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Infants, Toddlers and Mobile Technology: Examining Parental Choices and the Impact of Early Technology Introduction on Cognitive and Motor Development

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Abstract

Despite recommendations of no screen time for children under the age of 2, parents are introducing mobile technology to their children at very young ages (Rideout, 2013). While research on television use has found negative impacts in all areas of development (Barr, Lauricella, Zack & Clavert, 2010), research has yet to investigate the impact of mobile technology use with very young children. The current set of 3 studies included interviews, a survey, and direct observations of parents using mobile technology with children 1 to 2 years of age. The main finding across all studies was that parents introduce mobile technology to their children at increasingly earlier ages. In particular, parents are using smartphones more frequently than tablets with their younger children. While parents indicated mixed opinions and a number of concerns about the use of mobile technology with very young children, this did not discourage them from using the devices with their young children. Rationales for providing mobile technology to their very young child were consistent across studies and included the need for parent time, avoidance or alleviation of the child's boredom and potential educational benefits. While touchscreen technology is commonly perceived as easy to use, observations of children in this age group indicate a lack of necessary cognitive and fine motor skills to efficiently operate the devices. Parents compensated for children's limitations by selecting passive activities such as watching videos or by taking control of the device which was consistent across all studies. The use of mobile technology for passive activities to preoccupy the child, is a concern that may result in similar negative developmental outcomes that are found for television viewing rather than enhancing children's learning opportunities through technology. This study was a first to indicate that there may be a decrease in verbal interactions while using mobile technology, similar to the decrease in interactions found when children are exposed to television.

Contradicting evidence was found to the common perception that mobile technology is inherently interesting. While children showed an initial interest in a novel device, this was not necessarily sustained. However, repeated exposure to mobile technology may be important for encouraging ongoing or further interest. When investigating potential developmental implications contradicting results were found among two of the studies. Self-reported developmental assessments from the survey showed higher fine-motor and problem solving scores in those that had also indicated that their child had been introduced to mobile technology versus those that had not been introduced. However, when using an objective assessment of development higher frequency of mobile technology use was related to lower scores in fine-motor development. Although observations of joint parent-child media play suggest that learning potential from mobile technology may best be supported when parents actively engage with their child, it is clear that parents may need more information to consistently promote this type of engagement. Extending beyond the confines of the study, outcomes do support the need to develop guidelines to ensure that parents know how to maximize the benefits from mobile technology and minimize potential deficits.

This work is dedicated to my two little monkeys Elias and Felix who inspire me every day.

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Infants, Toddlers and Mobile Technology: Examining Parental Choices and the Impact of Early Technology Introduction on Cognitive and Motor Development

Screen media use has seen rapid growth since the introduction of the television in homes in the 1940's right up to present times with the introduction of mobile computer technologies and ease of access to the Internet. Young children represent an important market for advertisers and program developers for both television and computer outlets (DeLoache & Chiong, 2009; Wartella, Richert, & Robb, 2010; Wood, Gottardo, Grant, Evans, Phillips, & Savage, 2012). Indeed, a recent study found that 47% of infants under one year of age watch live television or DVDs on a daily basis and spend an average of nearly two hours a day doing so (Rideout, 2011). Interestingly, this exposure is in direct conflict with the recommendation stipulated by the American Academy of Pediatrics (1999, 2011) indicating a zero exposure mandate for children under two years of age. This recommendation follows a plethora of research reporting a wide array of negative social and cognitive consequences associated with early screen exposure (Armstrong & Greenberg, 1990; Fosarelli, 1984; Taras, Sallis, Nader, & Nelson, 1990). Much of the extant literature is based on 'screen-effects' associated with television viewing. The negative effects observed with early exposure to television, has subsequently been generalized to all screen-based technologies. Given the differences in interactivity, design and mobility available with computer-based digital devices, combined with the absence of research on infants, investigating the impact of early exposure is important in order to understand the impact of these particular screen-based technologies on development. In addition, rapid changes in availability and accessibility of computer-based screen technologies, especially mobile devices, make it increasingly urgent that researchers examine the impact of these devices on the social, emotional and physical well-being of infants and toddlers. In addition, given the dearth of information regarding very early exposure, it is also critical to understand parental decision–making, attitudes and experiences with technology and early introduction to children.

The recommendation of zero screen exposure in children under two years of age, however, may not reflect current practice (American Academy of Pediatrics, 1999, 2011; Holloway, Green, Livingstone, 2013; Rideout, 2011, 2013). Parents are introducing screen technologies, especially mobile digital technologies, to their infant children. Indeed, in a recent study, 57% of parents advocated introduction to technology prior to 2.5 years of age (Petkovski, 2014). There may be many reasons to explain this preference by parents for early introduction. For example, it may be the case that parents are simply unaware of potential risks and of the American Academy of Pediatrics recommendations. In some cases, early introduction may be unintentional and may simply be an artifact of circumstance, where children become exposed in an effort to entertain or share an adult experience. Alternatively, early introduction may reflect an active decision made by parents. For example, some parents disagree with the American Academy of Pediatrics recommendation and endorse the educational value of television for children (DeLoache et al., 2010) which may also reflect their views toward digital technologies. Further, the argument can be made that the use of technology such as computers and mobile devices is interactive and, therefore, may be far more advantageous than passively watching television. This is evident in a study by Rideout and Hamel (2006) who found that while only 38% of parents (with children under 6) felt that television "mostly helped their children's learning," nearly 70% of the parents believed that computers "helped their learning." The term "screen time" is possibly used too broadly, and it is, therefore, important to consider when, how, and why parents allow their children to use these devices, as well as the varying capabilities of different devices. Research has yet to investigate whether the introduction of this technology during such early years is beneficial or harmful to children's development, and how best to use these devices, if at all. The purpose of the present studies is to investigate the impact of early exposure to mobile technology and parental behaviours and attitudes that may drive or inhibit use.

Roadmap

The following document provides an overview of research contributing to the argument that early exposure to screen based technologies needs to be revisited. In particular, the research summary identifies the primarily negative outcomes associated with early screen-based research tied to television along with some of the positive outcomes. The need for re-investigation identifies changes in technology which potentially increase interactivity, mobility and accessibility. In addition, human interface developments which support younger users are also examined. Finally, a significant consideration involves parental attitudes and behaviours regarding technology use in their own lives and the lives of their children. Understanding the capabilities and limitation of very young children, those 12 to 36 months of age, in the context of affordances and limitations of available technology and parental attitudes serves as the core of the introduction. The outcome of this review provides a framework for three novel studies that assess the impact of mobile technology use on the cognitive, language, social and motor skills development of very young children. These studies also explore the factors that influence young children's use of mobile technology and whether or not there are ways, such as parental scaffolding, that could eliminate or moderate potential negative outcomes from early introduction of technology.

Technology Use by Infants and Toddlers

One of the largest factors contributing to the increased use of technology is the prevalence of technology, often multiple technologies, in the home. Rideout (2013) found that children under two spend an average of almost one hour a day using screen media. Time spent shows a decrease in the use of traditional screen media such as television, DVDs, computer and console video games, but an increase in mobile technologies such as smartphones and tablets. Specifically, between 2011 and 2013 access to tablet devices and smartphones increased dramatically from 8% to 40%, and from 41% to 63% respectively (Rideout, 2013). As age increases, so does media use (Lauricella, Wartella, & Rideout, 2015). Although increases in mobile technologies are apparent, television screen use continues to be prevalent.

Television. Historically, examination of media use and the impact of media was restricted to television screen use. Despite longstanding recommendations prohibiting television exposure for children under the age of two, television viewing by infants and toddlers continues to prevail (American Academy of Pediatrics, 1999, 2011; Rideout, 2013). Significant research has examined the negative and positive impacts of television viewing on numerous developmental outcomes for younger and older children. Overall, negative impacts have been found in all areas of development including cognitive, language and social development (Barr, Lauricella, Zack & Clavert, 2010; Conners-Burrow, McKelvey, & Fussell, 2011; Lin, Cherng, Chen, Chen, & Yang, 2015; Christakis, Zimmerman, DiGiuseppe, & McCarty, 2004). In part, some negative outcomes are associated with the perceived passive nature of television. Users 'consume' the content/media rather than interacting with the content. Despite this concern about passivity, when viewing television, positive effects also have been documented. For example, among children three years of age and older, positive educational and behavioural results have been demonstrated when children view content that is high quality, educational and age-appropriate (Bar-on, 2000; Barr, Zack, Garcia, & Muentener, 2008). These studies, suggest that in some contexts, even passive television viewing can result in positive developmental outcomes.

Today, the notion of passive television viewing may need reconsideration. For example, television traditionally was viewed as an activity done in the home, in a relatively static environment, with a large non-mobile television. Modern media on which television content is available and the viewing context may be very different than it was historically. However, despite changes in technologies used or environments involved, passive viewing of videos, television shows and movies continues to be very prevalent today. The role and impact of television and other media are examined below as a function of developmental age.

Toddlers and television. Although much research targets younger children, indicators suggest that very young children and infants increasingly are becoming exposed to screen-based technologies. In a recent survey, Rideout (2013) found that 2-4 year old children watched an average of one hour and four minutes of television per day with 76% of the children watching educational shows ‘sometimes’ or ‘often’, 48% watching children’s entertainment shows and 14% watching general audience or adult shows. Access to television and children’s control over television was evident in about a third of the households sampled as over a third (37%) of children 2 and 4 years of age had a television in their own bedroom (Rideout, 2013).

Infants and television. Research shows that the introduction to television is very early -- as young as 3 months with an average age of approximately 9 months (Zimmerman, Christakis, Meltzoff, 2007a). By age two 90% of children are regularly watching television for an average of 40-44 minutes per day (Rideout, 2013; Zimmerman et al., 2007a). Accessibility to television has also increased. Rideout (2013) found that 16% children under two years of age had a television in their own room. Accessibility to different types of programming is also high, even among infant populations. For example, among infants 0 to 1 years of age, parents reported that their children 'sometimes' or 'often' watched educational shows (40%), children's entertainment shows (20%) and even general audience or adult shows (14%; Rideout, 2013).

Impact of television on language development. Possibly one of the most extensively researched topics in childhood development and the impact of television, is how it has affected language development. Results consistently indicate a strong relationship between increased levels of viewing television and delays in vocabulary development (Lin et al., 2015; Nathanson & Rasmussen, 2011; Zimmerman Christakis, & Meltzoff, 2007b). The evidence suggests that language developmental delays occur due to a reduction in interaction between parents and children (Nathanson & Rasmussen, 2011). The more time children spend watching television, the less time they spend interacting with other people, and, therefore, they have fewer opportunities to engage in activities that promote language development. To investigate this effect more completely, research has looked at two very different contexts: television as background and co-viewing. Overall, in both of these contexts, interactions between parents and children are severely reduced and thus have a negative impact on language development (Hudon, Fennell, & Hoftyzer, 2013; Lavigne, Hanson, & Anderson, 2015; Pempek, Kirkorian, & Anderson, 2014). One study looking at co-viewing distinguished between quantity and quality of the parent-child interaction. Lavigne and colleagues (2015) found that the co-viewing of certain baby videos, Baby Einstein and Sesame Beginnings, resulted in a decrease in the quantity of parental language, but an increase in some of the qualitative aspects of language. For example, parents increased the number of new words per utterance (Lavigne et al., 2015). Similar results have been found indicating that negative effects of television watching on vocabulary can potentially be extinguished through parental interactions (Blankson, O'Brien, Leerkes, Calkins, & Marcovitch, 2015; Zimmerman, Gilkerson, Richards, Christakis, Xu, Gray, & Yapanel, 2009).

Impact of television on cognitive development. Research has found mixed results regarding the impact of television on cognitive development (Barr et al., 2010; Christakis et al., 2004; Courage & Setliff, 2009). In part the mixed findings are a product of the multiple factors involved in the construction, delivery and consumption of video based materials. For example, differences in content, and the speed/pace of delivery impact potential for learning. Similarly consumption factors such as the quantity of time spent watching, and the age of children impact cognitive outcomes.

The content of the programming watched by infants and toddlers may be an indicator of the extent of the impact on children's cognitive development. For example, Barr and colleagues (2010) found that infants with a high level of exposure to adult-directed television demonstrated poor executive functioning skills, specifically inhibitory self-control and emergent metacognition skills; these results were not found in infants exposed only to age appropriate content. Similarly, another study found an increase in hyperactivity and aggression in children who watched inappropriate content for their age (Conners-Burrow et al., 2011). Increased attention problems have also been found in children who watched violent and entertainment focused programs, but not programs listed as educational (Zimmerman & Christakis, 2007).

The speed and pace of television has also been investigated as a potential factor in the cognitive developmental impact of television viewing. Christakis and colleagues (2004) attributed decrements in attention to the overstimulation of children's brains during development. Television presents a series of images that are constantly changing at a very rapid pace unlike the much slower pace of real life. This constant change in images could potentially cause a continuous need to re-orient to the material (i.e., an orienting response) rather than sustaining attention. Researchers speculated that this constant orienting rather than sustaining response could be a critical factor in the shortening of children's attention span (Christakis et al., 2004). Research looking at both immediate and long-term effects has supported this view. Lillard and Peterson (2011) found deficits in children's executive functioning immediately following the viewing of a fast paced cartoon. Similar shortfalls were not found in children who watched educational television, or in control groups who did not watch television at all. Longitudinal impacts have also been observed. Specifically, the number of hours of television viewing at age one was associated with an increased likelihood of attention problems at age seven (Christakis et al., 2004). Contrary to this view however, research has shown that even infants can sustain their attention across changes and are able to habituate to video material over time (Barr et al., 2008; Courage & Setliff, 2009; Richards & Turner, 2001). Due to contradicting evidence it is difficult to conclusively understand the impact of pace of television on cognitive outcomes.

Quantity of time spent viewing and the age of children seem to be important factors in both the adverse or beneficial impact of television. Children who were exposed to television more frequently were nearly four times more likely to have delayed cognitive development than those who were expose less frequently (Lin et al., 2015). In one study, researchers found television viewing to have unfavourable outcomes for children under the age of 3, while children older than 3 showed positive effects when watching educational content targeted towards their age group (Mares & Pan, 2013; Zimmerman & Christakis, 2005). Further support for the important role that age plays in the impact of television can be found in the extensive research looking at the video deficit effect.

Video deficit effect. Researchers have discovered a video deficit phenomenon that seems to occur in children under 2 years of age (Anderson & Pempek, 2005). This deficit is the tendency for children to learn better from live models rather than through video (Hayne, Herbert & Simcock, 2003; Krcmar, 2010; McCall, Parke & Kavanaugh, 1977). This phenomenon shows a strong deficit in the ability of children to learn from television before 24 months of age and depending on the task up until three years of age. Age seems to be the key factor as research has shown some benefits of educational television programming for children over 3 years of age (Rice, Huston, Truglio & Wright, 1990). When the programming is appropriate, the ability to learn from television seems to continue to improve with age (Rice & Woodsmall, 1988).

While it is often taken for granted, the concept of using a video screen to learn things about the world is actually quite complex. For children to fully understand the video context they must be able to understand that the images on the screen are *symbols* that represent people and objects in real life (DeLoache & Chiong, 2009). This concept, known as “dual representation”, is very difficult for young children to acquire. In fact, research indicates that even children 2 ½ years of age are not successful in this level of symbolic reasoning-- even when a clear connection is made between a model and actual objects (DeLoache, Miller, & Rosengren, 1997). One further point of confusion is the need to transfer between two dimensional (2D) and three dimensional representations (3D). Objects presented in a 3D live state differ in a number of features from a 2D static visual only depiction. For example, with tangible manipulatives children have information about size and shape of the object within a real life context relative to themselves and the environment. In addition, children can rotate and manipulate objects to reveal front, back, and sides from multiple perspectives. Finally, this spatial information can be understood in terms of other familiar three-dimensional objects. To date the literature perceives screen representations to be less robust in terms of the features available and how these features are understood, especially for young learners. Having knowledge of these differences and understanding how to transfer between the two contexts is a necessary component in learning from a screen. These requirements are challenging for young children (Barr, 2013). Research shows that transfer difficulty is bi-directional; children not only have difficulty transferring from 2D to 3D, but also from transferring knowledge from 3D to 2D (Zack, Barr, Gerhardstein, Dickerson & Meltzoff, 2009). Children were far more successful in imitation tasks when the dimension (2D or 3D) remained the same between the demonstration and imitation phases (Zack et al., 2009).

Research has investigated whether it is possible to reduce the video deficit effect. It seems that manipulating certain aspects such as repetition, prior experience, working memory, attention, video features and language cues can impact the severity of the video deficit effect (Barr, 2013). However, the complexity of transfer between two contexts has an overall impact and, therefore, researchers have not had success in completely eliminating the effect (Barr, 2013).

Social meaningfulness of the characters on screen has also been investigated as a potential mediator for the video deficit effect (Krcmar, 2010; Lauricella, Gola & Calvert, 2011). In one exploration, social relevance assisted children by increasing their ability to imitate actions seen in the video. However, social relevance did not contribute to the tasks involving word learning (Krcmar, 2010). One suggested reason was the importance of interactivity during word learning because verbal language typically involves interacting with another person. Research has found that when presenters are more interactive and socially engaging, learning from a television screen increased (Nielsen, 2006; Nielsen, Simcock, & Jenkins, 2008). This finding has potentially important implications for computer-based media contexts. If newer technologies enable greater interactivity with the user, offering immediate responsiveness, it may be possible to reduce or eliminate the video deficit effect, and, thereby, allow children to learn from technological devices.

It is important to clarify the connection between the video deficit effect and the recommendation of the AAP to avoid screen time for children under two (American Academy of Pediatrics, 1999, 2011). Children learn by interacting with the world around them. For example, playing with blocks allows children opportunities to practice and refine fine motor skills. Throwing or kicking a real ball allows children to develop gross motor skills and build coordination. Having a conversation with an adult allows children to develop social skills as well as general cognitive and language skills (Linn, 2010). When engaged with media, the video deficit effect limits some of these learning opportunities—especially social and cognitive gains because children do not learn as readily from screen-based interactions as they might from a similar live interaction involving direct experience. In addition, motor skills learned from actual manipulation and engagement in activities cannot be replicated in passive, viewing contexts. Therefore, the time that children spend passively watching television provides less effective learning opportunities while at the same time reducing alternative opportunities to interact with people and the world around them. Passive viewing, therefore, takes time away from potential learning opportunities, and hence may negatively impact on children's development (Linn, 2010).

Impact of television on social development. Television has a pronounced impact on children's potential for social development. The arrival of the television heralded an era where young children, who were previously in constant contact with an adult due to the necessity for supervision, are now left alone without any social interaction (Napier, 2014). Television viewing negatively impacts social development in two ways. Firstly, time spent viewing television replaces potentially vital social interactions with adults and other children. Secondly, messages conveyed through television may instill unfavourable behaviours that can negatively impact children's' interactions with others.

The importance of social environments and social interactions from adults who surround children throughout their development is widely known (Bronfenbrenner, 1979; Vygotsky, 1978). Children often spend time watching television alone (Zimmerman et al., 2007a) and even when an adult is present, communication is altered and in most case reduced in both quantity and quality (Lavigne et al., 2015; Nathanson & Rasmussen, 2011; Pempek et al., 2014). This detrimental effect to communication and even responsiveness by the parent can have a very negative impact on the development of a secure attachment, which plays a vital role in the social and emotional development of children (Napier, 2014). While some research has seen positive effects on the parent-child interaction during television viewing, with appropriate content, these benefits can only be attained if the parent is regularly watching television with the child--- which research indicates is not the case (Kirkorian, Pempek, Murphy, Schmidt, & Anderson, 2009).

Television viewing impacts may areas of development that could in turn affect children's behaviour towards others and, therefore, their social development. Delays shown in areas such as language development could impact children's ability to communicate with other children, and impede further social opportunities that are so fundamental to children's social development (Lin et al., 2015; Nathanson & Rasmussen, 2011; Zimmerman et al., 2007b). Not only can a lack of abilities have a negative impact, but also the promotion of negative behaviours such as hyperactivity and aggression have been shown to be associated with poorer social skills (Conners-Burrow et al., 2011). Imitation of on screen behaviours can also impact children's social skills. While research has shown that children can imitate prosocial behaviours seen on television, violent and aggressive behaviour is also imitated (Bar-on, 2000).

Summary of television and its effects given the screen-based delivery system. One key message that research on television suggests is that examining television simply as a medium is insufficient. In any consideration of the medium there must also be careful scrutiny of contextual factors including content, parent-child interaction, and individual difference variables such as age, cognitive, social, and language skills. Consideration also needs to be given to the rationales parents have for exposing their children to television. For example, one study reports that higher achieving parents used the television as a supplement to learning while parents rated as lower achievers used it a substitute (Zimmerman & Christakis, 2005). Differences in rationales for parents' decision to employ television, in conjunction with contextual and individual differences may explain some of the contradicting results found in this research. Clarifying the contributions of multiple factors is an important consideration in media-based research. The present study extends current research to include a consideration of parenting attitudes, decision-making, and behaviours in the context of newer mobile media technologies.

Computer based media. While still a type of screen based technology, the computer differs from television, in that it has the potential to be interactive, making each experience different and unique. Additionally, high quality computer games can provide immediate and dynamic feedback, which is an important component of children's learning environment (Roschelle, Pea, Hoadley, Gordin, & Means, 2000). There is considerable research that demonstrates how computers can be used to successfully contribute to children's language and reading development. For example, studies show learning gains among preschool and school aged children after 4 years of age (Castles, et al. 2013; Piquette, Savage, & Abrami, 2014; Wood et al., 2012). However, due to a reluctance to engage very young children in screen-based contexts, little research examines the effects of computer-based technologies on very young infants and toddlers. In addition, until recent technological innovations were developed, infants were unable to interact effectively with computer-based technologies, due to limited cognitive and motor skills.

Toddlers and computers. While documented computer use in toddlers is still fairly rare, Carson and colleagues (2013) found that children two to four years of age spend an average of 8.4 minutes per day engaged with the computer. Studies from around the world showed children as young as 3 to 4 years old going online: 30% in the UK, 50% in Austria, 70% in Belgium and Sweden, and 78% in the Netherlands (Holloway et al., 2013). In the United States one study found 25% of 3 year olds went online daily (Holloway et al., 2013). Of children between 2 and 4 years of age, 35% use educational programs on a computer and 14% visited educational and informational websites (Rideout, 2013).

