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Informal Use of Technology by Children to Promote Cognitive and Social Skills

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Abstract

Structural and functional magnetic resonance imaging studies have shown extensive structural changes in the adolescent brain accompany these changes in function. Improvement of functions such as attention and cognitive flexibility in adolescence for example is likely a result of myelination and pruning in the frontal and parietal lobes. Pruning refers to the selective elimination of synapses, which are initially overabundant in young brains. This process largely occurs throughout puberty and adolescence; children tend to exhibit higher density of dendritic spines than adults, with a subsequent decrease during puberty.

Keywords: Cognitive flexibility; Higher density; Developmental abilities; Magnitude and location; Brain structures

Introduction

Sensitive periods in early childhood and adolescence when critical brain development and reorganisation occurs can be strongly influenced by experiences and environmental factors that can impact future functioning. Sensitive periods used to be referred to as critical periods, as it was believed that this was a window of opportunity in brain development that, if missed, would lead to the loss or underdevelopment of critical developmental abilities [1]. However, the adoption of the term sensitive periods in favour of critical periods has become widespread, as research has demonstrated that development of language and visual processes, for example, once thought to occur only in critical periods of early childhood, can occur outside of this window [2]. Deprivation does take a toll on brain and cognitive functions, however when previously deprived children are taken out of a deprived context some developmental processes can be recovered. It is important to keep in mind that neuroplasticity is an underlying function of learning, although it is not an inherently good or bad thing. Depending on the magnitude and location of changes taking place, outcomes can be different [3]. Furthermore, it is pertinent to note that major brain changes, akin to what is suggested by the phrase rewiring the brain are unlikely. Genetic factors also play a large role in changing of brain structures during childhood and adolescence. Measuring these changes and activation patterns can be difficult. For example, Functional Magnetic Resonance Imaging allows for detection of brain activity as shown through changes in local cerebral blood flow and from changes in oxygenation concentration [4].

Methodology

Functional Magnetic Resonance Imaging is a non-invasive way of examining the central nervous system, and can provide researchers and clinicians with high resolution scans and demonstrate networks of engaged brain regions when specific tasks are performed [5]. However, it does not clarify the neural mechanisms underlying certain functions. Additionally, when studying certain regions of the brain such as the temporal or prefrontal cortex regions for example, due to difference in magnetic susceptibility it can distort results. Brain imaging can give some insight into brain structure and activation patterns, however functional relevance is difficult to infer, and this type of research is still in a rather exploratory phase. Both nature and nurture play a role in the development of children and adolescents' brains and cognitive skills. Furthermore, measuring these changes in cognitive skills or brain reorganisation is not always clear cut, and does not produce definitive results [6].

Discussion

Consequently, shock headlines touting total restructuring of children's mind as a result of technology use are not based on empirical evidence and are inaccurate. There is a relatively large body of literature exploring television and children; in part this is because television has been around for a long time. Researchers have explored the implications on verbal abilities, as well as cognitive, physical and emotional development. However, the quantity of research in this field outpaces the quality, many studies report very small effect sizes, are correlational in nature, and there is much contradicting evidence presented even when analysing the same datasets [7]. Thus, results in this domain must be interpreted with caution. This section serves to provide an overview of some of the literature regarding television viewing and child outcomes, and some of its limitations. Some research has linked viewing television for longer periods of time during childhood with attention problems in adolescence, and has suggested there may be modest adverse effects of watching television before the age on cognitive outcomes later in childhood [8]. One contested study suggested that one extra hour of television at age which was associated with a increase in the probability of having attention issues at an age, with similar effect sizes for the amount of television watched at age on in attention later in childhood. Subsequent reanalysis of the same dataset suggested that the risk of attention problems was significant only for the children in the survey who watched for more hours of television per day. One conclusion of this reanalysis was that modest levels of television viewing, even for younger children, may not be detrimental. Furthermore, retesting the hypothesis in a Danish sample found no significant association between hours of television watching in early childhood and behavioural problems later on [9]. The authors do note that Danish children in the sample tended to watch less

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television than their American counterparts, which does not rule out potential threshold effects that this study was unable to determine [10]. Other longitudinal research has suggested watching over three hours of television daily might be associated with a small increase in conduct problems at age when compared to children who watched for under an hour. However, there was no association found with outcomes such as attention hyperactivity as well as emotional symptoms, relationship problems and pro-social behaviour, nor with these outcomes and playing electronic games. Results implicating television watching in socio-emotional development of infants have also been inconsistent. However, on a more promising note, some literature points to more positive associations with television watching and children, suggesting it may promote literacy, mathematics, problem solving and science skills, as well as pro-social behaviour in preschool-aged children. Some scholars cite an opportunity cost associated with time spent watching television rather than engaging in more educational activities [11]. For example, time spent playing attention training games versus watching popular children's videos may contribute to improvements in executive attention and intelligence. Analyses of how children's brains react to television use are scarcer than those concerning cognitive or behavioural outcomes, and causality remains difficult to ascertain [12]. Despite these limitations, some results indicate that television viewing is correlated with differences in volume in different regions of the brain. For example, Takeuchi and colleagues found positive correlations between viewing television and volumetric properties in regions such as the medial prefrontal cortex and front polar area, which was negatively correlated with verbal Intelligence quotient and was predictive of a decrease in verbal Intelligence quotient over time. Sensorimotor regions may also be affected by television viewing, which is theorised to be because children who view TV more frequently are likely to engage in less physical activity which may have an impact on the volumetric properties in these brain regions. Limitations of this research include use of small samples and lack of intervention; therefore it is not clear whether TV viewing directly causes the outcomes measured, and whether the results are generalizable [13]. Furthermore, functional relevance of volumetric changes in different brain regions is not always clear. As referenced in the previous section, time spent watching television may have an opportunity cost in terms of children engaging in other activities. For example, attention training in young children may be implicated in provoking adult-like brain response patterns, and can raise questions as to whether these kinds of activities are more beneficial in preparing children for early childhood education than watching popular, age-appropriate programming [14]. It is important to note that attention training programmes delivered to children may also be screen-based, including elements such as stimulus discrimination and matching activities. In this sense, children are still engaging with screens and tallying up screen time, although outcomes might be different regarding active versus passive engagement, and type of screen use and activity. In sum, the effects of television viewing on children are not clear. If time spent watching television is time away from other activities, such as health-promoting behaviours, perhaps this could be a cause for concern. However, the evidence is conflicting, and there is no clear proof that moderate television watching displaces other behaviours essential for well-being or development [15]. Moreover, if television watching does impact outcomes such as attention or volumetric differences in brain regions, there is a need for research on the mechanisms leading to these outcomes, as this is a current weakness in the literature. Other cross-sectional research suggests that daily television watching, reading and physical activity when done with a caregiver is associated with higher linguistic and cognitive development than in children who engage in these activities only once or twice per week. One conclusion here might be that independent of the content of the activity, simply engaging in behaviours with a caregiver may be beneficial for child development. Another note about co-view and parental mediation of screen content more generally, is that there is a deepening divide between high and low socio-economic status families.

Conclusion

Children whose parents are able to spend time both curating and mentoring their experiences with screen time may reap more benefits than those in families with fewer financial resources and with parents who are less able to be involved in daily activities. This equity dimension of television viewing is important to consider, especially if there is a relationship between cognitive outcomes and time spent watching television, as children from low socio-economic status backgrounds, or with low educated mothers tend to watch more television than children from higher socio-economic status backgrounds.

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Conflict of Interest

None

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