Collaborate for kids

TELETHON KIDS INSTITUTE

MINDEROO FOUNDATION

CoLab EVIDENCE REPORT

Young children's use of digital technologies: Risks and opportunities for early childhood development

CoLab EVIDENCE REPORT

Young children's use of digital technologies: Risks and opportunities for early childhood development

AUTHOR:

Alice Wrobel, Professor Donna Cross, Dr Helen Monks, Amy Barnes and Phoebe George, Telethon Kids Institute

ACKNOWLEDGEMENTS:

Thank you to Professor Donna Cross, Dr Helen Monks, Amy Barnes and Phoebe George for their review and contributions to this Evidence Report.

SUGGESTED CITATION:

Wrobel, A. (2019). Young children's use of digital technologies: Risks and opportunities for early childhood development [CoLab Evidence Report]. Retrieved from https://colab.telethonkids.org.au/resources/

Andrew & Nicola Forrest, Minderoo Foundation

ABOUT COLAB:

CoLab brings together families, clinicians, educators, policy makers, other practitioners and researchers to provide evidence to improve service delivery and community capacity to meet the needs of children, families and communities who are experiencing vulnerability. Our vision is that young children in Australia develop, learn and thrive so they can build a better future for themselves and their communities. CoLab has three priorities, including: providing better support to families experiencing adversity; advocating for place-based approaches to improve the ways that families, services and communities work together, and; advancing the economic understanding of early childhood, with a focus on where the best early investments can be made. CoLab was launched in 2017 through a partnership between Telethon Kids and the Minderoo Foundation, made possible by Minderoo's founding commitment to ensure every Australian child gets the best possible start in life.

Telethon Kids Institute
Perth Children's Hospital
Northern Entrance
15 Hospital Avenue
Nedlands, Western Australia, 6009
Email: CoLab@telethonkids.org.au

CoLab EVIDENCE REPORT

Young children's use of digital technologies: Risks and opportunities for early childhood development

RESEARCH HIGHLIGHTS

- Children are being **exposed** to **digital technologies** at increasingly earlier ages and the rising popularity of technology use, even among very young children, can pose **considerable risks** to many aspects of their development.

- When used effectively, technology can promote children's **active engagement** and **creativity**, provide novel learning challenges and promote the development of **problem-solving skills**. These outcomes can help to lay the foundations for their future cognitive development.

- Official guidelines recommend a limit of **one hour of screen time** per day for children over the age of two years. However, it is not just the amount of time children spend using technology but the **way technology is used**, that matters most.

- Technology has the potential to both **enhance** and **detract** from healthy child development and learning, depending on how it is used. For instance, it is important technology does not displace other active and more enriching activities.

- Young children's use of technology needs to be **actively supported** and **monitored** by adults, who can provide learning opportunities, as well as help children to understand what they are viewing and its **relevance** to the world around them.

CoLab EVIDENCE REPORT

Young children's use of digital technologies: Risks and opportunities for early childhood development

The term 'technology' refers to a variety of devices including smartphones and tablets, video game consoles, laptops, televisions and a range of other interactive electronic devices. These serve a range of functions in children's (and their parents') lives, including for purposes of entertainment, education and emotional relief, as well as being used as rewards or discipline [1]. The rising popularity of technology use among even very young children can pose considerable risks to many aspects of their development [2]. This evidence report will discuss how technology use in early childhood can influence children's physical, social, emotional and cognitive development in both positive and negative ways. It will also provide practical strategies that suggest ways to limit and support young children's technology use. Technology provides many opportunities for children and it is important to equip them with the skills to succeed in a digital society. It is vital we approach technology use pro-actively to help raise a generation of well-informed, safe and responsible digital citizens [3].

How has technology use changed for children?

