FOCUS ON VOCABULARY AND LANGUAGE

Biology and Behavior

Without our bodies, we would be *nobodies*. To say a person is a *"nobody"* means that he or she is not important, successful, or significant (that is, a nonentity). Another more literal meaning of this sentence is that, without a body, you would have *no body*—you'd be a *"nobody."* The humor here is derived from this double meaning. To feel, think, and behave, we need a *body* and, more importantly, we need a brain. Our sense of self feels as though it is inside our skulls *(you reside in your head)* and every idea, every mood, every urge is a biological happening. We love, laugh, and cry with our body *(everything psychological is simultaneously biological)*. In essence, biological influences and psychological influences are different aspects of the same thing *(they are two sides of the same coin)*.

Neural Communication

The story begins with the **nervous system's** basic *building block*, the ***neuron***, or nerve cell. *Building blocks* are the basic or fundamental parts (for example, the bricks) that make up a structure (for example, a house). The structure of our nervous system, or neural-information system, is made up of ***neurons*** (its *building blocks*).

A Neuron's Structure

Glial cells are worker bees. Here, the analogy 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 *(sheathe)* themselves *(glial cells are worker bees)*. *Glial cells* may also be involved *(play a role)* in information transmission, thinking, learning, and memory.

Researchers have tracked some **action potentials** *trudging along* at a *sluggish* 2 miles per hour, and others *racing along* at 200 or more miles per hour. The speed of the neural impulse ranges from extremely slow (*trudging along* or *sluggish*) to very fast *(racing along)*. Compared with the speed of electricity or sophisticated electronics systems, your neural impulses travel at a relatively slow pace. At their fastest, they are still 3 million times slower than electric current traveling *(zipping)* through a wire.

"Like *elegant ladies air-kissing so as not to muss their makeup*, **dendrites** and **axons** don't quite touch," noted poet Diane Ackerman (2004). The analogy here is to sophisticated females *(elegant ladies)* whose lips don't quite touch the faces of the people they greet (they are *air-kissing*) to avoid disturbing their facial cosmetics *(so as not to muss their makeup)*. Much like the small space between one lady's lips and her friend's cheek, there is a tiny gap separating the axon of a sending neuron and the dendrite or cell body of a receiving neuron. This gap (spatial *junction*) is called the **synapse**.

How Neurons Communicate

Most of these signals are *excitatory, somewhat like pushing a neuron's gas pedal*. 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 pushing on its gas pedal *(the excitatory effect)* or slowing it down by applying its brake *(the 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 don't, the party *(the action potential)* will happen *(the party's on)*.

How, then, do we distinguish a big hug from a gentle touch? This question is concerned with how we become aware of the magnitude of a stimulus, from a soft stroke or pat *(a gentle touch)* to a strong embrace *(a 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.

How Neurotransmitters Influence Us

. . . *a radioactive tracer* . . . This is a chemical substance with a *radioactive* isotope that can be attached to a molecule in the body, allowing researchers to detect its movement. When the *tracer* was attached to morphine, researchers found that the brain had natural opiate receptors. This, in turn, led to the discovery of **endorphins—neurotransmitters** linked to pain control and pleasure.

. . . *"runner's high"* . . . This refers to the feeling of emotional well-being or euphoria *(the "high")* following vigorous exercise such as *running* or jogging. It is the result of the release of **opiate**-like substances called *endorphins*. Myers notes that these neurotransmitters are part of the brain's natural pain-reducing and mood-elevating chemistry (*its own "feel-good" chemistry*).

Nature charges a price for suppressing the body's own neurotransmitter production. When flooded with mood-altering drugs such as heroin and morphine, the brain stops producing its own endorphins (that is, the drugs *suppress the body's own neurotransmitter production*). When the drugs are withheld or withdrawn the brain is deprived of any form of relief and the cost may be a great deal of pain and agony *(nature charges a price)*.

The Nervous System
The Peripheral Nervous System

Like an *automatic pilot*, this system may be consciously *overridden*, but usually it operates on its own *(autonomously)*. The **autonomic nervous system** (ANS) automatically takes care of the operation of our internal organs much as a plane can be flown by its onboard computerized, mechanical system (*automatic pilot* or *autopilot*). While the ANS is usually self-directed and independent *(autonomous)*, the system can be consciously taken over *(overridden)* in the same way that the real pilot can take over flying the plane.