Infants and computers. Having not yet acquired the skills necessary to use computers, such as ability to use a mouse and keyboard, computer use in infants is substantially lower than in older age groups. However, computer use of children age 1 and under did increase between 2011 and 2013 from 4% to 10% (Rideout, 2013). For children under 1 year of age 5% of parents indicated their children use educational games or programs on the computer (Rideout, 2013).

Limitations in computer use by infants and toddlers. Human-computer interfaces require specific cognitive and motor skills (Wood, Willoughby, Schmidt, Porter, Specht, & Gilbert, 2004). Specifically, cognitive skills involving spatial representation, orientation and memory skills are inherent in the design and operation of most interface devises. For example, when operating a mouse, users must first understand that the mouse on the desk is represented by the arrow on the screen. They must then be able to map the physical movements of the mouse and their hand with the movements that occur on the screen. In addition, users must have the coordination to click the buttons on the mouse the required number of times and be able to hold and glide the mouse smoothly in order to drag objects across the screen. Even touch technologies are challenging as they require pressure to operate. For example, touch screens and touch pads may require constant pressure throughout a particular function in order to achieve a task (e.g., pressing on a target item and dragging across to another location). Changes in pressure may be recorded as a failed attempt or drop in some software and the software will start a new trial (Wood, Willoughby, Rushing, Bechtel, & Gilbert, 2005). Pressing on one part of a screen may also obscure vision for the part of the screen immediately behind or under the hand (Wood et al., 2005). The keyboard is even more complex as it requires the user to be able to read the letters/symbols on each key and understand what they correspond to on the screen at any given moment in time. Across all technologies, selection of specific target items requires fine motor skills. It is clear that the demands of the computer interface require consideration as an important predictor of successful use by young users. Some concerns may be augmented by physical or verbal scaffolding by parents, but some, such as the language requirements for the keyboard, may be simply too challenging for infant users.

"Lapware" for infants and toddlers. In the late nineties as the educational software market was exploding, software programs nicknamed 'lapware' appeared in the market (Galley, 2000). These software programs were developed for children aged 6 to 24 months on a widely held belief that the younger children were introduced to the computer the better. The programs were designed to lock down the computer to avoid accidentally deleting data, and allowed the infant to interact with the visually and auditory appealing images by hitting any key on the keyboard. However, there was no empirical evidence to support claims for cognitive gains made by companies, and, even more notably, the educational claims of the software were often either too simple or far too advanced for the target age group making it clear that there was no developmental basis to the content of the programs (Elkind, 1998). While they may not have had overwhelming success in this niche market, the arrival of touchscreen technology brought about change.

Mobile technology. The introduction of touch technologies paved the way for very young toddlers to interact with computer-based technologies. This initial step was advanced further with the development of mobile touchscreen technologies, especially those sensitive yet robust enough to be handled by infants and toddlers. The interactive and intuitive features of mobile touchscreen technology, combined with affordability, and manageability of these devices for even very young children, encouraged earlier introduction with mobile technology (Rideout, 2013).

Toddlers and mobile technology. A recent study found that at 2 years of age or younger, 89% of children had touched or scrolled the screen of a mobile media device, 95% had watched television on a mobile device, and 77% had used apps (Kabali et al., 2015). Of children between 2 and 4 years of age 43% play educational games on mobile devices (Rideout, 2013). Specifically, children use mobile devices primarily for playing games (63%) followed by watching videos (47%) and far fewer are using the devices for educational content (30%) such as reading (Rideout, 2013).

Infants and mobile technology. Mobile device use by infants substantially increased from 2011 to 2013 from 10% to 38% (Rideout, 2013). By 1 year of age 14% of children were using mobile media at least an hour a day, with that number increasing to 26% by age 2 (Kabali et al., 2015). Parents indicated that their children 1 year and under used mobile applications 'sometimes' or 'often' for the following: 13% for educational games, 15% for 'just for fun' games, 19% for creative apps and 13% for apps based on television characters.

Affordances and limitations of using touchscreen technology with young children.

Interactively. Interactivity has been shown to be a very important component in children's learning. When educational content is made interactive, requiring the participation of children, engagement and interest are increased which often results in better understanding of the content (Calvert, Strong & Gallagher, 2005; Calvert, Strong, Jacobs & Conger, 2007). Research indicates that learning from screens can be improved by making content interactive, especially when the interaction is a social one (Lauricella, Pempek, Barr & Calvert, 2010; O'Doherty, Troseth, Shimpi, Goldenberg, Akhtar & Saylor, 2011; Strouse, O'Doherty & Troseth, 2013).

Although well-designed interactive software has the potential to engage young children in appropriate and meaningful learning opportunities, research suggests that the applications typically chosen to present to children include passive, non-interactive presentations. For example, parents indicate that almost half of the applications (47%) selected for their children use involve simply viewing videos (Rideout, 2013), which fails to utilize the interactive capacity of the devices and would be expected to yield outcomes similar to those of watching television.

Intuitively. Touch screen technology may better complement the abilities of children in the sensorimotor stage of development (Holloway et al., 2013). According to Piaget (1953), around their first birthday children are moving from the coordination of reactions stage and entering the tertiary circular reactions stage. This shift further enables their active exploration and engagement in trial and error learning (Piaget, 1953). Screen technologies may reward this kind of exploration. Touching the screen is usually the first and only operation required to initiate interaction with the technology. Subsequent refinements include learning where, when and how to touch the screen for a desired outcome. These operations can be learned through trial and error and, therefore, even very young children can quickly come to understand how to manipulate objects on the screen.

Portability. Finally, the portability of mobile technology makes it a more accessible technology. While desktop, and even some larger laptop computer technologies, as well as television (with its associated cable, satellite connection or Internet connections) tie users to one location, mobile tablet and smartphone technology is easily portable and quickly accessed for use almost anywhere. Indeed, many parents take advantage of this portability when they run errands as they can quickly and easily occupy their children, anytime, anywhere (Zimmerman et al., 2007a). The portability of small mobile technologies also permits more natural interactions for young children. Typically, very young children are themselves mobile and are not accustomed to sitting at a desk or on a chair in an upright position for long periods of time. They move frequently even when engaged in a single task, which can be achieved easily with mobile technology such as a tablet.

Distractibility. Mobile devices have the potential to offer a limitless number of tasks or activities. For example, users can listen to music, watch videos, take pictures and videos, look at and edit pictures and videos, play games, access the Internet, and make voice and video phone calls. Among adults the multitude of options have been shown to serve as a distraction for the user in academic settings (Mueller, Wood, De Pasquale, & Archer, 2011). Lower working memory and poorer attention control have been linked to a decreased ability to limit the distraction effect of mobile technology (Hadlington, 2015). In an age group where working memory and attention control are still developing, concerns about distractibility and promoting distractibility must be considered.

Cost and Durability. The cost of most mobile devices ranges considerably, however, decreasing costs for basic devices has made affordability more widespread throughout the world. Interestingly, recent research has found that there is no digital divide between low-income and high-income communities for mobile technologies as was found with previous computer technologies (Kabali et al., 2015). Indeed, results indicate that age of introduction, frequency of use, and ownership of devices is as prevalent in urban, low-income communities as in other communities (Kabali et al., 2015).

Access to inappropriate content. Another potential problem with mobile devices is the ease of accessibility to inappropriate content. Nearly all mobile devices have Internet capabilities and because affordances and design allow very young children to navigate these devices, children could potentially access the Internet at a very young age. Also, while the Internet previously required typing skills which would have prevented young children from accessing inappropriate content, today simple clicks of a button (or taps of the touchscreen in the case of mobile devices) may be all that is required. While the Internet is the most obvious concern, links to inappropriate content are embedded in many applications through advertisement banners and in app purchases. It is a very real possibility that very young children could access this inappropriate or undesirable content simply by tapping on the screen. Access to inappropriate content at young age can have a variety of negative developmental implications (Barr et al., 2010; Conners-Burrow et al., 2011; Zimmerman & Christakis, 2007).

Parental Involvement

Parental beliefs. While the parental need for personal time is cited as a common reason for television use with children, many parents also believe in the use of television for the educational benefits and the well being of their children as an enjoyable relaxing activity (Zimmerman et al., 2007a). Kabali et al. (2015) found that 60% of parents let their children play with mobile media while running errands, 73% while doing chores around the house, 65% used mobile media to calm their children and 29% used it to put their children to sleep.

There seems to be a clear division of parental opinion on the use of technology; those who believe the technology has educational benefits encourage its use, while those who do not believe in its educational value discourage their children from using it (Lauricella et al., 2015). The importance of parental beliefs regarding the ability of technology to educate and advance their children is reflected by the rapid consumption of products believed to enhance learning. For example, the advent of the *Baby Einstein* videos, resulted in more than $400 million worth of sales, with a study in 2003 estimating that 1 in every 3 American children watched the videos (DeLoache & Chiong, 2009). This was followed by the development of computer programs and toddler friendly video game consoles such as Leapster (Garrison & Christakis, 2005). Currently, there are many mobile device apps to choose from that have been specially designed for easy use by infants and toddlers. Unfortunately, despite many claims made by companies in the educational value of their products, in most cases there is no scientific evidence to support these claims (Christakis, 2009).

Parental use of technology. Parental use of technology as well as their attitude towards technology have a large impact on children's use of technology (Lauricella et al., 2015; Vaala & Hornik, 2014; Xu, Wen & Rissel, 2014). In one study 36% of parents indicated that their TV is on in the background most of the time, regardless of whether anyone is watching it (Rideout, 2013). Research investigating the effects of “background” television demonstrates negative effects due to the lowered quality of interaction between parents and children (Lavigne et al., 2015; Pempek et al., 2014). Mobile technology allows for this distraction to be taken out of the home. A recent report indicated that 32% of parents say they use mobile technology ‘sometimes’ or ‘often’ to keep themselves occupied while out playing with their children (Rideout, 2013). Parental use may impact interaction between parents and children.

Parental scaffolding. The setting in which children watch or interact with technology is also very important. Whether children watch television alone, with a sibling, or with a parent and how they interact during that time seems to have an impact and can potentially facilitate the experience for that child (Barr & Hayne, 2003; Blankson et al., 2015; Strouse et al., 2013).

According to Vygotsky (1978) learning is a social process. Learning occurs from and with others within a cultural and social context (Vygotsky, 1978). In particular, parents, teachers, and peers provide opportunities for learning through scaffolding. Specifically, at any given moment there are tasks which children can successfully complete on their own and there are tasks just beyond their reach. The distance between what a child can and cannot do without assistance is called the Zone of Proximal Development. In the social context of learning, tasks just beyond children’s abilities can be reached when another scaffolds the learning task (Vygotsky, 1978).

The way in which assistance is provided is also very important. Bruner’s theory of scaffolding best describes how important it is for parents to provide assistance, but just enough assistance necessary to help the children complete a task (Wood, Bruner, & Ross, 1976). During the initial stages of learning a new concept children are dependent on adults to support them more extensively in order to grasp the new concept or skill. Then as children acquire the necessary knowledge or skill, the adult must gradually remove the support one step at a time until children can accomplish the task independently. It is important that parents scale back their assistance to provide only what is necessary at that moment by children (Wood et al., 1976).

Adapting the construct of scaffolding to children's use of technology may be especially important when examining early introduction of technology. If infants and toddlers have difficulty or are unable to learn from technology independently, scaffolding could provide a means for making technology useful as an educational tool. For example, parents could scaffold their children when using technology by physically assisting them or talking to them about what they are looking at, thereby allowing children to learn from a situation that they would not be able to learn from on their own (Barr et al., 2008; Strouse et al., 2013). Recent research has shown success in extinguishing some of the negative developmental effects of screen exposure by focusing on the interaction between parents and children during technology use (Lavigne et al., 2015). For example, Flynn and Richert (2015) found that parents who focused their support on the content rather than on the device, had children who improved in both content and device skills, while children of parents who focused their support on the device did not show similar improvements. This study also highlighted how traditional computers may overload children's working memory and interfere with their ability to learn content. With new touchscreen devices, that do not require the mental link between the mouse and screen, this effect may be reduced and may allow for the focus of both children and parents to remain on the content of the games rather than the device (Flynn & Richert, 2015). Research has found success in assisting children through three methods of scaffolding; adult-provided, peer-provided and software-provided (McCarrick & Xiaoming, 2007). McCarrick and Xiaoming (2007) stressed that because of the individualistic nature of software-scaffolding, the personal feedback these devices could potentially offer to children far exceeds what an adult, a teacher for example with class full of students, could provide. With the ability to complete tasks on mobile technology similar to those on the computer, it is feasible to extend the use of scaffolding to mobile technology in a similar way that is currently used for computers.

Unfortunately, many parents do not engage with their children in shared time with technology. Just over a third of parents report not watching television with their children every time they watch (Zimmerman et al., 2007a). While 58% of parents believe that media use does not impact face-to-face family time, 28% say that it decreases time spent together and 12% believe they spend more time together (Rideout, 2013; Verenikina, & Kervin, 2011). If parents use technology to distract or occupy children while parents engage in other tasks (e.g., errands and chores), children could potentially miss the benefits these devices may have to offer.

Parenting styles. Parenting styles serve a critical role in the development of children socially, emotionally and cognitively. It is possible that parenting styles might also impact on decisions to introduce technology as well as how technologies are used.

Baumrind's Parenting Typology (1966) identified three basic parenting styles (authoritative, indulgent/permissive, authoritarian), which are defined based on two main dimensions one looking at responsiveness (i.e., responsive versus unresponsiveness) and the other concerned with demandingness (i.e., demanding versus undemanding). A later iteration of this typology introduced a fourth parenting style, neglectful/uninvolved, which included parents who scored low on both responsiveness as well as demandingness (Maccoby & Martin, 1983). Authoritative parenting (high demand, high responsiveness) has been linked to a number of positive outcomes later in life including, emotional development, adaptability, social skills, academic achievement, and lower occurrence of problem behaviour (Baumrind, 1967, 1991;

Dornbusch, Ritter, Leiderman, Roberts, & Fraleigh, 1987; Panetta, Somers, Ceresnie, Hillman, & Partridge, 2014) Parenting style can also play a role in how well a parent provides assistance to their children and how successful they are at scaffolding. Authoritative parents seem to be better at using appropriate levels of scaffolding and adjusting to children's changing needs (Pratt, Kerig, Cowan, & Cowan, 1988).

In the context of technology use children with parents who were rated higher in demandingness (authoritative & authoritarian parenting styles) spent less time using screen media than those with lower demanding parents (indulgent & neglectful) (Veldhuis, Grieken, Renders, HiraSing, & Raat, 2014). Similarly, Valcke, Bonte, De Wever, and Rots (2010) found the highest Internet usage in children of permissive parents and the lowest use in children with authoritarian parenting style.

A new definition of parenting style which includes how media are incorporated into every aspect of the home life is beginning to develop. Wartella and colleagues (2013) defined three parenting styles specifically related to media use; they are media-centric, media-moderate and media light. To place the comparison into perspective, media-centric parents (39% of the sample) use screen media for an average of 11:03 hours per day while their children use it for an average of 4:40 hours per day; Media-moderate parents (45% of sample) use screen media for an average of 4:42 hours per day while their children use it for an average of 2:51 hours per day; and media-light parents (16% of sample) use screen media for an average of 1:48 hours per day while their children use it for an average of 1:35 hours per day (Wartella, Rideout, Lauricella, & Connell, 2013). These parenting styles reflect the complete home environment in regards to media including: number of media devices available, location of devices, attitudes towards media, uses of media as a parenting tool, and amount of time parents themselves spend using media.

This media focused “parenting style” is directly related to the amount of time children spend using media (Wartella et al., 2013).

Individual Differences

In addition to parental influences, developmental research has frequently focused on the potential impacts of individual differences in the child. A child’s temperament has been shown to impact both cognitive and motor development (Lemelin, Tarabulsy, & Provost, 2006; Nasreen, Kabir, Forsell, & Edhborg, 2013). Additionally, differences such as a child’s temperament, for example shyness, could impact how a child approaches novel situations and, therefore, could play an important role in the introduction of new technology (Calkins & Fox, 1992). Specifically, some research suggests that a higher level of exposure to television was related to higher levels of activity or fussiness in infants (Thompson, Adair, & Bentley, 2012). Given the recent introduction of mobile devices within our culture, it is important to investigate how individual differences in the child could play a role in use and exposure to mobile technology.

The Present Research

Despite the increasing use of mobile technology in general, and in particular, in the home, there is a lack of research examining the use of mobile technology with infants, and very few studies examining introduction to technology with very young children under the age of three (Holloway et al., 2013). In part, this lack of research is the product of the rapid rate of technological innovation. The development of more powerful, mobile and affordable technologies and the corresponding infrastructure to support them has outpaced research. The limited research also reflects ethical concerns. There has been a hesitancy for researchers to engage children in activities deemed to have a potentially negative impact (American Academy of Pediatrics, 2011). Although this concern is a valid one, technologies have become a ubiquitous part of even very young children's lives. While technology may be potentially harmful to the development of young children, especially if used incorrectly, there is evidence that regardless of potentially harmful influences of screen exposure, parents are using these technologies with infants and young children, therefore it is important to determine the impact of technology use early in life (Kaufman, 2013). In addition, current software applications provide instructional opportunities, creative play, and communication opportunities. For example, infants can chat, view and interact in common activities (e.g., shared book reading) with family members who are not physically present. Many applications are interactive, age-appropriate and employ effective instructional supports (Grant, Wood, Gottardo, Evans, Phillips, & Savage, 2012). The design of high quality computer software offers interactive instructional supports more than television or more static screen-based alternatives. Examining early technology use with children, including the perspective of parents of young children, is important to determine why and when technologies are introduced as well as the impact of use for children and families. This will allow for the development of guidelines and inform policies regarding early technology introduction for parents, caregivers and early childhood educators.

The current set of three studies examined early technology use from the perspective of parents and with respect to the impact on children. Specifically, the first study involved interviews with parents who have or have not introduced technology to infants and toddlers. The goal was to assess factors parents consider in their decisions regarding technology use for their children. The second study employed survey methodology, to further and more directly examine early introduction to technology. The survey permitted a broader sampling of parents and provided an opportunity to explore issues related to development through the use of standardized measures of cognitive, motor, communication and social-emotional, as well as adaptive behaviours. The third study involved direct observation of parent-child interactions during mobile technology use to gain a greater understanding of early technology use. Observations examined both hands-on use of a familiar mobile device, as well as the introduction of a new device or software. Children's reactions as well as parental behaviours were observed. In particular, parental support, assistance and interactions were assessed. Together these three studies provided a foundation for understanding how mobile technology is used, how it is integrated into the family life, and the implications of mobile technology use at very young ages for development.

Overarching Research Questions Addressed in the Present Research

The current set of three studies represents the first formal examination involving infant use of mobile technologies. One of the key contributions to the literature involves documenting and describing early introduction of technology. These studies also provide a first examination of potential developmental effect resulting from early introduction of mobile technology. In addition, the context of the home, and parent-child interactions involving technology are also explored in these studies. Research goals examined through these studies include:

1. Exploring the events that lead to the early introduction of mobile technology, and what factors parents take into consideration when deciding to introduce it.
2. Documenting and categorizing parental behaviours (supports, scaffolds, attention, expectations) when infants and toddlers are first introduced to mobile technology.
3. Exploring the relationship between parental opinion, attitude, and use of mobile technology and the child's use of mobile technologies
4. Exploring the developmental impact of technology use on early social, cognitive and physical development.

5. Exploring boundaries and limitations that parents employ to control their child's use of and access to mobile technology.

Study 1

Study 1 employed interview methodology to examine when and how mobile technology is introduced to infants and toddlers. Current research (Rideout 2011, 2013) suggests that increasing numbers of parents are introducing technology to their children early, well before 2 years of age. A critical first step in understanding why parents are or are not providing mobile technology to their children involves interviewing parents to determine their views on the use of mobile technology and the variables that influence their decisions. Interviewing parents permits a rich understanding of contextual, economic and personal factors that contribute to their decisions regarding children's use of mobile technology.

In the present study, both parents who do and those who do not currently allow their children access to mobile technologies were included. In addition, both mothers and fathers were sampled to investigate potential gender role differences. Parents of infants and toddlers were recruited in an effort to more clearly establish the age or ages at which *early* introduction occurs in this Canadian sample. The interview methodology was deemed particularly appropriate in this context as it provided parents an opportunity to more fully describe factors leading to the introduction of technology to their child and how they and their child experienced that early introduction. In addition, through open-ended questions in the interview, parents could elaborate on and provide specific examples to augment answers to specific questions about introduction and use of technology for young children. This qualitative data allowed for a more complete picture of the presence of mobile technology in the family life and the conditions that lead to a young child's initial contact with mobile technology to emerge. In addition, an understanding of how parents regulate children's continued use of the technology, that is setting and enforcing what they feel are acceptable boundaries, was also possible. Finally, aspects of family context including parental use of technology and the role of older siblings was also explored to more fully understand how young children situated within a family context become exposed to mobile technology.

Given the exploratory nature of this study, research questions involve a descriptive analysis of the qualitative data. Specifically, the interviews were used to determine the following:

1. Age at which parents feel it is best to introduce their child to technology and their rationale for that choice.
2. How children come to be introduced to mobile devices.
3. When and how parents assist children in using the technology.
4. What factors parents consider when introducing technology early.
5. The impact of children's age on parental views and introduction to mobile technology.
6. The impact of older siblings on parents' views and introduction to mobile technology for younger siblings.

In addition to these exploratory questions the first study also assessed potential difference in response as a function of parental gender to confirm whether gender is an important methodological concern for examining early introduction to technology.

Methods

Participants

Participants included 20 couples (i.e., 20 mothers and 20 fathers) from midsized cities in Southwestern Ontario, Canada with a mean age of 31.62 (*SD* = 4.00*)* each reporting on the same target child. Mean ages of mothers (*M* = 31.30, *SD* = 4.23, range: 22-37 years) and fathers (*M* = 31.95, *SD* = 3.85, range: 28-39 years) did not differ, $t(38) = .51$, p = .614. All couples indicated that they were married. Overall, the majority of participants (92.5%) had some higher education: 10.5% indicated some post-secondary education (Mothers = 5.0%, Fathers = 20.0%), 42.1% indicated college diploma (Mothers = 35.0%, Fathers = 50.0%), 22.5% indicated bachelor degree (Mothers = 25.0%, Fathers = 20.0%), 10% indicated Master's degree (Mothers = 15.0%, Fathers = 5.0%), 2.5% doctorate degree (Mothers = 5.0%, Fathers = 0%), and 2.5% post-doctorate (Mothers = 5.0%, Fathers = 0%). The remaining 7.5% had completed a high school diploma (Mothers = 10.0%, Fathers = 5.0%). No significant differences were found in the education level of mothers and fathers, $t(38) = 1.66$, p = .106. Thirty-seven participants (92.5%) indicated that their first language was English (Mothers = 95%, Fathers = 90%), with very few indicating French (2.5%) (Mothers = 0%, Fathers = 5.0%) and other (5.0%)(Mothers = 5.0%, Fathers = 5.0%) as their first language. No significant differences were found in the first language of mothers and fathers, X^2 (2, $N = 40$) = 1.03, $p = .598$. Most participants (90.0%) indicated that they speak only English at home (Mothers = 90%, Fathers = 90%), some also indicated they speak English and French (7.5%)(Mothers = 10%, Fathers = 5%) at home, and few (2.5%) indicated that they speak English, French and another language (Mothers = 0%, Fathers = 5%) at home. No significant differences were found in the languages spoken at home between mothers and fathers, X^2 (2, $N = 40$) = 1.33, $p = .513$.

