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Technology and the Mind & Body:
How Technology Affects Cognitive Development

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April 24, 2017

Abstract

This paper explores the questions of how the growing use of technology, such as mobile phones and other devices, may affect people, especially children and adolescents, in terms of their physical body and cognitive mind. A growing number of adults, teens, and even children are gaining access to devices, which is pushing health organizations to conduct research and studies based around these factors. One such study is known as the Study of Cognition, Adolescents and Mobile Phones, or SCAMP, in which several thousand students in London are being tested at grade seven, and later in grade nine, to determine the effect mobile phone use has on cognitive and other abilities. COSMOS, otherwise regarded as the Research Initiative on Health and Mobile Telecommunications, is another study underway that is looking at the relation between mobile phone use and health. Overall, there is some evidence that suggests constant use of technology may result in obesity, or developing certain learning or behavioral disorders. However, there is currently no concrete evidence that technology use directly impacts the cognitive brain and mind.

As the times change, and years go by, different aspects of the world around us tend to develop and progress more than the rest. Each century is typically defined as being the ‘age of ‘something,’” where that thing takes the world by storm with its involvement in each and every facet of life including everyday use, manufacturing, scientific development, and world growth.

The Stone Age was a broad prehistoric period during which stone was widely used to make implements with an edge, a point, or a percussion surface (wikipedia.com, 2017).¹ The period lasted roughly 3.4 million years, and ended right around 5000 BCE with the advent of metalworking. The 16th century, or the 1500s, is regarded by historians as the century in which the rise of the West occurred (wikipedia.com, 2017).² During the 18th century, or the 1700s, the Enlightenment culminated in the French and American revolutions, while philosophy and science increased in prominence, and philosophers dreamed of a brighter age (wikipedia.com, 2017).³ The Industrial Revolution was the transition to new manufacturing processes in the period from the mid 1700s to the mid 1800s. This transition included going from hand production methods to machines, new chemical manufacturing and iron production processes, improved efficiency of water power, the increasing use of steam power, the development of machine tools, and the rise of the factory system (wikipedia.com, 2017).⁴

The Information Age, also known as the Computer Age, Digital Age, or New Media Age, is a period in human history characterized by the shift from traditional

industry that the Industrial Revolution brought through industrialization, to an economy based on information computerization. The onset of the Information Age is associated with the Digital Revolution, just as the Industrial Revolution marked the onset of the Industrial Age. The definition of what digital means, or what information means, continues to change over time as new technologies, user devices, methods of interaction with other humans and devices enter the domain of research, development and market launch (wikipedia.com, 2017).⁵

As with any new developments in the world, there are both positives and negatives of what is taking place and being produced. In the case of the Information Age, the questions are mainly focused on whether constantly being surrounded by technology is good for a person's health, especially with their brain and cognitive development. People today are surrounded by more electronic devices than ever before. Someone could be sitting on the couch watching a television show on their new flat screen, which is hooked up to a cable line, a Blue Ray DVD player, an Apple TV device, an Amazon Fire Stick, and several speakers. Another person could be sitting in a media room in front of a television that is wired to an Xbox One, a Playstation 4, an Xbox 360, a Playstation 3, a Wii, cable, and speakers. Someone else could be in the library listening to music on their iPod while browsing their smartphone for media, looking at their tablet for research, and typing on a computer. There are endless possibilities and situations where someone is carrying, near, looking at, or hooked up to upwards of four or five electronic devices. And, the scary part is, the amount will continue to grow. New augmented reality devices are in the works that will allow us to

see a virtual image of the world over what we already see. Gadgets such as wearable glasses or even implanted chips will make the virtual world as realistic as possible.

With all of this technology that is coming to fruition, there is a question of whether it is safe to be in the presence of so many devices, and if they will cause harm to the brain and cognitive development.

The debate over whether the use of digital technology found in smartphones and other devices has an effect on brain development in children, teens, and adolescents has been an ongoing concern of parents and educators. Despite scientific uncertainties, studies can only benefit in finding the truth about these issues. On average, children are 12.1 [years of age] when they receive their first mobile device (growingwireless.com, 2017).⁶ Surprisingly, studies effect even babies and toddlers, since 38% of children two years old and younger have used a mobile device for media. However, researchers warned that using a tablet or smartphone to divert a child's attention could be detrimental to 'their social-emotional development' (Walters, 2015).⁷ 88% of teenagers ages 13 to 17 have or have access to a cell phone, while 91% have access to the internet on a cell phone, tablet, or other mobile device. 51% of high schoolers carry a smartphone with them everyday, compared to 28% of middle schoolers.

