Children's brains shaped by their time on tech devices, review shows

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Time spent watching television or playing computer games has measurable and long-term effects on children's brain function, according to a review of 23 years of neuroimaging research, which—while showing

negative impacts—also demonstrates some positive effects.

However, the researchers stop short of advocating limits on screen time, which they say can lead to confrontation. Instead, they urge policymakers to help parents navigate the digital world by promoting programs that support positive brain development.

The evidence review, published today in *Early Education and Development*, is an analysis of 33 studies which use neuroimaging technology to measure the impact of digital technology on the brains of children under the age of 12. In total, more than 30,000 participants are included.

In particular, the research finds screen time leads to changes in the pre-frontal cortex of the brain, which is the base of executive functions such as working memory and the ability to plan or to respond flexibly to situations. It also finds impacts on the parietal lobe, which helps us to process touch, pressure, heat, cold, and pain; the temporal lobe, which is important for memory, hearing and language; and the occipital lobe, which helps us to interpret visual information.

"It should be recognized by both educators and caregivers that children's cognitive development may be influenced by their digital experiences," says the study's corresponding author, Chair Professor Hui Li, from the Faculty of Education and Human Development Faculty of Education and Human Development, at The Education University of Hong Kong.

"Limiting their screen time is an effective but confronting way, and more innovative, friendly, and practical strategies could be developed and implemented. Those in policymaking positions should supply suitable guidance, involvement and backing for children's digital use."

The research team, which as well as experts from the Education

University of Hong Kong, included those from the Shanghai Normal University in China and Macquarie University in Australia, wanted to know how digital activity affected the brain's plasticity—or malleability—during critical periods of development. It is known that visual development mostly takes place before the age of eight, while the key time for language acquisition is up to 12.

They synthesized and evaluated studies on children's digital use and associated brain development published between January 2000 and April 2023, with the ages of participants ranging from six months upwards.

Screen-based media were the most commonly used by the participants, followed by games, virtual visual scenes, video viewing and editing, and internet or pad use.

The paper concludes that these early digital experiences are having a significant impact on the shape of children's brains and their functioning. This was deemed as both potentially positive and negative, but mainly more negative.

For example, negative impacts were witnessed in some studies with how screen time influences the brain function required for attention, executive control abilities, inhibitory control, cognitive processes, and functional connectivity. Other studies suggested that higher screen time is associated with lower functional connectivity in brain areas related to language and cognitive control, potentially adversely affecting cognitive development.

Some device-based research were assessed in the research pool. Tablet device users were found to have worse brain function and problem-solving tasks. Video gaming and high internet users were found, in four studies, to produce negative changes in brain areas, impacting intelligence scores and brain volume.

And general "intensive media usage" was shown to potentially impact visual processing and higher cognitive function regions.

There were six studies, however, demonstrating how these digital experiences can positively impact a child's brain functionality.

One study found improved focusing and learning abilities in the frontal lobe of the brain. Meanwhile, another study suggested that playing video games can increase cognitive demand, potentially enhancing children's executive functions and cognitive skills.

Overall, Chair Professor Li's team conclude that policymakers must act on these findings to support evidence-based practice for teachers and parents.

Lead author, Dr. Dandan Wu of the Education University of Hong Kong, states, "This investigation contains significant implications for practical improvement and policymaking. Foremost, it should be recognized by both educators and caregivers that children's cognitive development may be influenced by their digital experiences. As such, they should supply suitable guidance, involvement, and backing for children's digital use.

"It is imperative for policymakers to develop and execute policies grounded in empirical evidence to safeguard and enhance brain development in children as they navigate the digital era. This could involve offering resources and incentives for the creation and examination of digital interventions aimed at bolstering brain growth in children."

A limitation of the study, the authors comment, is the lack of research reviewed, which they state may be because this topic is "novel and emerging, and research technologies are also evolving." Additionally, "this scoping review," they add, "has not addressed the critical questions,

such as whether it is the early digital use (for example, screen time) or the cognitive processes (i.e., learning experience) that have driven the change of brain function and structure, and whether there are different effects of digital equipment types and the mode of use."

Therefore, the authors recommend that future research explore techniques such as longitudinal research on the impact of screens on brain functions.

More information: How Early Digital Experience Shapes Young Brains During 0-12 Years: A Scoping Review, *Early Education and Development* (2023). DOI: 10.1080/10409289.2023.2278117

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