. . . *macho swagger* . . . When Myers was having an **MRI (magnetic resonance imaging)** scan, he assured the technician—with a certain amount of masculine bravado or fearlessness *(macho swagger)*—that he had no anxiety about being confined in an enclosed space (he had no *claustrophobia issues*). Nevertheless, during his 20-minute confinement in the small, enclosed space *(the coffin-sized box)*, he experienced activation of both his **sympathetic nervous system** (which caused arousal) and **parasympathetic nervous system** (which caused calm). His two autonomic nervous system (ANS) subdivisions fluctuated up and down (he experienced an *ANS roller-coaster ride*) as he felt some claustrophobic anxiety and then calmed down.

The Central Nervous System

. . . *heart-of-your-smarts computing system* . . . Your brain is the central organ that makes you human—it governs your thinking, feeling, behavior, and intelligence (it is the *heart-of-your-smarts computing system*). Although it accounts for only 2 percent of your body weight, it uses 20 percent of your energy.

The brain's neurons *cluster* into *work groups* called *neural networks* . . . Myers points out that neurons communicate *(network)* with nearby neurons *(close neighbors)* via a short rapid connection. This is accomplished by *clusters* of interconnected neurons *(work groups)*. Neurons work with other nearby neurons for much the same reason people live *(cluster)* in cities—it is easier for brief, quick interactions. Learning occurs as experience builds and strengthens these neural connections *(neurons that fire together wire together)*.

. . . *two-way highway* . . . The spinal cord is similar to a large roadway or freeway *(highway)* but, instead of cars moving up and down in opposite directions, sensory and motor messages *(information)* travel between the **peripheral nervous system** and the brain. This *information* moves either up to the brain or down from the brain (it is a *two-way highway*).

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 (this is *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

The **endocrine system** and nervous system are therefore *close relatives*. These two systems share similarities, are intimately connected; like two members of the same family, they have much in common *(they are close relatives)* and, like family members, they also differ. 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 *(with text-message speed)* compared with endocrine system messages, which move relatively slowly *(more like sending a letter)*.

In charge of this whole *electrochemical orchestra* is *that master conductor* we call the brain. Myers is comparing the functioning of the neurotransmitters and hormones to a large group of musicians *(an electrochemical orchestra)* whose movements and actions are directed by their leader *(that master conductor)*, the brain.

The Brain
Close-Up: Tools of Discovery—Having Our Head Examined

Some use *microelectrodes* to *snoop on* the messages of individual neurons. Some attach larger electrodes to the *scalp* to *eavesdrop* with an **EEG (electroencephalograph)** on the *chatter* of billions of neurons. With today's technological tools, it is possible to unobtrusively monitor *(snoop on)* the messages of single nerve cells using extremely small wires *(microelectrodes)*. By attaching larger electrodes to the skin covering the skull *(scalp)* and using the EEG, it is possible to covertly listen to *(eavesdrop on)* the back-and-forth communication *(chatter)* of billions of nerve cells.

Others use scans that *peer into* the thinking, feeling brain and give us a *Superman-like* ability to see what's happening. Modern technological means of viewing the brain, such as the **PET (positron emission tomography) scan**, **MRI (magnetic resonance imaging)** scan, and **fMRI (functional MRI)**, provide us with a greater-than-normal *(Superman-like)* ability to look inside *(peer into)* 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.) As Myers points out, we are living in a period of great achievement and rapid progress *(the golden age)* of brain science.

. . . *glucose hogs* . . . To *hog* means to take an unfair share of something or to be greedy and selfish. When neurons are active, they consume more of the brain's chemical fuel, the sugar *glucose* (they are *glucose hogs*). Cognitive activity, such as doing math calculations, uses greater amounts of *glucose*, which can be tracked by the PET scan *(PET-scan "hot spots")*. Myers jokes that the *glucose* consumed during cognitive activity is like *"food for thought."*

Older Brain Structures

Here, you'll find a *peculiar* sort of cross-wiring, with most **nerves** to and from each side of the brain connecting to the body's opposite side. 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 *(the brainstem is a crossover point)*. The strange *(peculiar)* crisscross of nerves from one side to the other that occurs in the brainstem *(this cross-wiring)* is one of the many marvels or astonishing findings *(surprises)* about the brain.

