FOCUS ON VOCABULARY AND LANGUAGE

Page 47: . . . to shoot a basketball . . . This means to throw the ball, in the game of basketball, through the hoop. Science today is intensely focused on (*riveted on*) research involving the brain and how it accomplishes a wide variety of mental and physical tasks.

Page 47: . . . ill-fated theory . . . Myers is referring to the theory that bumps or lumps on the skull could reveal our personality (*phrenology*). It was a theory destined for failure (*ill-fated*), despite its popularity during the early 1800s.

Page 47 (caption): A *wrongheaded theory*. Even though phrenology was without any scientific merit (*wrong-headed*), it did suggest the idea that different parts of the brain influence a variety of functions and behaviors.

Page 48: To *fathom* our thoughts and actions, memories and moods, we must first understand how neurons work and communicate. To *fathom* means to have a deep comprehension. (A *fathom* is also a unit for measuring the depth of water.) To obtain an in-depth understanding of (to *fathom*) our cognitions and behaviors, our memories and emotions, we need to have a thorough appreciation of what neurons are, as well as how they operate and communicate.

Neural Communication

Page 48: For scientists, it is a *happy fact of nature* that the information systems of humans and other animals operate similarly . . . The structure and function of neurons are very similar in humans and other animals (e.g., squids and sea slugs). This is a good thing (*a happy fact of nature*) for those researching the nervous system. Myers makes the important point about this similarity, noting that it would not be possible to tell the difference between a small piece of your brain tissue and that of a monkey.

Page 49: Its *building blocks* are **neurons,** or nerve cells**.** *Building blocks* are the basic or fundamental parts (e.g., bricks) that make up a structure (e.g., a house). The structure of our nervous system, or neural information system, is made up of neurons (they are *its building blocks*).

Page 49: . . . a neural impulse travels at speeds ranging from a *sluggish* 2 miles per hour to a *breakneck* 200 or more miles per hour. The speed of the neural impulse ranges from extremely slow (*sluggish*) to very fast (a *breakneck* speed). Compared to the speed of electricity or sophisticated electronics systems, your neural impulses travel at a relatively slow pace.

Page 50: . . . The first bit of the axon opens its gates, *rather like manhole covers flipping open,* and the positively charged sodium ions flood through the membrane. The circular metal tops that cover entrances to sewer lines, water pipes, etc. are called *manhole covers.* When a neuron fires, the resting axon no longer blocks access to positive sodium ions (*the security parameters change*). Consequently, the axon begins to open its gates in sequence, much like a series of lids that open in succession (*like manhole covers flipping open*) allowing sodium ions in. The sequential opening of each channel is like a chain reaction with each event affecting the next, and so on (*like dominoes falling, each one tripping the next*).

Page 50: The mind *boggles* . . . *Boggle* means to startle, alarm, or surprise. Our minds are amazed (*boggled*) by the astounding complexity and intricate activity of the brain and nervous system.

Page 50: Most of these signals are *excitatory, somewhat like pushing a neuron's accelerator.* Others are *inhibitory, more like pushing its brake.* Myers is making a comparison between the effect of a neuron firing and the effect of speeding up a car by accelerating (*excitatory effect*) or slowing it down by applying the brake (*inhibitory effect*). He also likens excitatory signals to those who love social gatherings (*party animals*) and inhibitory signals to those who do not (*party poopers*); if those who want to have a party outvote those who do not, the party (the *action potential*) will happen (i.e., *the party's on*).

Page 51: How do we distinguish a gentle touch from a big hug? This question is concerned with how we become aware of the magnitude of a stimulus, from a soft stroke or pat (*gentle touch*) to a strong embrace (*big hug*). The answer is that the intensity of the stimulus is a function of the number and frequency of neurons firing. A strong stimulus (*big hug*) does not initiate (*trigger*) a more powerful or faster impulse than a weak stimulus (*gentle touch*). Rather, it triggers more neurons to fire, and to fire more often.

