Neuromyths in Education and Development: A Comprehensive Approach

Dr. Efthymios Papatzikis
Canadian University Dubai, Educational Neuroscience

Abstract

A lot of people imagine neuroscience, and its neuroimaging techniques, as the holly grail of information as far as the capacities of the brain and its developmental path is concerned. Therefore, not long ago, there was a rage for "brain-based learning". It purported to use neuroscience to design activities that were more amenable to the brain's structure and behavior, or that helped to integrate the work of the two hemispheres. For several decades thereafter, myths about the brain — neuromyths — have persisted in all cognitive, social and environmental levels, often being used to justify ineffective approaches to teaching, learning and reacting to various stimuli found in our everyday life. Many of these myths are biased distortions of scientific fact. Cultural conditions, such as differences in terminology and language, as well as general miscommunication have all contributed to a 'gap' of knowledge that has largely shielded these distortions from scrutiny, while further 'harm' typical and atypical development in both the educational and the professional contexts. The aim of the specific paper is to present the nature and substance of neuromyths, after explaining five major of them and providing a way to act against their creation or to avoid them when met.

Keywords: Education, Neuroscience, Neuromyths

What are the neuromyths?

A lot of people imagine neuroscience, and its neuroimaging techniques, as the holly grail of information as far as the capacities of the brain and its developmental path is concerned. They turn to this fairly new but indeed very complex domain of science to prove or disprove theories, to develop or improve teaching, learning or rehabilitation methods, to solve problems that in someways cannot be solved otherwise. Nevertheless, even if knowing the complexity of the domain's substance and methods, people don't usually take time to critically address what they read or 'served', while most of all, they don't really try to understand how this very specialised, yet very practical domain of research and practice works.

Because of this, a lot of oversimplification occurs in terms of the brain function and structure, and this is where and why the term neuromyth appears. These myths about the brain have persisted in all cognitive, social and environmental levels, often being used to justify ineffective approaches to teaching, learning and reacting to various stimuli found in our everyday life. Many of these myths are biased distortions of scientific fact. Cultural conditions, such as differences in terminology and language, as well as general miscommunication have all contributed to a 'gap' of knowledge that has largely shielded these distortions from scrutiny, while further 'harm' typical and atypical development in both the educational and the professional contexts.

Where do the neuromyths come from?

Neuromyths usually are not created having in mind either malpractice or distortion of scientific evidence. Even if there are examples where private companies use non-precise information and facts in order to persuade their customers to buy their brain related product, neuromyths are usually developed after a 'genuine scientific confusion'. For example, the misunderstood fact that children become hyperactive when over-consuming sugar, has been wrongly fed through some very old and falsely structured research projects. These research projects were unfortunately not detailed in their conceptualisation and implementation. On the contrary, nowadays we find an emerging number of scientific facts and well designed scientific protocols showcasing no connection between sugar consumption and children's hyper activity (Legg, 2014; Kim & Chang, 2011).

Generally, it seems that neuromyths may also appear due to immaturely published scientific evidence, which at a primary data collection and analysis level present a possible connection of facts. Unfortunately, at any initial stage of research, many facts can be left unverified due to time or funding constrains, whereas the need for an extended period of retesting validity may prevent researchers from communicating the correct outcome in time, avoiding the aforementioned. This whole approach is falsely reproduced even more by non-specialists, rendering in the end impossible any rightful and valuable usage of the initial outcome due to the extended damage the first communiqué has achieved in society.

However, some neuromyths may be created through personal or social biases, or even through a wrong approach of research data translation. Neuroscience is one of the most complex and detailed scientific fields, hence open usually to misconceptions and false assumptions. People while trying to discuss neuroscience in simple terms, they tend to oversimplify the brain related mechanisms of function and structure, harming in the end both neuroscientific practice and fundamental knowledge of life. We can present here as an example the ‘first 3 years of development and learning’ neuromyth. This neuromyth suggests that someone, unless he or she is exposed to a specific stimulus or skill learning process of a particular field in the very first three years of life, they will never manage to reach the outmost of performance in the particular field. In reality however, things don’t exactly work like this. While the first three years of life are indeed important for development and learning, it has been repeatedly proven through many neuroplasticity related research projects that the human brain is equally capable towards functional adaption throughout the whole lifespan and not just in the very first three years of life.