With the widespread use of this technology, the question remains whether the use of such phones can lead to long term cognitive effects that impact language development skills, memory capability and maintaining focus on tasks at hand (Glatter, 2014).⁸ There is ongoing research, known as the Study of Cognition, Adolescents and

Mobile Phones (SCAMP), and being conducted by the Department of Epidemiology and Biostatistics at Imperial College London, which is looking at 2,500 seventh grade students in 160 schools throughout London. This is, in fact, the largest investigation regarding the relationship of cellphone or smartphone use on the developing brains of teens. The aim of this study is to investigate whether children's use of mobile phones and/or other technologies that use radio waves e.g. portable landline phones and wireless internet, might affect their cognitive or behavioural development e.g. attention, memory, language understanding (scampstudy.org, 2017).⁹ Being a participant in the study involves undertaking a computerised school assessment (including cognitive tasks e.g. attention, memory, and questions on mobile phone use and lifestyle) (scampstudy.org, 2017).¹⁰ Furthermore, all pupils will repeat this in-class assessment when they are in year 9. This will allow the researchers to look at changing exposures to mobile phones and other wireless technologies, and assess children's cognitive and behavioural development over time in relation to these changes (scampstudy.org, 2017).¹¹ This study is important because scientists remain uncertain as to whether the brains of children or adolescents might be more vulnerable than adults to exposure to radio waves emitted from electronic devices, specifically mobile phones and other wireless technologies. This research will improve understanding of children's radiofrequency exposures and whether there are any possible health effects linked to exposure. Specific ways to reduce exposure levels may be identified to provide targeted advice to parents and children as needed (scampstudy.org, 2017).¹² The Stewart Report (IEGMP, 2000) concluded that: '...children may be more vulnerable because of

their developing nervous system, the greater absorption of energy in the tissues of the head, and a longer lifetime of exposure' (scampstudy.org, 2017).¹³

Furthermore, a subset of the main Study of Cognition, Adolescents and Mobile Phones is also underway, known as the SCAMP Bio-zone. This study is only being done in a small portion of the schools in the normal SCAMP test, and goes more in-depth than a simple online test. What it does is take urine and saliva samples and other measurements from the students in order to get more accurate depiction of the individual's body. This includes the amount of passive smoke the child is exposed to, measured in a substance called cotinine. The Bio-zone also tests the child's stage of puberty, by measuring the levels of hormones, and estimates stress levels by determining the level of cortisol. All of this information creates a more complete image of the child, as they are all known to be related to cognition, lifestyle, and mobile phone use. It more accurately assesses the effects of phone and wireless technology use on the children's cognitive function and behavioral outcomes. As of right now, all phases of the SCAMP study are still under development, and there has not been any published results available to the public.

COSMOS is another study underway that is looking at the relation between mobile phone use and health. It is also known as the Research Initiative on Health and Mobile Telecommunications. The COSMOS study aims to carry out long term health monitoring (twenty to thirty years) of a large group of people (anywhere between 100,000 and 250,000 participants) to identify health issues related to long term phone use. An international committee of experts chaired by Sir William Stewart in London

announced the new research initiative, to be funded cooperatively with £7.4 million by the cell phone industry and U.K. government. The goal is to explore biological effects of radio-frequency EMF (bems.org, 2014).¹⁴ COSMOS is being conducted in six European countries - United Kingdom, Denmark, Sweden, Finland, the Netherlands, and France - and is investigating the possible health effects of long-term use of wireless technologies. The first fifteen projects which received funding were set to address five major research areas, improved dosimetry, epidemiologic and human volunteer studies, effects on brain function, impact (if any) of pulsed signals, possible health impact of changes in cell or sub-cellular function (bems.org, 2014).¹⁵ One of these projects consisted of a case-control study of risk of brain tumors and acoustic neuroma in relation to use of mobile phones in southeast England, conducted by Anthony J. Swedlow, of the Institute of Cancer Research. There was a United Kingdom case-control study of adult brain tumors, a case-control study of risk of leukemia in relation to mobile phones, and a study of mobile cellular communication and cognitive functioning. These assignments were led by R. Cartwright of the Institute of Epidemiology, Anthony J. Swedlow of the Institute of Cancer Research, and Riccardo Russo of the University of Essex, respectively. Furthermore, a study to evaluate the effects of mobile phone usage on labyrinthine function and the effect of the phone's radiation on blood pressure and brain physiology and function were also done. These were led by Linda Luxon of the National Hospital for Neurology and Neurosurgery, Anthony T. Barker of the Royal Hallamshire Hospital, and Zenon Sienkiewicz of the National Radiological Protection Board, respectively. Unlike other approaches,

COSMOS addressed a wide range of disease outcomes of importance for public health in one investigation, including neurodegenerative disease, stroke and depression which have rarely been studied; previous studies have focused on few outcomes, mainly tumours of the brain and head (Toledano, 2015).¹⁶ Results suggested possible increased risks of glioma at the highest levels of mobile phone use, but interpretation was unclear and the possible health effects of long-term heavy use of mobile phones remain uncertain (Toledano, 2015).¹⁷ Large long-term cohort studies have huge potential to increase understanding of environmental exposures and disease and thus improve the health of current and future generations, but require sustained investment from funders and continued involvement by participants (Toledano, 2015).¹⁸ To maximize the value of this investment and the benefit to public health....COSMOS is not only collecting data to address the question of mobile phones and health, but also has obtained extensive data on wider environmental exposures, lifestyle and demographics, so as to address a wide range of environment and health questions (Toledano, 2015).¹⁹ One clear, measurable result that was concluded from the research was that the more an individual uses their phone, the greater the chance of obesity. Child obesity and diabetes are now national epidemics in both Canada and the U.S., causally related to technology overuse (Rowan, 2013).²⁰ Furthermore, the impact of rapidly advancing technology on the developing child has seen an increase of physical, psychological and behavioral disorders that the health and education systems are just beginning to detect, much less understand (Rowan, 2013).²¹ Diagnoses of ADHD, coordination disorder, developmental delays, unintelligible speech, learning difficulties, sensory processing