Children are being exposed to digital technologies at increasingly earlier ages [4], and we are now witnessing a generation of children who have had ready access to digital technologies since birth and no memory of life before the Internet [5, 6]. Over 60 per cent of Australian children aged two to four years old use tablets for an average of 20 minutes per day [7]. A key feature of technology in recent years is the development of touchscreen devices, which has important implications for very young children. Children learn to point their forefinger between the ages of 10 and 14 months and, as such, they also gain the ability to swipe and tap a touchscreen [3, 8]. Essentially, young children can pick up touchscreen devices, press buttons and open icons with little assistance or modelling from adults [9, 10]. In comparison, operating traditional technologies such as laptops and computers require the assistance of an adult to operate a mouse or keyboard and open browsers [3, 9]. Therefore, touchscreen devices provide children with more digital independence [9]. Children's use of such devices is now so common that Apple has an entire support page explaining the various ways to set up devices to ensure they are child-friendly [11]. This includes ways to limit Internet access, prevent iTunes or App Store purchases and restrict the use of mobile applications (apps) or music with explicit content [11].

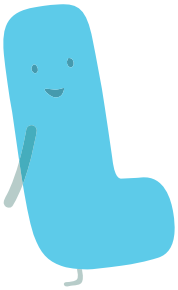
What are the guidelines?

Official guidelines recommend children under 18 months old avoid screen technologies, with the exception of video chatting such as Facetime or Skype [12]. Children between 18 months and two years of age should be supervised by their parents when watching digital technology. Over the age of two years, it is suggested that screen time is limited to one hour per day and only be used to view high-quality programs [12]. Parents need to proactively engage with their children when they are using screen technologies to ensure they benefit from the interaction. They can for example, help children to understand what they are viewing and link the content to real life by explaining how it is relevant to the world around them [12]. It is also important that parents ensure there are some technology-free zones in their house such as in children's bedrooms and at the table and parents need to try to avoid using technology as an 'emotional pacifier' [12]. While these recommendations provide important advice for parents, they may not always be realistic when technology use is so embedded in daily life. Moreover, these guidelines do not necessarily reflect the more active and positive ways children can interact with technology [9], including using devices to enhance creativity [13] and interact with family members [14]. It is more important to consider the ways children are using technology, rather than just how long they are using it for.

The impact of technology on early childhood development

Recent research has found that excessive screen time in early childhood predicts poor performance on developmental screening tests [2]. However, technology also has the potential to positively influence child development, depending on how it is used [15].

The use of technologies appears to be 'brain changing', particularly among infants and children [1]. Brains constantly rewire to incorporate new experiences, with new pathways in the brain continuously being formed and refined according to experience [16], even when these experiences are virtual (i.e. simulated through technology). The use of screen technologies is perceived by the brain as a pleasurable and rewarding experience [17], so it can be difficult for children to regulate their own media use [18]. Parents should aim to model regulated use of technology themselves to promote balance and limits to their children [12]. It is also important that parents communicate consistent and realistic messages about how much and what kind of screen time is allowed [12] and as children grow older prepare agreements that clearly describe how technology can be used by family members [19].



Cognitive and language development

Technology use can affect cognitive development both positively and negatively. The negative consequences of television viewing for example, are largely associated with the displacement of other, more enriching activities for learning and development [5, 15]. However, when used correctly and in moderation, technology can be an important tool for learning [13, 20]. It can encourage children to work with complex ideas from an earlier age, provide novel learning challenges and promote the development of problem solving skills. Additionally, by preschool-age, viewing well designed educational, interactive technology during childhood can assist in learning language and literacy skills [15, 21–23], and having access to a computer in the home is significantly associated with a better vocabulary at 8 years of age [24].

The creation of mobile applications ('apps') designed to operate on touchscreen technologies can allow individuals to customise their experience with the Internet, and provide more choice in the activities undertaken [1]. These apps can be important tools in promoting children's active engagement and creativity, especially when they allow children the opportunity to experiment and create in ways which are meaningful to them [13, 20].

It is essential for parents to carefully select apps for children [15, 20]. While 47% of the top-selling apps are designed for children between 0 and 12, 75% of these are only instructive in nature, giving little opportunity for interaction and open ended play [25]. Further, while over 80,000 children's apps in the Apple store are marketed as 'educational' [3], most have had no input from developmental research, nor are they based on specific educational curricula [15]. They generally only target simple skills such as colours and 'ABCs' [15]. As mentioned, children's technology use must be supported and monitored by adults, who can provide encouragement and learning assistance [12, 15]. Parents can also help their child to apply the new learning material to real-world contexts. For instance, young children can learn novel words through technology, particularly if parents are co-viewing that content and use the same new words in everyday interactions with their child [15].

