What You Should Know About Your BRAIN

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Although the brain is an amazing organ, it's not equipped to process the billions of bits of information that bombard it every second. Filters in your brain protect it from becoming overloaded. These filters control the information flow so that only approximately 2,000 bits of information per second enter the brain.

The Thinking Brain and the Reactive Brain

Once sensory information enters the brain, it's routed to one of two areas: (1) The *prefrontal cortex*, what we might call the thinking brain, which can consciously process and reflect on information; or (2) the lower, automatic brain, what we might call the reactive brain, which reacts to information instinctively rather than through thinking. The prefrontal cortex is actually only 17 percent of your brain; the rest makes up the reactive brain.

When you are not stressed by negative emotions, you can control what information makes it into your brain. By calming your brain, you can control which sensory data from your environment your brain lets in or keeps out—and influence which information gets admitted to your prefrontal cortex.

When your stress levels are down and your interest is high, the most valuable information tends to pass into your thinking brain. When you are anxious, sad, frustrated, or bored, brain filters conduct sensory information from the world around you into your reactive brain. These reactive brain systems do one of three things with the information: ignore it; fight against it as a negative experience (sending signals that may cause *you* to act inappropriately); or avoid it (causing you to daydream). If information gets routed to this reactive brain, it's unlikely your brain will truly process the information or remember it.

Three major brain elements help control what information your brain takes in: the reticular activating system, the limbic system, and the transmitter dopamine. Let's look at how you can help each one work in your favor.

RAS: The Gatekeeper

The first filter that data passes through when entering your brain is the reticular activating system (RAS). Located at the lower back of your brain (your brain stem), the RAS receives input from sensory nerves that come from nerve endings in your eyes, ears, mouth, face, skin, muscles, and internal organs and meet at the top of your spinal cord. These sensory messages must pass through the RAS to gain entry to your higher, thinking brain.

You will learn more successfully if you keep the RAS filter

pen to the flow of information *you* want to enter your prefrontal cortex. If you build your power to focus your attention on the sensory input that is most valuable and important to attend to at the moment, the important input will make it into your thinking brain. If you feel overwhelmed, your reactive brain will take over. Then, what you experience, focus on, and remember will no longer be in your control. It's the difference between *reflecting on* and *reacting to* your world.

➠ *What You Can Do*

A key to making your brain work optimally, then, is to keep yourself physically healthy and well rested and to develop awareness of—and some control over—your emotions. Then you can approach learning calmly and with positive emotions.

Practice focusing and observing yourself, for example, by taking a short break from work to check in with your emotions. Just take a few minutes to think about what you're feeling. If it's a good feeling, take time to enjoy it and consider how your good emotional state affects your thinking. Do you understand more and get ideas about what you might do with the information you're learning? If you don't like the way you're feeling, think about times you've felt a similar negative emotion (like anxiety or loneliness). What has helped you return to a better mood in the past?

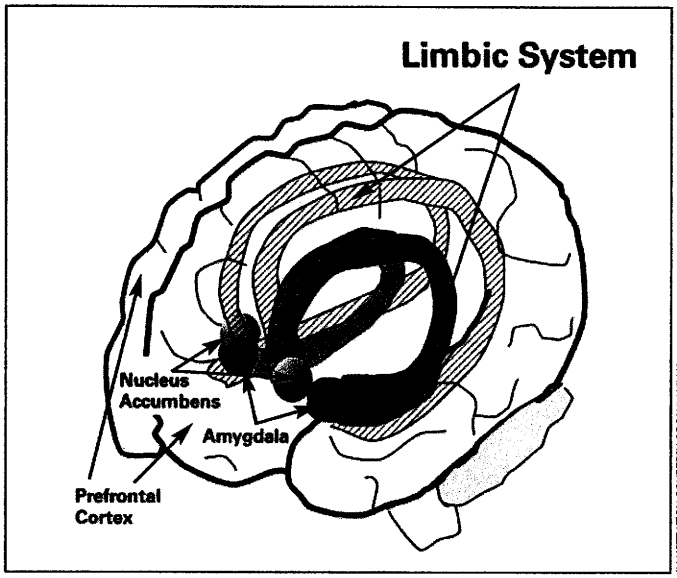
Even though you're not sleeping, you can think of such rain breaks as "syn-naps" because they let your brain replenish neurotransmitters like dopamine (which we'll discuss shortly). As you become aware of your emotions, you build brain networks that help you control your actions with your thinking brain. It also helps to do something active during a short break—such as toss a ball back and forth with a classmate, saying a word related to your lesson each time you catch the ball.

The Limbic System: Your Emotional Core

After the information coming in through your senses gets through the RAS, it travels to the sensory intake centers of your brain. New information that becomes memory is eventually stored in the *sensory cortex areas* located in brain lobes that are each specialized to analyze data from one of your five senses. These data must first pass through your brain's emotional core, the *limbic system*, where your *amygdala* and *hippocampus* evaluate whether this information is useful because it will help you physically survive or bring you pleasure.

The Amygdala

The amygdala is like a central train-routing station; it's a system for routing information based on your emotional state. When you experience negative emotions like fear, anxiety, or even boredom, your amygdala's filter takes up excessive amounts of your brain's available nutrients and oxygen. This



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The shaded areas show major components of the limbic system deep within the brain.

puts your brain into survival mode, which blocks entry of any new information into your prefrontal cortex.