. . . they made a *magnificent mistake*. James Olds and Peter Milner accidentally discovered *(stumbled upon)* a brain area that provides a pleasurable reward and then went on to find other similar areas. 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)*.

The Cerebral Cortex

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* or seed) inside the shell of a very large *(oversized) walnut*.

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).

In a sense, we *do* have *eyes in the back of our head!* This refers to the visual cortex of the **occipital lobes**, which processes visual information and is located at the rear of the brain. Thus, seeing is not done with the eyes alone but also involves specialized areas at the back of the brain. We need these areas to experience vision so, in a way, we *do* have *eyes in the back of our head!*

Their [the association areas'] silence has led to what Donald McBurney (1996, p. 44) called *"one of the hardiest weeds in the garden of psychology"*—the claim that we really use only 10 percent of our brain. 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 get rid of *("one of the hardiest weeds in the garden of psychology")*. Research into the **association areas** of the brain has shown that they do not have specific functions; rather, they are involved in many different operations such as interpreting, integrating, and acting on sensory information and linking it with stored memories. 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.

With his frontal lobes *ruptured*, Gage's *moral compass* had disconnected from his behavior. Phineas Gage's frontal lobes were severely damaged *(ruptured)* when an iron tamping rod 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*). As noted, frontal lobe damage can alter personality and eliminate a person's restraint and self-control (it can *remove a person's inhibitions*).

Ditto for religious experience. The word *"ditto"* means that whatever has just been said about someone or something applies equally to another person or thing. Memory, language, and attention are a function of synchronized activity among distinct brain areas; the same is true *(ditto)* for religious experience (for example, prayer and meditation). More than 40 different brain regions become active during these experiences, which suggests that there is not one isolated brain area devoted to belief in a deity *(there is no simple "God spot")*.

This plasticity helps explain why *deaf people* who learned *sign language* before any other may have better-than-average peripheral vision (Bosworth & Dobkins, 1999). People who cannot hear or are hearing-impaired *(deaf people)* and whose first or primary language involves communicating with hand signals *(sign language)* tend to have enhanced peripheral vision. The brain's ability to change or reorganize *(plasticity)* may account for this phenomenon.

Our Divided Brain

Waking from surgery, one even *joked* that he had a *"splitting headache"* (Gazzaniga, 1967). People have had their **corpus callosum** severed or cut to control epileptic seizures, and are thus called ***split-brain*** *patients*. Despite such a major operation, this patient managed to make fun of the situation *(he joked)* by saying that 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*.

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 people with split-brains and people with intact brains 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)*.

Brain States and Consciousness

Selective Attention

Now, suddenly, *the spotlight shifts. Your feet feel encased, your nose stubbornly intrudes on the words before you*. **Selective attention** refers to our tendency to focus on only a small part of what it is possible for us to experience. If you do attend to more aspects of your experience (if *the spotlight shifts*), you will be surprised at the amount of stimulation you process without awareness, such as

the feel of the shoes on your feet *(your feet feel encased)* and the fact that your nose actually blocks your line of vision *(your nose stubbornly intrudes on the words before you)*.

. . . *we pay a toll for switching attentional gears* . . . When talking on the phone or doing other tasks while driving, our selective attention will alternate, or switch back and forth, between monitoring driving conditions and these other competing activities *(we switch attentional gears)*. The consequence of doing this *(the toll we pay)* is a slight delay in coping with potentially hazardous circumstances. In experiments that simulated *(mimicked)* actual driving conditions, participants talking on cell phones were slower to detect and respond to traffic signals, roadside signs *(billboards)*, and other cars. Doing more than one thing at a time *(multitasking)* can also overload our attentional resources *(multitasking comes at a cost)*.