Background television can have a negative effect on children's language and cognitive development, and executive function skills [26]. Researchers recommended that background television should be turned off, and for children under age three, careful supervision is recommended when the television is on. It is also recommended that, if the television is switched on, parents should actively participate and co-view it with their children, and that the media should not be fast-paced [26].

Social and emotional development

Technology use in early childhood holds some potential for supporting a child's social development. For instance, advances in technology provide opportunities to connect audio-visually with friends and family members through programs such as FaceTime or Skype [14]. A video connection can have many of the same positive effects as physical presence for young children [3], as it allows children to see who they are communicating with and show them the things they want to talk about, enabling them to sustain relationships with family who they are not able to physically see [14]. Furthermore, children over 24 months are able to learn social skills from video chat, including important conversational skills such as taking turns, taking account of their conversation partner, and learning to explain something to someone who isn't in the same place [14, 27]. However, there are also some concerns that children's use of technology will result in fewer opportunities for social interaction, especially face-to-face leading to impaired social development [2, 28].

Excessive screen time during the early years of development has been linked to a number of psychological difficulties [29–31], as it is associated with increased loneliness, depression, withdrawal, and anxiety and attention problems [32]. This may result in part from the potential for technology to decrease the quality of parent-child relationships [33]. Parents for example, must be careful to use activities involving technology as an opportunity to interact with their children such as watching television together, using apps together, or taking and viewing photos together. Such activities provide shared experiences and stimuli for children to ask questions about or can be used as a basis for imaginative play [12, 15]. Likewise, parents are encouraged to actively participate in their children's play and learning experience with technology through guided interaction [15, 34]. This includes being nearby to show interest in the activities, ask questions, and offer help or encouragement. It is also beneficial for parents to extend the themes of online activities into real life. This exposes children to the practical uses of the online skills they are learning, and opens up avenues for conversations and learning relating to the activities [12, 15].

Physical development

Technology use in early childhood also has important implications for various aspects of physical development. For example, the use of electronics by children is linked to a delayed bedtime, a shorter overall sleep time, and decreased sleep quality, particularly when devices are present in bedrooms or used in the last 90 minutes before sleep [32]. This is because screen technologies including tablets, phones, computers, and televisions all emit light in the relevant range to suppress melatonin, the primary hormone in regulating the body's sleep cycle [35]. Even though devices can be calibrated to emit levels of light that are not thought to affect melatonin production, this does not always translate to the actual levels of light experienced by the viewer [35]. Additionally, even when avoiding melatonin suppression, it is likely that children's sleep can be negatively impacted from the psychological, mental or emotional stimulation associated with technology use [15, 31]. To address this, it is recommended that a curfew for electronic devices be set one to two hours before children's bedtimes, and that children instead wind down with activities such as reading, talking, or bathing [15, 36]. These recommendations also apply to adults [36], who need to model this behaviour to their children.

Technology use in children has also been associated with a higher Body Mass Index (BMI) [15, 30, 31, 37], likely because children are using digital technologies instead of engaging in physical play activities, face to face interactions and sleep [32, 37]. When they are using digital technologies (particularly watching television), children's heart rate, movement levels, respiration, and energy use are all similar to while they are at rest. Another factor contributing to the link between technology use and a higher BMI is the impact of technology on diet and food intake, both through an increase in food consumption while using technology [38], and an increased exposure to fast food advertising [37]. Elevated BMI caused by habits formed around screen use is likely to become an ongoing issue as sedentary habits formed during childhood can extend into adulthood [39]. It is recommended that screen time be replaced with exercise as much as possible, and that consumption of food and drinks during screen time should be limited, especially at night time [12].

There is some evidence linking children's ability to independently interact with touch screen devices with enhancing their fine motor skills [40]. However, a number of musculoskeletal problems may also arise from excessive use of technology by children. Increased screen time is associated with lower back pain and headaches [41], partly due to the poor posture that is particularly common while using tablet devices [41]. For example, when children place the tablet on the floor, they must then adopt postures which require the neck muscles to be flexed at angles which are associated with tissue strain [41]. Repetitive movements such as the 'swiping' and 'tapping' of screens are also a concern, as this can potentially lead to upper-limb pain [41]. Therefore, it is important that parents and caretakers understand and provide proper instruction on how to use tablets and other touch-screen devices, and supervise use, to minimise potential musculoskeletal impacts [41]. For instance, parents can correct a child's posture while they are using tablet or touch-screen devices, and encourage the use of cases or stands to improve the screen's viewing angle and minimise stress on muscles and joints [38].

