



Effects of screen-based media on the developing brain

By Theresa Workheiser & Brandi Pitts



When we lack the need to know, we also lack the ability to know. Younger generations no longer need the brain space to remember phone numbers because their smartphones house this information for them. They do not need to recall spatial directions to the next town over or the recipe for a particular dish because Google knows these things for them. As our environments change over time, so does the way our brains evolve.

Children today are being exposed to portable and rapidly developing technology as early as age 1. At your next family gathering, you may be shocked to find your 4-year-old grandchild asking if you have games on your phone or even requesting to watch videos of other children playing on YouTube rather than engaging in play themselves. The constant altering and upgrading of new and emerging technologies, in combination with children being exposed to these technologies at younger and younger ages, has left us with a lack

of research regarding the subsequent effects on brain health.

During the COVID-19 pandemic, technology has become even more prominent in the lives of young people. Many students are attending virtual classes synchronously, meeting with their teachers using online platforms, completing asynchronous assignments, and chatting with fellow students outside of class time using virtual technologies. Technology has been a vital part of physical distancing and the lockdown response to the pandemic. It has allowed millions of students to continue pursuing their education despite being unable to access brick-and-mortar in-person learning.

When used in moderation, technology can be beneficial. When not used in moderation, it may be harmful. According to the American Academy of Pediatrics, children under the age of 5 should be limited to one to two hours of screen time per day. Parents, caregivers and counselors should be educated on the detriments of excessive screen time,

including impediments to physiological and neurological development.

Our brains continue to develop throughout childhood, our 20s and, in some cases, even into our early 30s. During the first few years of life, our neural pathways are growing exponentially, with neurons becoming myelinated as we learn. While the developing brain is continuously forming these connections, it is also reducing those that are underused.

The way that we use screen-based media is now affecting and even governing these functions. Type and quality of brain stimulation are important to consider.

Screen-based stimulation

Children may benefit in some ways from screen-based technology stimulation. However, it is important to have well-rounded experiences of both virtual and nonvirtual stimulation.

Virtual stimulation does not nourish the brain in the same ways that real-life experiences do. In addition to

overstimulation, lack of restful sleep and increased exposure to blue light, screen-based media is linked to an inability to retain information. Lack of restful REM sleep decreases functioning that is critical for processing and storing information into long-term memory. Constructive environmental stimulation, such as parents reading aloud with their children, has a much larger beneficial effect on reading abilities than does screen-based media (e.g., watching a video of someone reading a book).

Reward center

Screen-based media use is also altering our brains' reward center processing. For example, social media works on a variable reward system that can hook consumers so that the behavior continues even as the reward diminishes or varies over time. This addictive behavior can be extremely difficult for adults to break and may be even more challenging for children. Excessive screen time is correlated with impaired dopamine functioning. Dopamine is often released from the reward center and is associated with addictive behaviors. This impaired dopamine response may produce brain changes that resemble those found with other addictions.

Researcher Debra Bradley Ruder found in 2019 that children with developing brains even at healthy levels lack a mature prefrontal cortex, which is associated with developed self-control. This can make putting screens down even more difficult for children.

White matter

Recent evidence shows significant neurobiological risk factors in brain development. With MRI technology, researchers are discovering that the integrity of white matter, particularly in the prefrontal cortex, is compromised in children using screen-based media.

In 2019, researchers John Hutton, Jonathan Dudley and Tzipi Horowitz-Kraus presented new evidence, using fMRI technology reporting, on the development of children's brains in correlation to overconsumption of

screen-based media. These researchers found that as the myelination of white matter tracts is compromised in the prefrontal cortex, a variety of sociobiological and cognitive-behavioral complications develop as a result. For example, language, executive functioning, emotion regulation and literacy are negatively affected.

Damage to the white matter of the brain can result in lessened communication within the hemispheres and regions of the brain. This can lead to the misfiring of neurons, dysregulation of the brain and slow signals. Individuals who have damage to the white matter of their brains may have a harder time processing and retaining information.

Gray matter

The brain's gray matter is also affected, both in structure and function, by screen-based stimulation. If your mother ever told you not to watch too much television because it would "rot your brain," she may have been on to something.

Within the past decade, we have seen an increase in screen time to about seven hours per day for the average child. Author and integrative child psychiatrist Victoria Dunckley discovered in 2014 that excessive screen time is linked with atrophy of the brain's gray matter. Largely, the brain's frontal lobe is affected. This is where executive functioning, decision-making, impulse control and emotion regulation occur.

Children who experience this may suffer from sensory overload, lack of restful sleep and a hyperaroused nervous system. According to Dunckley's research, behavioral correlations may include impulsivity, lack of mood control, lack of focus, lack of ability to form relationships, and even violent outbursts.