The total number of children in the home ranged from 1 to 6 (*M* = 2.05, *SD* = 1.22) with most participants (80%) indicating they had only one (35.0%) or two children (45.0%). An additional 10% indicated families with three children with the remaining two families having 4 and 6 children. Of the 13 children who had a sibling, 50% had an older sibling while 50% did not have an older sibling.

Target children's ages ranged from 13 months to 40 months (*M* = 22.80, *SD* = 7.78). For some analyses, participants were divided into 2 age groups, parents of younger children (age range of 13 months to 20 months; $M_{child\ age}$ = 16.70, *SD* = 2.20) and parents of somewhat older children (age range of 21 months to 40 months; $M_{child\ age}$ = 28.90, *SD* = 6.42; see Figure 1 for the age distribution of each age group). This grouping yielded groups of similar size (*n* =10 per group) while also permitting comparisons among younger and older children.

Parents were recruited through flyers posted at various venues where parents and children attend (e.g., recreation centres, libraries, early years centres). All participants were treated in accordance with APA/CPA ethical standards.

Materials

Materials included questions/prompts developed for the interview, recording devices and a short survey.

Interview. The interviews were designed to invite parents to discuss their views and experiences related to mobile technology use by infants and toddlers in general, and, more specifically, their experiences with the introduction of technology for their child. A set of questions/prompts was constructed to serve as a template for topics covered. Questions were introduced in a static order but only if needed. A total of three questions were forced-choice (yes/no) in format. These questions were used to determine subsequent follow-up questions. Specifically, parents were asked whether they had introduced their child to mobile technology, whether they have employed boundaries regarding mobile technology use for their child and whether their child watches television. All remaining questions were open-ended and these are described in more detail below and in Appendix A. If parents already addressed topics that would be initiated through a question, that question would not be introduced (see Appendix A for full question protocol).

The opening question for all interviews was the same and prompted parents to share their views regarding mobile technology use and young children (i.e., "What do you think about technology such as iPads®, smartphones and laptops with very young children?"). Parents were then asked a forced choice question regarding whether or not they have introduced mobile technology to their child. For parents who answered in the affirmative, 13 follow-up questions were asked to explore when and how mobile technology was introduced, the assistance parents provided to their child, what the child uses the technology for, how frequently the child uses the technology, whether the child has older siblings, and whether or not those siblings had a similar experience with the introduction and use of mobile technology.

Parents who indicated that they had not introduced mobile technology to their children, were asked four follow-up questions. These questions explored factors parents considered when deciding not to introduce the technology to their children, at what age they might introduce mobile technology to their child, what mobile technology they would introduce and who would make the decision about introducing it.

After these initial questions, parents were prompted to discuss whether or not they employ boundaries in their children's use of mobile technology or, in the case of parents not yet introducing technology, whether they anticipate establishing boundaries regarding use. Parents who responded affirmatively to this prompt were asked three follow-up open ended questions about when and how these boundaries were set or would be set and maintained and whether or not they have or would change over time and in different contexts. Parents who responded that they have not or would not set boundaries for their children's use of technology were asked two open-ended follow-up questions about why they do not or would not have boundaries and whether they feel this decision would remain consistent or change in the future.

Following the questions about mobile technologies, parents were asked questions about their child's television use. First, parents were asked to indicate whether their child watches television. Parents answering affirmatively were asked four subsequent questions including: how much the child watches television, what they watch on television, whether the child is supervised when they are watching television, and how the parent feels the television compares to mobile technology. Parents who responded that their child does not watch television were not asked any follow-up questions for that specific technology.

Each interview concluded with an opportunity for parents to reflect on the interview and add any other information they would like to provide regarding mobile technology and young children.

Recording device. Each interview was audio-recorded using a Sony ICD-PX333 Digital Flash Voice Recorder. These small, portable recorders (2.1 x 3.8 x 11.4 cm) could be placed relatively unobtrusively between the interviewer and parent (e.g., on a table or arm of a chair).

Survey. Each participant completed one, short, 8-question, hard-copy survey to assess demographic information. Specifically, parent age, gender, marital status, education, first language, language spoken in the home, number of children, target child age as well as siblings ages were assessed (see Appendix B).

Procedure

All parents were interviewed individually in a place convenient for them. Most parents were interviewed in their home. Because participants were 20 couples, interviews were conducted independently with the mothers and fathers so that the one spouse could not listen to the other spouse's responses. Interviews were also conducted in immediate succession to ensure there was no time for couples to discuss responses.

Each session began with a welcome and an introduction to the study followed by a request to complete a consent form (see Appendix C). Participants were provided a verbal summary regarding the nature of the study and were reminded that they could choose not to answer any question and that they could terminate the interview at any time. After this introduction, participants were advised that the researcher would begin the recording and the recording device was turned on and placed in full view of the researcher and participant. Once the recording started the researcher first stated the participant code and then began the interview. Questions were asked in the static order outlined above with the researcher omitting unnecessary questions depending upon the respondent's answers. Participants were encouraged to elaborate if brief or unclear responses were generated. Interviews lasted approximately 20-30 minutes.

After the interview was completed, the participant was asked to complete the survey. Surveys took approximately 5 minutes to complete. At the end of the session a debriefing letter outlining the study was provided to each participant (see Appendix D).

Results

Qualitative methodology was used to analyze the interview data. The audio recordings of the interviews were transcribed verbatim. The two raters discussed the content and read the transcripts one at a time using an inductive coding strategy (Boyatzis, 1998; Strauss and Corbin, 1990; Thomas, 2006) to identify and label emerging themes. The themes were re-evaluated as the raters progressed through the transcripts to reflect additional themes or refinements to thematic categories until saturation of themes was achieved. Given the open-ended nature of the interview, themes were extracted based on the content of the interview in its entirety. Reliability was assessed by having each of the two raters independently code 20% of the remaining transcripts (n = 8, n = 4 for mothers and n = 4 for fathers). Percentage agreement was 86.83% indicating high agreement. The Cohen's Kappa value was .60 indicating good agreement between the two raters, Kappa = 0.60 ($p < .001$), 95% CI (0.491,0 .715). Any disagreements were resolved through discussion. Remaining transcripts were coded by one of the two raters.

Strategy for Analysis of Qualitative Data

Analyses of the qualitative data were first conducted for the overall sample and then examined as a function of target child's age, family context and parent gender. Thus, for the 12 overarching topics, 77 main themes and 40 subthemes are first identified and described and then compared for each of the two conditions (i.e., age, family context; see Table 1 for summary of participants within each condition). For age, participants were organized into two groups based on the child's age. Specifically, parents were categorized as having a younger infant/toddler (20 months and younger) or an older toddler/preschooler (i.e., 21 months and older). This division by age provided an equal sample size for each age grouping with 50% of parents falling into each of the two age categories.

Responses were also examined as a function of family context. Specifically, outcomes of families of children without older siblings were compared to families of children with older siblings. Overall, half of the sample (50%) was comprised of families with only 1 child or with a target child who was the oldest sibling and the remaining half of the sample (50%) reflected families in which the target child was a younger sibling.

Finally, responses were compared as a function of parent gender. Again, half of the sample was reflected by this division. Participants included 40 parents (20 mothers, 20 fathers). [1]

A cut-off of $p \leq .05$ was set for each analysis. However, given the exploratory nature of this research, outcomes indicating a strong trend were also identified. Comparisons as a function of child age or presence of older siblings were only conducted in cases where at least four responses were present within a theme. Cases where no responses were present in one of the cells are identified.

Themes Relating to Age of Introduction and Use of Mobile Technology

In addition to asking parents about the age of introduction, parents were asked to share their views regarding young children using mobile technology, their reasons for introducing mobile technology to their child and what their child does with technology.

Age of introduction to mobile devices. Of the 40 parents interviewed 32 (80%) indicated that their child had already been introduced to mobile technology. The average age of introduction was 13.22 months (*SD* = 6.25) with a minimum age of 1 month and a maximum age of 30 months. Of the 32 parents who had introduced technology, 20 (62.5%) introduced mobile technology during the first year of their child's life (i.e., at the age of 12 months or younger). An additional 11 parents (34.4%) introduced their child to mobile technology when the child was between 13 and 24 months of age and the remaining parent reported introducing mobile technology when the child was 30 months old. Of the eight parents who had not introduced technology, seven had children in the younger age group (*M* = 18.29, *SD* = .95) and one had a child in the older age group. Interestingly, among these eight parents, two couples disagreed on their response to whether or not their child had been introduced to mobile technology. As a result

[1] Some themes were reported in an earlier study conducted by Megan Dodds 2016 as part of her honours thesis research which was conducted under the supervision of the author of this dissertation.

one parent in each couple received interview questions consistent with the protocols for a child being a user of technology while the other parent received questions consistent with protocols for non-technology use. Because each parent was treated as an individual participant, all subsequent analyses were based on each individual parent's responses to questions posed. This difference in responses is considered later in the subsection discussing gender differences.

The types of technologies introduced to children by the 32 parents indicating early introduction were captured by four categories including: cellphone/smartphone, tablet/ iPad®, children's device (i.e., Leap Pad, Fischer Price) and iPod. Although parents could indicate multiple devices, overall, the most frequently reported device was the cellphone/smartphone (90.6%), followed by the tablet/ iPad® (59.4%), children's device (12.5%) and iPod (by only 1 parent).

Age of introduction to mobile technology by age group. Of the 32 children introduced to technology, older children (95.0%) were significantly more likely to be introduced to at least one device than younger children (65%), X^2 (1, N = 32) = 5.63, p = .02. Comparisons for each of the four identified devices indicated that more older children (73.7%) were introduced to a tablet/ iPad® than younger children (38.5%), X^2 (1, N = 32) = 3.97, p = .046. Comparisons for the remaining devices did not reach statistical significance (see Table 2 for complete results).

Age of introduction to mobile technology in the context of sibling. Of the 32 children introduced to technology, 70% of those with older siblings had been introduced to at least one mobile device while 90% of those without an older sibling had been introduced to at least one device. No significant differences in introduction were found for any of the devices between those with older siblings and those without (see Table 2 for complete results).

General opinions regarding mobile technology use by young children. Parents were asked about their general views toward young children using mobile technology. All 40 parents provided a response to this question. Overall, 35% of parents expressed a negative opinion, 30% of parents expressed a positive opinion, and 32.5% of parents stated both positive and negative opinions.

Although opinions could be captured generally as positive or negative, within these global categories parents often provided qualifiers. With respect to positive opinions three qualifiers were identified. One qualifier identified a generally positive view when technology was used in moderation (32.5%). The second positive view was qualified by the assertion that technology promotes education (30.0%). In one additional case a parent qualified their positive view toward introducing technology explaining that it develops confidence in the child. Four qualifiers were identified in support of negative opinions regarding early use of technology. Specifically, parents expressed concern that technology takes away opportunities to engage in other activities (25.0%), and the worry of overexposure (20.0%). An additional two parents provided unique responses to qualify their negative opinions; one indicated that technology promotes concrete rather than abstract thinking, and the other stated that young children cannot appreciate the value or purpose of mobile technology (see Table 3 for descriptions and examples of each code).

Opinions of mobile technology by age group. Overall fewer parents of younger children (15.0%) expressed positive views toward early technology use than parents with older children (45.0%), X^2 (1, N = 40) = 4.29, p = .038. Indeed, more parents of younger children (55.0%) were likely to express a negative opinion regarding younger children's exposure to mobile technology than parents of older children (15.0%), X^2 (1, N = 40) = 7.03, p = .008.

Examination of qualifying subthemes could only be conducted for those occurring more frequently. Specifically, more parents of older children (50.0%) than those with younger children (15.0%) provided the qualifiers that access occur in moderation, X^2 (1, N = 40) = 5.58, p = .018, and that technology serves an educational purpose (50.0%, 10.0%), X^2 (1, N = 40) = 7.62, p = .006. No significant results were found between parents of younger and older children when providing a qualifier for their negative opinions (see table 4 for complete results).

Opinions of mobile technology in the context of siblings. Of the three general opinions on mobile technology use with young children two were significantly different between parents of children with and without older siblings. Parents of children without older siblings (45.0%) were significantly more likely to have a positive opinion regarding use of mobile technology than parents of children with older siblings (15.0%), X^2 (1, N = 40) = 4.29, p = .038. Similarly parents of children without older siblings (20.0%) were significantly less likely to have a negative opinion than parents of children with older siblings (50.0%), X^2 (1, N = 40) = 3.96, p = .047.

Only one of the four qualifiers differed significantly between homes where an older sibling was or was not present. Specifically, more parents of children without an older sibling (50.0%) stated that mobile technology use with children is positive when used in moderation than parents of children in homes with an older sibling (15.0%), X^2 (1, N = 40) = 5.58, p = .018 (see Table 4 for complete results).

Amount of use. All 32 parents who indicated their child had been introduced to mobile technology provided an answer regarding how often their child initially used mobile technology. Most parents (53.1%) indicated that their child used the device once to a few times a week while 21.9% of parents said their child used the device daily and an additional 21.9% stated their child used mobile technology 'rarely'. One parent stated that their child used technology "a lot". Parents were also asked how much their child uses mobile technology now. Of the 32 parents who responded, 30 responses could be captured by 3 themes: the child's use had increased since initial introduction (31.3%), the child's use had decreased since initial introduction (18.8%) and the amount of use had remained the same (43.8%).

Amount of use by age group. No significant differences were found between age groups for the amount of time the child initially used mobile technology, nor in the change in mobile technology use over time (see Table 2 for complete results).

Amount of use in the context of sibling. No significant differences in the amount of time children initially or currently use the device were found between those with older siblings and those without (see Table 2 for complete results).

Reasons for using mobile technology with young children. The 32 parents who indicated their child had been introduced to mobile technology were asked to explain why they would provide mobile technology for their children. Overall, seven themes emerged. Themes were not mutually exclusive; therefore parents who provided more than one reason were coded within multiple themes (see Table 5 for a full summary of themes). Three of the themes involved providing a distraction for the child. Specifically, parents provided technology in an attempt to alleviate or prevent their child from being bored (46.9%), to serve as a distraction while travelling (21.9%) and to allow parents time to complete other tasks (40.6%). Two themes indicated that technology was used as a tool to calm the child (34.4%) and as a teaching tool (31.3%). In addition, three parents indicated that using mobile technology provided an easy babysitter, and two parents stated that they use technology to entertain their child when their child is sick.

Reasons for using mobile technology by age group. No significant differences were found for any of the themes between parents of young children and parents of older children when discussing reasons for using mobile technology with their young child (see Table 6 for complete results).

Reasons for using mobile technology in the context of siblings. Only one significant difference was found amongst the themes for providing mobile technology to young children; parents of children with older siblings (71.4%) were more likely than parents of children without older siblings (27.8%) to give their child mobile technology to distract them in an attempt to avoid boredom, X^2 (1, N = 32) = 6.03, p = .014 (see Table 6 for complete results).

What young children do with the mobile technology. The 32 parents who had introduced their children to mobile technology, were asked to explain what their children do with mobile technology. Ten themes emerged; three of which are inherent to the device, four referred to applications on the device, two described using the device for movies and videos and one relatively rare theme related to picture taking (see Table 7 for a full summary of themes). Parent responses were not mutually exclusive, and therefore, could be coded within multiple themes. Of the three themes capturing functions of the device itself, most parents indicated that their child uses the device to look at pictures (40.6%), many parents indicated that their child manipulates the device as an object (i.e., such as holding it up to their ear: 25.0%), and 12.5% of parents said their child uses the device as a phone to make calls. Applications on the device were also commonly discussed. Approximately a third of parents indicated their child uses specific infant/toddler apps including looking at animal sounds, shapes, and colours (37.5%) while others, more generally, said that their child uses educational apps (28.1%). Some (28.1%) parents indicated their child plays free play games without a specific goal on the device, and 9.4% of parents stated their child play goal-directed games on the device. Finally, two themes captured the use of the device for videos; 46.9% of parents indicated their child watches videos or video clips on the device while 34.4% of parents stated that their child watches movies or shows on the device. Finally, three parents indicated that their children use the device to take pictures.

What young children do with mobile technology by age group. Of the nine themes that could be analyzed by age, two significant differences were found between parents of younger children and parents of older children in what their children do with the mobile devices. Parents of younger children (46.2%) were more likely to indicate that their child manipulates the device as an object than parents of older children (10.5%), X^2 (1, N = 32) = 5.23, p = .022. Parents of older children (42.1%) were more likely to indicate that their children use the device for educational apps than parents of younger children (7.7%), X^2 (1, N = 32) = 4.52, p = .033 (see Table 8 for complete results).

What young children do with mobile technology in the context of siblings. Of the nine themes that could be analyzed, only one significant difference was found between parents of children with an older sibling and those without. Parents of children without an older sibling (55.6%) were significantly more likely than parents of children with an older sibling (14.3%) to state that their child plays infant/toddler applications, X^2 (1, N = 32) = 5.72, p = .017 (see Table 8 for complete results).

Themes Relating to how Early Introduction to Mobile Technology Use Happens

Parents were asked to discuss the setting where initial introduction to mobile technology took place with their young child. Additionally, parents commented on how this initial introduction happened and what factors they considered in their decision to wait or introduce mobile technology to their young child.

Setting and reaction during first introduction of mobile technology to young children. Of the 32 parents asked to describe the setting and reaction of the child for the first time parents introduced technology three main themes emerged describing the setting (see Table 9 for a full summary of themes). Two of the three themes identified location of the introduction: home (50.0%), and outside of the home (28.1%). One of the three themes specified that other family members were around during the introduction (15.6%).

With respect to children's initial reaction to the technology, only one main theme appeared. The child's initial response to the mobile technology was most often excitement and enjoyment (87.5%). One parent, however, did indicate a reaction of frustration to initial introduction. Three parents provided responses that did not specify a reaction.

Setting and reaction to first introduction of mobile technology by age group. No significant difference between parents of older children and those of younger children were found regarding the setting in which their child was first introduced to mobile technology (see Table 10 for complete results).

Setting and reaction to first introduction of mobile technology in the context of siblings. No significant differences were found as a function of the presence or absence of an older sibling for the themes regarding either location for the first introduction to mobile technology setting or children's reactions. However, one trend toward significance suggested that parents of children with siblings (28.6%) were more likely to state that there were other family members around during initial introduction, than parents of children without older siblings (5.6%), X^2 (1, N = 32) = 3.16, p = .075 (see Table 10 for complete results).

Who initiated introduction to mobile technology. Interestingly, 29 of the 32 parents whose children had been introduced to mobile technology spontaneously indicated who initiated the introduction. More than half of these parents indicated that mobile technology was introduced by an adult (53.1%) while just over a third indicated introduction by the child (37.5%)(see Table 11 for descriptions and examples of each code).

Who Initiated Introduction to mobile technology by age group. Comparisons across the two age groups of children for the source of initial introduction yielded no significant differences (see Table 12 for complete results).

Who Initiated Introduction to mobile technology in the context of siblings. The source of initial introduction to mobile technology did not differ as a function of the presence or absence of an older sibling (see Table 12 for complete results).

Factors for introducing and waiting to introduce mobile technology to young children. All 40 parents were asked to identify reasons for introducing or waiting to introduce mobile technology to young children. While all parents were able to provide reasons for waiting to introduce mobile technology, only the 32 parents who had already introduced mobile technology to their child provided reasons for introducing technology. Eight main themes emerged, five relating to reasons for introducing mobile technology and three involved reasons for waiting. Themes that emerged were not mutually exclusive and, therefore, parent responses may have been coded for more than one of the themes.

Among the 32 parents who had introduced technology to their child, five frequently occurring themes explained why technology was introduced. Specifically, 21.9% of parents indicated that the child 'grabbed' the device out of interest or curiosity, 37.5% reported that the child 'grabbed' the device after seeing an adult use it, 46.9% indicated that the device was introduced to give the adult time to complete other tasks, 34.4% stated that technology was perceived to be a necessary and inevitable part of their child's future, and 21.9% stated that the technology is naturally engaging.

Among the 40 parents asked about reasons to wait rather than introduce technology early, the most frequent response that emerged was waiting because of the child's limited ability to use the device (22.5%). Additionally, some parents stated that they would wait because the thier own experience or upbringing supported a lack of availability or knowledge to use mobile technology, or lack of necessity for parents to use technology (15.0%), or waiting for fear of physical damage to the device (12.5%). Three additional parents stated waiting to introduce mobile technology to avoid temper tantrums and potential arguments with their child, and one parent stated waiting because they felt too many screens had already been introduced (see Table 11 description of all themes).

Factors for introducing or waiting to introduce mobile technology by age group. No significant differences between age groups were found for the reasons parents provided for why devices were introduced.

Of the three main reasons for waiting to introduce mobile technology, one comparison was significant. Parents of younger children (40.0%) were significantly more likely to wait to introduce technology because of their child's lack of abilities than parents of older children (5.0%), X^2 (1, N = 40) = 7.03, p = .008. Interestingly analyses could not be run on the theme "parents own personal experience or upbringing" because while 30% of parents with younger children indicated this reason, no parents of older children stated this reason (see Table 12 for complete results).

Factors for introducing or waiting to introduce mobile technology in the context of siblings. When exploring reasons for waiting no significant differences were found between children with and without siblings. One trend towards significance appeared; parents of children without older siblings (33.3%) were more likely to indicate that introduction happened because the child grabbed the device, than parents of children without older siblings (7.1%), X^2 (1, N = 32) = 3.16, p = .075. Interestingly, although analyses could not be run, 25% of parents of children with older siblings stated waiting for fear of physical damage to the device, while no parents of children without an older sibling indicated this reason (see Table 12 for complete results).