The online environment

When considering young children's use of technology, it is important to be aware of the Internet-related harms they can be exposed to, and how to minimise these risks. The range of online risks associated with children's technology include concerns about confidentiality, content and contact [42, 43].

Confidentiality risks refer to the potential for data provided by children to be stored in a personally identifying manner, or be distributed in unexpected ways [44]. For example, Club Penguin and the Hello Barbie app, both widely used and well-loved platforms for young children to engage with, have been known to collect extensive information on users' locations, all text content, and all transactions and registration information [44]. Websites often provide privacy policies that are too complex for children and their parents to understand, or display them in the Terms and Conditions, which most parents and children will scroll through without thoroughly reading [44]. Furthermore, if users opt out of information collection and sharing practices they generally will not be able to fully experience the service, or will be blocked altogether [44]. Through exposure to cyber environments from a young age, children can become desensitised to confidentiality issues [45]. Despite having awareness of various online risks, children often are not able to translate this knowledge to identify 'real life' risks or recall potential risks spontaneously [9]. For example, children may be able to identify a risk if they were asked for personal information directly, but are less likely to link joining clubs, filling out surveys, and entering competitions with the exposure of their personal information [45]. In the case of entering competitions, it is likely that the safety is overlooked as children are focused on the prospect of winning [45]. However, it should be noted that some types of technology that pose a risk to privacy may also provide unique benefits to children's development. For example, the personalisation of interactive media, including data-collecting toys, offers a flexible learning environment for children, showing significant educational benefits [44].

Content risks experienced by children include exposure to inappropriate or unsuitable content including violence, swearing, and aggression [9]. For instance, exposure to simulated violence though technology appears to impact the brain in the same way as when children are exposed to violence in real life [46]. This may be because children under 7 years of age have difficulty distinguishing between virtual worlds and reality [46]. Children who engage with this harmful content through technology can also become desensitised to violence, and more likely to see the world as a hostile and dangerous place [46]. In turn, this encourages their development of attitudes problem solving methods that promote aggression [46]. There is also the risk that children may imitate the behaviours they observe on screen [15], whether they are playing violent video games themselves or observing another person playing, such as a parent or older sibling [15]. It is important for parents to be aware of these harms and replace violent media content with educational and pro-social programming as appropriate [15].

Contact risks include a range of issues encountered when interacting with others through technology, such as cyberbullying, inappropriate contact with strangers, and privacy risks through the distribution of personal details [43]. While these serious risks may be more frequently encountered by adolescents and pre-adolescents on social networking sites, it is also important to be aware of the potential risk they pose in early childhood. For instance, although there is limited research into cyberbullying during early childhood, studies demonstrate this behaviour among children as young as six years old [47]. Cyberbullying typically refers to aggression which is carried out in electronic contexts, including smartphones, computers and social media, and includes behaviours such as sending insulting or threatening messages, posting humiliating comments, posting embarrassing photos or videos, or impersonating someone online to humiliate or cause them harm [47]. It is linked with a range of negative outcomes including anxiety, depression, difficulty sleeping, decreased performance in school, and absenteeism [47]. Another major concern with children's use of technology is inappropriate contact with strangers online. For example, surveys show that many children would not consider it dangerous to meet up with online friends they have never met in real life [45]. This may be because children assume that the people they interact with online are children of a similar age, and overestimate how well they 'know' them [45]. This further demonstrates the importance of young children's behaviour being supervised and monitored by parents or caregivers. Parents should also aim to talk with their child about technology and online safety so they can learn the importance of protecting themselves against these risks.

Conclusion

The current research shows the way children interact with technology is crucial to the impact it has on their development. By interacting with educational apps that promote learning and creativity, with the support and encouragement of a supervising adult, children can use technology to gain new skills and develop their creativity. However, to promote healthy development in all areas, care should be taken to ensure that technology use does not displace opportunities for social interaction and physical activity, and it is important for parents to lead by example. Additionally, by supervising and supporting children's technology use, parents are aware of the online risks that their children could be exposed to and can address these and model safer Internet behaviour.