disorder, anxiety, depression, and sleep disorders are associated with technology overuse, and are increasing at an alarming rate (Rowan, 2013).²²

The United Kingdom government published a pamphlet called, “Mobile Phones and Base Stations: Health Advice on Using Mobile Phones.” In it, they described their best advice concerning how long or how much an adolescent should be using a mobile device. They say there is no immediate need for concern when using mobile phones or having a base station in your area. This is because, despite much research, there is no convincing evidence that either will cause harm. However, individuals have only been using mobile phones widely for the last decade or so and scientists need more research to look at the situation, particularly in the long term (Mobile Phones and Base Stations, 2011).²³ However, they do express a bit of concern, as the leaflet goes on to say that the body and nervous system are still developing into the teenage years. Therefore, as a precaution, the UK Chief Medical Officers advise that children and young people under 16 should be encouraged to use mobile phones for essential purposes only, and to keep calls short (Mobile Phones and Base Stations, 2011).²⁴ Children’s developing sensory, motor, and attachment systems have biologically not evolved to accommodate this sedentary, yet frenzied and chaotic nature of today’s technology (Rowan, 2013).²⁵ There is a concern that radio waves from phone towers and antennas can lead to cancer. However, the UK Mobile Telecommunications and Health Research programme reported in 2007 that no association was found between mobile phone use of less than ten years and cancers of the brain and nervous system. However, as the situation for long-term exposures is less clear, the HPA continues to monitor the

scientific evidence (Mobile Phones and Base Stations, 2011).²⁶ Some people believe that mobile phones heat up the brain while using them against the ear, because of the phone screen, pixels, and electromagnetic waves that extend from the device. But, it was found that any increase in brain temperature that may occur from using a mobile phone close to the head is very small, well within the normal body heating from everyday activities such as exercise and is not considered by the WHO to be harmful to health (Mobile Phones and Base Stations, 2011).²⁷

So, in conclusion, with all of these investigations underway, and countless others in the works or on the horizon, it is evident that there is worry within the scientific and health fields that different facets of mobile technology, such as radiation or other effects, could be a real issue as usage increases each year. Although scientists have not yet found concrete evidence on most issues, there are studies and research that are still ongoing because of how rapidly the Information and Technology age has come about. The first computer, known as the ENIAC, was produced in 1946 at the University of Pennsylvania, and occupied about 1,800 square feet and used about 18,000 vacuum tubes, weighing almost 50 tons (computerhope.com, 2017).²⁸ It took until 1973 for the first handheld, commercialized mobile phone to be produced, which weighed over two pounds and took ten hours to recharge, while having a talk time of just thirty minutes. This was around the same time (more specifically the 1970s - 1980s) when the modern internet was invented. The iPhone then came out in 2007, which only weighed 4.8 ounces, compared to the original mobile phone in 1973 which weighed over eight times more. The tablet computer was originally developed in 2000 by Bill Gates and

Microsoft, but took off in 2010 with Apple's and Steve Jobs' iPad. Since the late 2010s, there have been fifteen different models of the iPhone released, (totaling over one billion sales), with each getting faster, more powerful, larger (screen), lighter, thinner, and more adapt to what is popular at the time. There have also been twelve models of the iPad released, (totaling over 250 million sales), continuing the same trend as the iPhone. As evidence suggests, technology is innovating and growing at an exponential rate in today's society. The world went from waiting twenty seven years between the first computer and the first cell phone, to having new smartphones and other devices being released annually. This rapid evolution is an exciting, but scary, thing. There have already been instances where technology has physically injured or killed consumers, including exploding hoverboards and Samsung Note 7's. However, problems such as these, which are seemingly the result of poor manufacturing, are nothing compared to what could happen in the sphere of mental and cognitive injuries. It is feared that too much exposure to electronics and their radioactivity could cause anything from stunted growth, brain tumors and cancers, and cognitive underdevelopment. So, there is a pressing need to seek out the truth of what impact, if any, being constantly wired and connected really has. The evidence of concern is overwhelming, with numerous studies being put in place, and even the United Kingdom government releasing statements and leaflets that outline the concern they have for the nation's youth, and other citizens, in regards to technology use. Overuse of technology, and the negatives that come with it, has even been recommended as a high priority by the World Health Organization (Toledano, 2015).²⁹ In the end, it is only a matter of time

before something groundbreaking occurs and the world has to change its habits regarding the use of mobile phones and devices.

Endnotes

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