Themes Relating to Assistance, Supervision, Limitations and Boundaries

Parents were asked to describe the assistance and supervision that they provide, if any, when their young child uses mobile technology. Additionally, parents were asked about any limitations and boundaries that they have implemented in relation to their young child using mobile technology.

Assistance and supervision when young children are using mobile technology. Among the 32 parents who had introduced their child to technology, overall 84.4% of parents indicated providing some type of supervision (84.4%) and 84.4% also indicated providing some type of assistance (84.4%). Responses were further coded into twelve subthemes; nine subthemes captured the type of assistance and supervision that parents provided and three subthemes captured why they provided this assistance and supervision (see Table 13 for a full summary of themes).

The nine subthemes capturing specific types of supervision and assistance included four that referred to supervision of the device while four were specific types of assistance. The four subthemes relating to supervision included: Constant supervision (68.8%), the parent uses the device together with their child (40.6%), the child can use the device on their own with no supervision (37.5%), and nearby supervision (12.5%). The four specific types of assistance included: they navigate the device for their child (59.4%), they hold the device for their child (37.5%), they show the child how to use the device (21.9%), and they unlock the device for the child (15.6%). Interestingly, two parents also stated that they explain and discuss content with their child.

The three subthemes capturing why parents provide assistance to their child were: because of the child's limited ability (25.0%), that the child is destructive (25.0%), and that the child is too young (12.5%).

Assistance and supervision by age group. No significant differences were found between parents of younger or older children in any of the themes, investigating types of assistance and supervision. Interestingly, analyses could not be conducted for two of the subthemes because only parents of older children indicated nearby supervision (21.1%) and unlocking the device for their child (26.3%), while neither of these themes appeared in the responses of parents with younger children.

There were no significant differences between parents of younger and older children for two of the three subthemes investigating the reasons why parents provide assistance. For the third subtheme, no analyses could be run because only parents of younger children provided the reason of the child is too young (30.8%), while no parents of older children stated this reason (see Table 14 for complete results).

Assistance and supervision in the context of siblings. Overall, parents of children with older siblings (100%) were more likely to indicate some form of supervision than parents of children without older siblings (72.2%), X^2 (1, N = 32) = 4.61, p = .032.

No significant differences were found between parents of children with or without older siblings in the eight subthemes investigating type of assistance and supervision.

Of the three themes of why parents provide assistance no significant differences were found between parents of children with and without older siblings. However, no statistical analyses could be conducted on one of the themes because only parents of children with older siblings stated the reason that the child is too young (28.6%) while no parents of children without older siblings provided this reason (see Table 14 for complete results).

Limits and boundaries. The 32 parents who indicated that their child had been introduced to mobile technology were asked about what limits or boundaries, if any, they have for their children. Eleven themes captured parents' response to limits and boundaries and three themes captured when the limits and boundaries were introduced (see Table 15 for a full summary of themes). Themes were not mutually exclusive; therefore, parents' responses may have been coded in multiple themes. Three of the eleven themes examined general limits and boundaries, 40.6% of parents stated they had general limits but qualified this by saying that they had no hard boundaries, 37.5% of parents indicated that they had limits for their children on screen time in general, and 18.8% of parents stated that they had no boundaries because they felt it was not necessary. Three of the eleven themes identified specific situations where limitations would occur: 21.9% of parents stated no technology during mealtimes, 18.8% of parents indicated limiting based on actual content, and 12.5% of parents stated no mobile technology outside of the home. Two of the eleven themes allowed for the parent to remain in control of the device and its use: 18.8% of parents indicating the child had to ask for permission before using it and 16.6% of parents stating that they keep the device physically out of reach or locked. In addition to these more frequently occurring themes three parents stated that they do not allow their child to use mobile technology when they have visitors present, three parents indicated that they would not allow its use when the child is having a temper tantrum and two parents stated that they set limitations and boundaries based on the child's abilities.

Parents were also asked when limits and boundaries were introduced and if or how they changed over time. The three themes that emerged from the most common responses included: the limits were set right away (46.9%), the limits were set after watching the child use the device for a while (28.1%), and the child gained more freedom with the device as age increases (12.5%) (see Table 16 for complete results).

Limitations and boundaries by age group. Of the eight themes investigating limitations and boundaries, and the three themes looking at when boundaries were introduced and how they changed over time, no significant differences were found between parents of younger children and parents of older children when discussing limitations and boundaries (see Table 16 for complete results).

Limitations and boundaries in the context of siblings. Of the eight themes investigating limitations and boundaries, and the three themes looking at when boundaries were introduced and how they changed over time, no significant differences were found as a function of siblings. There was one trend towards significance; parents of children with older siblings (28.6%) were more likely to state that they keep the device physically unattainable by locking it or putting out of reach compared to parents of children without siblings (5.6%), X^2 (1, N = 32) = 3.16, p = .075 (see Table 16 for complete results).

Themes Relating to Television Use and Older Sibling Comparison

Although the interview was primarily interested in the introduction and use of mobile technologies in particular, parents were also asked to report on other technology use involving media-based technologies. Additionally, parents were asked to compare their young child's introduction and use of mobile technology with that of older siblings.

Television use. All 40 parents were asked about their child's television viewing habits. Three types of themes emerged regarding the child's television use. Seven themes expressed the amount of time the child watches television, three themes investigated specific situations in which children can watch television, six themes reflected what children are watching on television, and three themes involved supervision while children are watching television (see Table 17 for a full summary of themes).

Parents were asked if and how much their child watches television. The four most common themes that emerged included: having the television on in the background which also reflected relatively continuous exposure (25.0%), their child watching 2 hours a day (17.5%), their child watching 1 hour a day (17.5%), and their child watching television under 1 hour a day (45.0%). In addition, heavy, regular television viewing was reported by two parents (5%) who indicated that their child watches 3 hours a day and one parent who reported more than 4 hours of television a day. Only three parents indicated that their child does not watch television.

Three themes reflected specific situations in which the child watches television. Some parents mentioned that their child watches television only on weekends (15.0%) and 12.5% of parents indicated their child watches television before bed. Additionally, two parents (5%) stated that their child watches television at daycare.

Six themes explained what children were watching on television. By far the most common response by parents was child content such as cartoons (82.5%). In addition, some parents (12.5%) identified the specific child-oriented Treehouse program or network channel such as PBS (5%). Some parents reported that their child watches what their older sibling watches (10.0%). Additionally, one parent generally identified educational shows. Two parents indicated that their child is not allowed to watch the specific channel YTV.

The final type of theme involved investigated supervision while the child is watching television. By far the most common response from parents was that they provide constant supervision while their child watches television (65.0%), with an additional 17.5% of parents stating that they provide nearby supervision. Only 15.0% of parents indicated that their child watches television without supervision.

Television use by age group. None of the themes related to television use yielded significant differences between younger and older children. Interestingly, statistical comparisons could not be made for one theme as only parents of older children mentioned watching television only on weekends (30%). (see Table 18 for complete results).

Television use by siblings. None of the themes related to television use yielded significant differences between parents of children with and without older siblings. However, there was one trend towards significance, such that parents of children without an older sibling (60.0%) were more likely to state that their child watches under 1 hour per day, than parents of children with an older sibling (30.0%), X^2 (1, N = 40) = 3.64, p = .057 (see Table 18 for complete results).

Mobile technology comparison to television. Parents were asked to reflect on television in comparison to mobile technologies. Overall, parents' reflections were captured through six themes (se e Table 19 for a full summary of themes). Three of these themes indicated shortcomings in television relative to mobile technologies: less interactivity with television (32.5%), television being less beneficial (22.5%), and television being perceived as a one way reception (15.0%). One theme saw benefits for television over mobile technologies as television was perceived as easier to control (22.5%). One theme supported equivalence in the two technologies with television and mobile technology perceived as being used the same way (10.0%). The final theme indicated a need to be more cautious when using mobile technology because they (children) have access to the world (10.0%).

Television and mobile technology comparison by age group. No significant differences were found for the six themes investigating television and mobile technology comparisons between parents of older children and parents of younger children (see Table 20 for complete results).

Television and mobile technology comparison in the context of siblings. No significant differences were found for the six themes investigating television and mobile technology comparisons between parents of children with older siblings and parents of children without older siblings. However, there was one trend where parents of children with an older sibling (35.0%) were more likely to indicate that the television is easier to control than parents of children without older siblings (10.0%), X^2 (1, N = 40) = 3.58, p = .058 (see Table 20 for complete results).

Older sibling introduction and amount of use in comparison to target child. Half of the parents indicated that their child had an older sibling (N = 20). This sample of parents was asked additional questions regarding the introduction and use of mobile technology for their older children versus the younger target child. Eight themes emerged (see Table 21 for a full summary of themes). Three of the eight themes reflected timing for introduction of technology. Half of these parents stated similar introductions for both children (50.0%), 30.0% stated that the older sibling was introduced later and 15.0% qualified the later introduction for the older sibling indicating the older child progressed faster.

Because parents with older children have had more opportunities to observe how their older child uses mobile technology over time, they provided information about how their older child's use of mobile technology has changed over time. Three of the eight themes described use over time. Parents indicated that their child's overall use (50.0%), attention span (35.0%), and independence in using the device (30.0%) increased with increasing age.

Of the remaining themes one indicated that the older child sparked interest in using mobile technology for their younger child (35.0%). Finally, one of the eight themes stated that the older sibling uses mobile technology for school (15.0%) where the younger child does not.

Comparison to sibling introduction and use by age group. Of the eight themes no significant differences were found between parents of younger children and parents of older children (see Table 22 for complete results).

Themes Relating to Adult Use of Mobile Technology

In addition to commenting on their young child's use of mobile technology, parents were also asked to discuss their own mobile technology use.

Adult use of mobile technology. The 32 parents who had indicated that their child had been introduced to mobile technology were asked about the technology use of adults in the home. Nine themes emerged (see Table 23 for a full summary of themes). Themes were not mutually exclusive; therefore parents' responses could be coded within multiple codes. Three of the themes identified how frequently parents use the technology. Most parents indicated that adults in the house use mobile technology constantly (65.0%), while fewer parents stated a couple of hours a day (28.1%). Additionally, three parents indicated that they use mobile technology too much. Two of the nine themes reflected the purpose parents' use of mobile technology with 25% of parents indicating that they use mobile technology for work and 21.9% using it for personal use. Three of the themes reflected what parents do with the technology. These themes included: texting (18.8%), email (12.5%), and Facebook (12.5%). Finally, one of the nine themes indicated that parents were aware that they are models for technology use for their children (15.6%).

Adult mobile technology use by age group. No significant differences were found in any of the themes investigating adult use of mobile technology between parents of older children and parents of younger children (see Table 24 for complete results).

Adult mobile technology use in the context of siblings. No significant differences were found in any of the themes investigating adult use of mobile technology between parents of children with older siblings and parents of children without older siblings (see Table 24 for complete results).

Themes Examined as Function of Gender

All themes were analyzed as a function of gender, specifically, comparing the responses of mothers versus fathers. One interesting difference occurred during the interview when parents were asked to identify whether their child had or had not used technology. Within two couples, responses differed. In one case the mother indicated the child had been introduced to mobile technology while the father indicated no introduction and vice versa for the other couple. As noted earlier, within a couple two different interview protocols were used. Overall, virtually no differences emerged as a function of gender. Of the 104 themes that could be analysed from the interviews only two themes differed between mothers and fathers. Mothers (37.5%) were more likely than fathers (6.2%) to indicate that introduction to mobile technology was initiated because the child grabbed the device, X^2 (1, N = 32) = 4.57, p = .033. Mothers (37.5%) were also more likely than fathers (6.2%) to indicate that they use technology for personal use, X^2 (1, N = 32) = 4.57, p = .033. Additionally, there were two codes that showed a trend towards significance. Mothers (56.2%) were more likely than fathers (25.0%) to indicate that they use the device together with their child, X^2 (1, N = 32) = 3.24, p = .072 and fathers (35.0%) were more likely than mothers (10.0%) to state that TV is less beneficial, X^2 (1, N = 40) = 3.58, p = .058 (see Table 25 for complete results) (see Table 26 for summary of all t-tests conducted).

Discussion

The primary goal of Study 1 was to understand how parents approach the question of introducing mobile technologies to their very young children. This included identifying how technology is used and managed. In addition to providing a descriptive account of early technology use, the study also allowed a more in depth examination of introduction comparing younger and older children as well as the impact of contextual variables such as the presence or absence of siblings, and the presence of older siblings in particular. Finally, the present study also examined the perspectives of mothers and fathers. Together these elements provide a picture of very young children's experiences of technology within the home.

Age of Introduction and Use of Mobile Technology

Consistent with previous research (e.g., Kabali et al., 2015) the vast majority of the children in the present sample (80%) had been introduced to at least one mobile technology device before the age of 2.5. In addition, of those children who were introduced to mobile technologies, there appeared to be a higher rate of introduction for children age 1 year and younger (62.5%) than is reported in previous research (e.g., Rideout, 2013). Indeed, the average age of introduction for this sample was just over a year with cellphone/smartphones and Tablet/ iPads® serving as the most common devices for first exposure. This early introduction supports the suggestion that more children are being introduced to mobile technology at increasingly younger ages every year (e.g., Rideout, 2013). Although the average age of introduction was just over a year, it is important to note the range spanned from just one month of age to 30 months indicating considerable variation across families. In addition, it is also important to note that a smaller group of parents actively chose not to introduce technologies to their very young children. Thus, parents are not uniformly shifting to early introduction.

Rationales for introducing or not introducing technology explain some of the diversity among parents in age of introduction. Interestingly, positive parental views toward the early introduction of technology often were accompanied by qualifiers explaining conditions under which their positive views occurred. For example, some parents indicated that introduction needed to be in moderation. Some parents supported their positive view by alluding to potential gains their child might experience such as potential educational benefits. Thus, positive views toward early exposure were not entirely unconditional. In fact, many parents expressed mixed opinions regarding early exposure with some acknowledging merits and some concerns. Negative opinions often reflected concerns about the potential for overexposure and that use of mobile technology takes away from other more beneficial activities in which the child could be engaged. Concerns about overexposure, passivity and lack of opportunities for other learning opportunities concurs with similar concerns raised in research regarding television viewing and the negative impact television has for children's development (e.g., Linn, 2010).

Interestingly, positive opinions were more prevalent in parents with older children and negative opinions were more prevalent in parents with younger children. Consistently the educational benefits were mentioned more by parents of older children than younger children, suggesting the possibly that there are some developmental milestones reached half way through the child's 2nd year of life that make using mobile technology appear more educationally beneficial to parents. Also of interest was the finding that parents of children with older siblings were more likely to have a negative opinion of mobile technology while parents of children without older siblings were more likely to have a positive opinion. Apparently, greater experience with children's use of technology may contribute to more negative views or perhaps experiences associated with multiple children accessing technology may increase negative perceptions.

Distraction seemed to be the most common reason that parents indicated for using mobile technology with their children. There seemed to be three frequently cited reasons to distract which included: to avoid boredom such as waiting for appointments, to give the parents time to complete other tasks such as chores or cooking dinner, and while travelling. Parents also frequently stated that they use mobile technology as a teaching tool for their children and to calm their child when they are upset. Responses were similar to those reported in previous research which indicated that parents provided their children with access to mobile technology in order to allow parents to run errands, and do chores, or to calm their children, and put their children to sleep (Kabali et al., 2015). Interestingly, parents of children with older siblings were more inclined to use mobile technology as a distraction to preoccupy their child. Potentially, this may be due to older siblings having activities and events that the younger child must attend with the parents, and therefore there may be more situations in which the child might be bored, than for children without older siblings. It seems that mobile devices are used most often for convenience purposes but parents do perceive some additional benefits that the devices can offer.

Asking parents whether or not their child had been introduced to mobile technology was found to be a problematic and more complex question than initially anticipated. For example, activities such as taking or looking at family photos, or watching videos, were not necessarily considered criteria for "using" the device among all parents. Only when parents were asked to describe what their child did while having access to a mobile device did it become clear whether the child was or was not using the device. This is an important finding that could impact future survey based research. Given that taking pictures is an active use of technology while viewing content is a passive activity even simple differences such as passive/active use are not being used by all parents to define ‘use’ when it comes to technology. In order to more accurately depict when children are initiated to technology future questionnaires need to ensure clarity when defining what constitutes use.

With respect to how children engage with mobile technologies, by far the most common response, with over 45% of parents, was that children watch video clips on mobile technology. This is consistent with previous research that found parents indicating that almost half (47%) of the applications selected for their children to use involved simply viewing videos (Rideout, 2013). Also frequently mentioned were looking at pictures, and watching movies or shows. Considering that the interactivity of mobile technology makes it engaging, and that same interactivity is associated with potential learning gains, it is concerning that the most common tasks children are doing on the devices are more passive activities (Calvert et al., 2005; Calvert et al., 2007). If early exposure to mobile devices primarily involves these passive activities, it is conceivable that the same developmental delays found to occur from the impact of television (Lin et al., 2015; Nathanson & Rasmussen, 2011; Zimmerman et al., 2007b) could also result from mobile technology use.

When parents did mention their children using applications on the mobile device, they most frequently identified age-appropriate applications and applications with educational content, thus parents appear to be sensitive to the kind of content provided to their young children. The potential use of mobile technology for very young children to engage in interactive educational games is exciting. Research has shown that high quality games that provide immediate and dynamic feedback can successfully contribute to learning gains (Castles et al., 2013; Piquette et al., 2014; Roschelle et al., 2000; Wood et al., 2012). Prior to the introduction of mobile technology, computer-based learning activities were generally not available to very young children because of the skills necessary to operate the computer (Wood et al., 2004). The decreased demands associated with mobile technology makes it possible for computer-based learning opportunities to be realized in a much younger age group provided the technology is used properly.

One interesting finding was that parents of children without siblings were more likely to mention using infant and toddler applications than those with older siblings. Perhaps if parents feel that mobile technology is more suited for older children then they would be more inclined to download and use applications geared towards older children, while parents of children with no older siblings would focus more on the young child's age when deciding what applications to download.

Interestingly, more parents also indicated that their children use free-play games than those who indicated goal-directed games. This could reflect that applications geared toward infants and toddlers are more likely to be free-play rather than goal-directed perhaps or that goal-directed games may be too complex at their age. This finding should be investigated further as it may be an important feature for understanding how to best design games for very young users.

How Early Introduction to Mobile Technology Use Happens

Most parents described the first time introducing technology as happening inside the home. Most parents also said that their children's initial response to the mobile technology was enjoyment and excitement. One very interesting finding was who initiated the initial introduction of the mobile technology. Approximately half of parents indicated initiating the introduction to mobile technology with child curiosity and interest on the part of the child serving as an important impetus for sharing the technology.

Although few parents provided reasons of why they would wait to introduce mobile technology to their very young, the most common reason for waiting was the child lacking the ability to use the device. This is an interesting finding given that mobile technology is commonly considered intuitive and extremely easy to use even by very young children (Holloway et al., 2013). Given that almost all of the parents indicating that the child's lack of ability was an important consideration for waiting were parents of the younger children (under 20 months of age), it may be that some important developmental milestones appear during the child's second year where parents believe their child is more capable of using mobile technology devices. Given that some parents also indicated concerns regarding the child damaging the device, it would be useful to determine what developmental capabilities parents believe are most important for supporting early technology use. Interestingly, all of the parents concerned with damage to the device represented families where an older sibling was present, thus their cautions may reflect first-hand experience with damage to devices or other items within the home from the older child may have heightened these parents awareness of this concern. Alternatively, arguments between siblings involving technology may have also resulted in damage being done to a device. Some parents also indicated that their own lack of fluency and skill with mobile devices inhibited introducing the technology to their children. Interestingly, only parents of younger children (under 20 months of age) expressed this concern, perhaps confidence and skill are especially important when teaching younger children or applying adult skills to tasks with young children.

Assistance, Supervision, Limitations and Boundaries

The supervision mentioned while children are using mobile technology ranged from no supervision at all to constant supervision. Nearly 70% of parents indicated that they constantly supervise their child when they use mobile technology, however, only 40% indicated that they use the device together with their child. In addition, nearly 40% of parents indicated that their child can use the device on their own and just over 10% stated that they provide nearby supervision. Overall, although parents indicate some supervision, consistent with the findings of Lavigne and colleagues (2015) the degree of supervision is not sufficient to maximize learning gains. Previous research regarding television viewing indicated that higher levels of interaction and integration promoted greater learning (Lavigne et al., 2015; Nielsen et al., 2008). For example, developmental delays found in toddlers exposed to television are primarily due to the reduction in interaction between the parent and child while using the technology (Nathanson & Rasmussen, 2011). These negative outcomes can be reduced when parents actively engage with their child in shared-media use. Results in the current study indicate that lack of parental involvement continues to be a concern in media-related activities with young children. Devising strategies to enhance awareness and education among new parents may be important to ensure best practices when using technology.

When asked to describe the types of assistance they provided, parents provided helped with navigating the device, holding the device, and showing the child how to use the device. In addition to these supports, only parents of older children stated unlocking the device for the child to use, again, indicating a support to permit the child to use the device on their own and providing only the most basic assistance to get the child started. No parents identified any support for understanding or exploring content, for jointly engaging with the technology for a specific goal (i.e., education or enjoyment). Research indicates that learning from screens is most beneficial when the content involves social interaction (Lauricella et al., 2010; O'Doherty, et al., 2011; Strouse, et al., 2013). The absence of enhancing engagement, joint interaction and exploration of content again supports the need for greater training for parents regarding ideal media use. It may also be the case, however, that parents do engage in joint media activities but that they did not identify this as a form of assistance. Direct observation of parent-child interactions is necessary to provide a more complete picture of parental supports.

Some parents offered reasons for providing their children with supervision and assistance while they are using mobile technology. The most common responses were that the child is too young, they are too destructive, and that they lack the ability to use the device. As expected, parents of younger children were the only ones who gave the reason that the child is too young. Interestingly, all of the parents who indicated that the child is too young were parents of children with older siblings. Consistent with other findings in the current study past experience in introducing and using mobile technology with their older children may drive their conclusions that the younger child is too young to use the device.

