In their research, many biopsychologists try to relate specific parts of the brain to the control of particular cognitive or behavioral functions, such as being able to recognize faces or move your hands. That is, they try to learn where functions are localized (located) in the brain. Many techniques have been developed to help identify brain structures and the functions they control. Anatomists have learned much about brain structure by dissecting (cutting apart) autopsied human and animal brains and examining them under a microscope. Dissection reveals that the brain is made up of many anatomically distinct areas or "parts." Less intrusive newer methods, such as the CT scan and the MRI scan, can be used to map brain structures in living brains.

Computerized scanning equipment has revolutionized the study of brain structures and made it easier to identify brain diseases and injuries. At best, conventional X-rays produce only shadowy images of the brain. Computed tomographic (CT) scanning is a specialized type of X-ray that does a much better job of making the brain visible. In a CT scan, X-rays taken from a number of different angles are collected by a computer and formed into an image of the brain. A CT scan can reveal the location of strokes, injuries, tumors, and other brain disorders. *Magnetic resonance imaging* (MRI), on the other hand, uses a very strong magnetic field, rather than X-rays, to produce an image of the body's interior. During an MRI scan, the body is placed inside a magnetic field. Processing by a computer then creates a three-dimensional model of the brain or body. Any two-dimensional plane, or slice, of the body can be selected and displayed as an image on a computer screen. MRI scans produce more detailed images than are possible with CT scans, allowing us to peer into the living brain almost as if it were transparent.

How does the brain allow us to think, feel, perceive, or act? To answer questions like these, we must localize function by linking these psychological or behavioral capacities with particular brain structures. In many instances, this has been done through clinical case studies. Such studies examine changes in personality, behavior, or sensory capacity caused by brain diseases or injuries. If damage to a particular part of the brain consistently leads to a particular loss of function, then we say the function is localized in that structure. Presumably, that part of the brain controls the same function in all of us.

Instead of relying on clinical studies, researchers have learned much from electrical stimulation of the brain (ESB). For example, the surface of the brain can be "turned on" by stimulating it with a mild electrical current delivered through a thin insulated wire called an electrode. When this is done during brain surgery, the patient can describe what effect the stimulation had. (The brain has no pain receptors, so surgery can be done while a patient is awake. Only local painkillers are used for the scalp and skull.) (Any volunteers?) Even structures below the surface of the brain can be activated by lowering a stimulating electrode, insulated except at the tip, into a target area inside the brain. ESB can call forth behavior with astonishing power. Instantly, it can bring about aggression, alertness, escape, eating, drinking, sleeping, movement, euphoria, memories, speech, tears, and more. It might seem that ESB could be used to control a person like a robot. But the details of emotions and behaviors elicited by ESB are modified by personality and circumstances. Sci-fi movies to the contrary, it would be impossible for a ruthless dictator to enslave people by "radio controlling" their brains.

An alternate approach is ablation of parts of the brain. When ablation into the purpose of the missing "part." By using deep lesioning, structures below the surface of the brain can also be removed. A strong electric current can be used to destroy a small amount of brain tissue when delivered via an electrode lowered into a target area inside the brain. Again, changes in behavior give clues to the function of the affected area. By using ESB, ablation, and deep lesioning, researchers are creating a three-dimensional brain map. This "atlas" shows the sensory, motor, and emotional responses that can be elicited from various parts of the brain. It promises to be a valuable guide for medical treatment, as well as for exploring the brain. To find out what individual neurons are doing, we need to do a microelectrode recording. A *microelectrode* is an extremely thin glass tube filled with a salty fluid. The tip of a microelectrode is small enough to detect the electrical activity of a *single* neuron. Watching the action potentials of just one neuron provides a fascinating glimpse into the true origins of behavior.

Several techniques allow us to observe the activity of parts of the brain without doing any damage at all. These include the EEG, PET scan, and fMRI. Such techniques allow biopsychologists to pinpoint areas in the brain responsible for thoughts, feelings, and actions.

