NEUROSCIENCE

3. 12 BRAIN RULES

Note: Brain Rules: 12 Principles for Surviving and Thriving at Work, Home, and School was written by John Medina, a developmental molecular biologist and research consultant. Brain Rules consists of 12 chapters which try to demonstrate how our brains work. Each chapter demonstrates things scientists already know about the brain, and things we as people do that can affect how our brain will develop. In this book, the reader will also discover amazing facts about the brain such as the brain's need for physical activity for it to work at its maximum potential. Knowing the 12 rules about brain function can help you learn better and stay smarter.

3.1. Rule #1 – Exercise Increases the Brain Power: EXERCISE

Physical activity is vital to keep your body and mind working in tip-top shape. Retired television exercise guru, Jack La Lanne, is a perfect example. At age 70, he celebrated his birthday by swimming across California's Long Beach Harbor pulling 70 boats with passengers onboard. His history of exercising and eating well contributed to his perennially quick wit and agile humor. Anthropologists note that the first humans roamed in search of food, covering dozens of miles a day, so their brains evolved to handle regular physical activity. Because human brains were first forged in the furnace of physical activity, if you want to use your entire IQ you must exercise. Inactive couch potatoes lose mental facilities along with physical capabilities. To regain your mental abilities, get aerobic exercise, even if you have neglected yourself. Just walking half an hour a few times a week will boost your cognitive output and reduce your risk of dementia. Children who find concentrating difficult will benefit from physical activity. Exercise makes oxygen flow more efficiently through the blood and into the cells, cleaning up toxic wastes left behind by food metabolism. When you move you're keeping your brain cells healthy. More than food or water, your brain, which consumes 20% of your body's energy, requires oxygen to function. Exercise also makes your mental engine run cleanly. Unfortunately, modern civilization requires people to sit for long periods without moving. If schools and offices incorporated physical activity, students and staffers would get smarter, healthier and more productive.

3.2. Rule #2 – The Human Brain Has Also Evolved: SURVIVAL

There is one section of the brain, the cortex, which sets the human brain apart from any other species. This part of our brain helped our ancestors to discover the importance of relationships. By simply working together, we could learn from each other and protect each other. Much of our lives today are based around our relationships with people. It is one of the driving forces in everything we do. Our ability to learn has deep roots in relationships. To learn effectively we must feel comfortable with the one who is teaching us. When we trust the teacher, we are more willing to receive the information and skills they are trying to pass down. To sum up this chapter in one sentence, "We became, we changed, and we're still changing." The human species is weak, but brainpower helped people survive and thrive. Humans have a great capacity to adapt. Over thousands of years, thanks to their powerful brains, people adjusted to changes in climate and food supply, and came to dominate the planet. Their advanced brains also allow them to "read" each other and negotiate. Your brain's memory is an informational "database," and you use mental "software" to improvise and solve problems. You may perform best with encouragement and be unable to perform as well near someone who threatens you.

3.3. Rule #3 – Every Brain Is Wired Differently: CONNECTION

Each person's brain develops at different pace and in different patterns, with no two people having the same brain roadmap. Students learn complex knowledge at different times and different depths. Nerve cells, known as neurons, look a bit like fried eggs that have been stepped on. The yolk holds important genetic coding. The long tentacle-shaped edges transmit and receive electrochemical messages at blinding speed. This is the cellular basis of learning. The brain's neural connections are in constant flux. Your specific brain structure depends on your culture and other external inputs. A musician's brain has different cellular wiring than scuba divers. As children grow, so do their brains. Key brain growth occurs up until the early 20s and changes can continue for decades. Many researchers have worked to understand intelligence and to map how the brain functions. Some even believe there are multiple types of IQ. One person might be great at math while another excels at physical movement. Different parts of the brain are activated for different memories and skills, so your brain scan looks different than anyone else's, even a twin's.

3.4. Rule #4 – We Do Not Pay Attention to Boring Things: CARE

When you find something boring, you don't pay close attention and you can't retain the content. So when you're giving a presentation, capture the audience's interest as soon as you can, because you want your audience to focus. Multitasking is a recipe for inefficiency and danger. In fact, multi-taskers are prone to 50% more errors and take 50% longer to finish a task than people who do one thing at a time. Studies say that chatting on your cell phone while you're behind the wheel of an automobile is as dangerous as driving under the influence of alcohol. People remember emotional situations longer than calm ones for neurochemical reasons. During emotional events, your brain releases a neurotransmitter called dopamine, which is associated with attention and rewards as it helps you cement the memories. At stressful moments, the brain doesn't pick up details. It focuses on the big picture. If you're trying to teach someone, present the key ideas and, in a hierarchical fashion, form the details around these larger notions. Finally, provide information in 10-minute chunks and use entertaining hooks between those chunks.

