

Paying attention: Is toddler attention shaped by early media exposure?

Professor Tim Smith, Professor of Cognitive Data Science, Creative Computing Institute, University of the Arts London

Professor Rachael Bedford, Professor of Biological and Experimental Psychology, Queen Mary University of London

Claire Essex, Centre for Brain and Cognitive Development, Birkbeck, University of London

Dr Hannah Pickard, Centre for Brain and Cognitive Development, Birkbeck, University of London

Author Photos



The intensity of toddler screen exposure is increasing year-on-year. UK children watch on average 9.6 hours of broadcast TV or on-demand video per week with the majority of toddlers using touchscreens daily (Bedford et al., 2016; OfCom, 2022). The sensory-cognitive stimulation provided by screens far exceeds that of reality, potentially shaping cognition during a child's first few years when brain development is at its peak. Concerned parents, policymakers, and scientists have long questioned the potential impact of screen time on young children's cognitive development, with some authorities recommending strict time limits for toddler media use (American Academy of Pediatrics, AAP; Hill et al., 2016). But such recommendations often fail to appreciate the potential educational benefits of age-appropriate content designed with child development in mind (Linebarger et al., 2014, Barr et al., 2010).

A particular concern for parents is how screen exposure may impact developing attention skills. Attention control (i.e., learning to control what we focus our brain's limited cognitive resources on) develops rapidly during the first few years of life and plays an important role in how a child learns to regulate their behaviours and emotions, skills which are critical for later educational success (Hendry, Jones & Charman, 2016). Many studies looking at the association with early screen media exposure have reported greater attentional problems in children who have more screen time (e.g. Nikkelen et al., 2014). Although, associations are often moderated by a family's socioeconomic background, parenting styles and the educational nature of the content being presented. Researchers propose that such associations come

about because screen media is designed to make all viewers attend to content in the same way, maximising the *automatic pull of attention* to the screen and minimising the need for viewers to *voluntarily decide* where to look. Spending too much time in an automatic attention mode during toddlerhood may limit opportunities to practice and develop more deliberate control, leading to attention problems in later childhood.

But what evidence supports this theory and what does it mean for media creators?

Directing Attention

Eye-tracking, which can record how children shift their eyes and attention over time, has shown how infant attention progresses from being predominantly under automatic control, attracted to prominent visual details like motion in the first few months of life to increasingly under voluntary control as the child learns to direct attention to points of interest such as faces and objects (see Figure 1; Haensel, Saez de Urabain, Senju & Smith, 2016) . Children's media must accommodate immature attention by guiding the young viewer towards critical scene details (e.g., speaking character; Wass & Smith, 2015). When it does so, screen media can maximise toddler attention and aid learning (Ildirar & Smith, 2018; Smith, Mital & Dekker, 2021). However, too much direction towards cognitively challenging content during viewing may have consequences after viewing.

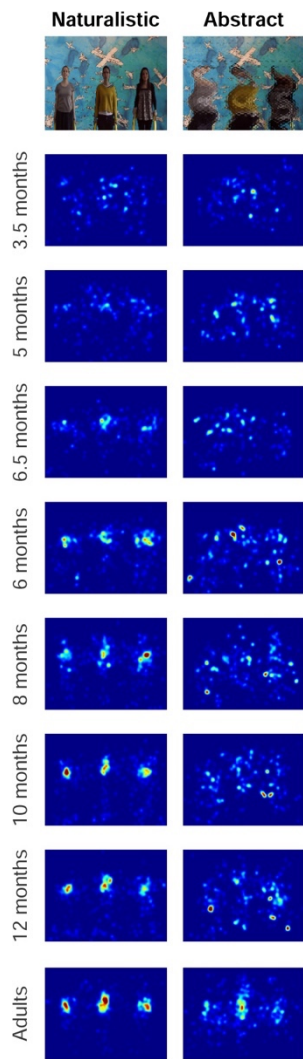


Figure 1: Heatmaps of infant (3.5 to 12-months-of age) and adult gaze (bottom row) whilst watching videos of women performing child-friendly actions (e.g. peak-a-boo; Naturalistic column, stimulus shown at top) and scrambled versions of the same videos (Abstract column). Hotter colours indicate more frequent gaze in that screen location; cooler colours indicate more dispersed gaze. Notice how gaze is increasingly directed to faces across age in Naturalistic but not Abstract versions (except in adults). Taken from Haensel and colleagues (2016).

