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The Impact of Technology on the Brain

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Abstract

Technology has many impacts on us and has deeply affected our daily life with its nonstop advancements; however, though it proves us leisure and fun, it also may have damaging effects to our body without us noticing it. This literature review paper examines a few impacts of technology on the brain, varying from radiation impacts and blue light effects to the addiction to technology. Radiation, as a process of energy emission in the form of waves, specifically through space or a material medium, is transmitted through the LED screens of electronics and damages our body. Blue light is similar to radiation, also a form of waves unwittingly affecting our body, and is considered to be the most potent wavelength that can impact sleep, mood, and other factors. Additionally, some individuals may experience internet addiction, such that they do not have control over their internet usage, potentially leading to harmful impacts to their careers, relationships, and daily lives. Though these studies include the pros and cons of electronic related effects, future research should focus on a broader variety of electronics affecting our body with daily usage. The aftereffects of technology usages are not all negative, but more detailed examination is needed to better understand these effects.

Keywords

Neuroscience; Cognitive Neuroscience; Cognitive Abilities; Psychology.

1. INTRODUCTION

The first creation of electronics started nearly a hundred years ago, and it now has become an essential part of our daily lives. The advancement of technology does bring various conveniences that are encouraged throughout the history of development, like the creation of computers, mobile phones, and other necessities that could make life easier; however, technology also can have negative impacts on many aspects of our wellness, even our physical bodies and mental healthiness. The impact of technology on our lives has been a topic of discussion for decades. From infants to teenagers, adults to elderly groups, people are constantly using the technology to access information, communicate, and entertain themselves. While technology has many benefits, there is growing concern about its potential negative effects on our brains and behavior. The average technology usage has continuously increased and nearly doubled from 2011 to 2013 (Perrin et al., 2015). People often recognize the more overt downside of too much LED and technology exposure, such as temporary impacts to our vision; however, the potential negative effects of these devices on our brains and behavior is not yet fully understood.

The purpose of this literature review is to explore the existing research on how electronics can impact people's brain behavior negatively. Studies have shown that prolonged exposure to electronic devices can have negative effects on our cognitive abilities, such as attention span, memory, and decision-making skills. Additionally, the blue light emitted by electronic screens

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can disrupt our circadian rhythms, leading to sleep disturbances and daytime fatigue. Radiation is also another potential damage towards our body, with the main effect of damaging the DNA in our cells, which high levels of radiation could bring serious body damage, like cancer. Furthermore, excessive use of technology has been associated with addiction-like behavior, including withdrawal symptoms and cravings. This can lead to problematic behaviors, such as excessive gaming or social media use, which can have negative effects on academic and occupational performance. Overall, while technology has many benefits, it is important to be aware of its potential negative effects on our brains and behavior. Further research is needed to fully understand the impact of electronics on our lives and to develop effective strategies for managing technology use.

2. RADIATION IMPACTS

Technology not only affects use while we're using it, but also can have significant aftereffects that are important to consider. An important effect that electronics have is the transmission of radiation. Radiation is the process of energy emission in the form of waves, specifically through space or a material medium (CDC et al., 2022). This energy can originate from a range of different sources, including nuclear reactions, electromagnetic fields, and thermal processes. Radiation can be classified into different types based on its properties and its frequency or wavelength. Radiation has various applications in fields such as medicine, industry, and communications, but it also poses potential hazards to human health and the environment, particularly when exposure is excessive or uncontrolled. In the context of radiation exposure from technology use, the specific radiation is Electromagnetic Radiation (EMF), which has influences on both the human body and cognitive development. Studies that have conducted experiments related to these impacts have mainly focused on the effect of EMF on brain reactions and neuro-metabolic effects.

One study conducted by Curcio and colleagues (2006) examined the relationships between EMF and brain hemisphere reactions. The study was separated into two sessions for testing with 15 male volunteers. In one session the signal was turned on and in the other it was turned off for 45 minutes. Motor Evoked Potentials (MEPs) were recorded using a paradigm both before and at different times after exposure to the EMF. Results showed that intracortical excitability curves were being modified during the EMF-on exposure, Short Intracortical Inhibition and Facilitation decreased with acutely exposed brain hemisphere compared to EMF-off exposure. Ultimately, this study found that brain activity decreased with high exposure to EMF, which supported the authors' original hypothesis.

