The Role of Neuroplasticity in Learning

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Abstract

Neuroscience is one of the greatest supporters in the understanding of human physiology and what actually makes us who we are. How do we learn? Why do some people learn things more quickly and easily than others? We will go on a journey inside the most complex organ in the universe learning more about the science of Neuroplasticity while we try answering these questions. After reading this article, you will leave with a new recognition of how majestic your brain is. Your plastic brain is regularly and continually being formed by the world around you. That change can be for the better and even for the worse. Understanding that everything you do, encounter, and experience can change your brain is a crucial thing. Moreover, learning is not that easy. It involves a physical structure change to your brain and in order to do that you have to practice, exercise, and struggle more to achieve your dream.

I. Introduction

Everything we understand about the brain is developing at a stunning and astonishing pace; what we thought we understood about the brain turns out to be inaccurate and incomplete. For example, we used to believe that the mind couldn't change after childhood, which is a misconception. Another misconception is that the brain is silent when we are at rest; however, it turned out that even when we are thinking of nothing, our brain is extremely active. Later, many progressions in technology such as MRI allowed us to make many important discoveries. Perhaps the most exciting and intriguing one is that the brain is changing every time we learn a new fact or skill. Our brain is actually changing with every single behavior we do. It is what we call the science of Neuroplasticity.

The brain could change in two different ways to sustain learning. The first one is in a chemical way such that the brain works by transferring chemical signals between neurons and this triggers a sequence of actions and reactions, but this only supports short-term improvement. The second is by modifying its physical structure during learning since the brain can actually alter the connections between neurons changing the arrangement and composition of the brain and it takes more time. This is related to long-term improvement. Structural changes also can form integrated networks and regions that function together for learning and create specific regions essential for particular behaviors, changing the structure of the brain in the process [1].

II. The Brain

Did you know obviously that your brain is needed for everything we do - how we think, feel, and act. The brain is the most complex organ; there is nothing as complex as the human brain. It is reckoned that the brain ought one hundred billion nerve cells, and every two cells are not connected to each other in a one-to-one connection but up to ten thousand individual connections. So, fun fact: you have more connections in your skull than there are stars in the universe. Moreover, even though your brain is 2% of your body weight, it uses 20-30% of the calories that you consume. So, about the breakfast you had this morning, almost the third of it goes to feed this 2% of your body's weight [2].

Furthermore, the brain is the main organ of personality, character, judgment, and innovation. So, when your brain works right, your work is excellent; and when your brain has trouble, you are much more likely to have trouble in your life. With a healthier brain, it is fairly clear that you are happier, healthier, wealthier, wiser, and more creative. The health of the brain either accelerates innovation or decelerates it, and the thing that affects your brain health is your behavior. Your behaviors and what you learn every day affect the brain directly in the way of neuroplasticity. By using MRI technology, we can get images of the brain as shown in figure 1 where the first and third rows belong to the "Normal" category whereas the second and fourth rows belong to the "Abnormal" category [3].

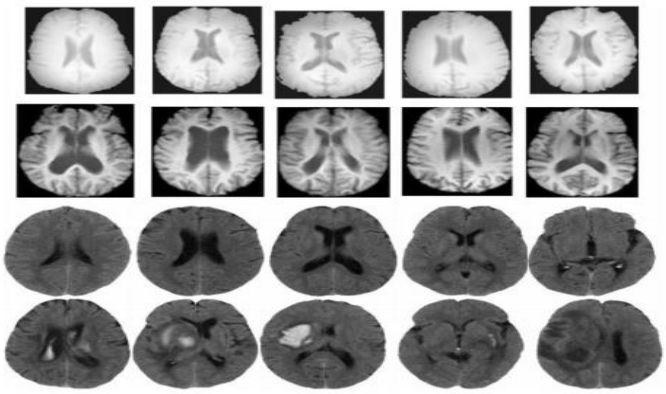

Figure 1: MRI images of healthy and unhealthy brains

III. An Intriguing Case Study

An interesting example of how learning changes our brain structure for the better of keeping it healthy is that bilingualism provides a protective mechanism against age-related cognitive decline, which was examined by a recent study by Jubin Abutalebi and David Green. These authors observed a group of aging participants from Hong Kong, who spoke either English and Chinese or Mandarin and Cantonese, then analyzed the brain structure and language performance of them with another group of monolinguals, whose mother language is Italian, in a picture-naming task in which L1 (monolinguals and bilinguals) and L2 (bilinguals only). The two groups were about the same age (mean age of 62), education, and cognitive abilities. The collected data showed that bilinguals had a greater GM (gray matter) amount than monolinguals, particularly in the left anterior division of the temporal pole (TP). Further ROI-based examinations also showed that the naming performance of the L2 group was positively proportional with the GM amount in the left TP. The authors inferred that the TP might play a significant role in bilingual lexical conceptual processing and that bilingual knowledge works as a protective factor to the rapid reduction of GM amount in this region in normal aging. Moreover, in figure 2, a representation of the regions that show increased GM amount with group comparisons of Bilinguals vs Monolinguals [4].

IV. You have to do the work!

The main operator of the modification in the brain is nothing but our behavior. So, there is nothing called a drug for neuroplasticity. Nothing is more efficient

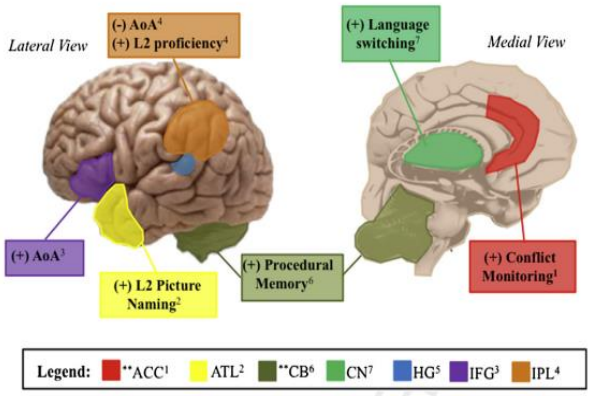

Figure 2: Regions labeled with "**" in the above legend indicate bilateral GM. Further, (+) means positive correlation whereas (-) means negative correlation.

than practice and exercise. The bottom line is: You have to do the work. In fact, research has shown that increasing difficulty and struggle during practice at learning actually leads to more prominent development in the brain. The problem here is that neuroplasticity can work either the positive when you learn something new and skill or the negative way when you forget something or get addicted to drugs. The brain is remarkably plastic; it is shaped not only by what you do but also by what you don't do [1].

V. Conclusion

Behaviors that we employ every day are critical; they are changing our brains. So, when you have just finished reading this article now, your brain will not be the same as when you started reading. The amazing part is that every reader will change his brain differently. Understanding these differences and variabilities will enable the next great advance in the field of neuroscience. Study what you learn best. Repeat these behaviors that keep your brain healthy, and break those that make it unhealthy. Practice! Learning is all about doing the work that your brain requires. The best strategies are going to vary between people. Actually, it is going to vary within a single individual. For instance, one can learn to play the piano fast but struggle to play football. So, when you leave today, go out and build the brain you want!

VI. References

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