Disengaging from a screen

Any parent of a toddler will be familiar with the tantrums and hyperactivity that may erupt immediately after the screen is switched off. Several studies have investigated this spill-over effect and shown that screen content which is too intense or too fantastical for children can impair voluntary control of attention and as a result limit children's ability to regulate behaviours (Kostyrka-Allchorne et al., 2017). Not all content has the same depleting effect: 4-year-old children performed worse on real-world attention control tasks after watching episodes of *SpongeBob SquarePants*, a fantastical kid's cartoon, than when they watched an educational show, *Caillou* (Lillard and Peterson 2011). TV shows which deplete attention control capacity tend to be more visually intense (Essex et al. 2022) but even when these visual differences are controlled, fantastical content still leads to poorer attentional control immediately after viewing (Essex, Gliga & Smith, under review).

Is there a longer-term link between screen time and later attention control?

In 2015, we ran a lab study which followed infants over time, measuring screen use and developing attention control. Capitalising on the “natural experiment” of whether parents chose to expose their infants to touchscreen devices (tablets and smartphones) or not, we recruited families into the Leverhulme Trust and Wellcome-funded Toddler Attentional Behaviours and Learning with Touchscreens (TABLET) project. Infants were recruited based on whether their daily exposure to touchscreen devices was above (*high users*) or below (*low users*) the average at 12 months-of-age (10 minutes). By matching groups on critical background factors at 12 months, including child age, sex, family socioeconomic status, child IQ, and temperament we were able to ensure that the link between touch screen use and attention findings was not driven by existing confounding differences between families.

Toddlers completed eye-tracking tasks to measure attention control at 12 months, 18 months and 3.5 years. We found that high touchscreen users had faster automatic attention (e.g. quicker to spot the odd-one-out) and showed some evidence of less voluntary attention control – they looked more towards a distractor that was not relevant for their task (Portugal et al., 2020; 2021). This finding of reduced voluntary attention control was also reflected across several real-world and computer-based tasks at 3.5 years; the high-users showed reduced working memory and less flexible switching between rules (Portugal et al., 2023). This finding may be due to the child’s broader media environment, rather than specific to touchscreen use, as it did not remain after controlling for TV viewing. The longitudinal design also allowed us to test whether early screen use predicted later attention differences. While we found evidence for concurrent associations between screen use and attention control, we did not find evidence for longitudinal effects. In other words, early screen use was not linked to later attention control, suggesting any short-term effects of screen use on attention may not persist over time.

Does screen exposure cause attention differences?

We have shown that screen media can directly shape attention during viewing, have immediate spill-over effects after viewing, and is associated with concurrent individual differences in attention. However, to show that screen exposure *causes* attention control to develop differently we need to manipulate screen exposure in randomly selected families, i.e. conduct a randomised controlled trial (RCT).

In 2022 we began the first RCT of a Parent-Administered Screen Time Intervention (PASTI; funded by Nuffield Foundation). This trial aimed to look at whether removing screen time in the hour before bed improved toddler sleep and attention over seven weeks. We focussed on the hour before bed because a) there is global consensus on this recommendation (e.g. AAP, Royal College of Paediatrics and Child Health, Viner, Davie & Firth, 2019); and b) our conversations with early years practitioners and parents suggested that this change would be more feasible given the realities of modern family life.

Over the course of a year, we managed to recruit a diverse sample of 105 families into the PASTI project. Families reported finding it easy to stop their toddler seeing screens in the hour before bed and maintain this for most of the seven-week trial. Analysis of whether the intervention improved toddler attention and sleep is on-going but once available it will be the first time we will be able to say whether toddler screen media exposure is causing differences in attention. See www.cinelabresearch.com for updates on our findings.

The developmental science of early-years media effects is an expanding area with many research questions still to be investigated. Based on our current findings we'd like to make the following recommendations:

Researchers

- Co-create research questions with diverse parents and media creators to ensure research can maximise impact.
- Conduct more RCTs of early-years media use to provide a strong evidence-base that can inform policy and practice.
- Create better measures of the quality of content (i.e. developmental-appropriateness) and the context of viewing to move the field beyond “quantity” measures of exposure.