Page 51: Spanish anatomist Santiago Ramón y Cajal (1852–1934) marveled at these near-unions of neurons, calling them "*protoplasmic kisses*." Here, the reference is to the fact that the axon terminal of one neuron is separated from the receiving neuron by a tiny space called the *synaptic gap*. *Protoplasm* is the material that constitutes all living cells, and the communication between cells is likened to a *kiss* between cells (*protoplasmic kisses*). The transmission between sender and receiver is via chemicals called **neurotransmitters**. The cells do not actually touch but send messages across the synaptic gap. In this case, Myers makes an analogy to sophisticated females (*elegant ladies*) who kiss the cheeks of someone, but their lips do not actually make physical contact (*air-kissing*).

Page 53: . . . "runner's high" . . . This refers to the feeling of emotional well-being or euphoria (*high*) that follows vigorous exercise (e.g., running or jogging). It is the result of the release of opiate-like substances called **endorphins**.

Page 53: For suppressing the body's own neurotransmitter production, *nature charges a price*. When flooded with mood-altering drugs such as, heroin and morphine, the brain stops producing its own endorphins (i.e., they *suppress production*). Withdrawal from such drugs initiates changes (*intense discomfort*) that persist for a period of time. For the addict who stops taking the drugs, the cost may be a great deal of pain and agony (*nature charges a price*).

The Nervous System

Page 55: Like an *automatic pilot*, this system may be consciously *overridden*, but usually it operates on its own (autonomously). The **autonomic nervous system** automatically takes care of the operation of our internal organs, much as a plane can be flown by the *automatic* (or mechanical/computerized) *pilot*. However, the system can be consciously taken over (*overridden*) in the same way that the real pilot can take over flying the plane.

Page 56: Tens of billions of neurons, each communicating with thousands of other neurons, *yield an ever-changing wiring diagram that dwarfs a powerful computer*. The complexity of the **central nervous system** allows or makes possible (*enables*) our thinking, feeling, and behavior. In this way, it is similar to the electronic circuitry (*wiring diagrams)* of the best computer, except that the computer would appear to be extremely tiny or small by comparison (*dwarfed by*), and the brain's wiring would seem to be constantly modifying or altering itself (*ever-changing*).

Page 57: The brain's neurons cluster into *work groups* called *neural networks*. Myers points out that the brain works much like a computer making many simultaneous computations. This is accomplished by *neural networks*, which are clusters of interconnected neurons (*work groups*). Neurons work with nearby neurons for much the same reason that people live in cities—it is easier for brief, quick interactions with other people. Learning occurs as feedback builds and strengthens these neural connections (*neurons that fire together wire together*).

Page 57: . . . information highway . . . The spinal cord is similar to the freeway (*highway*). But, instead of cars moving up and down, sensory and motor messages (*information*) travel between the peripheral nervous system and the brain. This information moves either up (*ascending*) to the brain or down (*descending*) from the brain.

Page 57: The knee-jerk response, for example, involves one such simple pathway. *A headless warm body could do it.* When the patellar tendon of a bent knee is struck, the whole leg reflexively straightens out (*the knee-jerk response*). This automatic reaction is a function of a simple spinal reflex pathway, so it does not require mediation by the brain (*a headless warm* [live] *body could do it*).

The Endocrine System

Page 59: The **endocrine system** and nervous system are therefore *close relatives*. These two systems share similarities and are intimately connected; like two members of the same family, they have much in common (they are *close relatives*). The **hormones** of the endocrine system are chemically equivalent to neurotransmitters but operate at a much slower speed. Messages in the nervous system move very rapidly (*like e-mail*) compared with endocrine system messages, which move relatively slowly (like *"snail" mail*).

Page 60: Conducting and coordinating this whole *electrochemical orchestra* is that *maestro* we call the brain. Myers is comparing the functioning of neurotransmitters and hormones to a large group of musicians (*electrochemical orchestra*). Their movements and actions are directed by the conductor or master (*maestro*), the brain.