. . . they failed to notice a young woman carrying an umbrella *stroll* across the screen midway through the clip. In this experiment, viewers had to watch a video of basketball players and signal when the ball was passed. Because of their intense selective attention, they generally failed to notice a female walking slowly *(strolling)* through the players. In a replication of this study, the investigators had a colleague in a gorilla costume *(a gorilla-suited assistant)* walk through the twisting, turning participants *(the swirl of players)* beating his fists on his chest *(thumping his chest)*. Fifty percent of the viewers failed to notice the gorilla! This failure to see visible objects when attention is directed elsewhere is called **inattentional blindness**.

Out of sight, out of mind. This refers to our tendency to stop thinking about something *(out of mind)* that is no longer in our visual field *(out of sight)*. In an experiment, two-thirds of the participants failed to notice that the person they were giving directions to had been replaced by another person during a brief visual interruption. This failure to notice changes in the environment is called **change blindness**.

Sleep and Dreams

Try *pulling an all-nighter*, or working an occasional *night shift*. You will feel *groggiest* in the middle of the night but may *gain new energy* around the time you would normally wake up. If we decide to stay up all night *(pull an all-nighter)* or have to work during the night *(work a night shift)*, we feel most mentally confused and uncoordinated *(groggiest)* about halfway through the night. But we may feel more lively and vigorous *(gain new energy)* close to the time we would normally wake up.

. . . "owls" . . . "larks" . . . Like birds that are nocturnal (*owls* are an example), many younger adults stay up late and are lively at nighttime (they are *evening-energized "owls"*). As we get older, we are more energetic in the morning *(morning-loving "larks")* and our performance tends to decline as the day progresses—much like birds that wake and become active with the dawn of a new day (*larks* are birds that do this).

. . . Aserinsky watched the machine *go wild*, tracing *deep zigzags* on the graph paper. The discovery of **REM (rapid eye movement) sleep** occurred accidentally. To see if an EEG *(electroencephalograph)* was working properly, Aserinsky placed the electrodes near his 8-year-old son's eyes. Periodically during the night the machine responded vigorously *(went wild)*, producing a pattern of high-frequency waves *(deep zigzags)* on the printout. These patterns were produced by rapid, spasmodic *(jerky)* eye movements and accompanied by very frantic brain activity. When awakened during one of these periods, the boy said he was dreaming.

. . . *saw-toothed* . . . The cutting edge of a *saw* is serrated; its jagged surface resembles a row of pointed teeth *(saw-toothed)*. During REM sleep, when most **dreams** occur, your brain waves resemble fast, uneven NREM-1 waves (they are *saw-toothed*). However, unlike NREM-1 sleep, REM sleep is characterized by internal physiological arousal and, paradoxically, near-paralysis of muscles.

As the night *wears on*, deep NREM-3 sleep grows shorter and disappears. As the night progresses *(wears on)*, the time spent in NREM-3 deep sleep gets shorter and eventually ceases altogether, while time spent in REM and NREM-2 sleep periods increases. We spend 20 to 25 percent of an average night's sleep in REM sleep and about 50 percent in NREM-2 sleep.

*When **consciousness** leaves your house, brain construction workers come in for a makeover*. One theory of why we **sleep** suggests that sleep helps repair and restore brain tissue. In much the same way that *construction workers* may carry out repairs and renovations when the house is unoccupied *(they come in for a makeover)*, the brain uses the time when we are not actively alert and awake *(when consciousness leaves your house)* to repair and restore brain tissue.

After working on a task, then *sleeping on it*, people *solve problems* more insightfully than do those who stay awake (Wagner et al., 2004). People who go to sleep after working on a task *(they sleep on it)* are more innovative at finding solutions to puzzles *(solving problems)* than those who stay awake. Sleep is beneficial for imaginative and original thinking *(sleep feeds creative thinking)*, for improving *(boosting)* learning and memory, and for thinking more intelligently *(thinking smart)*. To enhance these cognitive skills, it is a good idea to get sufficient sleep *(it often pays to sleep on it)*.

When the going gets boring, the students start snoring. Teenagers get much less sleep than they need and are often seriously sleep deprived *(they run up a sleep debt)*. As a result, they are very likely to fall asleep during class, especially during routine lectures *(when the going gets boring, the students start snoring)*. Sleep deprivation can result in difficulty studying, diminished productivity, a tendency to make mistakes, depression, weight gain, immune system suppression, irritability, and fatigue.