Research on young children's use of technology is in its infancy and emerging research in this area provides useful guidance on potential intervention strategies. However, further research is necessary to gain a more nuanced understanding of how young children (and their parents) use technology in the early years. Future research should also aim to provide a more comprehensive understanding of the effects of technology on early childhood development, including tracking these effects over time. There are limited studies including children under nine years of age that measure the impacts of technology use, and even fewer that include children aged between birth and four years [9]. There is also a lack of studies within this age group which use a control group [3]. Given how widespread the use of technology is in today's society, this is an important gap for future research to fill. Future research should also aim to guide new recommendations which make clear differentiations between the variety of screen activities that young children can engage in rather than referring to only overall usage rates, as it has been established that not all activities will have the same effects on children's development. This is important because considering technology use collectively is more likely to lend itself to the creation of blanket bans on use, which can shut out parents and exclude children from the beneficial uses of technology [9]. Such information will provide important guidance for how to best manage the risks posed to young children by technology, while also highlighting the opportunities this new digital world opens up to children and how we can equip them with the skills to thrive in an increasingly digital society.

References

1. Holloway, D., Green, L., & Love, C. (2014). "It's all about the apps": Parental mediation of pre-schoolers' digital lives. *Media International Australia*, (153), 148–156. doi:10.1177/1329878X1415300117
2. Madigan, S., Browne, D., Racine, N., Mori, C., & Tough, S. (2019). Association between screen time and children's performance on a developmental screening test. *JAMA Pediatrics, 173*(3), 244–250. doi:10.1001/jamapediatrics.2018.5056
3. Holloway, D. J., Green, L., & Stevenson, K. (2015). Digitods: Toddlers, Touch Screens and Australian Family Life. *M/C Journal, 18*(5), 149.
4. Australian Bureau of Statistics. (2013). *Internet activity, Australia, December 2012* (Cat. No. 8153.0). Canberra. Retrieved from https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by Subject/1370.0~2010~Chapter~Children and mobile phones (4.8.5.3.2)
5. Palfrey, J., & Gasser, U. (2008). *Born digital: Understanding the first generation of Digital Natives.* New York: Basic Books.
6. Tapscott, D. (1998). *Growing up digital (Vol. 302)*. San Francisco: McGraw-Hill Companies.
7. Neumann, M. M. (2015). Young children and screen time: Creating a mindful approach to digital technology. *Australian Educational Computing, 30*(2).
8. Ahearne, C., Dilworth, S., Rollings, R., Livingstone, V., & Murray, D. (2016). Touch-screen technology usage in toddlers. *Archives of Disease in Childhood, 101*(2), 181–183. doi:10.1136/archdischild-2015-309278
9. Holloway, D., Green, L. and Livingstone, S. (2013). (2013). Zero to eight. Your children and their internet use. *LSE, London: EU Kids Online, 10*(1). doi:10.1186/1479-5868-10-137
10. Nansen, B. (2015). Accidental, assisted, automated: An emerging repertoire of infant mobile media techniques. *A Journal of Media and Culture, 18*(5), 1–9.
11. Apple Support. (2018). Using parental controls on your child's iPhone, iPad, and iPod touch. Retrieved from https://support.apple.com/en-au/HT201304
12. American Academy of Pediatrics. (2018). Children and media tips from the American Academy of Pediatrics. Retrieved from https://www.aap.org/en-us/about-the-aap/aap-press-room/news-features-and-safety-tips/Pages/Children-and-Media-Tips.aspx