Most parents indicated that limitations and boundaries were introduced as soon as their child began using mobile technology, however many parents also stated that limitations were introduced after watching the child use mobile technology. Interestingly, most parents stated that they place limits on screen time overall suggesting that parents are perceiving technologies as equivalent despite clearly describing differences in the use and benefits of different screen technologies. Again, this suggests that although parents understand that technologies may afford different experiences, they may not extend this understanding to practices which would maximize learning outcomes. Interestingly, a number of parents also stated not having any boundaries because they felt their child’s lack of interest in using the device made limitations unnecessary. This observation by parents is important and suggests the need for more refined investigation of the amount of time children spend with different technologies in relation to how effectively children navigate and use the technology alone or jointly with a parent.

Types of limitations mentioned seemed to fall into two categories. One category was limitations on content the child could access. Parents frequently talked about maintaining control over what the child does on the device by, for example, selecting a video and putting it on for them, or downloading suitable applications and allowing the child to choose from those. The second category focused more on situations that the child is not allowed to use the technology such as during meal times or outside of the home. Some parents also discussed maintaining control of use of the device in a different manner by physically keeping the device out of reach of the child and that the child must ask permission every time before using the device.

Other Factors to Consider

Other factors to consider in the use of mobile technology with very young children are the use of the technology by adults in the house, television use, and how mobile technology use and introduction with younger children compared to that of older siblings.

Adult use of mobile technology. The prevalence of technology in adult's lives seems to be impacting young children's use of mobile technology; therefore it is important to investigate parents' own use of mobile technology. Over half of parents indicated that they use mobile technology constantly with another quarter stating that they use it at least a couple of hours a day. Parents seem to use technology equally for work and personal tasks with the most common tasks mentioned being texting, email and Facebook. Only 15% of parents recognized that their use of mobile technology was being observed by and may potentially have an impact on their children.

Television use. Similar to previous research (e.g., Rideout, 2013) most parents stated that their children watched television under an hour a day, however, many also indicated 1 hour a day and 2 hours a day. A quarter of the parents stated that the television is often on in the background. Consistent with previous research very few parents mentioned that their children do not watch television at all indicating most children had been introduced to the television well under 2 years of age (Rideout, 2013). Some parents offered more specific information, in that their child watches television before bed and that their child only watches television on the weekends. All of the parents who mentioned television only on the weekends were parents of older children rather than younger children. It could be the case that older children are more likely to be in preschool or other organized activities keeping them busier throughout the week.

Over 80% of parents stated that their children are watching child-oriented content such as cartoons. Few parents stated that their younger child watches whatever their older sibling is watching. A few parents also mentioned that their child watches Treehouse which is a channel dedicated to children's programming. Overall, these responses indicate parents are attempting to provide developmentally appropriate content for their children.

Despite children being introduced at an age younger than the recommendation (American Academy of Pediatrics, 1999, 2011), 65% of parents did state that their child is constantly supervised when watching television. Some parents also stated nearby supervision and 15% stated their child is not supervised which can be concerning at this age. These numbers are very similar to parental responses in their supervision when their child is using mobile technology. Interestingly, the age of the child had no significant impact on the type of supervision while children are watching television.

Consistent with previous research when asked to compare television and mobile technology a number of parents said that television is less interactive than mobile technology. This is an interesting finding since parents are acknowledging the interactive features of mobile technology, but are not necessarily always taking advantage of those features in what their children do on the device. Other opinions in favour of mobile technology included that the television is less beneficial and is more passive with only one-way reception. A few parents described the positive features of television in comparison to mobile technology by stating that the television is easier to control. Previous research has shown a variety of negative developmental implications when young children access inappropriate content (Barr et al., 2010; Conners-Burrow et al., 2011; Zimmerman & Christakis, 2007). It is interesting then, that very few parents acknowledged that they must be more cautious of mobile technology because of the easy access to potentially inappropriate content.

Comparison to sibling introduction and use. Half of parents of children with older siblings stated that introduction to mobile technology happened in the same way for both children. About a third indicated that their older child was introduced later than their younger child. It appears that older children were introduced later because when they were younger the parents did not own the devices yet. Some parents also mentioned that the older sibling sparked interest in the younger child's desire to use mobile technology.

Consistent with previous research, parents indicated that as age increases so does the use of mobile technology (Lauricella et al., 2015). Some factors mentioned by parents that may contribute to this increase in use of mobile technology is an increase in the child's attention span and independence because they have acquired the ability to use the device on their own.

Gender

Overall, gender differences among parents were almost non-existent (i.e., given that only two out of 104 analyzed themes differed between mothers and fathers). This also has important implications for future research. Typically, much developmental research has been conducted with mothers raising concerns that responses from mothers may differ from those provided from fathers. Given the lack of gender differences, it is likely that in the context of reporting about the early introduction to technology responses are likely to be similar when either mothers or fathers are sampled.

While there were no significant differences in the main themes and most of the subthemes regarding how the child was first introduced to mobile technology, parents did seem to differ on one subtheme. Mothers were more likely than fathers to indicate that introduction happened because the child grabbed the device out of curiosity. Potentially, mothers are more likely to be the ones home with their child throughout the day, and therefore, they may have had more opportunities for this to occur. Mothers were also more likely to state that they themselves use mobile technology for personal use. While there was no significant difference, more fathers indicated using mobile technology for work. This would support the likelihood that mothers were the ones home with the child throughout the day while the fathers may be out of the house working. Overall, the present study suggests that parental gender does not play a role in the opinion and use of mobile technology with young children.

Limitations and Future Directions

The present study involved a moderate sample size, large for a qualitative examination but small for a quantitative examination of outcomes. To provide more support for quantitative outcomes, it is important to expand the sample size. Now that key themes have been established a survey conducted with a larger sample size could provide supporting evidence to confirm the findings of this study. Furthermore, it is important to note that the information presented is self-report obtained by parents and could benefit greatly by being substantiated with direct observations of young children interacting with mobile technology.

Conclusion

Children are being introduced to mobile technology and using that technology at very young ages. Despite this high level of use, parents have mixed opinions about early introduction to mobile technology. In part this discrepancy may result from the reasons why technology is being used. Overall, it appears that parents are introducing and using mobile technology for convenience rather than targeted developmental or educational outcomes for their child. Furthermore, introducing young children does not seem to be a planned occurrence but rather more typically it is a spontaneous occurrence prompted by the child's curiosity or by the parent when it is required to distract, occupy or calm their child. The context within the home, especially the presence of other siblings has some impact on when and how young children are introduced to technology. The present study provides a first exploration into the key contributors to early technology introduction as well as a description of what early introduction looks like within the context of the home. The following study expands on these key themes by further exploring the context and hands-on experiences of young infants engaged with technology.

Study 2

Study 2 extended the examination of early introduction to technology that was initiated in Study 1. Specifically, Study 2 employed survey methodology to examine the impact of early introduction of technology for infants. This methodology complements data gathered through Study 1 by permitting greater breadth in sampling and greater depth in isolating and targeting questions regarding infant use of mobile technologies. Indeed, given the outcomes of Study 1 it is clear that many infants are already exposed, or will be exposed to mobile technologies during infancy. It was important, therefore, that research explicitly examine the impact of these technologies on this population.

Consistent with research involving older children (preschoolers onward), Study 2 explored the impact of age of introduction and amount of exposure on critical developmental skills including social, emotional and physical development for parents who have introduced mobile technology to their infants (e.g., Ebbeck, Yim, Chan, & Goh, 2015; Holloway et al., 2013). In addition, the current study permitted an examination of self-reported perceptions and attitudes and behaviours regarding early introduction.

Based on the outcomes of Study 1, a survey tool was developed to further assess parental introduction of mobile technologies in young children and infants. In addition to questions derived from the interview, this survey was used to connect parental responses to theoretical literature regarding parenting styles, temperament, attention, cognitive development, language development, motor skills development, and social development. Given that infants' interactions with technology are mitigated in a social context involving parents, both parent and infant individual characteristics, preferences, and behaviours needed to be assessed in order to more fully understand the outcomes. Although previous research has shown mixed results regarding the importance of birth order in relation to media use, Study 2 permitted an opportunity to gather parental input regarding potential differences regarding the introduction of technology for older versus younger siblings. Thus, further investigation of birth order in the introduction of mobile technology was explored (Anand & Krosnick, 2005).

Finally, the extensive literature demonstrating that early exposure to the television results in a negative impact to both cognitive and language development warrant further study. The current study investigated whether a similar trend would be found with early exposure to mobile technology. In the present study parental experience with technology, parenting style, and parental attitudes as well as infant temperament, social skills, cognitive skills, and motor skills were examined in the context of interactive play with technology.

Hypotheses

The proposed study examined three intertwined elements when infants are engaged with mobile technology; the technology, the infant, and the parent. Given the exploratory nature of this research, both research questions and specific hypotheses are included. Among the research questions investigated are those that examine where, when and why technology is provided to infants and how technology use impacts on infant development. Specific examples of these questions include: What parental factors impact access and use of technology? How does child development (cognitive, social and motor) as well as temperament impact parental behaviour? How does parental behaviour impact child behaviour? How does access and use of technology impact child development (cognitive, social and fine motor)?

Based on the existing literature involving older children and use of technology, as well as developmental theories and trajectories (as outlined in the introduction), two hypotheses were also directly examined. These hypotheses include:

1. Positive parental attitude and experience with technology would be related to increased infant's use of mobile technology as well as earlier introduction of technology.
2. Increasing use of mobile technology by infants would be correlated with a decrease in cognitive, and social-emotional skills.

Exploratory questions investigated which parental behaviours impact early introduction to mobile technology, and how infant temperament influences the use of mobile technology. Finally, this study examined the impact of mobile device use on the development of motor skills.

Methods

Participants

The initial sample of 125 participants was comprised of 123 women (M_{age} = 32.16, *SD* = 4.42) and 2 men (M_{age} = 34.50, *SD* = 2.12). The sample was subsequently reduced to 116 participants as 9 participants were removed from the sample because they had only completed the demographic section of the survey. Of the remaining 116 participants 114 were female (M_{age} = 32.04, *SD* = 4.51) and 2 were male (M_{age} = 34.50, *SD* = 2.12) respondents. Education level ranged from a high school diploma to post-doctorate degree: High School Diploma (0.9%), Some Post-Secondary Education (5.2%), college degree (24.1%), Bachelor Degree (41.4%), Master's Degree (24.1%), Doctorate Degree (2.6%), and Post-Doctorate Degree (1.7%). Overall, the sample represented a relatively well-educated sample. All participants stated that they were the child's mother or father. Most participants were married (85.3%) or in a common law relationship (9.5%) with only 5.2% indicating they were single. Thus, the sample mainly reflected dual parent rather than single parent families.

Most parents indicated their first language was English (88.9%) while a few (11.2%) stated "other" as their first language (i.e., Arabic, Cantonese, Chinese, Greek, Japanese, Portuguese, Punjabi, Romanian, Russian, Spanish, and Vietnamese; of these other languages none were endorsed by more than one parent). Ninety-one people stated that one language was spoken at home (78.4%), 22 stated that two languages were spoken in the home (19.0%) and one person indicated that three languages were spoken in the home (.9%). Of the languages spoken within the home, nearly all participants indicated that English was spoken (94.8%), with only a few participants indicating that French (4.3%) or another language was spoken in the home (19.8%).

Target child participants. Parents filled out the survey based on a target child between the ages of 12 and 24 months. These target child participants were subsequently divided into one of 2 age groups: the younger group was comprised of children with ages ranging from 12 to 17 months (N = 62) and the older group was comprised of children with ages ranging from 18 to 24 months (N = 54). The vast majority of parents indicated their child's first language as English (94.0%) while the remaining parents indicated their child's first language as other (6.0%; including Polish, Cantonese, Chinese, Italian, Greek, Portuguese, and Punjabi). Of these other languages none were endorsed by more than one parent. When looking at family context most parents indicated their child was an only child (60.3%), nearly a third (28.4%) of parents stated they had two children (28.4%) with smaller numbers of parents reporting families of three (9.5%) and four children (1.7%).

Materials

Survey. Participants completed one online survey. The survey assessed demographic information, developmental skills, parenting styles, temperament, shyness, and a series of measures relevant to technology. These technology measures included children's introduction and use of technological devices, access and time spent on devices, what children are using the devices for, concerns and boundaries, support and supervision and parental opinion and use (See appendix E for complete survey).

Demographics. Demographics included information regarding parents' age, gender, marital status, education, and their relationship to the child. The child's age was also included.

Additionally, the survey contained questions regarding first language, languages spoken at home and the size of the family. Finally, the survey asked how frequently the target child accesses and uses a variety of technologies that are available in the home and in other contexts.

Development. The Ages and Stages Questionnaire: Third Edition assesses five areas of development; communication, gross motor, fine motor, problem solving and personal-social (Squires & Bricker, 2009). The questionnaire has multiple forms. These forms represent different expectations consistent with age appropriate norms in 2-month increments. The age of the child was determined from the survey. In addition, a logic statement was inserted into each survey to ensure that when parents identified the age of their target child, only questions from this measure appropriate to children of that age would be available for that parent to answer. The questionnaires to be used for this specific study include those for ages: 12 months, 14 months, 16 months, 18 months, 20 months, 22 months, 24 months (Sample questions for age 12 months included in Appendix E).

Parenting style. The original version of the Parenting Behaviour Questionnaire included 62 items (Robinson, Mandleco, Olsen & Hart, 1995). Robinson and colleagues (2001) revised the questionnaire to 32 items. Each question on the 32-item questionnaire was assessed by two researchers according to relevance for parents of 1 to 2 year old children. Items that are not relevant to parents of this age group were discarded. From initial examination 6 items were not reasonable questions for parents of 1 to 2 year olds, leaving a 26-item scale.

Each of the questions on the scale related to one of three parenting styles: authoritative (10 items), authoritarian (11 items), and permissive (5 items). Items were scored on a 5-point likert scale from (*1 – never to 5 – always*). The mean of each set of questions was used to provide a score for each of the three parenting styles. A higher score meant that the item was more reflective of that parenting style. Parents were asked to fill out the 26-item questionnaire in reference to their own parenting behaviours, and again in reference to their spouse's parenting behaviours.

Internal reliability for the 10 items assessing the authoritative parenting style were assessed using Cronbach's alpha, α=.69 for self and α= .85 for the spouse. Cronbach's alphas for the 11 items assessing the authoritarian parenting style were α=.63 for self and α=.64 for the spouse. Although these outcomes were somewhat lower, they were included in subsequent analyses. Given a lower than ideal reliability score for the authoritarian scale, results should be interpreted with caution. Cronbach's alphas for the 5 items assessing the permissive parenting style were very low, α=.55 for self and α=.52 for the spouse. Given the low reliability for the permissive parenting style no analyses were conducted using this scale.

Temperament. Temperament was assessed using the Colorado Childhood Temperament Inventory (Rowe & Plomin, 1977). This measure has 30 questions divided into 6 distinct areas (Sociability, Emotionality, Activity, Attention span-persistence, reaction to food, soothability)[2].

Five items initially assessed sociability; one item (child makes friend easily) was removed because of irrelevance, given the children's young age. The four remaining items that assessed sociability (α = .87) were scored from 1 (*not at all socialable*) to 5 (*very socialable*). The five items assessing emotionality (α = .85) were scored from 1 (*not at all emotional*) to 5 (*very emotional*). The five items assessing activity (α = .85) were scored from 1 (*not at all active*) to 5 (*very active*). The five items assessing attention (α = .77) were scored from 1 (*very low attention*) to 5 (*very high attention*). The five items assessing soothabiliy (α = .72) were scored from 1 (*very difficult to sooth*) to 5 (*very easy to sooth*).

[2] Reaction to food is not relevant to this particular study, so in an effort to keep the survey as concise as possible, this subsection was removed leaving a temperament scale with 25 items assessing five subsections. All items were rated on a five-point scale.

Shyness. Shyness was assessed through a subsection of the Early Childhood Behavior Questionnaire (Putnam, Gartstein, & Rothbart, 2006). This subscale measures “Slow or inhibited approach and/or discomfort in social situations involving novelty or uncertainty” (Putnam, et al., 2006). The scale includes 12 items (α = .79) that were scored on a 7-point scale (*1 – never, 2 – very rarely, 3 – less than half the time, 4 – about half the time, 5 – more than half the time, 6 – almost always, 7 – always*). An overall mean score was calculated from 1 (*not at all shy*) to 7 (*very shy*). In general, parents rated their child slightly above the mid-point on the scale (M = 3.17, SD = .79).

Access to technology and use. The survey included questions pertaining to nine technological devices including: desktop computer, laptop computer, television, tablet, smartphone, iPod, eReader, children’s learning tablet, handheld gaming system, as well as exposure to background television and overall screen time. Two items assessed mobile technology use, frequency of accessing and amount of time using these devices. Frequency of access to technology was assessed on a 6-point Likert type scale from 1 (*never*) to 6 (*daily*). Amount to of time was also rated on a 6-point Likert type scale ranging from 1 (*under 5 minutes*) to 6 (*61 minutes or more*).

Introduction to mobile technology. Parents were asked to indicate the age at which each of their children was introduced to the smartphone and the tablet. Four further questions, rated on a 5-point Likert scale from 1 (*strongly agree*) to 5 (*strongly disagree*), asked parents to indicate how much introduction to each of the two devices (for the target child only) was a conscious decision and how much it was an unplanned decision. How parents introduced mobile technology to their child was assessed through two questions, one for each device, and rated from 1 (*showed my child exactly what to do*) to 5 (*allowed my child to explore and learn on their* *own*). Finally, this section also investigated whether or not there was a novelty effect immediately after introducing new technology through one question for each device rated on a 5-point Likert scale from 1 (*They are far less interested now than when they were first introduced*) to 5 (*They are far more interested now than when they were first introduced*).

Mobile technology use. This section of the survey asked questions pertaining to the use of tablets and smartphones. Parents were initially asked about how frequently their child does each of 22 tasks on mobile technology devices. Tasks included device specific tasks (i.e. held/touched the device), personal tasks (i.e. looking at pictures), watching videos (i.e. watching movies), using applications (i.e. using apps for entertainment), and music and books (i.e., listening to books). Tasks were rated on a 5-point Likert scale ranging from 1 (*never*), to 5 (*always*). Ability in performing touchscreen gestures was also assessed. Parents were asked to rate how frequently they had seen their child perform each of ten touchscreen gestures on a 5-point Likert scale ranging from 1 (*never*), to 5 (*always*). One question rated on a 7-point Likert scale from 1 (*always at home*), to 5 (*always outside of the home*), asked parents where their child uses mobile technology. A further question asked parents about how frequently their child uses mobile technology in ten very specific situations (i.e. restaurant, grocery store). Parents were again asked to rate each response on a 5-point Likert scale from 1 (*never*), to 5 (*always*). Finally, frequency of use for a variety of specific reasons was also examined (e.g., as a reward, to occupy the child, to keep the child quiet) on a 5-point Likert scale from 1 (*never*), to 5 (*always*).

Device attributes. Parental views towards the attributes of three technologies, television, tablet, and smartphone were assessed. Parents rated each technological device on a 5-point scale depending on how much they felt each device encourages each of ten attributes (e.g., passivity, interactivity, engagement). To investigate how much each device encourages certain physical activities, one further question asked parents to rate how frequently they have observed their child doing seven actions with each device, using a 5-point Likert scale from 1 (*never*), to 5 (*always*) (e.g., dancing, singing, clapping).

***Concerns and boundaries for technology*.** Parents rated their concern level for six potential problems that technological devices may offer. The items included: the child using the technology too much, the child seeing inappropriate content, the child seeing advertisements, the child damaging the device, the child being able to navigate the device without the adult being there, and the child deleting important information. Responses were rated on a 5-point Likert scale from 1 (*not at all concerned*) to 5 (*extremely concerned*) for each of 3 devices, television, tablet, and smartphone.

Parental opinion and use. In the final section of the survey, parental opinion and use of technology was examined. Parents were asked to respond on a 5-point Likert scale ranging from 1 (*never*) to 5 (*always*) to rate how frequently they perform 14 tasks on their mobile devices. Parents were also be asked how much they use their mobile devices for work versus personal use, and how much their spouse uses mobile technology when compared to themselves. Parents were asked to rate how they feel mobile technology contributes to various areas of their child's development using a 5-point scale from 1 (*Extremely harmful*) to 5 (*Extremely helpful*).

Procedure

Survey procedure. Recruiting took place through advertisements placed on publicly available online platforms (e.g. kijiji). Additionally, flyers were distributed to early years centres and daycares within the community. A link to the survey was also placed on a research lab website, allowing parents seeking to participate in research to fill out the survey. Participants were entered into a draw to win a $100 gift certificate. Participants were able to complete the survey online at their convenience and in a place of their choosing.

Results

Analyses of the survey data is presented first, with a descriptive summary of outcomes followed by age comparisons and examination of the relationships among the variables. This summary of survey findings is followed by examination of the observational data.

For data reduction purposes, factor analyses were conducted for multi-item questions to assess potential scales. All factor analyses employed the principle components extraction and a varimax rotation. Only eigenvalues of greater than 1 were accepted for each factor. For analyses involving individual items a minimal p value of .05 was set as criterion for significance. For all analyses involving multiple items, more conservative p values were determined using a Bonferroni correction.

Child Factors in Technology Use

Child factors including technology use, age of introduction to technology, how mobile technology was introduced, and the child's temperament and development were examined.

Technology use. All parents were asked about their child's access to nine technological devices (desktop computer, laptop computer, television, tablet (adult or child model), smartphone, iPod, eReader, children's tablet, and handheld gaming device) as well as background television and screen time in general. Parents were asked to indicate both how frequently their child accessed each device and how much time they spent on each device when they accessed it.

Frequency of technology use. On average infants were introduced to 2.5 of the nine listed devices (M = 2.49, SD = 1.34). Television was by far the most consistently endorsed exposure to technology with 95.5% of participants indicating exposure to some form of television and 81.3% indicating their child both watched television directly (M = 3.97, SD = 2.00) approximately 3-4 days a week and were exposed to television in the background between 3 and 6 days a week (M = 4.40, SD = 1.89). In contrast, most parents indicated that their child never used a desktop (86.9%) or laptop computer (79.2%), an iPod (93.3%), an eReader (98.4%), a children's tablet (77.0%), or a handheld gaming device (98.1%). Given the low number of children who use these devices, no further analyses were conducted for these devices. With respect to the remaining devices, of the 86 participants who responded, 37.2% indicated that their child used both a smartphone (M = 3.20, SD = 1.81) one to two times a week and a tablet (M = 2.30, SD = 1.69) less than once a week. In addition, 45.3% of parents indicated that their child uses one of these devices at least some of the time, and only 17.4% stated their child never uses these devices. More generally, parents indicated that their child is exposed to screen time approximately 3-4 days a week (M = 4.27, SD = 1.79). Only 4.7% of participants stated that their child is never exposed to screen time (see Table 27 for complete results).

