A Guiding Framework for Considering Touchscreens in Children under Two

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Abbreviations: AAP = American Academy of Pediatrics; app = application, TV = television.

Parents, teachers, pediatricians and other child health professionals face the challenge of widespread[1], increasing[2] and multipurpose[3] use of touchscreens. Even toddlers are accessing technologies such as tablets, smartphones, iTouch and other mobile devices with increasing frequency. Child use of this engaging technology is associated with diverse beliefs and practices on the part of parents, motivated by what is best for the child and by the difficulty of limiting touchscreen use[4].

The American Academy of Pediatrics (AAP, 2016[5]) concludes that there is insufficient evidence to suggest that the use of technology is beneficial for children under 18-24 months and recommends that screen media be discouraged for this age group. Toddler use of touchscreens has exploded nonetheless and child health professionals and educators require a more adequate research base to confidently communicate recommendations to parents. Yet, as with any innovative technology intervention, a key research challenge relates to building a longitudinal evidence base with a rapidly evolving hardware features and functionalities, necessitating repeated research studies.

This short narrative review builds on a recent summary of the field[6] and broader recommendations concerning all screens and screen time more generally[7,8] to propose a guiding framework concerning *touchscreens* and children aged under two years. The aim is to support health professionals, researchers, educators and advocates, in their discussions with parents about touchscreens' use with children under two years. There are four inter-related factors in this framework: research, content, context and developmental issues. There is no specific order to these four factors, and some are more related to each other than others, depending on the circumstances. We review the literature according to the four factors with the purpose of providing a clear view on the area of interest and at the same time, highlighting that the four

issues constitute one framework that, as a whole, needs to guide future research, practice and thinking in this area.

Research issues

Longitudinal evidence is needed to establish the effects of early onset use of touchscreens. The research base for the current AAP recommendations pertains largely to television and CD-ROM whereas current concerns relate primarily to the use of interactive touchscreens. Another methodological issue relates to the inconsistent definition of interactivity associated with children's digital books accessible on touchscreens. Here, interactivity can relate to interactive areas *within the book,* that can be activated through touch (the so-called hotspots[9]), but also to the interactivity *between* the child and an adult.[10] In addition, different research teams subsume different features under the broad umbrella term of interactivity[11]. While some researchers distinguish between interactivity and multimedia features[12], others focus on more narrowly defined features of the child's interactive experience with digital books[13]. These features include customization of stories, direct manipulation of on-screen characters, augmented and virtual reality.

A more refined definition of interactivity is also needed in video-based learning and communication where attention gets activated through verbal and visual stimuli rather than textual prompts. Emerging data[14] show that children under age 3 can learn new words (verbs), as well as respond in a reciprocal manner to learn novel patterns[15,] from socially interactive input from touchscreens (e.g. video chat). Online surveys[16] show that parents often use video chat to establish and maintain relationship between their young children and remote parents and relatives. Given the often shared and social context of use, and communication-relevant

experiences with touchscreens, some argue[17] that such use of touchscreens should not count as part of children's screen time and be treated as a separate research category.

A final research issue, not included in most policy statements, is the need to promote a broader range of research methods including qualitative studies (such as ethnography, multimodal analysis), as well as research with ethnically and culturally diverse groups. These alternative research methods can provide theoretical extensions, lead to the development of alternative outcome measures, and help explain learning mechanisms. These research issues affect our understanding of how touchscreens influence children's development and their contribution needs to be considered in light of unique developmental factors germane to children under the age of two.

Developmental factors

In a recent online survey, 715 parents of 6- to 36-month-olds retrospectively reported the age of first touchscreen usage, walking, stacking blocks, and producing two-word utterances (i.e., the gross motor, fine motor and language milestones).[18] The researchers concluded that the novel interactive characteristics of touchscreens could improve children's developmental skills such as fine motor control, hand/eye coordination and visual attention. Causal relations cannot be deduced from a retrospective parent survey and therefore, other empirical data, especially data that would be supplemented with observations and interviews with parents, are necessary for gauging the potential impact of touchscreens on the developmental capacities and needs of young children.

First, a developmental approach needs to consider the multipurpose role of touchscreens in infants' lives *beyond learning* and for situations of use where convenience is important. Some parents use mobile devices to calm or quiet[19] or distract their infants and toddlers in situations

such as airplane trips or medical procedures. Thus, touchscreens potentially affect children's lives in several distinct ways, including children's self-regulation skills and parents' regulation strategies.

Second, age-related guidance risks excluding children whose abilities do not follow typical developmental patterns. Although the AAP guidance refined the cut-off point from two-year-olds to 18-24-month-olds, parents, as they already do with many other activities[20] need to consider children's actual developmental skills and temperamental differences.