Physiological effects

Children and adolescents who exceed the recommended amount of screen time can suffer from psychological and physiological issues. Excessive screen time is associated with poor sleep and risk factors for cardiovascular diseases

such as high blood pressure, obesity, low HDL cholesterol, poor stress regulation (high sympathetic arousal and cortisol dysregulation), and insulin resistance. Other physical health consequences include impaired vision and reduced bone density.

A variety of physiological issues that develop are related to the amount of white matter in the brain. The amount of white matter is a key area in the development of language, literacy and cognitive skills. Hutton, Dudley and Horowitz-Kraus' 2019 research was conducted using fMRIs to scan the brains of 3- to 5-year-olds. In this study, the experimental group — the children with over the recommended one to two hours per day of screen time — showed lower levels of white matter.

Psychological implications

Psychological issues related to excessive screen time in children include school failure, relationship issues, anxiety and depression. Studies have shown that the unhappiest teenagers are those who spend more time than average on digital media and less time than average on face-to-face social interaction.

In 2018, researchers Elizabeth Seay and Jeanne Whalen found that both the amount of time spent on screen and how that time was utilized were important factors in children's mental health. This research suggests that children who isolate themselves when engaging in screen time with shows, games and other activities can feel depressive symptoms that may in part be due to a lack of face-to-face interactions with friends and family members. But children who use their devices to stay connected with loved ones show a lower rate of depression. Depressive symptoms are also associated with poor sleep, night usage of digital devices and mobile phone dependency.

Melatonin

Children and adolescents who use devices such as tablets, televisions and smartphones before bedtime are more likely to experience a disruption in healthy sleep habits. While technology

is keeping kids occupied late at night, the blue light emitted through these devices slows down the production of melatonin.

Humans are diurnal animals, and melatonin is a hormone that is secreted when light levels are low in a person's environment. Melatonin secretion promotes restful sleep. When melatonin secretion is blocked because of exposure to synthetic light (e.g., blue light from electronic devices), it causes delays in sleep onset. Disruption of sleep patterns is linked to lack of attention, lack of ability to retain information or convert it to memory, and slow processing.

Implications for counseling

Given the influence of screen time on the developing brain in children and adolescents, the monitoring of screen time is imperative. The brain develops most rapidly in the first five years of a child's life. This is because of the brain's increased plasticity that allows children to process information quickly. It is recommended that children spend two hours or less on screens per day to prevent negative side effects that can affect mental development and physiology.

Counselors have a responsibility to be aware of and to educate parents and caregivers on the importance of monitoring screen time and the effects that screen time can have on the developing mind. It is essential to remind parents that technology is not necessarily bad for their children. However, screen time can become an issue when it displaces more productive or meaningful activities or takes up most of a child's time until they are functionally impaired. For parents to work toward two hours or less of screen time per day, there is a need for stronger digital literacy, including the necessity of shutting down smartphones and other electronics a minimum of 30 minutes before bedtime.

Counselors can educate and assist caregivers in formulating a plan or approach to reduce screen time use among children and adolescents. For example, counselors can help parents use warm, clear communication about



the rules and discipline regarding screen usage. Counselors can also help parents understand the importance of passwords and parental controls. It can be challenging to monitor screen time with teenagers because of the ease with which they can access technology outside of the home, such as at school or with friends. Teens often initiate social communication with peers using technology and may also use technology to express independent interests (e.g., using social media platforms to learn and converse about a hobby or other interest). Teens may therefore initiate conflict with caregivers around these issues.

It may be helpful to educate caregivers about the importance of setting expectations for technology use with children and reinforcing these expectations with discipline to establish good habits early on. One tool that caregivers can use is a Wi-Fi control that can be accessed through various internet providers. This tool allows parents to pick and choose which devices can be connected to the internet and set time limits on how long these devices can be connected. Caregivers who use this tool can easily control who is connected to the internet and for how long, which adds another way for parents to reduce the amount of leisure time kids spend

engaging with technology. Caregivers should also aim to increase the number of face-to-face interactions their children have with others.

Summary

Technology and screen time cannot be avoided, but caregivers need to monitor how (and for how long) their children utilize screen time. Technology does offer benefits for children and can aid in their development when used in moderation. For example, educational apps and educational TV programs can facilitate learning. These tools can encourage children to engage in fun and interesting ways of learning various skills such as counting, speaking, problem-solving and color identification. During the COVID-19 pandemic, technology has been even further intertwined with children's education.

Although technology can be used to develop children's brains, caregivers should limit screen time to two hours or less and also use face-to-face learning activities so that the negative repercussions of screen time do not develop. It is easier to simply hand a child a tablet or phone to keep them occupied, but a child's development should be prioritized. Counselors should educate parents and caregivers about the effects of screen time on the developing brain as well as the benefits of reducing screen time and increasing opportunities for face-to-face interactive learning. ❖

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