The most famous Neuromyths

One of the most basic neuromyths existing out there is this one of the 10% performing capacity of the brain versus the 90% one. The idea that we only use 10% of our brains is probably one of the most famous and convenient ones adjunct to the brain science, as it has been proved to be almost comforting to believe that we do have some spare capacity of performance to use when needed. We think that this 90% of the brain can help us excel in difficult situations, or that this is the part lying there inactive and waiting somehow to wake and drastically improve us. This factoid has been widely used to sell products to enhance brain performance, while it has been put forth as the responsible part of the brain which produces and explains mystical and paranormal human powers.

Even if deeply believed from most of the people, none of the above is based on evidence whatsoever, while there are four good reasons proving all the above almost certainly false (Beyerstein, 1999):

1) If we only use just the 10% of our brains then damage to some parts of our brains should have no effect on us.
2) From an evolutionary perspective it is highly unlikely we developed a resource-guzzling organ, of which we only use 10%.
3) Brain imaging shows that even while asleep there aren’t any areas in the brain that completely switch off.
4) Parts of the body that aren’t used soon shrivel and die. Same goes for the brain. Any neurons we weren’t using should soon shrivel and die.

A second famous neuromyth that should be surely debunked along with the first one, is the right-left lateralisation of brain activity and consequently behaviour. There is this common assumption in the world suggesting that right-brained people are more creative, while the left-brained are more practical, analytical and logical in their life. The idea behind this assumption lies again in brain activity, claiming that one hemisphere could be more active - or inactive accordingly - than the other. Fortunately, this neuromyth has been disproved many times the last few years, finding evidence in many research studies utilising the knowledge after analysing many research subjects. For example, Dr. Nielsen and his colleagues (2013) collected data with the help of the Magnetic Resonance Imaging (MRI) technique of over 1000 people and then explained that "..we just don't see patterns where the whole left-brain network is more connected or the whole right-brain network is more connected in some people". The same results come from the music domain research - a very creative activity according to most people - suggesting that "(a) not only one brain part is active during creative musical tasks, meaning there is not just one part of the brain connected to [..] creativity and (b) that both hemispheres show activation when music is present either as an acoustic stimulus, as performance or as pure creation (Papatzikis, 2014).

In 2015, the Organisation for Economic Co-operation and Development (OECD) has pronounced the following six neuromyths as the most wide-spread in the academic and corporate community (OECD, 2015):

1. The 'first three years' neuromyth. This neuromyth suggests that our brain "is only plastic for certain kinds of information during specific 'critical periods'. Thereby, the first three years of a child are decisive for later development and success". On the contrary, what actually is nowadays seen as valid refers to the optimal periods of development, showcasing that while there are indeed some periods where neuronal connections can be created easier in the brain, neuroplasticity refers to the whole life-span involving all types of information and analyses of them.
2. The 'early enriched environments' neuromyth. This neuromyth suggests that only "enriched environments enhance the brain's capacity for learning", therefore children need to be exposed to rich and diverse stimuli to develop, especially in the first three years of life. While this path of brain development has been followed and verified as true for rodents, it has not yet verified fully for humans. On the contrary, research has shown that even if someone is not exposed to an enriched environment of stimuli in the first three years of life, they can still achieve a high level of performance later on. This is due to the human brain's capacity to develop synaptic contacts and neuronal circuits even beyond the first three years of life, without 'asking' for a specific enriched approach in the very beginning of development.
3. The 'types of learning' neuromyth. This neuromyth suggests that "there is either a visual, auditive or a haptic type of learning for human beings". Accordingly, we learn the alphabet better for example either by seeing it on the board, by listening the letters from a teacher, or by touching some letter shaped toys instead. While it has been repeatedly stated that

learning occurs through all these different channels of perception, it has been falsely implied also that only one of the above can improve an individual's learning efficacy. Fortunately this is not true, as learning occurs through the intellectual process that summarises all the above rather by involving just one of the three types of perception mentioned here. Human beings need indeed to first perceive information to initiate the process of learning. Nevertheless, they need to understand it later on in order to acquire knowledge, consolidate it and finally achieve learning. The latter is a step in the process that is more important than any perceptual level and goes beyond the senses themselves (Pashler, McDaniel, Rohrer & Bjork, 2008).