Additional research conducted by Valentini and colleagues (2007) focused on the influence of electromagnetic fields (EMFs) on human electrophysiological and neuro-metabolic effects. This study specifically examined how mobile phone-related EMFs with Global System for Mobile Communication (GSM) signals impact sleep, measured using electroencephalogram (EEG). The researchers reviewed 32 studies to discuss the different outcomes of interest, including the effects of GSM-like signals on walking EEG, sleep EEG, evoked cerebral activity, brain metabolism, and excitability. The study was conducted with male adult participants under blind conditions, and randomized and counterbalanced experimental conditions. The results showed that the hypothesis of effects not only on the cerebral cortex but also on subcortical structures like the thalamus and hypothalamus was supported by the studies. While there were a few negative responses, such as a lack of EMF-induced effects on EPs and little persuasive literature reporting alterations in ERP activity, the overall conclusion was that the reflection of LED light by electronics leads to a deficiency in sleep quality and brain activity performances that could eventually decrease cavity wellness. The study highlights the importance of considering EMF influences in relation to other elements to better understand their impact on human health and

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the negative influences that EMF and other factors contributed to decreased brain development; furthermore, in future research, particular care should be dedicated to meet various controls with elements that meet the criteria.

However, the increasing concerns about exposure to multimedia have become a great problem in society. Radiations' damage to human bodies are becoming more complex and varianted. To explain the apprehensions about technologies and multimedia, Ziegler, Mishra, and Gazzaley (2019) conducted a study with the purpose to reveal and recognize the concerns about media exposure and multi-tasking and how this might interfere with brain functions (such as memories and brain images), The main participants were teenagers, young adults, and college students. The study examined brain volume and connectivity in regions such as the amygdala, the prefrontal cortex, and other networks implicated in social cognition Add in main findings here However, on the positive side, the investigation also showed that technology does not only have negative impacts on people; if the technology is used correctly, even infants could have a positive benefit from it in later life. The right exposure to technologies can enhance learning for children with ADHD. Overall, studies suggest that the effects of electronics on brain activation are associated with declining memory capacity.

3. BLUE LIGHT EFFECTS

Blue light can have a significant impact on our daily performance both physically and psychologically. As mentioned earlier, blue light can interfere with our sleep patterns and circadian rhythm, which can have a negative impact on our physical and mental health (Health et al., 2022). This is because a disrupted circadian rhythm can affect our hormone levels, immune function, and metabolism among other things. Additionally, exposure to blue light can also affect our mood and cognitive performance, as it can cause feelings of fatigue, irritability, and reduced alertness. Unfortunately, many electronic devices that we use daily emit a significant amount of blue light, and many people are not aware of the potential harm that it can cause. This is especially true for teenagers, as studies show that over 70% of them have access to the Internet and use electronic devices for extended periods (Pewresearch et al., 2015). This is important because it examines the effects of blue light, which is more than people's expectations, and numerous case studies have indicated the impacts of blue light, and had mainly focused on the effects of blue light during the night.

One study conducted by Green and Cohen-Zion (2017) aimed to investigate the effects of blue light exposure on both physiological and behavioral measures in young adults. The researchers measured screen light intensity and wavelengths to determine the level of exposure to blue light. They also examined the effectiveness of prevention measures such as reducing screen brightness. The study involved 19 participants between 24 and 27 years old who spent four nights separately in a laboratory. Each night, the participants were required to arrive at 21:00 and complete verbal or arithmetic tasks in front of a computer screen. They then took a break and rested with a specialist monitoring their sleep. The study measured three physiological measures: polysomnography, melatonin, and body temperature. Polysomnography measures brain waves, eye movements, and muscle activity during sleep. Melatonin is a hormone that regulates sleep and wakefulness. Body temperature is an indicator of the body's circadian rhythm. The results of the study showed that reducing the brightness of electronic screens did not protect participants from the harmful effects of blue light emitted from the screens. The study had limitations since participants were only tested with a 22-inch computer LED screen, and future research should examine the effects of different types and sizes of electronic LED screens. Overall, this study highlights the potential harm of blue light exposure from electronic screens and the need for effective prevention measures. It also underscores the importance of understanding the physiological and behavioral effects of blue light on young adults, which can