For example, suppose your day starts off badly. You overslept, had no time for breakfast, and have too many things to do before school. You're worried about whether your friends will sit with you at lunch and afraid that the mean kid in your class will say hurtful things to you.

It's not only your body that suffers on this kind of day: Your brain is also stressed. This stress closes off the pathways through the RAS and amygdala that direct information into your thinking brain and memory centers. Unless you restore a positive mood, you won't learn much on this particular school day. But if you can turn things around to become calm and focused, your amygdala will "decide" to send new information to your prefrontal cortex.

➠ *What You Can Do*

Slow down and take a moment to reflect instead of react when you take a test at school or face social conflicts with friends. You might take a deep breath and visualize yourself in a peaceful place. Another technique that helps you choose what to do with your emotions—something only humans can do—is to imagine you're directing yourself in a play. You are the director sitting in a balcony seat watching an actor (the emotional you) on stage below. What advice would you give the emotion-filled actor on the stage if he or she had been pushed by a classmate and wanted to hit back, for example? This technique helps you move away from using your reactive brain and tap your thinking brain, where memories that might help you are stored.

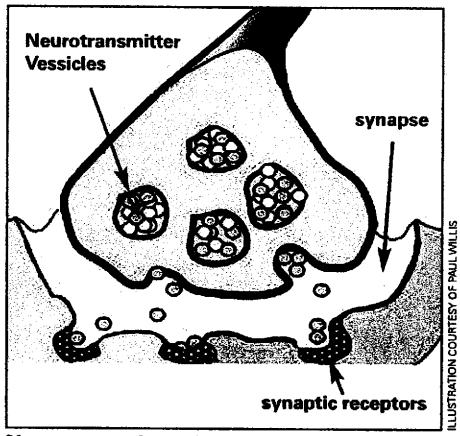
Your teachers play a role too. If your teachers set up lessons

to include some fun activities so that you feel good during a lesson, your amygdala will add a neurochemical enhancement, like a memory chip, that strengthens the staying power of any information presented in the lesson. People actually remember more of what they hear and read if they are in a positive emotional state when they hear or read it.

The Hippocampus

Next to the amygdala is the *hippocampus*. Here, your brain links new sensory input to both memories of your past and knowledge already stored in your long-term memory to make new *relational memories*. These new memories are now ready for processing in your prefrontal cortex.

Your prefrontal cortex contains highly developed nerve communication networks that process new information through what are called *executive functions*, including judgment, analysis, organizing, problem solving, planning, and creativity. The executive function networks can convert short-term relational memories into long-term memories. When you are focused and in a positive or controlled emotional state, your executive functions can more successfully organize newly coded memories into long-term knowledge.



Neurotransmitters like dopamine carry messages across the synapse.

➡ *What You Can Do*

Reviewing and practicing something you've learned helps. Nerve cells (neurons) forge information into memories by sending messages to other neurons through branches—called axons and dendrites—that almost touch the branches of each neighboring neuron. It takes lots of connections between neurons to relate each neuron's tiny bit of information to that of other neurons so that all the bits add up to a complete memory. When you review or practice something you've learned, dendrites actually grow between nerve cells in the network that holds that memory.

Each time you review that knowledge, this mental manipulation increases activity along the connections between nerve cells. Repeated stimulation—for example, studying the times tables many times—makes the network stronger, just like muscles become stronger when you exercise them. And that makes the memory stay in your brain. Practice makes permanent.

When you review new learning through actions, using the knowledge to create something, solve problems, or apply it to another subject (such as using the times tables to measure the areas of paintings for framing them), this mental manipulation strengthens the neural pathways and your brain becomes even more efficiently wired.

Dopamine: Feeling Good Helps You Learn

Dopamine is one of the brain's most important *neurotransmitters*. Messages connected to new information travel from neuron to neuron as tiny electrical currents. Like electricity, these messages need wiring to carry them. But there are gaps, called *synapses*, between the branches that connect nerve cells and there's no wiring at these gaps. Chemical neurotransmitters like dopamine carry electrical messages across the gap from one neuron to another. This transmission is crucial to your brain's capacity to process new information.

Your brain releases extra dopamine when an experience is enjoyable. As positive emotions cause dopamine to travel to more parts of your brain, additional neurons are activated. Thus a boost in dopamine not only increases your own sense of pleasure, but also increases other neurotransmitters, such as acetylcholine, that enhance alertness, memory, and executive functions in the prefrontal cortex.

➡ *What You Can Do*

Certain activities, such as interacting with friends, laughing, physical activity, listening to someone read to you, and acting kindly increase dopamine levels. You'll boost your learning if you get them into your day.

Experiencing pride at accomplishing something is also correlated with higher dopamine. It will increase your learning power if you pursue activities that give you a sense of accomplishment. Think about your personal strengths, such as artistic ability, leadership, helping classmates resolve conflicts, athletic skill, or even qualities like optimism, kindness, and empathy. Use these skills to do projects you want to do—and do them well—and you'll find you can use your brain power more successfully to make judgments and solve problems.

You now have the power to use your most powerful tool to achieve the goals you choose. Congratulations on the dendrites you've grown along the way!

Judy Willis, MD, practiced neurology for 20 years; she currently teaches at Santa Barbara Middle School in California and conducts professional development workshops. She is the author of *Teaching the Brain to Read: Strategies for Improving Fluency, Vocabulary, and Comprehension* (ASCD, 2008); www.RADTeach.com; jwillisneuro@aol.com.