3.5. Rule #5 – Repeat to Remember: SHORT-TERM MEMORY

Containing many types of memory systems to encode, store, retrieve and forget our brain gathers information by fragments. For example, the faster people talk the more we are able to remember at a time because it is received in chunks rather than one continuous memory. The more we encode a memory the stronger it is. Just like math you must practice something to remember it. Constantly putting the same situation into your brain helps to strengthen the memory. An encoding test can be made by answering different questions. One example is to read the word football. After reading the word, ask if that word fits the sentence; "I turned to fight____"? Obviously no, it does not make sense to put football in the blank space. We as people are able to recognize that the word football does not make sense in that sentence, by using encoding. Encoding means to convert data into code, a code that involves translating information from one form into another. It is a manner in which we apprehend, pay attention, and ultimately organize information for storage purposes. The brain is capable of performing several types of encoding. One encoding is automatic and can be illustrated by talking about what you had for dinner. Information is remembered best when it is elaborate, meaningful, and contextual. The more a learner focuses on the meaning of the presented information the more elaborately the encoding is processed. When trying to learn information we need to make sure to understand exactly what the information is. Information is immediately split into fragments to different regions of the cortex

for storage.

When you can recall a piece of information immediately, it is stored in your short-term or working memory. To make a memory last longer, repeat it and link it to something familiar. For instance, students forget 90% of a classroom lesson in less than a month, but going over the material at regular intervals and associating one piece of data with another will improve their retention rates. Information in a list of unrelated items is harder to recall than material with meaningful connections to something familiar. Thus, people learn better when they can refer to familiar examples.

3.6. Rule #6 – Remember to Repeat: LONG-TERM MEMORY

Although very few memories stay with a person throughout their whole life the ones that do stay get stronger every time you bring back the memory. Long-term memories are formed between the hippocampus and the cortex. The hippocampus breaks the connection and the cortex repairs each memory. This process is very lengthy, but is more stable when it comes to having to remember. Most memories are stored together so having a memory from the past and one from a more recent moment could combine and impose as the same memory. It takes many years to solidify a memory into the brain. During the process of solidifying a memory repetition is key, because when an action is repeated the action is engraved into the brain for a short amount of time and the more times it is repeated the easier it will be to remember the action. Another tool that can be used to help remember something is association. By associating an object or action with a memory that is already engraved into the mind it forms a link that can be used to remember the action or object that is being remembered. The current model for memory retrieval in the brain is Step 1 where long-term memories occur from the accumulation of synaptic changes in the cortex as a result of multiple reinstatements of the memory. During Step 2, these reinstatements are directed by the hippocampus, perhaps for many years. During Step 3, eventually the memory becomes independent of the medial temporal lobe, and this newer, more stable memory trace is permanently stored in the cortex. During Step 4, retrieval mechanisms may reconstruct the original pattern of neurons initially recruited during the first moments of learning.

Sound and images enhance short-term memory, but you won't retain information in your long-term memory without a stabilizing process called consolidation, and subsequent recall and repetition, or reconsolidation. Stored memories are more malleable than you might expect. Today's fresh memories can fade after a few

years, forcing your brain to struggle to recall the specifics of events that once were clear. Studies show that the brain might cheerily insert false information to make a coherent story. This has disturbing implications for the value of witnesses in a court of law, among other things. If you want to retain something, be deliberate. For example, ignoring your homework and then studying all night before a test is counterproductive. You will do better by spacing out multiple study sessions. To retain specific information, you need to think about the information within the first hour or so after you learn it. Immediately speak to other people about it in great detail. Have a good night's sleep and rehearse the information again afterward.

3.7. Rule #7 – Sleep Benefits Cognition: SLEEP

The human body increasingly malfunctions when deprived of sleep. If you are sleepless for a few days, in addition to severe fatigue, you will experience stomach upsets, crankiness, poor memory recall, disorientation, and eventually paranoia and hallucinations. For about 80% of the time you spend asleep, your brain doesn't really rest. Brain scans show enormous electrical activity among the neurons, even more than when you are awake. The body has a delicate control process, called the circadian cycle, which keeps you alternating between wakefulness and sleep periods. An individual's preferred sleep timeframe varies genetically. Early birds (called larks and early chronotypes by scientists) make up about 10% of the population; another 20% of people are late nighters (called owls and late chronotypes). Everyone else falls midrange on the continuum. Your brain slows in the afternoon, but a nap can work wonders. Napping for 45 minutes will turbo-charge your brain for six hours. Conversely, students who skip even an hour of sleep each night face a dramatic drop in academic performance. Sleep deprivation impairs attention, executive function, immediate memory, working memory, mood, quantitative skills, logical reasoning ability, and general math knowledge. Wouldn't it be great to match job schedules with people's inherent sleep patterns? As an idea, a later school day would address teenagers' normal tendency to sleep late.

