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For a balanced and purposeful life

Why taking your brain to school

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Did you ever think about why humans have schools? Does it seem to you a little unfair that cats and dogs and actually no other animal besides humans spend so much lifetime going to school? Is there any convincing reason for that? The answer is yes!: It is because of our brain!

Our brain has evolved to be prepared to learn from teachers like no other species. Before we go to schools, we are as good as chimpanzees (with much respect to them, because they are great!) in things like spatial memory (example: memorizing where things are hiding), comparing amounts (ex.: knowing if a container has more or less food than other), or using tools (ex.: using a stick to get something that is otherwise out of reach). However, we are much better than chimps or any other animal at learning from others, and that even before going to schools. This suggests that our brain is born with a disposition to learn from others. In fact, two things are quite different in the human brain compared to the brain of other species (see **Figure 1**). One is that we have a frontal part of the brain, called the prefrontal cortex, that is much bigger compared to other mammals or even primates. The second is that we have extended the surface of the brain quite a lot by folding the brain inside the skull. This is why the human brain looks a bit like crumpled tissue. The surface part of the brain, called the cortex, is a very important part because it contains the bodies of neurons and dendrites, the little branches of neurons that are used to share information. Besides, the frontal part of the brain is really important for controlling attention, thinking about others' thoughts and feelings, holding information in memory while we think, using language, etc. Therefore, these two facts of the human brain makes it really skilled to learn from others.

Sharing what we know with others is really important for having better chances to survive and progress. Also, teaching the new members of the species (that is children and young people) what adults and others generations before (grandparents, great-grandparents, great-great grandparents, and so on) came to know is quite

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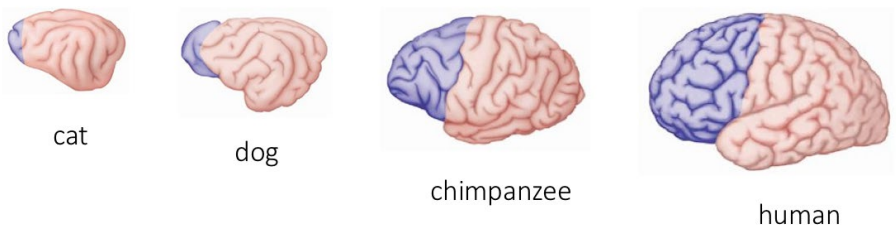


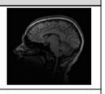
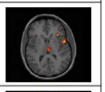
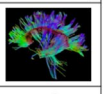
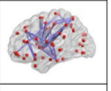
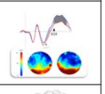
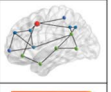
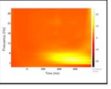
Figure 1. The human brain in comparison with the brain of other mammals. The purple area of each brain is the prefrontal cortex.

helpful and saves us a lot of time and energy for generating knowledge. Think about all the knowledge (maths, physics, technology, weather, etc) that was necessary to share in order to build a rocket and travel to the moon! And, think about how much long it would have taken to be prepared for that trip if Nicolaus Copernicus or Galileo Galilei wouldn't have shared their ideas about the organization of planets, laws of movement, or methods to know about the universe. How awful would it be if every generation would have to start science from the beginning!

Another important reason for going to school is that our brain gets better with education. This is called *brain plasticity*. In order for us to pay attention, learn how to read, or solve math problems, neurons must organize and configurate networks that carry out sophisticated computations. The brain learns to do all these things as we practice. Neurons are eager to learn because facing new challenges helps them to create teams that specialize in solving tasks. As more teams of specialized neurons are created, the brain will get faster at processing information and more able to solve new problems. This is particularly important for the frontal part of the brain. Thus, going to school is really important for the brain. Also, because brain plasticity is stronger during childhood and adolescence that when we are adults. Think about this: We humans have childhoods that are much longer than that of other species. For example, a baby cat becomes adult at only 6 months of age, whereas humans take about 18 years to reach adulthood! Actually, many scientists think that humans have long periods of youth just to give our brain more time to grow a big prefrontal cortex and thus get smarter.

In the past decades, machines have been invented that allow looking inside the brain while we think (see **Table 1**). This gives us lots of information about how the brain works in order to do tasks such as paying attention, reading a book, or

Table 1. Advances in neuroimaging

Brain information	Technology	Image
High-resolution 3D images of brain structure	MRI	
Metabolic changes in blood-oxygen levels linked to task performance	fMRI / NIRS	
Imaging of directionality and integrity of white-matter fibers (Diffusion Tensor Imaging, DTI)	MRI	
Functional circuits (synchronized functional activation) either at rest or task-related	fMRI	
Fast changes (in the order of milliseconds) of brain activation either at rest of task-related	EEG-ERPs / MEG-ERFs	
Functional organization (using graph theory with brain activation data)	fMRI / EEG	
Oscillatory activity related to the firing rate of neurons	EEG	

MRI: Magnetic Resonance Imaging; fMRI: Functional MRI; NIRS: Near InfraRed Spectroscopy; EEG: Electroencephalography; ERPs: Event-Related Potentials; MEG: Magnetoencephalography; ERFs: Event-Related Fields.

getting happy about doing a good job, and also about how the brain changes as we grow up or as we learn new things. This knowledge gives teachers lots of information about how the brain uses tools for learning (attention, memory, reasoning, perceiving, reading, etc.), and also about the best ways to teach contents. With these machines, scientists have demonstrated that training makes changes to the brain that make us smarter. For example, practicing with attention tasks makes the brain faster at processing information and enhances reasoning skills.

Neuroimaging devices are also quite important for understand what happens in the brain of people that have difficulties for learning. Dyslexia is how we call a particular struggle for reading. The brain of children with dyslexia has problems to learn what sounds go with what letters or combinations of them. Likewise, the brain of people suffering attention-deficit/hyperactivity disorder (i.e. ADHD) appears to have a bad regulation of a substance called *dopamine*, which is really important for the prefrontal cortex to work well. People with this problem often have difficulties waiting turns, or controlling their responses. If we understand better what parts of the brain do not work properly in these children, we will be much more able to help them fight their difficulties.

Definitely, bringing the brain to school is like feeding it. The brain needs learning experiences to grow up. And, if we grow a strong, smart brain, we will in turn be more able to learn more things. This circle of the brain's life is what makes us humans such extraordinary animals. We have long childhoods and schools in order to build the best brain possible for each of us. Therefore, don't forget to take your brain to school!