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have implications for their physical and mental health. Another study led by Daneault and her group (2014) introduced a surprising study about blue light effects on people's cognition, which compared teenagers to elderly groups. There were 16 teenage participants and 14 older healthy participants recruited in the study, and the team used functional magnetic resonance imaging to record brain activation during multiple tasks. Results suggested that elderly people's brains were more capable of showing sustained responses towards the lights in several brain areas, and the effects of bluelight had significantly decreased activation in brain regions such as pulvinar, amygdala, and tegmentum as well as in the insular, prefrontal, and occipital cortices. The result of this study indicates a possibility that bluelight cognition may be reduced by healthy aging, but broader research needed to be conducted.

4. INTERNET ADDICTION

The definition of addiction is rather simple according to the dictionary, within the condition of being physically or mentally dependent on a particular substance. As internet usage has increased over the past few decades, experts have become more concerned about the possibility of Internet Addiction (IA), including gaming, social network site use, compulsive buying, pornography use, or other Internet activities (Besser et al., 2019). Hongxia and her group (2020) led an experiment focusing on the topological properties of brain networks during the performance of working memory (WM) tasks in individuals with IA and healthy controls. All participants completed visual memory tasks. IA subjects were those who spent more than 10 hours per day, 6 days per week using the internet and whose internet addiction test (IAT) score was greater than 50. HCs who spent less than 2 hours per day on the internet were selected, with IAT scores that were less than 50.The team recorded the lagged phase synchronization between all pairs of Brodman areas during the WM tasks. Interestingly, WM performance was better in IA subjects compared to those of HCs. Thus, the results of the experiment suggested that IA subjects had more integrated brain networks in the alpha band, with altered centrality mainly focused in frontal and limbic lobes.

However, other studies produced differing results. A study conducted by Yuan and his group (2011)highlighted a finding in the area of neuroimaging. The study focused on Internet addiction disorder (IAD), which could be associated with impairment in the individual's psychological, academic, and work performances Their work included findings from three biological measures : tomography (PET), electroencephalogram (EEG), and magnetic resonance imaging (MRI). Each finding had suggested various differences between the IAD group and normal control group. The EEG finding suggested that the IAD subjects showed less efficiency in information processing and lower cognitive control. This result explains that when participants tend to experience more IA, their level of behavior performances decreased compared to healthy controls. Considering the findings from Hongxia and her group, further research should explore internet addiction disorders.

5. FUTURE DIRECTIONS AND CONCLUSIONS

This literature review paper covered a broad range of research to present the most common effects that technology has on t our bodies. Some serious negative health outcomes are associated with technology use, however technology can also be useful in moderation. As the research on technology use is still relatively new,, this literature review cannot make any definite conclusions on the impact of technology on the brain and body. Future research should explore the effect of technology on children's development specifically to gain a more comprehensive understanding of how technology exposure can impact the developing brain. Future directions of research may include a wider variety of testing components, like the types

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of electronics and the amount of usage recorded.. Different types of electronics and different durations of technology usage could have various effects on our body..

This review outlined the negative impacts of electronics on people's mental and physical development, reviewing studies focused on the aftereffects of radiation impacts, the impact of blue light effects, and also the negative consequences of addiction to technology. Findings suggest that there are multiple effects that electronics have on the human body, not only on the physical level but also the psychological level. Serious cortical area damage could come from radiation or blue light effects, and the addiction to the internet can cause significant impairment in daily life. They are all the components being affected during our daily use, and they are not acquired by everyone. To protect both ourselves and others, serious care and understanding of technology's effects should be considered.

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