3.8. Rule #8 – Every Brain Is Wired Differently: STRESS

A little bit of stress heightens your ability to learn, but ongoing, chronic stress damages brain function. Chronic stress can cause a phenomenon called learned helplessness, in which people simply give up hope and no longer engage their brains or try to solve problems. During times of stress, people experience a fight or

flight response. The resulting blood pressure rise and racing pulse are detrimental over the long term, raising the risk of strokes and heart attacks. Chronic stress worsens your ability to work with numbers and language. When you are seriously stressed, you don't learn as well and have difficulty concentrating, remembering and solving problems. Chronic stress can lead to acute depression. One kind of stress has serious implications for children. For example, kids who live in homes where parents fight constantly have more difficulty regulating their emotions, soothing themselves, focusing their attention on others, and are more often absent from school. Their ability to learn, study and remember is so diminished that their test scores drop.

3.9. Rule #9 – Stimulating Multiple Senses Facilitates Learning: SENSORY INTEGRATION

Throughout our lives, we are constantly learning while using our senses. An important factor in sensory integration is perception. There are three steps on how perception is created. First is sensation, when as individuals, we capture the energies from our environment and push them onto our orifices and rubbing against our skin, forming brain friendly electrical language. Second is routing, when the sensation is translated into head-speak and sent off to the appropriate regions of the brain for further processing. Third and final is the perception formed, when the various senses merge and sent to brain perceiving what our perception is. However, no scientist is entirely sure of how brain perception works. Although Medina did arrive to this conclusion: the sensory information absorbed in an event through our sense translates into electrical signals, dispersing in different parts of the brain, perceiving the event as a whole. This can be concluded with the majority of scientists. Furthermore, Medina states the brain relies on past experiences to decide how to combine these signals. Thus two people can perceive the same event in very different ways. Next, all the senses have evolved over time to work together. For example, an individual's vision influences their hearing which implies that learning is at its best when stimulated with several senses at once. In addition, Medina explains that the sense of smell has the gift of bringing back memories. He theorized that the sense of smell bypasses the thalamus and heads straight its destination, which includes the site of emotions known as the amygdala. Having this in mind, Medina's dream school setting would incorporate multiple senses in a school setting and the specific scents in a work/business setting, thus enhancing our level of learning.

3.10. Rule #10 – The Vision is the Most Important of the Senses: VISION

This chapter is called vision as it is the 10th brain rule. In this chapter, John Medina discusses human vision and how it outplays all the other senses. Vision is the most dominant of all the senses, yet it is not 100% accurate. Our view of the world is not what the brain tells us, rather it is an estimate. Using previous knowledge and the surrounding view, our brain fills in the gaps in our vision. These gaps or black holes are caused by a region in the eye where retina neurons, carrying visual information, gather to begin their journey into deep brain tissue. This place is called the optic disc and in this region there are no cells that can recognize sight, thus it is blind here. The brain is so powerful that it can fill in these gaps instantly. The brain has to work very hard in order for us to see, this causes it to use up a lot of its thinking resources. Vision is the most important tool for learning. Visual input of pictures is more likely to be remembered and recalled than visual input of texts. It is more work for our brains to remember texts because the brain sees words as many tiny pictures. Texts are a lot like pictures and it takes our brains longer to make sense of them. Even when we read something, we try to visualize what we are reading. The visual and smell senses are battling it out to see which one will dominate, and so far the visual sense is winning. Many of our other senses have been harmed by our vision because what we see alters what is real.

3.11. Rule #11 – The Brains of Men and Women Work Differently: GENDER

Throughout our society, men and women have faced their own separate challenges for their representation, women having a tougher fight. For example blacks had the ability to vote before the female sex could. Now as time counts on, women and men are more intermixed in society than ever before. People have a different perspective and standards for men then they do towards a woman. In this chapter, Medina talks about a study of how two groups were to rate two different bosses, one being male boss and the other female. The end results, the male and female were both competent, but the female was less likable. While both sexes go through the same process of being created at birth we don't necessarily take the same DNA. Women are made up of 2 X chromosomes while men are made up of 1 X and 1 Y. Scientist know that X chromosomes carry brain function genes. This is why males are more likely to have down syndrome rather than a female because a female can simply ignore one of the X chromosomes.

3.12. Rule #12 – We Are Natural Explorers: EXPLORATION

Medina focuses on Andrew Metzoff's incredible discovery of babies being able to learn soon after birth. He tried this theory on his own son Noah, within 30 minutes after he was born, the baby was imitating Medina as he stuck his tongue out at him. Continuing to stick his tongue out at Noah for months to come, the seemingly uninformed baby was learning to predict when he would expect to see this. Every time they saw each other, Noah and his father greeted one another with a stuck out tongue. Noah had, at nearly minutes old, taught himself by observation how to control certain parts of his body. By using a hypothesis, experimenting, and finally coming to a conclusion, John Medina's infant son had accomplished mirroring. This just reinforces that humans are born ready to learn, they are not a blank state until a certain age but are utilizing neurons from day one. As infants become toddlers, they act like little scientists, constantly examining their environment, and testing cause and effect. Their brains are busy gaining data and concepts to help them navigate their circumstances. The adult brain remains flexible and plastic. People are able to learn throughout their life spans.