

Special Edition
“Technology, Learning, and
the Brain”

Editorial

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Technology, Learning, and the Brain

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Ever since our earliest recorded memories, humans have explored how ideas are processed and communicated. A tremendous upsurge of studies in neuroscience and psychology has emerged in the past several decades with the advent of newer technologies. Neuroscientists have utilized technological advances such as functional magnetic resonance imaging (fMRI) to study processes of the mind and the brain since the early 1990's. Since then, there has been an exponential increase in publications utilizing fMRI data. The intent of scientists who adopt this approach is to identify brain behavior correlations in an effort to discover how psychological processes are localized in brain tissue as they conduct varying activities from watching television to meditation.

Neuroscience has further expanded its horizons with techniques that enable the measurement of important structural components of the brain such as diffusion tensor imaging (DTI) and positron emission tomography (PET). DTI data can be used to perform tractography within white matter resulting in increasingly accurate insight into the cognitive and biological processes of the human brain. PET neuroimaging examines links between specific psychological processes or disorders and brain activity.

Fast-forward to 2016 and we are conducting more research on the brain than ever with advances in more innovative and efficient technology. However, today more researchers are interested not only in where the brain learns, but also how it interacts with the use of technology in humans, particularly with the Millennials who spend upwards of half their days using technology on computers, television, mobile phones, video games, and virtual reality devices. Furthermore, technology is being used nearly three-fourths of a this generation's waking hours and young people today are accustomed to having it available around the clock and as quick as thought. The Millennial generation has never known a world without the internet and comparative studies with older generations as well as control groups will be beneficial to brain researchers.

Today, more emphasis has been put on the pros and cons of such immersion in technological devices than ever. Some researchers have found that the internet alone trains our minds to have a staccato train of thought in which it can jump between ideas with ease and without much interruption. Some may consider this experience as information overload where an individual finds no time for reflection, thinking, and problem solving. Others view technological advances as useful in training our brains to be nimble and to process new ideas quicker than ever before, thereby enabling us to become more open to new ideas that involve communicating continually and more seamlessly than ever. A growing body of research has suggested that technology has a profound altering effect on memory, particularly our working memory.

Implications of an impaired working memory on our cognitive functioning and overall intelligence levels are being examined. Complex factors of our intelligence require our ability to transfer information from working memory to long-term memory, our mind's central filing system. We have essentially replaced our working memory, the scratch pad of our consciousness, with very convenient smart phones and external devices with increasingly large storage. The paradoxical question is whether these devices are actually smart for us or are they hindering our brains from the work we were once accustomed to experience? We used to ask

children to memorize their parents' phone numbers, but now it's become a matter of convenience to have our handheld devices store this information for us, until the battery dies. The internet and convenience of devices and connection at all times has changed everything and, instead of calling a friend or loved one, more people are performing smartphone searches to confirm our recollection and our inquiries of facts and events. The wisdom of our social tribe has been inundated by the ease and infinite data of the internet and is woefully replacing our forebrains with external hard drives like a plot to a science fiction film. Although, it is all real time now.

A further question to examine might be whether this frees up any storage in the brain for other, more complex activities or does our working memory experience a digital overload like an overflowing glass of water causing us to lose the information filling the glass. Neuroscience has come to find that there's a continual depletion of new information that's constantly replaced by new and exciting information and, subsequently, there is no place to maintain or hold what one has already learned. In essence, we end up feeling overwhelmed with an endless amount of facts at our disposal that won't become meaningful unless we find ways to connect to them on a personal or emotional level.

Psychologists have discovered that retention of information is vastly improved with more and better connections that involve emotions that ignite the hippocampal memory centers within the brain. However, attention is also critical to forming strong memories and technological distractions abhorrently interrupt our retention of events. Forgetting, which was once thought of as part of simply growing old is now considered a good sign of how busy we are in our daily lives. Studies indicate Millennials are experiencing difficulties with remembering basic tasks when asked to recall them in order. It is apparent that when we are not paying attention to any one activity, our memories aren't very strong and we have difficulties retrieving the critical information we need. The good news is that researchers at MIT have identified a neural circuit that assists the brain to create long-term memories. The neural circuit works more optimally when the brain is focused and can potentially help us to recall and tend to projects better.

Still, it is evident that neuroscience views the brain as complex while not identifying a definitive response to whether technology has helped or hurt the human brain. In terms of productivity, there are those in the camp who identify an increase in efficiency since the advent of the internet. In terms of multi-tasking, a phenomena neuroscience does not see as viable, an individual can appear to utilize and attend to several areas of activity simultaneously. However, neuroscience indicates that the individual is actually cognitively shifting at a faster rate than ever before when moving between tasks. Studies have found that students who claim to multitask while doing schoolwork actually understand and retain less information than those who focus on single tasks at a time.

We know that an over-reliance on technology has a tendency to encourage us to isolate bits and pieces of information that we don't always fit into a broader cognitive and conceptual framework. However, we need a larger context of information in order to arrive at contextual details in our minds. So, the inherent worth of the internet is invaluable for obtaining the bigger story. The problem occurs when the overuse of such a useful and addicting resource leads to inattention and forgetting daily activities and responsibilities. Constant connectivity has, ultimately, been associated to increasing numbers of younger people forgetting basic tasks and information due to, at least in part, excessive reliance on technology.

It's a matter of finding balance with technology in positive ways. There is a bit of a trade-off when new technological advances are discovered and utilized. Our brains are very malleable and resilient like computers and, if we spend a lot of time engaged in a repeated mental task, the neural circuits involved will strengthen. On the other hand, if we neglect certain tasks, the associated neural circuits will weaken. Brain researchers have found that nearly 60% of synaptic connections are pruned away when not used. This leads to the question of what may occur to our brains as a result of the ever-expanding evolution of technology and its continual and pervasive presence in our everyday lives. As it appears our brains adapt to the various changes of its environment, one can only subsume that our brains will also evolve in an effort to accommodate and fulfill the needs of our human potential. We should all approach the future with enthusiasm and keep in mind that the changes to our brains will harmoniously adapt in a symbiotic relationship to advances in technology. We need to focus on the benefits technology brings to learning while being mindfully aware of the potential harm of technological overload. We walk a very slippery slope when it comes to balancing the use of technology and its effects on the brain. Consider the balance as learning a new masterpiece complete with the continual addition of new instruments, members, dimensions, and movements while, at any given time, you and your brain remain the sole conductor of the orchestra to which without, the music cannot be enjoyed.