Amount of time using technology. Television exposure, both directly (M = 3.66, SD = 1.56) and as background (M = 4.53, SD = 1.57), accounted for the greatest exposure to technology with means falling midway between 11 to 20 and 21 to 30 minutes on the scale for direct viewing and between 21 to 30 minutes and 31 to 60 minutes on the scale for background availability (see Table 28 for frequency of each response). Exposure time for tablets (M = 2.85, SD = 1.52) and smartphones (M = 2.03, SD = 1.12) reflected durations of 6 to 10 minutes on average. Interestingly, although very few parents indicated that their child used a children's tablet, those who provided this device to their children, reported durations of about 6-10 minutes per session. Length of exposure for other devices was relatively limited and must be interpreted cautiously as some devices were only made available to a small sample of children. Interestingly, overall screen time was reported as being just under 21 to 30 minutes (*M* = 3.83, *SD* = 1.75) each time screens were accessed (see Table 28 for complete results).

Introduction to technology. Consistent with Study 1, all parents were asked if their child had been introduced to mobile technology. Of the 89 participants who responded to this question 58 (65.2%) stated yes and 31 (34.8%) stated no. Parents who indicated that their child had been introduced were asked a set of further questions investigating their children's age of introduction for each of three devices (television, tablet, and smartphone).

A series of five t-tests were conducted to assess differences as a function of age group (younger children versus older children) for the tablet, smartphone, television, background television and screen time for two variables; frequency of technology use and amount of time using mobile technology. A Bonferroni correction of p = .01 was used. No significant differences were found between younger and older children in both frequency of technology use or amount of time using mobile technology. However, two trends towards significance emerged in frequency of tablet uses and frequency of background television exposure. Older children (*M* = 2.70, *SD* = 1.81), used a tablet more frequently than younger children (*M* = 1.89, *SD* = 1.47), $t(71) = -2.11$, $p = .039$ and younger children (*M* = 4.85, *SD* = 1.62) were more frequently exposed to background television than older children (*M* = 4.00, *SD* = 2.03), $t(85) = 2.15$, p = .035. (see Table 29 for complete results).

Target child's age of introduction to technology. The current study found an average age of introduction that was even lower than that found Study 1. Specifically, visual inspection of means suggest that age of introduction was lowest for television (*M* = 8.33 months, *SD* = 5.27) and only a little higher for the smartphone (*M* = 9.40 months, *SD* = 4.36) and the tablet (*M* =

10.13 months, *SD* = 6.50). Three paired samples t-tests were conducted to examine potential differences in age of introduction across the three devices. No significant differences were found (see Table 30). It is important to interpret this finding with caution given the limited number of children who had been exposed to all three, or even two of the three devices. In addition, to comparisons across age, three t-tests were conducted to assess potential differences in age of introduction for the tablet, for younger versus older children for each of the three devices. No significant differences were found between younger and older target children (see Table 31 for complete results).

Birth order and age of introduction technology. Since most participants (88.7%) indicated having only one or two children, age of introduction for the television, smartphone and tablet was investigated for both the first and second child. Parents were asked to respond to this question based on their first and second child, which may or may not be the target child. The average age of introduction to the smartphone was slightly over a year for their first child (*M* = 13.04, *SD* = 11.11) and slightly under a year for their second child (*M* = 10.63, *SD* = 6.15). The average age of introduction was higher for the tablet, around 15 months for both the first and second child (*M* = 15.03, *SD* = 13.31; *M* = 14.91, *SD* = 11.46). The television seemed to be introduced earlier than the other technologies, just under 11 months for the first child (*M* = 10.76, *SD* = 7.84) and just over 7 months for the second child (*M* = 7.42, *SD* = 6.59).

In order to assess whether the age of introduction was different for the first and second child, one paired samples t-test was conducted for each of three devices; tablet, smartphone and television. Results showed a significant difference in all three. The first child was significantly older than the second child when being introduced to the tablet (*M* = 24.90, *SD* = 17.31; *M* = 14.40, *SD* = 11.96), the smartphone (*M* = 15.53, *SD* = 10.12; *M* = 10.63, *SD* = 6.15), and the television (*M* = 12.39, *SD* = 10.05; *M* = 6.17, *SD* = 3.79), $t(9) = 2.33$, p = .045, $t(18) = 2.35$, p = .030, $t(17) = 3.33$, p = .004, respectively (see Table 32 for complete results).

How mobile technology is introduced. Parents were asked a set of questions relating to the introduction of mobile technology for both the tablet and the smartphone. Questions investigated whether the decision to introduce was a conscious one or unplanned, how parents introduced mobile technology, and their child's interest in the technology over time.

Conscious or unplanned decision to introduce mobile technology. Parents on average gave a rating between agree and neither agree nor disagree for both the tablet and smartphone (*M* = 2.50, *SD* = 1.35; *M* = 2.76, *SD* = 1.27, respectively) for the statement that introducing the device was a conscious decision. Consistent with this, when asked if their child's introduction to mobile technology was unplanned they rated it slightly above the midpoint of the scale for both the tablet and smartphone (*M* = 3.25, *SD* = 1.48; *M* = 3.06, *SD* = 1.38, respectively) (see Table 33 for complete results).

Guidance versus exploration when introducing mobile technology. One question asked how much parents showed their child how to use the device versus allowing them to explore when they introduced mobile technology. On average they rated near the mid-point of the scale indicating a combination of showing their child what to do while also allowing them to explore on their own for the tablet (*M* = 3.13, *SD* = 1.38) and for the smartphone (*M* = 3.36, *SD* = 1.47) (see Table 33 for complete results).

Child's interest in mobile technology over time. Parents were asked about their child's interest in mobile technology when they were first introduced versus now. The child's interest in mobile technology seemed to generally remain the same while slightly being more interested now than initially for both the tablet (*M* = 3.35, *SD* = 1.43) and the smartphone (*M* = 3.40, *SD* = 1.48) (see Table 33 for complete results).

Two t-tests were conducted to examine the role of age in how the tablet and the smartphone was introduced for each of three variables; whether the decision was conscious or unplanned, whether parents showed their child how to use the technology or allowed them to explore, and the child's interest in the technology over time. A Bonferroni correction of $p = .017$ was used. No significant differences were found between younger and older children for any of the three variables. However, one trend towards significance was found. Older children were slightly more interested in the tablet now (*M* = 3.81, *SD* = 1.47) while younger children were slighter more interested in the tablet initially (*M* = 2.87, *SD* = 1.25), $t(29) = -1.93$, $p = .064$ (see Table 34 for complete results).

Development and temperament. Developmental factors, specifically communication, gross motor, fine motor, problem solving, and personal-social skills were explored. Five subscales also investigated child's temperament: sociability, emotionality, activity, attention, and soothability. Finally, shyness was also examined in relation to mobile technology use.

Developmental factors. For the Ages and Stages Questionnaire (Squires & Bricker, 2009) overall participants scored fairly high on all five sections of the assessment; communication skills (*M* = 47.38, *SD* = 12.27), gross motor skills (*M* = 54.24, *SD* = 11.77), fine motor skills (*M* = 50.15, *SD* = 9.59), problem solving skills (*M* = 45.09, *SD* = 12.54), and personal-social skills (*M* = 47.28, *SD* = 8.91) (see Table 35 for complete results).

Temperament. Average rating for activity level was fairly high (*M* = 4.23, *SD* = .67), while the average rating for sociability (*M* 3.60, *SD* = .89), attention (*M* = 3.34, *SD* = .72) and soothability (M = 3.45, SD = .68) was just above the midpoint. Emotionality was rated slightly below the midpoint (M = 2.50, SD = .76) (see Table 36 for complete results).

Shyness. Shyness was assessed through a subsection of the Early Childhood Behavior Questionnaire (Putnam et al., 2006). In general, parents rated their child slightly above the middle (M = 3.17, SD = .79) of the scale.

One t-test was conducted to investigate age differences for each of the five development categories, the five subscales of temperament and for shyness. Only two significant differences were found between younger and older children in developmental skills. Older children (M = 50.24, SD = 11.35) scored significantly higher on the communication scale than younger children (M = 44.89, SD = 12.58), $t(114) = -2.39$, p =.018. Older children (M = 50.65, SD = 7.77) also scored significantly higher on the personal-social scale than younger children (M = 44.35, SD = 8.85), $t(114) = -4.04$, p <.001(see Table 37 for complete results). No significant differences were found in any of the five developmental categories, between age groups in the whether children scored in the below/near cut-off category or in the above cut-off category (see Table 38 for complete results). No significant differences were found in temperament or shyness between younger and older children (see Table 37 for complete results).

The Relationship between Introduction and Use of Mobile Technology and Child Factors

Potential relationships between introduction and use of mobile technology, age of introduction, and child factors involving development and temperament were investigated.

Relationship between the use of technological devices. Pearson's correlations were conducted to examine potential relationships among the most frequently used computer technologies (i.e., tablet and smartphone) and television use. Interestingly, use of tablets was positively correlated only with use of smartphones, $r(70) = .45$, $p < .001$. Use of smartphones, however, was positively correlated with both the frequency of television use, $r(82) = .45$, $p < .001$, and frequency of background television exposure, $r(81) = .32$, $p = .003$. Additionally, the frequency of television use was moderately correlated with frequency of background television exposure, $r(85) = .46$, $p < .001$.

Pearson's correlations were conducted to explore relationships between tablets, smartphones and television in the amount of time per episode of use. All correlations were positive and ranged from moderate to high correlations except for those involving tablets when related to direct television use or background television use. (see Table 39 for complete results).

Relationship between age of introduction and frequency of use. In order to assess whether age of introduction to technology was related to frequency or amount of technology use two regressions were conducted for each of the three technologies tablet, smartphone, television). A Bonferroni correction of $p = .025$ was used. Of all six regressions only the two for television were significant. Age of introduction was significantly related to both the frequency of watching television, $R^2 = .10$, $\beta = -.32$, $t = -2.31$, $p = .025$ and the amount of time spent watching television each time the child watches it, $R^2 = .10$, $\beta = -.35$, $t = -2.44$, $p = .019$. Younger ages of introduction were related to a higher frequency of use as well as amount of time using it. Age of introduction for either of the mobile devices was not a predictor of frequency of use for the tablet or the smartphone (see Table 40 for complete results).

Mobile technology factors related to development and temperament. The relationship between development, temperament and shyness was assessed, followed by how these factors relate to mobile technology introduction and use.

Development and temperament. Five linear regression analyses were conducted for each of the five developmental categories to assess the relation between temperament and development. Specifically, each of the five areas of development (i.e., communication, gross motor, fine motor, problem solving, and personal social) served as a dependent variable and the five subscales of the Colorado Childhood Temperament Inventory (Rowe & Plomin, 1977) served as the independent variables for each regression. Given the number of regressions conducted a more conservative alpha level of $p = .01$ was used.

None of the five temperament areas were significantly related to communication skills, problem-solving skills, or personal-social skills. However, the activity level subcategory of temperament was significantly related to gross motor skills, $R^2 = .12$, $\beta = .35$, $t = 3.55$, $p = .001$ such that higher activity level was related to more developed gross motor skills. Two trends toward significance also emerged for attention. The attention subscale approached significance when related to fine motor skills, $R^2 = .07$, $\beta = .26$, $t = 2.54$, $p = .013$ and personal-social skills, $R^2 = .06$, $\beta = .25$, $t = 2.38$, $p = .019$ (see Table 41 for complete results).

Development and shyness. One linear regression analysis was conducted for each of the five developmental categories to assess the relation between shyness and development. Specifically, each of the five areas of development (i.e., communication, gross motor, fine motor, problem solving, and personal social) served as a dependent variable and the mean shyness score served as the independent variable for each regression. No significant relationships were found between shyness and any of the five development categories (see Table 42 for complete results).

Introduction to mobile technology. Two t-tests were conducted to compare those who had introduced mobile technology to their child and those who had not, on the five components of development (communication skills, gross motor skills, fine motor skills, problem solving skills, personal-social skills), the five subscales of temperament, and the shyness scale. A

Bonferroni correction of *p* = .025 was used to accommodate the number of comparisons conducted for each analysis.

One significant difference was found, parents of children who had been introduced to mobile technology (*M* = 52.12, *SD* = 8.78) reported significantly higher fine motor skill scores for their children than those who had not been introduced (*M* = 47.26, *SD* = 9.30), $t(87) = 2.44$, $p = .017$. No significant differences were found in the five temperament subscales or in the shyness scale between parents who had and had not introduced mobile technology to their child (see Table 43 for complete results).

Frequency and amount of time using mobile technology. Two regression analyses were conducted for frequency of mobile technology use, and two regressions were conducted for amount of time using mobile technology for each of the five developmental categories (communication skills, gross motor skills, fine motor skills, problem solving skills, personal-social skills), the five subscales of temperament and the shyness scale. The developmental category, temperament subscale, and shyness scale served as the dependent variables while frequency of tablet use, and frequency of smartphone use served as the independent variables. A Bonferroni correction of *p* = .025 was used.

Of the five development categories only one regression was significant. Frequency of tablet use was significantly related to problem-solving skills, $R^2 = .09$, $\beta = .29$, $t = 2.60$, $p = .011$ (see Table 44 for complete results).

Of the five temperament subscales three regressions were significant. Higher activity level was significantly related to higher frequency of tablet use, $R^2 = .08$, $\beta = .29$, $t = 2.54$, $p = .013$ and higher frequency of smartphone use $R^2 = .10$, $\beta = .32$, $t = 3.06$, $p = .003$. A higher score in the activity level subscale of temperament was also related to a higher rating in the amount of time using the tablet, $R^2 = .22$, $\beta = .47$, $t = 3.04$, $p = .005$. (see Table 45 for complete results).

No significant relationships were found between shyness and frequency or amount of time using the tablet and smartphone (see Table 46 for complete results).

Parent Factors

Parenting styles, parental use of mobile technology, parental opinion of how mobile technology impacts areas of development, and parental concerns about technology were all assessed in relation to how much their child uses mobile technology.

Parenting styles. Overall, parents rated themselves highest on the authoritative parenting style ($M = 4.31$, $SD = .40$), and far lower on permissive parenting style ($M = 2.00$, $SD = .53$) and lowest on authoritarian parenting style ($M = 1.38$, $SD = .31$). Similarly, parents' rated their spouses highest on the authoritative parenting style ($M = 3.97$, $SD = .65$), and far lower on permissive parenting style ($M = 2.02$, $SD = .51$) and lowest on authoritarian parenting style ($M = 1.39$, $SD = .32$) (see Table 47 for complete results). When rating their spouse's parenting behaviours 95.4% scored their spouse highest on authoritative parenting style, while 4.6% scored their spouse highest on the permissive parenting style. No participant or his/her spouse scored highest on the authoritarian parenting style.

Parents' rating of their own authoritarian and permissive parenting behaviours were strongly and significantly correlated to their rating of their spouse's, $r = .82$, $p < .001$, $r = .71$, $p < .001$, respectively. Parents' rating of their own authoritative parenting behaviours was moderately and significantly correlated to their rating of their spouse's authoritative parenting behaviours, $r = .46$, $p < .001$.

Parental mobile technology use. Parents were asked to indicate how much they use mobile technology in an average day for each of 14 tasks. Data reduction for these 14 tasks was facilitated through the use of a factor analysis. This analysis yielded 4 factors. The initial eigenvalues showed that a first factor explained 35.3% of the variance, a second factor 12.1% of the variance, a third factor 9.8% of the variance and a fourth factor 9.0% of the variance. Of the 14 items that were analyzed 11 loaded highly on only one of the 4 factors and not the other 3. The first of four factors included four items that related to using the device for personal memories (i.e., take pictures, look at pictures, take home videos, look at home videos). When aggregated as a single scale the internal reliability was high ($\alpha = .88$). The second factor had three items that related to specific interactive/communication tasks: using email, browsing the Internet, and receiving notifications ($\alpha = .75$). The third factor included two items relating to playing games: play games online, play app game. Finally the fourth factor involved reading and included two items: reading books and reading news (see Table 48 for complete results).

Parents seem to be using the device most frequently for specific communication/interactive tasks such as email, notifications and browsing the Internet. They stated that on a daily basis they do these tasks slightly less than ‘often’ ($M = 3.79$, $SD = 0.88$). Also, fairly frequently, parents indicated using mobile technology on a daily basis for personal memories between ‘sometimes’ and ‘often’ ($M = 3.50$, $SD = 0.89$). Less frequently parents stated using mobile technology for reading between ‘rarely’ and ‘sometimes’ ($M = 2.67$, $SD = 1.06$). Finally, parents stated that they ‘rarely’ use mobile technology during an average day to play games ($M = 1.93$, $SD = 1.11$).

The additional three tasks loaded on to multiple factors: texting (*M* = 4.09, *SD* = .93), listening to music (*M* = 2.79, *SD* = 1.12), and watching videos (*M* = 2.51, *SD* = 1.04)(see Table 49 for complete results).

Parental opinion of how mobile technology impacts development. Parents were asked to rate how they felt mobile technology impacts four components of their child's development (cognitive, language, motor, and social). Of the 75 participants who responded to this question, 8.0% selected "haven't thought about it". Mean scores for the remaining 69 participants indicated that they thought mobile technology was generally neither harmful nor helpful to their child's cognitive development (*M* = 3.13, *SD* = 1.00). Of the 74 participants who responded to this question for language development, 4.1% selected "haven't thought about it. The remaining 71 participants overall indicated that they thought mobile technology was generally neither harmful nor helpful to their child's language development (*M* = 3.23, *SD* = .91). Of the 73 participants who responded to this question for motor development, 4.1% selected "haven't thought about it. The remaining 70 participants overall indicated that they thought mobile technology was generally neither harmful nor helpful to their child's motor development (*M* = 2.96, *SD* = .94). Of the 76 participants who responded to this question for social development, 6.6% selected "haven't thought about it. The remaining 71 participants overall indicated that they thought mobile technology was slightly below neither harmful nor helpful towards being harmful to their child's social development (*M* = 2.55, *SD* = .91).

Concerns about mobile technology use. Parents were asked to rate their level of concern for six items regarding children's use of tablets and smartphones.

The highest concern ratings reflected worry that children would use the technology too much (*M* = 3.07, *SD* = 1.62 and *M* = 3.69, *SD* = 1.33, for tablet and smartphone respectively).

Concerns regarding viewing inappropriate content, advertisements or challenges navigating the devices received the lowest concern ratings although these means still fell just below the midpoint indicating some concern (range of means M= 2.30 to M=2.52 for navigation with the tablet, (see Table 50 for complete results).

An overall concern score was calculated by taking the mean rating of all six items for both the tablet (α = .89) and smartphone (α = .76). A paired samples t-test was conducted to assess any potential differences in overall concern between the tablet and the smartphone. A significant difference was found; parents were more concerned about their child's smartphone use (M = 2.98, SD = 1.07) than their child's tablet use (M = 2.60, SD = 1.29), $t(41) = -2.70$, $p = .01$.

Parent Factors as a Function of Child Age

Parenting style, parental use of mobile technology, and parental opinion of how mobile technology impacts development were all analyzed as a function of age between younger and older children.

Parenting styles compared by age. Four t-tests were conducted to assess potential age differences in two parenting styles (authoritative and authoritarian)[3] for both the participant and the spouse. A Bonferroni correction of p = .0125 was used. No significant differences between parents of older children and parents of younger children were found in scores on the two parenting styles when rating their own parenting behaviours or their spouse's parenting behaviours (see Table 51 for complete results).

Parenting use of mobile technology compared by age. Seven t-tests assessed if there were any differences in parental use of mobile technology between younger and older children. A Bonferroni correction of p = .007 was used. No significant differences were found in any of

[3] Permissive parenting style was not included due to low reliability of the scale.

the four scales or three items assessing parental mobile technology use between younger and older children (see Table 52 for complete results).

Parental opinion of how mobile technology impacts development compared by age. A series of four t-tests assessed whether there were any differences in parental opinion of how mobile technology impacts development (cognitive, languages, motor, and social) between younger and older children. No significant differences were found (see Table 53 for complete results).

Concerns about mobile technology use compared by age. A series of six t-tests was conducted for the concerns about the tablet and six t-tests assessing concerns about the smartphone. No significant differences were found between parents concerns about mobile technology between younger and older children (see Table 54 for complete results).

The Relationship between Parent Factors and Use of Mobile Technology

Parenting style, parental use of mobile technology, and parental opinion of how mobile technology impacts development were all analyzed in terms of how they are related to the child's mobile technology use.

Parenting styles and the relationship to child's use of mobile technology. Four linear regressions were conducted for each of the two frequency of mobile technology use variables (frequency of tablet use and frequency of smartphone use) and the two amount of time using mobile technology variables (amount of tablet use and amount of smartphone use). The frequency and amount of mobile technology use served as the dependent variables while the four parenting styles scores (authoritative and authoritarian – for both the participant and their spouse)[4] served as the independent variables. Given the number of regressions conducted a more conservative alpha level of .0125 was used.

A significant relationship was found between the participant's authoritarian score and frequency of tablet use, R^2 = .10, β = .32, t = 2.76, p = .007. Consistently, one relationship also approached significance. Participant's authoritarian parenting style score was related to amount of time using the tablet, R^2 = .18, β = .42, t = 2.58, p = .015. Two trends towards significance were found. Both the participant's and spouse's authoritarian parenting style were related to a frequency of smartphone use, R^2 = .05, β = .23, t = 2.08, p = .040, R^2 = .05, β = .23, t = 2.12, p = .037. In all cases higher authoritarian scores were related to greater time on devices. No other significant differences were found in the frequency or amount of time using either the tablet or smartphone and any of the other parenting styles scores (see Table 55 for complete results).

Parental mobile technology use and the relationship to child's use of mobile technology. Seven linear regressions were conducted for each of the two frequency of mobile technology use variables (frequency of tablet use and frequency of smartphone use) and the two amount of time using mobile technology variables (amount of tablet use and amount of smartphone use). The frequency and amount of mobile technology use variables served as the dependent variables while the three parental mobile technology use scales (communication tasks, personal memories, reading, and games) and the three remaining items (texting, listening to music, and watching videos) served as the independent variables. Given the number of regressions conducted a more conservative alpha level of p = .007 was used. No significant relationships were found between parental technology use and the frequency of the child's mobile technology use. One regression was significant for the amount of time using mobile technology $F(1,52)$ = 14.89, p < .001. The relationship between the parents' use of mobile

[4] Permissive parenting style was not included due to low reliability of the scale.

technology for games was significantly related to the child's amount of time using the smartphone, $R^2 = .22$, $\beta = .47$, $t = 3.86$, $p < .001$ (see Table 56 for complete results).