4. The '10% neuromyth'. This neuromyth, as already mentioned, suggests that we use just a 10% of our brain and that only a few of us are capable of using some more of it through out our lives. It has been thoroughly explained above that fortunately this approach is not at all true.
5. The 'hemispheric specialisation" neuromyth which has been also explained in detailed above. Of course, the aforementioned do not mean that some persons are not more creative or more analytical and logical than others. The evidence just suggest that it is wrong to say that creative people are more 'right-brained' or that logical people are more 'left-brained'.
6. The 'multilingualism' neuromyth. This one includes three sub-neuromyths suggesting that "(a) two languages compete for brain resources, (b) knowledge acquired in one language is not accessible in the other language, and (c) the first language must be spoken well, before the second language is learnt." All three parts of the neuromyth can be disproved by mostly simple and everyday examples. For instance, regarding the first part, we all know that there are a lot of people who can speak fluently more than 10 or even 15 languages. Therefore, there is no point to argue for 'lost space' in the brain due to multilingualism. As far as the second part is concerned, it is well known that someone who knows how to calculate in one language, can do so in the second acquired language. Skills that are learned in on language are not lost due to the change of language code, therefore there is no compartmentalisation of knowledge in different languages. Finally, regarding the third part of this myth, research has shown that the more someone learns languages, the better their understanding becomes in terms of the techniques used to master the usage and implementation of languages. In no way therefore multilingualism is responsible for any language delays or dysfunctional comprehension (Baur & Meder, 1990).

Fighting the Neuromyths

While we enter ourselves deeper in the digital era, we all the more have easy and rapid access to a vast amount of information. However, it is unfortunate to realise that neuromyths shape a major part of the brain related knowledge. For, nowadays it seems difficult to effectively reverse this false taken path which practically harms educational growth and progress. Then, what can we do perhaps to achieve a positive equilibrium towards neuromyths' extinction?

One way could be to more effectively train and inform professionals in academia and schools on how to handle neuroscience and brain development. Especially to those who work in developmental settings, we should guide their acquisition of knowledge towards the right neuroscientific facts of neuromyths, while presenting them with all this basic information on how the brain works, in order to be able to spot and effectively handle evidence distortions. This approach, on the one hand could mean that all brain information may be used at an interdisciplinary level more efficiently between scholars, while on the other hand, new generations can benefit from this movement in applying brain facts and information on various other professional contexts that are not directly connected to the brain science.

Additionally, a second way would be to increase public exposure on these matters, showcasing evidence of information malpractice. In this way, the more personal and family context are effectively approached, providing a stable basis for reorganising knowledge in its roots, rather the later stages of academic development where 'remedy' of concepts and perception can be much more difficult. In this case, every-day life can directly benefit it-self, while blocking of wrongly communicated information will be further established due to the practical consideration and extension the brain data will enjoy in our lives.

References:

Baur, Rupprecht S. & Meder, Gregor (1990) The relationship between mother tongue and second language in children of migrant in the Federal Republic of Germany. In*:* Leerders-Kenmerken. Individuele verschillen in het leren van talen 2/90, 68-82.

Beyerstein, B. L. (1999). Pseudoscience and the brain: tuners and tonics for aspiring superhumans. In: S. Della Sala (Ed.). Mind myths: Exploring popular assumptions about the mind and brain. London: John Wiley & Sons.

Kim, Y., & Chang, H. (2011). Correlation between attention deficit hyperactivity disorder and sugar consumption, quality of diet, and dietary behavior in school children. *Nutrition research and practice*, *5*(3), 236-245.

Legg, K. M. (2014). *Effects of Sugar Ingestion Expectancies on Perceptions of Misbehavior* (Doctoral dissertation, SOUTHERN ILLINOIS UNIVERSITY AT EDWARDSVILLE).

Limb, C., & Braun, A. (2008). Neural Substrates of Spontaneous Musical Performance: An fMRI Study of Jazz Improvisation. *PLoS ONE, 3*. doi: 10.1371/journal.pone.0001679

Nielsen, J. A., Zielinski, B. A., Ferguson, M. A., Lainhart, J. E., & Anderson, J. S. (2013). An evaluation of the left-brain vs. right-brain hypothesis with resting state functional connectivity magnetic resonance imaging. *PloS one*, *8*(8), e71275.

Organisation for Economic Co-Operation and Development (OECD) (2015) Centre for Educational Research and Innovation: Neuromyths, http://www.oecd.org/edu/ceri/neuromyths.htm (last accessed 15 October 2016)

Papatzikis, E. (2014) *Fostering Creativity in Music Communities: A Biological and Psychological Perspective*. In C.Clouder (Ed.), Good Morning Creativity 3. Spain: Botin Foundation. ISBN: 978-84-15469-38-4

Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning styles concepts and evidence. *Psychological science in the public interest*, *9*(3), 105-119.