putting letters and words together) and calculation (which involved ordering and combining numbers) are critically dependent on the dominant parietal lobe. This side of the parietal lobe has also been heavily implicated in a condition known as **apraxia** ("an impairment of learned purposive movements").

Dressing apraxia is the most common form and reflects not only a lack of co-ordination but an actual forgetting of the movements required to achieve a goal (fastening a button, for example). As if to compound such problems, the dominant parietal lobe is also responsible for our body sense, that is, knowing our left from our right and sensing where one limb is in relation to the rest of our body.

Non-dominant parietal lobe

In contrast, the non-dominant parietal lobe (usually the right half) could be thought of as our '3D centre'. As mentioned previously, this part of the parietal lobe receives visual information from the occipital lobe. The function of this area is to combine such information into a 3D representation of the object being viewed.

Damage to this area leads to a symptom known as **visual agnosia**, an inability to recognize objects, faces or surroundings. Because visual information is processed separately from other modes of sensation, it is possible for individuals to fail to recognize a familiar face by sight but to know who they are once they speak.

The non-dominant parietal lobe also contributes to our understanding of space but in a different way from its dominant

counterpart. While the dominant parietal lobe deals with our body sense or personal space, the non-dominant portion helps us to locate objects in external space and to calculate the location of objects relative to one another and ourselves (for example, when we are reaching to pick something up).

The temporal lobe

The temporal lobes deal primarily with memory functions.

The dominant temporal lobe is specialized for verbal (word based) memory and the names of objects. We rely upon our non-dominant temporal lobe for our memory of visual (non-verbal) material – faces, scenes etc.

There are also different types of memory :

Episodic memory, as its name suggests, is our memory of event or episodes, which are recorded with a reference to the time when they occurred (for example: 'I ate eggs for breakfast this morning').

Semantic memory can be though of as our own encyclopaedia for facts and figures (for example: 'Eggs have a shell, are laid by hens, and can be eaten boiled, scrambled or fried').

In Alzheimer's disease it is the episodic memory, which is most commonly damaged. It is not yet clear exactly how or where long term memories are stored, but it seems that memories are achieved by strengthening the connections between relevant nerve cells. It does seem clear that remote or distant memories, such as where one went to school, are stored more deeply than familiar or recent memories, such as what one did yesterday. This seems compatible with the experience of someone with Alzheimer's who may find it easier to discuss their childhood than what has happened that day.

The frontal lobe

The frontal lobes contain several parts which all act together to form our executive or management centre.

Planning actions and learning new tasks

The lateral or outer surfaces of the frontal lobe appear to be critical for organizing and planning our actions and learning new tasks. In learning to drive, for example, these brain areas help us put together a very complex sequence of movements, which at first seem difficult and clumsy but gradually become more smooth and automatic. For someone with damage to this area, it is like being a learner all over again with many multi-stage tasks such as cooking and shopping becoming very difficult because the pattern or plan of action has been lost.

Damage to these lateral areas can also cause people to get stuck on what they are doing (known as 'perseveration'). As the frontal lobe interacts with many other brain areas, this perseveration may take the form of using the same word over and over again or taking one piece of clothing out of a drawer and then unpacking all the other clothes without a specific purpose.

Motivation

Moving towards the division between the two hemispheres, the middle portion of the frontal lobe generates our motivation and general impetus. If this part of the brain is affected, people can lose their 'get-up-and-go' becoming lethargic and reluctant to get out of bed or perform a particular activity. Again, it is important to realize that what might be perceived as laziness by some could be a direct consequence of the loss of cells in this area of the brain.

Regulation of behavior

The regulation of our behaviour appears to be governed by a third area of the frontal lobes, the orbitobasal area, located in the curvature at the very front of the bran.

In healthy people these parts of the brain help to monitor, control and moderate our behaviour : for example, preventing us from saying something rude when someone has really annoyed us.

To help one understand this idea of a failure of inhibition, we may look at some peculiar aspects of our own healthy behaviour. For example, we may pull a light cord on entering a room despite the fact the light is already on. In doing this, we fail to inhibit or break out of a programmed pattern of behaviour.

Other areas and structures

Many areas of cortex are concerned not so much with supporting a specific function but with integrating and associating the products of surrounding areas. A similar role is played by many structures, which lie beneath the cortex such as the limbic system which, amongst other things, permits memory and behaviour to influence one another. The limbic system also plays a vital role in the generation of emotions and their interaction with our behaviour.

Conclusions

It is fascinating to observe and learn about the complex way in which the components of the brain create and control aspects of our being. If we can combine this knowledge with the ever increasing technology which permits us to see how a brain affected by Alzheimer's changes, in future we may be able to predict, treat and manage the various symptoms associated with the disease.

For now, a greater appreciation of the relationship between the brain and our behaviour may help people with Alzheimer's disease and their carers to understand and cope with the many changes it brings.

This information sheet was written by Sebastian Crutch at the National Hospital for Neurology and Neurosurgery, Queen Square, London

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