The Brain

Page 60: That we can imagine such questions illustrates how convinced we are that we *live "somewhere north of the neck"* (Fodor, 1999). What this means is that we subjectively feel that the essence of our being, the mind, resides in our brain and inside our head, which is above our neck (*we live "somewhere north of the neck"*). The brain in our head allows us to function psychologically as well as physically: *the mind is what the brain does.*

Page 61: The known universe's most amazing organ is being probed and mapped by a new generation of neural cartographers. A cartographer is someone who prepares or makes maps. Myers is suggesting that the brain (*the known universe's most amazing organ*) is being graphically depicted (*mapped*) by a new younger group of neuroscientists (*a new generation of neural cartographers*).

Page 61 . . . snoop on the messages of *individual neurons* and *eavesdrop on the chatter* of billions of neurons. With today's technological tools it is possible to unobtrusively view or spy on (*snoop on*) single nerve cells *(individual neurons*) as well as covertly listen to (*eavesdrop on*) the back-and-forth communication (*chatter*) of millions and millions of cells.

Page 62: Newer windows into the brain give us that *Superman-like* ability to see inside the living brain. Modern technological means of viewing the brain (*new windows into the brain*), such as the PET scan, MRI, and fMRI, provide us with a greater than normal (*Superman-like*) ability to look inside the cortex without destroying tissue. (*Note:* Superman is a comic-book, TV, and movie character with x-ray vision, which allows him to see through solid matter.)

Page 62: Such *snapshots* of the brain's changing *activity* provide new insights into *how the brain divides its labor.* The fMRI technique allows pictures (*snapshots*) to be taken of different brain areas at work (*how the brain divides its labor*) while a person is carrying out various mental tasks.

Page 63: This peculiar cross-wiring is but one of the brain's many surprises. In the **brainstem**, most nerves from the left side of the body connect to the right side of the brain and those from the right connect to the left side of the brain. This strange (*peculiar*) traverse of nerves from one side to the other (*cross-wiring*), which occurs in the *pons*, is one of the many marvels or astonishing findings (*many surprises*) about the brain.

Page 64: Think of the thalamus as being to sensory input what *London is to England's trains*. London is the relay center for trains going to all parts of the country just as Chicago is the hub or relay center for many airlines flying to different parts of the United States. Myers uses this as an analogy for the **thalamus**, which receives messages from sensory neurons and sends them on, or relays them, to higher brain areas. (It also receives some of the higher brain's responses and directs them to the **medulla** and the **cerebellum**.)

Page 66: . . . they made *a magnificent mistake*. Olds and Milner accidentally discovered (*stumbled upon*) a brain area that provides a pleasurable reward and then went on to find other similar areas, which they called "*pleasure centers*." Myers calls this a splendid and spectacular error (*a magnificent mistake*). When rats are allowed to stimulate these areas by pressing a bar or lever (*pedal*) they seem to prefer this to any other activity and will continue at a very rapid rate (*feverish pace*) until they are too tired to go on (*until they drop from exhaustion*).

Page 68: If you opened a human skull, exposing the brain, you would see a *wrinkled* organ, shaped somewhat like the *meat of an oversized walnut*. The human brain has a convoluted (*wrinkled*) surface, and the cerebral cortex is divided into two halves or hemispheres just like the two lobes of the edible portion (*the meat*) in the shell of a very large (*oversized*) walnut.

Page 68: Being human *takes a lot of nerve*. Myers is using humor to make a point here. The expression "it takes a lot of nerve" means to be very brave or courageous. (Another expression, "it takes a lot of guts," means the same thing!) Thus, when Myers states that being human *takes a lot of nerve*, the literal meaning in this context is that humans are made up of many, many nerves (the humor is derived from the double meaning).

Page 68: Glial cells are worker bees. The analogy here is to a beehive where the queen bee has to rely on the worker bees to feed her and take care of her needs. **Glial cells** perform in a similar way by looking after the needs of neurons that, like queen bees, cannot feed or insulate themselves (*glial cells are worker bees*). Glial cells may also be involved (*play a role*) in learning, memory, and thinking by communicating ("*chatting*") with neurons and promoting information transmission.