Electroencephalography measures the waves of electrical activity produced near the surface of the brain. Small disk-shaped metal plates are placed on a person's scalp. Electrical impulses from the brain are detected by these electrodes and sent to an **electroencephalograph (EEG).** The EEG amplifies these very weak signals (brain waves) and records them on a moving sheet of paper or a computer screen. Various brain-wave patterns can identify the presence of tumors, epilepsy, and other diseases. The EEG also reveals changes in brain activity during sleep, daydreaming, hypnosis, and other mental states.

A newer technology, called positron emission tomography (PET), provides much more detailed images of activity both *near* the surface and *below* the surface of the brain. A **PET scan** detects positrons (subatomic particles) emitted by weakly radioactive glucose (sugar) as it is consumed by the brain. Because the brain runs on glucose, a PET scan shows which areas are using more energy. Higher energy use corresponds with higher activity. Thus, by placing positron detectors around the head and sending data to a computer, it is possible to create a moving, color picture of changes in brain activity.

Finally, a functional MRI (fMRI) uses MRI technology to make brain activity visible. Like PET scans, functional MRIs also provide images of activity throughout the brain. For example, if we scanned Carlos Santana while he played his guitar, areas of his brain that control his hands would be highlighted in an fMRI image. Psychiatrist Daniel Langleben and his colleagues have even used fMRI images to tell if a person is lying. As the figure shows, the front of the brain is more active when a person is lying, rather than telling the truth. This may occur because it takes extra effort to lie and the resulting extra brain activity is detected with fMRI. Eventually, fMRI may help us distinguish between lies, false statements made with the intention to deceive, and *confabulations,* which are false claims made by persons who believe they are telling the truth. Clearly, it is just a matter of time until even brighter beacons are flashed into the shadowy inner world of thought.

(Source: Coon, D. & Mitterer, J. O. (2010). Introduction to Psychology. Gateways to Mind and Behaviour. 12th Ed. Cengage)

Exercise 1 Read the text and indicate whether the following statements are True or False.

1. Biopsychologists use techniques such as CT scans and MRI scans to help identify brain structures and their functions. **T**

2. A CT scan uses a magnetic field to create an image of the brain. **F**

3. MRI scans produce more detailed images of the brain than CT scans. **T**

4. Electrical stimulation of the brain (ESB) cannot be used to bring out behaviors such as aggression or euphoria. **F**

5. Ablation involves removing or damaging parts of the brain to study behavior changes**. T**

6. The brain can be safely stimulated with a mild electrical current while the patient is awake because the brain has pain receptors. **F**

7. The EEG measures electrical activity in the brain by placing electrodes on the scalp. **T**

8. A PET scan detects the energy consumption of glucose in the brain, helping to identify areas of brain activity. **T**

9. Functional MRI (fMRI) uses the same technology as CT scans to measure brain activity. **F**

10. fMRI has been used to detect whether a person is lying, showing increased activity in the front of the brain during deception. **T**

Exercise 2 Fill in the blanks of the text using one of the words below.

disorders, specialized, scalp, MRI, behavioral, angles, CT, cognitive, dissection, functions

Biopsychologists study the brain to understand how specific brain areas control different ... (1) and ...(2) functions, like recognizing faces or moving hands. To do this, they use various methods to localize ... (3) in the brain. One of the oldest techniques is ...(4), which involves dissecting human or animal brains after death. Newer technologies, like the ... (5) scan and the ... (6) scan, allow for mapping brain structures in living people without the need for dissection.

The CT scan is a ... (7) X-ray method that creates images of the brain by collecting X-rays from multiple ...(8). MRI scans, on the other hand, use a magnetic field instead of X-rays to create detailed images of the brain. These scans help identify brain ... (9), such as strokes and tumors.

Biopsychologists also study brain activity using techniques like EEG, which involves placing electrodes on the ... (10) to measure brain waves. Another method, PET, uses radioactive glucose to detect areas of high brain activity, helping researchers understand which regions are involved in particular functions.

Answer: 1. cognitive, 2. behavioral, 3. functions, 4. dissection, 5.CT, 6. MRI, 7. specialized, 8. angles, 9. disorders, 10.scalp