13. Marsh, J., & Yamada-Rice, D. (2013). Early literacy development in the digital age. *Best Practices in Early Literacy Instruction*, 79–95.
14. McClure, E. R., Chentsova-Dutton, Y. E., Barr, R. F., Holochwost, S. J., & Parrott, W. G. (2015). "Facetime doesn't count": Video chat as an exception to media restrictions for infants and toddlers. *International Journal of Child-Computer Interaction, 6,* 1–6. doi:10.1016/j.ijcci.2016.02.002
15. Radesky, J. S., & Christakis, D. A. (2016). Increased screen time. *Pediatric Clinics of North America, 63*(5), 827–839. doi:10.1016/j.pcl.2016.06.006
16. Shonkoff, J. P. (2010). Building a new biodevelopmental framework to guide the future of early childhood policy. *Child Development, 81*(1), 357–367. doi:10.1111/j.1467-8624.2009.01399.x
17. Paulus, M. P., Squeglia, L. M., Bagot, K., Jacobus, J., Kuplicki, R., Breslin, F. J., … Tapert, S. F. (2019). Screen media activity and brain structure in youth: Evidence for diverse structural correlation networks from the ABCD study. *NeuroImage, 185,* 140–153. doi:10.1016/j.neuroimage.2018.10.040
18. Anderson, D., & Hanson, K. (2017). Screen media and parent–child interactions. In R. Barr & D. L. Linebarger (Eds.), *Media exposure during infancy and early childhood*. Springer.
19. eSafety Comissioner. (2019). Time online: A guide to managing online time for parents and carers. *eSafety parents and carers*. Retrieved from https://esafety.gov.au/parents/big-issues/time-online
20. Neumann, M. M. (2014). An examination of touch screen tablets and emergent literacy in Australian pre-school children. *Australian Journal of Education, 58*(2), 109–122. doi:10.1177/0004944114523368
21. Anderson, D. R., Huston, A. C., Schmitt, K. L., Linebarger, D. L., & Wright, J. C. (2001). Early childhood television viewing and adolescent behavior: The recontact study. *Monographs of the Society for Research in Child Development, 66*(1), 1–147. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11326591
22. Christakis, D. A., Garrison, M. M., Herrenkohl, T., Haggerty, K., Rivara, F. P., Zhou, C., & Liekweg, K. (2013). Modifying media content for preschool children: A Randomized Controlled Trial. *Pediatrics, 131*(3), 431–438. doi:10.1542/peds.2012-1493
23. Chiong, C., & Shuler, C. (2010). Learning: Is there an app for that? Retrieved from https://dmlcentral.net/wp-content/uploads/files/learningapps_final_110410.pdf
24. Bittman, M., Rutherford, L., Brown, J., & Unsworth, L. (2011). Digital natives? New and old media and children's outcomes. *Australian Journal of Education, 55*(2), 161–175. doi:10.1177/000494411105500206
25. Shuler, C. (2012). *iLearn II; An Analysis of the Education Category of the iTunes App Store.* New York.
26. Barr, R., & Lerner, C. (2014). Screen sense: setting the record straight. Research-based guidelines for screen use for children under 3 years old. *Zero to three, 35*(4), 1–10.
27. Roseberry, S., Hirsh-Pasek, K., & Golinkoff, R. M. (2014). Skype me! Socially contingent interactions help toddlers learn language. *Child Development, 85*(3), 956–970. doi:doi:10.1111/cdev.12166
28. Radesky, J. S., Peacock-Chambers, E., Zuckerman, B., & Silverstein, M. (2016). Use of mobile technology to calm upset children. *JAMA Pediatrics, 170*(4), 397. doi:10.1001/jamapediatrics.2015.4260
29. Sanders, W., Parent, J., & Forehand, R. (2018). Parenting to reduce child screen time: A feasibility pilot study. *Journal of Developmental & Behavioral Pediatrics, 39*(1), 46–54. doi:10.1097/DBP.0000000000000501. Parenting
30. LeBlanc, A. G., Spence, J. C., Carson, V., Connor Gorber, S., Dillman, C., Janssen, I., … Tremblay, M. S. (2012). Systematic review of sedentary behaviour and health indicators in the early years (aged 0–4 years). *Applied Physiology, Nutrition, and Metabolism, 37*(4), 753–772. doi:10.1139/h2012-063