Third, developmental skills need to be addressed individually for potential benefit or negative association. Here, knowledge from well-established areas of research can be incorporated into current considerations. For example, for reaching and grasping skills, infants progress from accidental reach to more purposeful reach of objects that is not fine-tuned until about nine months[21]. Even after this milestone, it is only with 3D explorations that children's hand-eye-coordination and problem-solving skills can improve[22] . Thus, if a child has multiple objects at their disposal, touchscreens are unlikely to add value to obtaining this skill in infants. On the other hand, children's language and cognitive competencies start with parent verbal and gestural responsiveness to child's utterances and gestures, leading to turn taking[23]. This experience represents a shared intention to communicate and value each other – a critical step for children's social and emotional development[24]. Such experience could be extended and enriched with touchscreens' use around family photo-sharing, for example.

Technology-related factors

Different touchscreens come with different kinds of software programs and skills necessitating their use. The first factor to consider is the suitability of the device for the child. As the name reveals, touchscreens are manipulable by touch, which may give the impression that

they are "intuitive" or easier to use than other technological devices. Icon-based navigation allows for independent exploration[25], but there are also physical skills that a child needs to master when operating an adult device. An observation study[26] of 14-22 months in a UK nursery revealed that children needed to learn how to handle the weight of the tablet while developing finger dexterity and stability in order to use tablets effectively. Furthermore, mastery of skills required for a specific activity on a touchscreen (e.g., InnoTab 2 Baby, a tablet game developed specifically for infants) does not necessarily translate to other fine-motor skills not involving a tablet.

Another key novel factor of touchscreens is that they are multimedia, that is they converge several media into one device. While single-function technologies afford a limited number of activities, there are a number of positive possibilities with touchscreens. The best examples include a camera, which can be used for taking pictures, video-calls with a traveling parent or absent grandparents to maintain connection; parent-child mutual enjoyment of music and visuals. Each functionality has different features and usage and their convergence in one device can be beneficial or challenging. For functionalities comparable to non-digital alternatives (e.g., a digital drawing board, which can be used for letter tracing or coloring just like paper-based drawing board), parents, and those who advise them, have to reflect on their own media practices to determine the, added value, if any, of this technology, in specific circumstances to achieve specific goals (e.g., learning different skills, distraction, family enjoyment).

Content-related factors

Based on studies examining the effects of learning new words from video on 2D screens,[27,28] we can deduce that young children can learn new words from touchscreens in some

conditions: specifically, the apps must provide high-quality content and the child's learning must

be effectively supported by an adult communicating with the child in real time. If content is

designed to scaffold children's learning as it is the case with lab-based content, then 24-month-

olds can learn how to solve a puzzle or learn new words[29]. Several app curating websites (e.g.,

Common Sense Media, Children's Technology Review) evaluate the educational potential of

apps based on theory-driven criteria[30] or parents' feedback, and are a good resource for parents.

Future research needs to examine the effects of specific content features on infants' learning,

especially in terms of psychological and non-cognitive outcomes.

Context-related factors

Previous research has examined children's use of technology in labs, homes or

kindergartens[31]. With touchscreens, however, the context of use has been widened to the so-

called third spaces (e.g., journey from home to pre-school; long-haul flights and bus rides;

grocery shopping and restaurants; waiting rooms). For the majority of young US children, there

is a potentially ubiquitous third space presence of touchscreens during a day. Based on their

values, available resources and pragmatic considerations, parents need to decide how to balance

technological engagement versus human engagement during third space time. These are not

mutually exclusive choices and it is clear that there are often short, disconnected three-way

interactions between the parent, touchscreen and the child. This makes it difficult to estimate

and recommend the overall time children should daily spend with touchscreens (cf AAP, 2016).

Last but not least, for all children but especially for younger children, technology use is by and

large managed by their parents/caregivers whose own use and views and attitudes, are crucial in

mediating children's actual use of touchscreens at home[32,33].

Framework summary

Based on a conceptual synthesis of the latest evidence on touchscreens and the youngest children with age two and under as a flexible age guideline, this review led to a guiding framework to support future thinking and activities of researchers and practitioners and appraise emerging research, about the role touchscreens might play in children's development. The complex nature of potential effects of touchscreens on young children can be broken down into developmental, technology-, content- and context-related considerations. It is important to have a discussion with parents about whether touchscreens and their multipurpose use are necessary for their child to achieve certain skills and how much their child's use, let alone their own use, displaces interactions with people. For technology-related factors, the suitability of functionality and quality of each activity enabled by a specific device and specific program downloaded on this device, needs to be considered. The quality of the content and the overall suitability of the device for the child, are important. For context-related factors, the third space use of touchscreens by children under two is already occurring, but merits further evaluation. Child health professionals can communicate this information when asked about the validity of a causal relationship between scientific evidence concerning touchscreens and child effects. Child professionals and parents can jointly evaluate how the home environment influences children's use of these technologies and how the family dynamics and parents' own technology practices impact on their children.

Regardless of what the eventual evidence shows about the value of touchscreens for children under two, it is important that children's physicians and others keep a socio-empirical approach towards the interpretation of this evidence and their recommendations for individual families. The framework outlined here can help guide this process.

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