Media creators

- Consider the flow of viewer attention through a show and whether the balance between moments that drive attention (e.g. intense/exciting) and calmer, more thoughtful moments is right for your viewer age.
- Children are active viewers, even from a very young age. Give them opportunities to actively search for and discover things on the screen to keep them engaged and help learn attention control.
- Collaborate with developmental scientists to test your intuitions about how to optimally shape viewer attention.

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References

Barr, R., Lauricella, A., Zack, E., & Calvert, S. L. (2010). Infant and early childhood exposure to adult-directed and child-directed television programming: Relations with cognitive skills at age four. *Merrill-Palmer Quarterly*, 21-48.

Bedford, R and Saez de Urabain, I. R. and Cheung, C. and Karmiloff-Smith, A. and Smith, T. J. (2016) Toddlers' fine motor milestone achievement is associated with early touchscreen scrolling. *Frontiers in Psychology* 7, ISSN 1664-1078.

Essex, C., Bedford, R., Gliga, T. & Smith, Tim J. (under review) Fantastical cartoons reduce toddler endogenous control without enhancing stimulus-driven exogenous control, *Developmental Science*

Essex, C., Gliga, T., Singh, M. & Smith, T. J. (2022) Understanding the differential impact of children's TV on executive functions: a narrative-processing analysis. *Infant Behavior and Development* 66 , ISSN 0163-6383.

OfCom (2022) *Children and parents: media use and attitudes report*

Haensel, J., de Urabain, I. S., Senju, A., & Smith, T. (2016). Developmental changes in infants' attention to naturalistic faces and visual saliency. *Journal of Vision*, 16(12), 65-65.

Hendry, A., Jones, E. J. H., & Charman, T. (2016). Executive function in the first three years of life: Precursors, predictors and patterns. *Developmental Review*, 42, 1–33.

Hill, D., Ameenuddin, N., Reid Chassiakos, Y. L., Cross, C., Hutchinson, J., Levine, A., ... & Swanson, W. S. (2016). Media and young minds. *Pediatrics*, 138(5).

Ildirar Kirbas, S. & Smith, T. J. (2018) How infants perceive animated films. In: Uhrig, M. (ed.) *Emotion in Animated Films*. Routledge Advances in Film Studies. Abingdon, UK: Routledge. ISBN 9781138303287.

Kostyrka-Allchorne, K., Cooper, N.R., & Simpson, A. (2017). The relationship between television exposure and children's cognition and behaviour: A systematic review. *Developmental Review*.

Lillard, A.S., & Peterson, J. (2011) The immediate impact of different types of television on young children's executive function. *Pediatrics*

Linebarger, D.L. et al. (2014). Associations Between Parenting, Media Use, Cumulative Risk, and Children's Executive Functioning. *Journal of Developmental & Behavioral Pediatrics*

Nikkelen, S. W. C., Valkenburg, P. M., Huizinga, M. & Bushman, B. J. (2014) Media use and ADHD-related behaviors in children and adolescents: A meta-analysis. *Developmental Psychology*, 50, 2228–2241.

Portugal, A.M., Bedford, R., Cheung, C. H.M., Gliga, T. & Smith, T. J. (2020) Saliency-driven visual search performance in toddlers with low- vs high-touch screen use. *JAMA pediatrics*, 175(1), 96-97.

Portugal, A.M., Bedford, R., Cheung, C., Mason, L. & Smith, T.J. (2021) Longitudinal touchscreen use across early development is associated with faster exogenous and reduced endogenous attention control. *Scientific Reports*, 11(1), 2205.

Portugal, A. M., Hendry, A., Smith, T. J. & Bedford, R. (2023) Do pre-schoolers with high touchscreen use show executive function differences? *Computers in Human Behavior* 139 , p. 107553. ISSN 0747-5632.

Smith, T. J., Mital, P.K. & Dekker, T.M. (2021) The debate on screen time: an empirical case study in infant-directed video. In: Thomas, Michael S.C. and Mareschal, Denis and Knowland, Victoria (eds.) *Taking Development Seriously: A Festschrift for Annette Karmiloff-Smith*. Routledge, pp. 258-279. ISBN 9781138334052.

Viner, R., Davie, M., & Firth, A. (2019). The health impacts of screen time: a guide for clinicians and parents. *Edinburgh, Scotland: Royal College of Paediatrics and Child Health*.

Wass, S.V. & Smith, T. J. (2015) Visual motherese? Signal-to-noise ratios in toddler-directed television. *Developmental Science* 18 (1), pp. 24-37. ISSN 1363-755x.

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