Page 71: In a sense, we *do* have *eyes in the back of our head!* The reference here is to the visual cortex (or occipital lobes), which processes visual information and is located at the rear of the brain. So, in a way seeing is not just done with the eyes but also involves specialized areas at the back of the brain (*eyes in the back of our head*).

Page 72: Their [the association areas'] silence has led to what Donald McBurney (1996, p. 44) calls "*one of the hardiest weeds in the garden of psychology*": the claim that we ordinarily *use only 10 percent of our brains*. McBurney compares this very persistent myth to the way weeds continue to grow in a garden despite efforts to eliminate them. The 10 percent myth, like a weed, is one of the toughest misconceptions to eradicate (*one of the hardiest weeds in the garden of psychology*). Research into the **association areas** of the brain showed that they do not have specific functions, but rather are involved in many different operations such as interpreting, integrating, and acting on information processed by the sensory areas. The incorrect notion that we *use only 10 percent of our brains* may have arisen because early researchers were unsure about the function of the association areas. Remember, we use all of our brain, all the time. Damage to the association areas would result in very serious deficits.

Page 73: With his frontal lobes *ruptured*, Gage's *moral compass* had disconnected from his behavior. Phineas Gage's frontal lobes were severely damaged (*ruptured*) when the tamping iron shot through his head. As a result, he lost many of his normal inhibitions, which caused him to veer away from his previous honest ways (he lost his *moral compass*).

Page 75: Waking from surgery, one even *joked* that he had a "*splitting headache*." People have had their corpus callosum severed or cut in order to control epileptic seizures and are thus called **split-brain** patients. Despite having had such a major operation, this patient managed to make fun of the situation (*joke*) by saying he had a very bad headache (*a splitting headache*). Personality and intellectual functioning were not affected by this procedure, and you would not be able to detect anything unusual if you were having a casual conversation with a split-brain patient.

Page 76: When the "two minds" are at odds, the left hemisphere does *mental gymnastics* to *rationalize* reactions it does not understand. In split-brain patients, if information or commands are delivered to the right hemisphere (which does not have language), then the left hemisphere, which can talk, would not be aware of what was requested. So if the patient carried out the command to do something (e.g., "walk" or "clap"), the left hemisphere will go through all kinds of contortions (*mental gymnastics*) to create some plausible story that accounts for the response (it *rationalizes* and constructs theories to explain our behavior).

Page 79: Simply looking at the two hemispheres, so alike to the *naked eye,* who would suppose they contribute uniquely to *the harmony of the whole?* Myers points out that research with split-brain people and normal people shows that we have unified brains with different parts that have specialized functions. Thus, if we observe the two hemispheres without optical aids (*with the naked eye*), they may seem to be the same; however, their differential functioning combines to produce an integrated unit (*the harmony of the whole*).

Page 80: Yet what is unknown still *dwarfs* what is known. This means that all that has been discovered so far is very, very small (*dwarfed*) compared to what yet remains to be discovered.

CHAPTER REVIEW: The Biology of Mind

Page 82: Agonists excite . . . *Antagonists* inhibit . . . An *agonist* drug molecule is enough like the neurotransmitter to imitate (*mimic*) its effects (for example, by producing a temporary euphoric feeling—a "high"). Or, it may prevent (*block*) the *reuptake* of the neurotransmitter (for example, too much ACh flooding the synapses causes muscle contractions, convulsions, or even death). An *antagonist* drug, on the other hand, can stop (*inhibit*) the release of a neurotransmitter (for example, preventing the release of ACh from the sending neuron can cause paralysis). Or, it may *occupy* the receptor sites on the receiving neuron so the neuron cannot fire (for example, toxins such as curare fill the ACh receptor sites, and paralysis will result when the neurons cannot fire).