31. Stiglic, N., & Viner, R. M. (2019). Effects of screentime on the health and well-being of children and adolescents: A systematic review of reviews. *BMJ Open*. doi:10.1136/bmjopen-2018-023191
32. Rosen, L. D., Lim, A. F., Felt, J., Carrier, L. M., Cheever, N. A., Lara-Ruiz, J. M., … Rokkum, J. (2014). Media and technology use predicts ill-being among children, preteens and teenagers independent of the negative health impacts of exercise and eating habits. *Computers in Human Behavior, 35*, 364–375. doi:10.2217/FON.09.6.Dendritic
33. Kildare, C. A., & Middlemiss, W. (2017). Impact of parents mobile device use on parent-child interaction: A literature review. *Computers in Human Behavior, 75*, 579–593. doi:10.1016/j.chb.2017.06.003
34. Shaheen, S. (2014). How child's play impacts executive function-related behaviors. *Applied Neuropsychology: Child, 3*(3), 182–187. doi:10.1080/21622965.2013.839612
35. Figueiro, M. G., Wood, B., Plitnick, B., & Rea, M. S. (2011). The impact of light from computer monitors on melatonin levels in college students. *Neuroendocrinology Letters, 32*(2), 158–163.
36. Schmidt, M. E., Haines, J., O'Brien, A., McDonald, J., Price, S., Sherry, B., & Taveras, E. M. (2012). Systematic review of effective strategies for reducing screen time among young children. *Obesity, 20*(7), 1338–1354. doi:10.1038/oby.2011.348
37. Cox, R., Skouteris, H., Rutherford, L., Fuller-Tyszkiewicz, M., Dell'Aquila, D., & Hardy, L. L. (2012). Television viewing, television content, food intake, physical activity and body mass index: a cross-sectional study of preschool children aged 2–6 years. *Health Promotion Journal of Australia, 23*(1), 58–62. doi:10.1071/he12058
38. De Jong, E., Visscher, T. L. S., Hirasing, R. A., Heymans, M. W., Seidell, J. C., & Renders, C. M. (2013). Association between TV viewing, computer use and overweight, determinants and competing activities of screen time in 4- to 13-year-old children. *International Journal of Obesity, 37*(1), 47–53. doi:10.1038/ijo.2011.244
39. Simmonds, M., Llewellyn, A., Owen, C. G., & Woolacott, N. (2016). Predicting adult obesity from childhood obesity: A systematic review and meta-analysis. *Obesity Reviews, 17*(2), 95–107. doi:10.1111/obr.12334
40. Bedford, R., Saez de Urabain, I. R., Celeste, C. H., Karmiloff-Smith, A., & Smith, T. J. (2016). Toddlers' fine motor milestone achievement is associated with early touchscreen scrolling. *Frontiers in Psychology, 7*, 1–8. doi:10.3389/fpsyg.2016.01108
41. Howie, E. K., Coenen, P., Campbell, A. C., Ranelli, S., & Straker, L. M. (2017). Head, trunk and arm posture amplitude and variation, muscle activity, sedentariness and physical activity of 3 to 5 year-old children during tablet computer use compared to television watching and toy play. *Applied Ergonomics, 65*, 41–50. doi:10.1016/j.apergo.2017.05.011
42. Muller, R. D., Skues, J. L., & Wise, L. Z. (2017). Cyberbullying in Australian primary schools: How victims differ in attachment, locus of control, self-esteem, and coping styles compared to non-victims. *Journal of Psychologists and Counsellors in Schools, 27*(1), 85–104. doi:10.1017/jgc.2016.5
43. Valcke, M., De Wever, B., Van Keer, H., & Schellens, T. (2011). Long-term study of safe Internet use of young children. *Computers and Education, 57*(1), 1292–1305. doi:10.1016/j.compedu.2011.01.010
44. Holloway, D., & Green, L. (2016). The Internet of toys. *Communication Research and Practice, 2*(4), 506–519. doi:10.1080/22041451.2016.1266124
45. Ey, L. A., & Cupit, C. G. (2011). Exploring young children's understanding of risks associated with internet usage and their concepts of management strategies. *Journal of Early Childhood Research, 9*(1), 53–65. doi:10.1177/1476718X10367471
46. Bavelier, D., Green, C. S., & Dye, M. W. G. (2010). Children, wired: For better and for worse. *Neuron, 67*(5), 692–701. doi:10.1016/j.neuron.2010.08.035
47. Kowalski, R. M., Giumetti, G. W., Schroeder, A. N., & Lattanner, M. R. (2014). Bullying in the digital age: A critical review and meta-analysis of cyberbullying research among youth. *Psychological Bulletin, 140*(4), 1073–1137. doi:10.1037/a0035618