Parental opinion of how mobile technology impacts development. One multiple regression was conducted for each of the two frequency of mobile technology use variables (frequency of tablet use, frequency of smartphone use) and two amount of mobile technology use variables (amount of tablet use, amount of smartphone use). The frequency and amount of mobile technology use variables served as the dependent variables while the parental opinion on the impact of mobile technology on development served as the independent variable.

Only one variable was significantly related to parents' opinion of the impact of mobile technology on development, total $R^2 = .15$, $F(4,64) = 2.73$, $p = .036$. Parental ratings of mobile technology as being helpful to cognitive development was related to a higher frequency of smartphone use by their child, $\beta = .58$, $t = 2.69$, $p = .009$. Additionally, one trend towards significance appeared, higher parental ratings of mobile technology as being helpful to language development was related to a higher frequency of tablet use for their child, $R^2 = .10$, $\beta = .58$, $t = 1.88$, $p = .066$.

For the amount of time using mobile technology one significant variable was found in relation to amount of smartphone use, $R^2 = .28$. Higher parental opinion that mobile technology is helpful to motor development was related to a higher amount of time spent on the smartphone $\beta = .35$, $t = 2.55$, $p = .014$ (see Table 57 for complete results).

Concerns and mobile technology use. Two linear regressions were conducted examining the relationship between tablet concerns and frequency as well as amount of time using the tablet. Two linear regressions examined the same relationships with the smartphone. The frequency and amount of mobile technology use served as the dependent variables while the overall concerns for the tablet and smartphone served as the independent variables. No significant relationship was found in the concerns for the tablet or smartphone and the frequency or amount of the child using the tablet and smartphone (see Table 58 for complete results).

When and How Children are Using Mobile Technology

When and how children are using mobile technology was investigated through a number of variables. First, what children are doing with the devices and how capable they are of using the gestures on touchscreen technology was examined. When, where and why parents use mobile technology was also investigated. Finally, what type of behaviours and activities parents feel the mobile technology encourages and the actions they have seen their children do are examined as well.

What children are doing on the mobile devices.

Device related tasks. Parents were asked to rate four tasks on how frequently they have observed their child engage in these on a mobile device. Parents indicated that their child 'sometimes' to 'often' has held/touched the device (M = 3.49, SD = .97) and 'sometimes' had the phone unlocked for them (M = 3.10, SD = 1.56). They stated the child 'rarely' navigates the device (M = 2.08, SD = 1.25) and between 'rarely' to 'never' unlocks the device themselves (M = 1.58, SD = 1.11).

Personal uses for the phone. Six items asked parents about personal tasks on the phone such as pictures, home videos, and phone calls. Parents indicated that their child 'sometimes' looks at pictures (M = 3.22, SD = 1.06). They responded that their child 'rarely' to 'sometimes' makes video phone calls (M = 2.88, SD = 1.30), watches home videos (M = 2.72, SD = 1.37), and makes audio calls (M = 2.63, SD = 1.01). Parents indicated that their child 'rarely' takes pictures (M = 2.18, SD = 1.35), or takes home videos (M = 1.98, SD = 1.33).

Watching videos. Four items asked parents about how frequently their child watched video on a mobile device. Specifically the four questions asked how frequently their child watched short videos, shows or episodes, movies, and YouTube. Parents stated that their child 'rarely' to 'sometimes' watched short videos (under 5 minutes in length) (M = 2.67, SD = 1.19), and watched shows or episodes (M = 2.30, SD = 1.36). Parents indicated that their child 'rarely' watched YouTube (M = 2.18, SD = 1.26) and between 'never' and 'rarely' watched movies (M = 1.57, SD = 1.12).

Applications. Five items asked parents about how frequently their child uses mobile technology for five types of applications. Ratings for all of the applications were generally low, falling just below 'sometimes' on the scale or less. Of the applications, those serving an educational purpose (M = 2.39, SD = 1.44) had the highest rating. Playing free-play games (M = 2.27, SD = 1.43) and entertainment purposes (M = 2.18, SD = 1.22) received a 'rarely' rating and goal-directed games (M = 1.47, SD = 1.02) were rated between 'never' and 'rarely'. Parents indicated that children 'never' use the device to play games on the Internet (M = 1.18, SD = 0.81).

Music and books. Three items asked parents about how often their child uses mobile technology for music and books. Parents indicated that their child 'rarely' to 'sometimes' uses mobile technology to listen to music (M = 2.65, SD = 1.29) and 'never' to 'rarely' uses mobile technology to read/look at books (M = 1.84, SD = 1.39) or listen to books (M = 1.55, SD = 1.12) (see Table 59 for complete results).

Gestures on the touchscreen technology. Parents were asked about how frequently they have seen their child use ten common gestures on touchscreen technology. On average parents indicated that their child uses around four gestures at least 'sometimes' (M = 4.39, SD = 2.10). The most frequently used gestures are the one-finger tap (quick one finger touch) (M = 3.71, SD

= 1.08) and the press (touch and hold for an extended period of time) (*M* = 3.31, *SD* = 1.09) which parents indicated their child do between ‘sometimes’ and ‘often’. Less frequently, parents indicated that their child does the flick (quickly brush surface with a fingertip, as if turning a book page) (*M* = 3.10, *SD* = 1.33), swipe (touch with multiple fingers and while holding down, move them slowly) (*M* = 2.90, *SD* = 1.36) and press and drag (touch with one finger and while holding down, move finger slowly) (*M* = 2.80, *SD* = 1.33) ‘sometimes’. Parents indicated their child bangs on the screen (with an open hand) between ‘rarely’ and ‘sometimes’ (*M* = 2.51, *SD* = 1.07). Finally, parents indicated their child ‘rarely’ to ‘never’ does the one-finger rotation (*M* = 1.61, *SD* = 1.08), pinch (Scale down, touch surface with two fingers and move them together) (*M* = 1.55, *SD* = 1.01), two-finger rotation (*M* = 1.51, *SD* = 1.00), and spread (Scale up, touch surface with two fingers and move them apart) (*M* = 1.43, *SD* = .90) (see Table 60 for complete results).

Mobile technology at home versus outside of the home. Parents were asked to rate how frequently their child uses mobile technology at home versus outside of the home, on a 7-point scale from 1 (*Always at home*) to 7 (*Always outside of the home*). Overall parents indicated that their child uses mobile technology far more at home, than outside of the home (*M* = 2.67, *SD* = 1.45).

Mobile technology in specific situations. Parents were asked about how frequently they would give their child mobile technology to use in ten situations.

A factor analysis was conducted. All ten items loaded on three factors (see Table 61 for complete results). The first factor included four items and involved more common frequent errands or activities including at the restaurant, medical appointments, grocery store, and waiting room (α = .83). The second factor was composed of three items and included more social activities involving multiple family members. Items were other people's houses, family outings, and sibling's activities (α = .80). Finally three items loaded heavily on the third factor and included travelling (both short and long distances) and church. Reliability for the third factor was low (α = .50), therefore an aggregated travel score was used and church was analyzed separately.

Overall parents indicated giving their child mobile technology infrequently in all of the situations. Parents indicated giving their child mobile technology 'rarely' while running common errands or activities (*M* = 2.06, *SD* = .86). Parents stated that they give their child mobile technology just less than 'rarely' while travelling (*M* = 1.80, *SD* = .89). Parents indicated giving their child mobile technology between 'never' or 'rarely' in more social situations (*M* = 1.54, *SD* = .68). Finally, parents stated that they 'almost never' give their child mobile technology in church (*M* = 1.15, *SD* = .46).

Reasons parents use mobile technology with their child. Parents were asked about how frequently they would give their child mobile technology to use for each of eight rationales using a 5-point scale.

A factor analysis for the 8 reasons resulted in two factors (see Table 62 for complete results). Five of the eight items loaded on to one factor, while the remaining three items loaded on a second factor. Items for each factor were combined to create two scales. One scale assessed unplanned use of mobile technology to distract or occupy the child and had high internal consistency (α = .86). The three items for the second factor did not yield a reliable scale and were subsequently handled as separate items: using mobile technology as a reward, as an educational tool and to settle the child before bed.

Overall, endorsement of these rationales was low. Parents indicated using mobile technology between 'rarely' and 'sometimes' in unplanned situations to distract or preoccupy their child (*M* = 2.34, *SD* = .91) and as an educational tool (*M* = 2.51, *SD* = 1.33). Parents indicated giving their child mobile technology 'never' to 'rarely' as a reward (*M* = 1.31, *SD* = .68) or to settle them before bed (*M* = 1.24, *SD* = .59).

Six paired samples t-tests were conducted comparing the scale (unplanned situations) and three individual items (as an educational tool, as a reward, and to settle before bed) to assess any potential differences in the reasons why parents give their child mobile technology to use. Given the number of t-tests conducted a more conservative alpha level of $p = .008$ was used. No significant difference was found in parents' frequency of using mobile technology in unplanned situations and as an educational tool. No significant difference was also found between parents' frequency of mobile technology use as a reward and to settle before bed. However, parents did rate frequency of mobile technology use as a reward (*M* = 1.31, *SD* = .68) and settle before bed (*M* = 1.24, *SD* = .59) significantly lower than both to distract and preoccupy their child (in unplanned situations) (*M* = 2.34, *SD* = .91), $t(50) = 7.94$, $p < .001$, $t(50) = 7.28$, $p < .001$, and as an educational tool (*M* = 2.51, *SD* =1.33), $t(50) = 6.08$, $p < .001$, $t(50) = 6.37$, $p < .001$.

How much mobile technology encourages activities. For the two mobile technologies (tablet and smartphone) parents were asked how much they feel each device encourages each of ten activities or interactions.

Two factor analyses were conducted, one for each device. Although, the factor analyses differed slightly between the two devices, there was some overlap in outcomes. Specifically, both factor analyses yielded two main factors, however, there were differences regarding which items loaded on the factors for each of the devices. For the tablet, the first factor included five items involving play (i.e., structured play, imaginative play, creative play, active play, and social interaction). Four of these same items loaded on the first factor for the smartphone (i.e., structured play, imaginative play, creative play, and active play; see Table 63 and 64 for complete results). Items were combined for these factors for each device to create a “play” scale. Reliability for these scales was high for both the tablet (α = .87) and smartphone play scale (α = .88). For the tablet, a second scale including three items involving entertainment, interactivity and engagement also yielded high reliability (α = .87). A two-item “entertainment/engagement” grouping was constructed for the smartphone. The remaining two items for the tablet (i.e., education and passiveness) and four items for the smartphone (i.e., social interaction, interactivity, education and passiveness) served as individual items in subsequent analyses.

Ratings for the tablet and smartphone were generally similar. Overall, with respect to play, parents’ ratings suggest a fairly low rating for the encouragement of play by both the tablet (M = 1.77, SD = .75) and the smartphone (M = 1.82, SD = .82). With respect to engagement mean scores suggest, this was encouraged for the tablet (M = 3.06, SD = 1.15) and the smartphone (M = 3.50, SD = .95). Encouragement of education was rated equally for both the tablet and smartphone (M = 3.17, SD = 1.18), falling just above the centre of the scale. Ratings for passiveness fell just below the centre of the scale for both the tablet (M = 2.85, SD = 1.38) and the smartphone (M = 2.89, SD = 1.30). Finally, the two variables that were analyzed separately for the smartphone were social interaction, which was rated as fairly low (M = 2.04, SD = 1.15), and interactivity which was rated at the centre (M = 3.09, SD = 1.21) (see Table 65 for complete results).

Comparison of how much technology encourages activities by device. The tablet, smartphone and television were compared regarding how much parents felt each device encouraged specific activities. Given that the items within the scales were not identical for all three devices, all ten activities were analyzed individually for this particular comparison. The activities compared were structured play, imaginative play, creative play, active play, engagement, passiveness, entertainment, education, interactivity and social interaction. For each of the activities three paired samples t-tests were conducted comparing the tablet and smartphone, smartphone and television, and the television and tablet (see Table 66 for complete results). Given the number of t-tests conducted a more conservative alpha level of .005 was used.

Play. No significant differences were found between the three devices in parents' ratings of how much they felt each technology encouraged any of the four types of play.

Interactivity. Of the three comparisons, one significant difference was found in encouragement of interactivity. Parents rated the smartphone (M = 3.09, SD = 1.21) significantly higher in interactivity than the television (M = 2.24, SD = 1.25), $t(45) = 4.37$, $p < .001$.

Engagement. No significant differences were found in encouragement of engagement between the three devices, however one comparison approached significance. Parents rated the smartphone (M = 3.13, SD = 1.17) higher in engagement than the television (M = 2.67, SD = 1.14), $t(45) = 2.90$, $p = .006$.

Passiveness. No significant differences were found between the three devices in encouragement of passiveness, however, two comparisons showed a trend towards significance. Parents rated the tablet (M = 2.85, SD = 1.38) lower in passiveness than the television (M = 3.40, SD = 1.35), $t(47) = -2.74$, $p = .009$. Parents also rated the smartphone (M = 2.89, SD = 1.30) lower in passiveness than the television (M = 3.43, SD = 1.33), $t(45) = -2.78$, $p = .008$.

Entertainment. No significant differences were found in parents' ratings of each device for encouraging entertainment.

Education. No significant differences were found in parents' ratings of each device for encouraging education.

Social Interaction. No significant differences were found in parents' ratings of each device for encouraging social interaction, however, one trend toward significance appeared. Parents rated the smartphone (M = 2.04, SD = 1.17) higher than the tablet (M = 1.60, SD = .81) in social interaction, $t(44)$ = -2.71, p = .009.

Actions parents have seen children do during mobile technology use. Parents were asked how frequently they have seen their child do each of seven actions while using each of the two technologies (i.e., tablet, smartphone).

Two factor analyses were conducted, one specific to each device. Responses to the tablet revealed five of the seven items loading heavily onto two factors. The remaining two items were analyzed independently. The first factor included three items involving active actions (α = .92). The items included dancing, singing and clapping. The second factor included two items involving passive actions and included standing still and sitting still. These two items were aggregated into one passive action score. The remaining items were pointing and lying (see Table 67 for complete results). For responses to the smartphone all seven items loaded heavily onto two factors (see Table 68 for complete results). The first factor included four items involving active actions (α = .80). The items were dancing, singing, clapping and pointing. The second factor included three items involving passive actions (α = .53).

Parents indicated seeing their child engage in active actions just below 'rarely' for the tablet (M = 1.92, SD = 1.16) and between 'rarely' and 'sometimes' for the smartphone (M = 2.58, SD = .98). Parents stated seeing their child engage in passive actions between 'rarely' and 'sometimes' for both the tablet (M = 2.14, SD = 1.03) and the smartphone (M = 2.63, SD = .84). For the tablet, parents indicated seeing their child lying (M = 1.72, SD = 1.11) just under 'rarely', and pointing just under less than 'sometimes' (M = 2.71, SD = 1.47).

Comparison of actions parents have seen children do during mobile technology use by device. The tablet, smartphone and television were compared regarding how often parents have seen their child do each action. The actions compared were dancing, singing, clapping, pointing, standing, sitting still, and lying down. For each of the actions three paired samples t-tests were conducted comparing the tablet and smartphone, smartphone and television, and the television and tablet (see Table 69 for complete results). A more conservative alpha level of .017 was used following a Bonferroni correction.

Dancing. All three t-tests were significant. Parents indicated seeing their child dance more frequently when using the smartphone (M = 2.41, SD = 1.17) versus the tablet (M = 1.86, SD = 1.25), t(43) = -2.74, p = .009. Parents also indicated seeing their child dance more frequently when using the television (M = 3.35, SD = 1.27; M = 3.43, SD = 1.22) when compared to the tablet (M = 1.83, SD = 1.24), and the smartphone (M = 2.43, SD = 1.15), t(45) = -6.87, p < .001; t(45) = -4.69, p < .001, respectively.

Singing. Two of the three t-tests were significant. Parents indicated seeing their child sing more frequently when using the television (M = 2.61, SD = 1.47; M = 2.70, SD = 1.47) when compared to the tablet (M = 1.83, SD = 1.27), and the smartphone (M = 2.09, SD = 1.24), t(46) = -4.14, p < .001;), t(46) = -3.96, p < .001, respectively.

Clapping. Two of the three t-tests were significant. Parents indicated seeing their child clap more frequently when using the television (M = 3.17, SD = 1.32; M = 3.27, SD = 1.23) when compared to the tablet (M = 2.11, SD = 1.25), and the smartphone (M = 2.49, SD = 1.16), t(46) = -4.48, p < .001;), t(45) = -3.83, p < .001, respectively.

Pointing. No significant differences were found between devices in how frequently parents indicated seeing their child point.

Standing still. All three t-tests were significant. Parents indicated seeing their child standing still significantly more frequently when using the smartphone (M = 2.58, SD = 1.12; M = 3.23, SD = 1.12) versus the tablet (M = 2.07, SD = 1.10) and also versus the television (M = 3.16, SD = 1.26), $t(43) = -3.18$, $p = .003$, $t(45) = -2.78$, $p < .008$, respectively. Parents also indicated seeing their child standing still significantly more frequently when using the television (M = 3.22, SD = 1.28) when compared to the tablet (M = 2.53, SD = 1.25), $t(44) = -3.67$, $p = .001$.

Sitting still. Two of three t-tests were significant. Parents indicated seeing their child sitting still more while using the smartphone (M = 3.23, SD = 1.13) and the television (M = 3.22, SD = 1.28) than when using the tablet (M = 2.56, SD = 1.26; M = 2.53, SD = 1.25), $t(42) = -3.44$, $p = .001$, $t(44) = -3.67$, $p = .001$, respectively.

Lying down. One of the three t-tests was significant. Parents indicated seeing their child lying down more frequently while watching the television (M = 2.24, SD = 1.45) than when using the tablet (M = 1.72, SD = 1.11), $t(45) = -2.73$, $p = .009$.

When and How Children are Using Mobile Technology Compared by Age

What children are doing on the mobile devices by age. A series of t-tests was conducted to assess differences in what parents reported children are doing with the device between the younger and older children in this sample. Five tasks significantly differed between the two age groups. Older children were significantly more likely than younger children to have had the phone unlocked for them (M = 3.67, SD = 1.31; M = 2.58, SD = 1.60), $t(48) = -2.62$, $p = .012$, navigated the device (M = 2.56, SD = 1.39; M = 1.62, SD = .90), $t(49) = -2.90$, $p = .006$, watched home videos (M = 3.12, SD = 1.20; M = 2.32, SD = 1.44), $t(48) = -2.14$, $p = .038$, watched episodes or shows (M = 2.88, SD = 1.39; M = 1.72, SD = 1.06), $t(48) = -3.31$, $p = .002$, and watched movies (*M* = 1.92, *SD* = 1.35; *M* = 1.21, *SD* = .66), $t(47) = -2.33$, $p = .024$ (see Table 70 for complete results).

Gestures on the touchscreen technology by age. A series of t-tests assessed age differences between younger and older children in the gestures they were performing on touchscreen technology. Only one difference was significant. Older children (*M* = 3.36, *SD* = 1.19) were more likely than younger children (*M* = 2.46, *SD* = 1.39) to perform the swiping motion (touch with multiple fingers and while holding down, move them slowly), $t(49) = -2.48$, $p = .017$. Additionally, one t-test approached significance such that older children (*M* = 4.96, *SD* = 2.17) performed more gestures overall than younger children (*M* = 3.85, *SD* = 1.91), $t(49) = -1.95$, $p = .057$ (see Table 71 for complete results).

Mobile technology at home versus outside of the home by age. One t-test was conducted to assess whether the location of the device use differed between age groups. No significant difference was found between younger children (*M* = 2.46, *SD* = 1.27) and older children (*M* = 2.88, *SD* = 1.62) regarding where they used mobile technology, $t(49) = -1.03$, $p = .308$.

Mobile technology in specific situations by age. A series of t-tests assessed whether there was a difference between younger and older children in where parents give their child mobile technology to use. No significant differences were found (see Table 72 for complete results).

Reasons parents use mobile technology with their child by age. A series of t-tests assessed whether there was a difference between younger and older children in why parents give their child mobile technology to use. No significant differences were found (see Table 73 for complete results).

How much mobile technology encourages activities by age. No significant differences were found for t-tests assessing mobile technology encouraging specific activities between younger and older children (see Table 74 for complete results).

Actions parents have seen children do during mobile technology use by age. A series of t-tests were conducted to assess any potential differences between younger and older children in actions parents have seen their children do. Only one significant difference appeared, parents of older children (*M* = 3.02, *SD* = .57) indicated a higher rate of seeing their child engaged in passive actions (*M* = 2.34, *SD* = .90) with the smartphone than younger children, $t(43) = -2.88$, p = .006 (see Table 75 for complete results).

Relationship Between How Children Use Mobile Technology and How Much they Use it

Analyses were conducted to examine whether the number of gestures produced was related to mobile technology use. Analyses also investigated whether a child's temperament was related to situations in which mobile technology was used and reasons why parents use mobile technology with their child.

Gestures and mobile technology use. One linear regression was conducted for each of the two variable assessing the frequency of mobile technology use (i.e., frequency of tablet use and frequency of smartphone use) and the two variables assessing the amount of time using mobile technology (i.e., amount of tablet use and amount of smartphone use). The frequency and amount of mobile technology use variables served as the dependent variables while the number of gestures served as the independent variable. Number of gestures observed by the parents was significantly related to frequency of tablet use $R^2 = .16$, $\beta = .40$, $t = 2.85$, $p = .007$, and frequency of smartphone use, $R^2 = .10$, $\beta = .31$, $t = 2.30$, $p = .026$. Number of gestures observed by the parents was also significantly related to amount of tablet use, $R^2 = .25$, $\beta = .50$, $t = 2.65$, $p = .015$.

A trend towards significance was found suggesting that the number of gestures was related to the amount of smartphone use, R^2 = .08, β = .29, t = 1.95, p = .058.

Mobile technology use in specific situations and temperament. Five linear regressions, one for each of the five temperament subcategories, were conducted for each of the four situations where mobile technology could be used (i.e., common errands, social situations, travelling, church). The specific situations of mobile technology use served as the dependent variables while the temperament categories served as the independent variables. A more conservative alpha (p = .01) was used.

None of the regression models were significant. One trend did emerge. A higher score in activity level on the temperament scale was related to a higher likelihood of using mobile technology while running common errands, R^2 = .12, β = .34, t = 2.54, p = .014 (see Table 76 for complete results).