. . . *"spring forward" to daylight savings time and "fall backward" to standard time*. Many countries adopt *"daylight savings" time*. This means that people move their clocks ahead one hour in the spring (*"spring forward"*) and back one hour in the fall (*"fall backward"*). Consequently, people lose one hour of sleep in the spring, which results in more traffic accidents on the Monday following the Sunday time change; with the extra hour of sleep in the fall, traffic accidents decline on the Monday following the time change.

. . . *cyberloafing* . . . To *loaf* means to be idle and do very little, so *cyberloafing* refers to wasting time on the computer without accomplishing very much *(frittering away time online)*. Being sleep deprived and unable to concentrate leads people to engage in meaningless, nonproductive computer activity *(cyberloafing)*.

Many others with true insomnia turn to *popular quick fixes*, such as sleeping pills and alcohol. The most common fast remedies *(popular quick fixes)* for **insomnia** are sleeping pills and alcohol. Unfortunately, they can aggravate the problem by suppressing REM sleep, and the next day the person may have less energy and feel very tired and listless (may suffer *the next-day blahs*). Having to take increasing doses to produce an effect *(tolerance)* is another problem associated with the use of sleeping pills and alcohol.

As a traffic menace, "*snoozing is second only to boozing*," said the American Sleep Disorders Association, and those with narcolepsy are especially at risk (Aldrich, 1989). Falling asleep *(snoozing)* while driving is almost as serious a problem as drinking *(boozing)* and driving. People with **narcolepsy** suffer from occasional periods of uncontrollable sleepiness often associated with emotional arousal, and are thus in danger, and dangerous, while driving.

Few dreams are sweet. Dreams during REM sleep are vivid, emotional, and often very strange *(bizarre)*. Not many dreams are pleasant, desirable, and satisfying *(few dreams are sweet)*. About 80 percent of both men's and women's dreams are troublesome (are *bad dreams*)—they have the common themes of failing in an attempt to do something; being attacked, pursued, or rejected; and experiencing misfortune.

He [Freud] proposed that *dreams act as a safety valve*, discharging feelings that cannot be expressed in public. The story line of the dream (its **manifest content**) is a disguised version of the real, but hidden, meaning of the dream (its **latent content**). According to Sigmund Freud, by symbolically expressing our hidden desires and erotic wishes, dreams allow us to ventilate unconscious drives that might otherwise be harmful *(they act as a safety valve)*. (A *safety valve* allows a system to dissipate built-up pressure and thus may prevent an explosion.)

Freud's critics say it is time to wake up from Freud's dream theory, which is a scientific nightmare. Myers is having some fun with a play on words here. The expression "it is time to wake up from something" means one should start paying attention to reality and facts, rather than fantasy; to say something is *"a nightmare"* means that it is unruly, difficult, or even frightening. Most contemporary psychologists believe that REM sleep and dreams are important aspects of our life but that Freud's theory of dream interpretation is erroneous, unscientific, and misguided *(a nightmare)*; thus, we should not place much reliance on its explanations *(it is time to wake up from it)*.

Sleep researcher Robert Stickgold (2000) believes many students suffer from *a kind of sleep bulimia, binge sleeping* on the weekend. The weekday sleep deprivation leaves not enough time for *memory consolidation*. Studies demonstrate that sleeping helps memory and learning through the process of *memory consolidation*—the sleep-aided conversion of new memories into stable long-term memories. The areas of the brain that are active when learning is taking place are active once more during REM sleep. This is important news for sleep-deprived students who tend to learn and remember less than their non-sleep-deprived counterparts. Attempting to make up for sleep loss by sleeping longer and later on weekends *(a kind of sleep bulimia—binge sleeping)* will not compensate for the lower levels of learning and recall. (Note that *bulimia nervosa* is an eating disorder characterized by uncontrolled eating episodes, or *binge* eating.)

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 with what yet remains to be discovered. We live in a time when the rate of discovery about the interaction of our biology, behavior, and mental processes is truly exciting and awe-inspiring *(breathtaking)*. Yet, we still want to know how the mind and consciousness emerge out of the electrochemical activity *(whir)* of brain tissue *(how do we get mind out of meat?)*. As scientist John Barrow notes, "a brain simple enough to be understood is too simple to produce a mind able to understand it."