Reasons parents use mobile technology with their child and temperament. Five linear regressions, one for each of the five temperament subcategories, were conducted for each of the four situations where mobile technology could be used (i.e., unplanned situations, as an educational tool, as a reward, to settle before bed). The specific situation of mobile technology use served as the dependent variables while the temperament categories served as the independent variables. A more conservative alpha was used (p = .01).

One regression model was significant, $F(1,49)$ = 7.23, p = .010. The relationship between the activity subcategory of temperament and the use of mobile technology in unplanned situations was significant, R^2 = .13, β = .36, t = 2.69, p = .010. In addition, one trend towards significance emerged between the activity level subcategory of temperament and the likelihood of using mobile technology as an educational tool, R^2 = .10, β = .32, t = 2.38, p = .021 (see Table 77 for complete results).

Discussion

Age of Introduction

Consistent with previous research (e.g., Rideout, 2013), television continues to be the most prevalent technology that very young children are exposed to, with over 95% of children in the present sample having been introduced this technology by eight months of age. Consistent with Study 1, over 80% of children in the current sample were using at least one mobile device. Further, while Study 1 showed an average age of introduction just over a year for mobile technology, the current study identified an even lower age of introduction of well under a year for both the smartphone and tablet. Identical to study 1, asking parents to identify whether or not their child has been introduced to mobile technology appears to be a problematic question. Specifically, although 80% of parents responded to questions describing how frequently their child was using one of the devices, only 65% of parents indicated that their child had been introduced to mobile technology. This discrepancy may reflect some hesitation on the part of parents to acknowledge introducing technology. However, when questions ask directly about use, which perhaps bypasses any perceived judgement regarding use, parents are willing to provide information. This discrepancy presents an interesting concern for acquiring accurate reports of children's use of technology both in research and applied contexts. Accurate reports in both contexts may be best served by asking parents how much children use technology rather than if their child uses technology or not.

Overall, children in the present study were familiar with technology, using an average of 2.5 devices, with the smartphone and tablet being the most commonly used devices after television. In addition, parents indicated that children used smartphones more frequently than tablets. Interestingly, higher reported use of smartphones was related to higher television use and use of tablets. Tablet use however was not related to television use. This suggests that children may be using the tablet and smartphone for different tasks, and possibly smartphones and television for similar tasks. For example, tablets may be more useful for games and applications, and smartphones for watching videos similar to the television. With this first indication of potential differences in the use of mobile devices, further research needs to be conducted to investigate where and why these differences exist.

Children seem to be using mobile technology for shorter periods of time than the television. While the average time spent using mobile technology was around 6 to 10 minutes each time they used it, time spent watching television was longer, averaging around 11 to 30 minutes. Time spent watching television is not surprising given that the children's shows are often 20-30 minutes in length. The amount of time using mobile technology may be a reflection of children's ability to manage other mobile technologies. Specifically, parents do not need to be present while children passively engage in television viewing, however, some level, or some greater level of parental supervision or involvement may be necessary for children to engage with mobile devices. This may be related to very young children and infant's limited motor or cognitive abilities in handling and navigating mobile technologies.

Older siblings have a significant impact on the age of introduction to technology for younger siblings. For all three technologies (i.e., television, smartphone, and tablet) the second child was introduced to technology at a much younger age than the first child. Furthermore, for television, the age of introduction also had an impact on frequency and amount of time using the television. Consistent with previous research, television viewing time increased over time

(Zimmerman et al., 2007a). This same trend was not found for mobile technology use. Given that the children in the current study were between 12 and 24 months of age and the age of introduction for mobile technology was just under a year, perhaps not enough time had passed for this trend to emerge. Specifically, since children had been introduced to television at a much younger age, more time had passed between introduction to television and the child's age at the time of the study, thus allowing older children more opportunities to demonstrate interest and preferences for television entertainment. It is possible that this same increase in time spent with mobile technologies would emerge if children were followed over a longer period of time and, as noted above, greater use might be evident as children acquire greater cognitive and motor skills to manage mobile devices more independently.

Parental Attitude and Mobile Technology Use

Similar to study 1, parents did not have a clear opinion on whether mobile technology was helpful or harmful to their child. Specifically, the current study assessed parents' opinions regarding whether the impact of mobile technology was helpful or harmful to cognitive development, language development, motor development, and social development and in all cases responses reflected the mid-point of the scale. Given the high rates of children's mobile technology use overall, it is clear the mixed parental opinion does not seem to be discouraging the use of this technology with their young children in general. Lauricella and colleagues (2015) found similar results, that with young children less than 2 years of age, parental opinion did not play a role in the amount of time the child uses the technology. Interestingly, these results were contradictory to the relationship between parental opinion and other technologies such as the computer or television (Lauricella et al., 2015). Perhaps since mobile technology is so new in comparison to the television and computer, parents are refraining from making definitive conclusions about the technology. This lack of connection between parental opinion and amount of use of mobile technology seems to be especially true for children under the age of 2. These mixed opinions do support the need for critical research such as the present study and future research which maps the impact of technology use clearly in order to provide parents with information to make an informed decision about technology use with their young children.

When looking at the relationship between perceived usefulness and development very little appeared to be related. Some evidence, based on one significant result and one trend, was found indicating that parental opinion of the usefulness of mobile technology for cognitive and language development was related to more frequent use of the smartphone and tablet. When looking specifically at how much time children spend using the device there was one significant relationship linking perceived usefulness to motor development. In general, these outcomes could indicate a perception by parents that mobile technology is useful for promoting general intellectual and some general motor development. Alternatively, this relatively small connection between perceived usefulness and cognitive or motor outcomes may reflect the same mixed opinions noted earlier. Specifically, given the lack of research regarding mobile technologies and young children, parents may not be sure whether technology is useful for their child's development but may hope that it is.

Parents were asked to rate six potential concerns to determine what concerns might influence access to mobile technologies. Of the specific concerns parents were asked to rate, those who evoked greater concern included their child using technology too much, potential repair costs if the device were to be damaged, and concerns about the child deleting important information. Of these concerns time-management is consistent with concerns identified in the literature by parents of older children (Lauricella et al., 2015) and may reflect attraction to the technology over other available activities (Vandewater, Bickham, & Lee, 2006). Concerns about costly repairs or deletion of information may be particularly salient, especially if the technologies belong to parents but are shared with their young children. Parents expressed less concern about their child seeing inappropriate content, seeing advertisements, and the child being able to navigate the device without the parent there. This is concerning given that mobile devices are typically connected to the Internet and, therefore, allow easier access to inappropriate content which, if accessed, can have negative developmental implications (Barr et al., 2010; Conners-Burrow et al., 2011; Zimmerman & Christakis, 2007). Apparently, independent use of technologies is not perceived to be worrisome and may even be somewhat desirable. Consistent with study 1, parents in this sample do not seem to acknowledge the ease of access to potentially inappropriate content on mobile devices as a concern. This latter apparent lack of concern may reflect parents' belief that children might not be able to access inappropriate content but may also reflect apathy regarding inappropriate exposure. Understanding this lack of concern may be important for developing guidelines for parents.

Parents indicated a greater overall concern for their child's use of the smartphone versus their child's use of the tablet which is an interesting finding considering smartphone use was much more prevalent amongst young children than tablet use. Overall, parental level of concern in general had no impact on how much their child used mobile technology, which again is consistent with the finding that parental opinion does not seem to influence the amount of mobile technology use (Lauricella et al., 2015). One possible explanation is that the list of possible concerns was not exhaustive, and there may be other concerns that parents have. Future research should explore this possibility. However, given that the list of concerns was created from those indicated by participants in study 1, it is possible that the list of concerns is not the issue, but rather parents are just not overly worried about mobile technology use with this young age group. Perhaps it may be something parents have in the back of their minds rather than at the forefront. For example, when directly asked to list concerns in study 1 parents had some thoughts on potential concerns, but it seems when actually rating the severity of those concerns, parents do not feel strongly about them.

While it was not clear whether parental technology use had an impact on their child's technology use, we examined this as a potential factor. Overall, parents were quite frequent users of mobile technology. While most tasks that parents used their devices for were not related to their child's use of mobile technology, one task was related. Parental use of mobile technology for games was related to the amount of time their child spent using a smartphone. This is an interesting finding. Perhaps the amount of time parents spend on the mobile device when playing games is greater than when completing other tasks such as responding to an email or text. Also, given that games are more visually appealing, maybe the child is more inclined to watch the parent using the device during this time. This could also be a result of the priorities of the parent, for example, if the parent spends more time using mobile technology for entertainment purposes, the child then could potentially have more time to do so as well. Perhaps the connection between the amount of time parents and children use mobile technology happens on a more global level rather than according to specific task or device. Wartella and colleagues (2013) defined 3 "media" related parenting styles indicating that overall greater amount of parental media use reflected greater amounts of media use in their children. This was also seen in the current sample. Further research needs to examine what factors of parental media use influence the child's media habits.

Some evidence was found for a relationship between parenting style and mobile technology use. Nearly all parents in the current study rated themselves and their spouses highest on the authoritative parenting styles in comparison to other parenting styles. Scores on authoritative parenting style did not seem to impact children's use of mobile technology. However, while scores on authoritarian parenting style were much lower overall, they were significantly related to the frequency of their child's mobile technology. These findings contradict previous research which found less screen time use in children with authoritative and authoritarian parents (Veldhuis et al., 2014). However, previous findings investigated a slightly older age group and were specifically looking at screen time as television, computer and game console use. There may be important differences with mobile technology use that could explain this inconsistency across technology contexts. Potentially, this could also be directly related to the fact that parents are using these devices with young children out of their own convenience. Authoritarian parenting style typically involves very little choice or explanations while placing importance on adherence to authority (Baumrind, 1966). A parent interested in just keeping their child quiet may be more inclined to use mobile technology since it provides an easy method to preoccupy the child with little or no interaction required from the parent.

Development and Temperament

No relationships were found for a child's use of mobile technology and parental reports of their development level for communication, gross motor and personal-social skills. When parents indicated how much their child used mobile technology, their use of the tablet was positively related to problem-solving skills. Parents who indicated that they had introduced mobile technology to their child also reported a higher score for their child's fine motor skills. This provides a first glimpse of the perceived developmental implications of mobile technology use and in this case, parents' reports suggest developmental gains. Such perceptions might be expected to encourage early use of technology. Importantly, these perceptions may or may not be accurate. In order to better understand the developmental impact of technologies, direct assessment and observation is needed.

In general a child's temperament, specifically, socially, emotionally, attention, and soothability, and their shyness did not impact mobile technology use. However, similar to previous findings, higher activity levels in the child were related to higher media use, in this case more frequent use of the tablet and smartphone (Thompson et al., 2012). More specifically, parents with more active children were more inclined to use mobile technology while running errands and in unplanned situations to distract or preoccupy their child. This is consistent with study 1 that found parents primarily using mobile technology out of convenience as a way to preoccupy their child. The current study sheds more light on this situation, indicating that parents may feel the need to use mobile technology to distract an overactive child, especially when they are out running errands. This outcome suggests that some individual differences may influence the possibility of early exposure to technology.

What Children are doing with the Devices?

Consistent with study 1, the most common tasks children are doing on the device are looking at pictures and watching videos. Children also seem to be using the device to keep in touch through voice and video calls. The toddlers in the present study were more inclined to have the device unlocked for them, to navigate the device, and watch videos on the device than younger children. Consistent with study 1 these tasks could imply more independence with age where parents allow their child to interact more independently with the device. Again, this suggests a possible sensitive time around 18 months of age where parents feel their child is more capable of using mobile technology on their own.

Interestingly, parents indicated that they use mobile technology with their children, equally as much in unplanned situations to distract, as they do for educational purposes. The tasks parents indicated their child is doing on the device contradict this perception. Children are using the devices more frequently for looking at pictures and videos than tasks such as educational applications. Perhaps parents believe the videos watched are educational in nature. Another explanation may be that external influences play a greater role in parents' decisions of when and how the child uses mobile technology, rather than inherent value of the device itself (such as its potential educational value). While parents are aware of the tasks their child does on the technology, parents may not be actively considering if and why they should use technology each time the device is given to the child. Thus, a greater understanding of contextual influences may be necessary to understand what motivates parents to select technology in unplanned contexts versus planned ones.

Given the simplicity in using touch screen technology parents were asked about gestures they have seen their child produce. On average children used four gestures: one finger tap, one finger press, flick, swipe and press and drag. As expected, greater presence of these gestures was associated with a higher age, older children produced more gestures than younger children. Interestingly, the number of gestures produced was strongly related to the amount of mobile technology use, supporting the suggestion that experience is an important component in learning the skills necessary for using touch screen technology.

Despite the mobile nature of the tablet and smartphone, parents indicated that their child used mobile technology much more frequently at home than outside of the house. This may coincide with concerns noted above, especially those regarding the need for supervision to ensure breakage does not occur or that important content will not be deleted. Given that mobile technology is used mostly inside the home, overall ratings of reasons for using mobile technology outside of the home were fairly low. However, of the reasons parents were asked to rate, the most frequently indicated one was as a distraction during common errands such as waiting at appointments, or going to a restaurant or grocery store. Parents also rated the frequency of mobile technology use during travelling similarly, which again indicates the need to preoccupy. Parents rated frequency of use at social events involving other family members such as sibling's events and family outings as much lower so there seems to be some perception of the importance of family time without mobile technology.

The perceived outcomes of technology use for children comprised both positive and negative possibilities. While parents did feel that mobile technology encouraged engagement and education to some degree, they also felt it encouraged passivity. Interestingly, parents generally felt that mobile technology did not encourage play. Overall, these findings suggest that parents see potential in technology but also perceive concerns. When looking at specific devices, as expected parents felt the smartphone encouraged engagement more than the television, and television encouraged passiveness more than both the smartphone and tablet. Surprisingly, parents also felt that the smartphone encouraged social interaction more than the tablet. Given the size of the two devices this finding is interesting, since a tablet would be easier to share. No distinction was made in the definition of social interaction so it is possible that parents were thinking about the communication abilities of the device when considering its use for social interaction.

Exploration of activities children engaged in while interacting with technology revealed particularly interesting results. The belief that the television is more passive and that mobile technology is more interactive and engaging has been clearly established and consistently documented over time (e.g., Rideout & Hamel, 2006). In the present study, however, parents described television interactions as much more active than passive. Parents stated that they saw their child singing, dancing and clapping, far more frequently while watching television than while using mobile technology. Consistent with this finding, passive actions such as standing still and sitting still were observed more frequently on the smartphone than on the television. This provides a first indication that parents are noting less interactivity and engagement when children are engaged with mobile devices than television. Parents also stated observing passive actions more frequently in older children than younger ones, perhaps concurrent with an increasing use of technology. While mobile technology is anticipated to be more interactive and television more passive, children's actions seem tell a very different story. These differences observed by parents may provide insight regarding parents greater use of television and concerns when using technology.

Conclusion

Clearly, children are being introduced to mobile technology at very early ages. Parents' express mixed opinions regarding introducing children to technology, but for the most part are opting to let their child experience the technology. One consistent message across both Study 1 and 2 is that parents do use mobile technology for convenience to distract and preoccupy their child more so than as an active learning tool. This outcome is consistent with recent reports in the literature involving older children (Kabali et al., 2015). However, parents' responses also suggest that other factors are important. Further research needs to examine what parents observe as potential indicators of benefits and drawbacks regarding their own children's use of technology. In particular, mobile technologies need to be understood relative to traditional technologies in terms of affordances from the technology but also in terms of action, and engagement both physically and socially. The current study indicates that these variables may be important in understanding parents' opinions. The present study also suggests the importance of including individual differences when investigating early introduction and use of technology. For example, young children's activity level may encourage greater use of mobile devices, specifically when the child is highly active. In summary, important insights regarding parental views and decisions regarding early technology introduction were obtained as well as important directions for future research. One key direction indicates the importance of supporting parental views and reported observations with direct observations of parents and children when jointly engaged with technology.

Study 3

A first step in examining early use of technology involves parental reports. To determine whether parental reports match more objective measures, direct testing and observation is necessary. Such testing can provide a more definitive measure of developmental outcomes and the impact of technology use on development.

While parental reports suggest that older infants (i.e., over 18 months of age) are more "ready" to use mobile devices more independently, observations are needed to investigate whether proficiency in using touch screen technology does actually increase at this point in development and how fine-motor skills play a role in this change. Study 3 involves direct assessment of children's cognitive, social and physical skills as well as direct observational data of joint parent-child interactions involving technology. In addition, Study 3 further examines children's 'interest' in using technologies. The previous studies presented here suggest that parents select technology because they feel that there is some inherent natural interest in using the devices. Such parental beliefs may influence decisions to introduce, maintain or extend technology use for their children. Further research needs to investigate whether this perceived inherent interest actually exists uniformly for all children, and whether interest is apparent from the outset or whether it develops over time.

Study 3 provides an opportunity to document and explore in greater detail parent and child behaviours when using mobile technology together. In particular, study 3 examines parent-child use of familiar mobile devices as well as one device consistent across dyads. Contrasting use of these devices provides insights regarding parent–child interactions when using more and less novel technologies. Most important, this study includes direct assessment of developmental skills and how these skills are related to technology use in general and in particular with the types of interactions in which parents engage. This is a first study examining infant/toddler interactions in this way. In light of relationships between fine-motor skills and problem solving skills with mobile technology use found in Study 2, using an objective measure of development in Study 3 allows for corroboration of the parent reported developmental assessment to further explore these relationships.

Methods

Participants

Thirty parents along with their child from Southwestern Ontario, Canada participated in the observation portion of the study. All but two parents who participated in the observations also completed the survey. The sample included 29 mothers and one father (M_{age} = 32.00, *SD* = 4.86, range: 19 years to 45 years). Consistent with the larger sample participants who completed the observation segment were well-educated. Education level ranged from some high school to a doctorate degree: Some High School (3.3%), High School Diploma (6.7%), College Degree (36.7%), Bachelor Degree (40.0%), Master’s Degree (10.0%), Doctorate Degree (3.3%). Most participants were married (86.7%) with a few indicating that they were in a common law relationship (13.3%).

Most parents indicated their first language was English (83.3%) while a few (16.7%) stated “other” as their first language (i.e., Portuguese, Punjabi, Spanish, Mandarin and Vietnamese). Most parents (63.3%) stated that only English is spoken in the home. Some parents (30.0%) stated that English and another language is spoken in the home and only a few (6.7%) indicated that English and French are spoken in the home.

All target children were between the ages of 12 and 24 months. These target child participants were assigned to one of two age groups: the younger group was comprised of children with ages ranging from 12 to 17 months (*N* = 15) and the older group was comprised of children with ages ranging from 18 to 24 months (*N* = 15). Each child participated with one of their parents during the observations. The majority of parents indicated that their child’s first language was English (90.0%; *N* = 27) with a subset (10%; *N* = 3) indicating Punjabi, Mandarin or Spanish. When looking at family context, also consistent with larger sample completing the survey, most participants indicated their child was an only child (43.3%; *N* = 13) or that the child had one sibling (43.3%; *N* = 13). Remaining families were comprised of three (10.0%; *N* = 3) or five children (3.3%; *N* = 1) with one parent who did not respond to this question.

Materials

Materials included the technology to be used during the observation session as well as standardized measurement tools to assess infant development and the home environment. Observations were conducted in family homes. Additionally two video cameras recorded parent-child interactions during the observational sessions.

Technology used. An iPad® was pre-loaded with games targeting 12 to 24 month olds and required differing levels of interaction from the user. A booklet was included alongside the iPad®. This booklet contained pictures and application information for each of the 12 games loaded onto the iPad®. The games were: Sago Mini Friends – Preschool Playdate for Kids and Toddlers, Fish School HD, Peppa Pig Paintbox, Toddler Counting 123, Kids Train & Transportation – Puzzle Games for Toddler, Toca Band, Animal Sounds – Fun Toddler Game, Chugginton Ready to Build – Train Play, Alphabet Aquarium School Volume 1: Game with Letters and Animals for Preschool, Tiny Hands Sorting 1, The Wheels on the bus – All in One Activity Centre and Sing Along, Cute Nursery Rhymes & Songs for Kids.

In addition to this technology, parents were asked to provide the technology they typically used with their child (if they provided their child with technologies).

Developmental measure. The Bayley Scales of Infant and Toddler Development assesses a child's development in 5 domains; Adaptive behaviour (α = .97), cognitive (α = .91), language (α = .93), motor (α = .92), and social-emotional (α = .90). The cognitive scale, fine motor scale, expressive language and receptive language were the four administered by the researcher within this study. All four required interaction with researcher during assessment. The social-emotional and adaptive behaviour questionnaire was also administered as part of the parent survey at the end of the observation session.

Final survey. The final survey asked about familiarity, comfort, ease of use and interest regarding technology using four questions. Two questions referred to the parent's experience with the iPad® and the software and two queried to the child's experience with the iPad® and the software (see Appendix F).

Procedure

Testing of the child and observations were conducted in the participant's home, at an early years centre, or at the university. After obtaining consent, two cameras were set up in the area where the child typically used the mobile device or in the room at the Early Years Centre or on campus. Cameras were setup from two angles to record the interaction between the caregiver and the child while using the mobile technology.

Parents were asked to use the mobile technology that they typically offer their child in the way that they typically offer the technology to the child. They were asked to make this technology available to their child for approximately 5 minutes.

Following this initial session the second researcher began the developmental assessment with the child while the parent was shown a list of the 12 games loaded onto an iPad® device. Parents were provided with both the iPad® device as well as the iTunes booklet. Parents were told that they could choose one game to introduce to their child and that they could have as much or little time as they wanted to choose the game. Parents were then given the social-emotional and adaptive behaviour questionnaire to complete.

When the child completed the developmental assessment, parents were given 5 minutes to introduce the chosen iPad® game to their child. They were asked to introduce the game in the same way they would introduce any new application to the child.

Finally, a short survey was provided to the caregiver to gather more detailed information on their own and their child's comfort and familiarity with the iPad® and software. Observation participants were entered into an additional draw to win a $100 gift certificate.

Results

Two sessions were recorded with each parent-child dyad, one in which they used their own mobile device for five minutes and one in which they used an iPad® for five minutes. When using their own device 73.3% (*n* = 22) of parents used a smartphone, while the remaining 26.7% (*n* = 8) parents used a tablet.

Qualitative methodology was used to analyze all video recordings of mobile technology use between the parent and the child. The two raters viewed the videos one at a time using an inductive coding strategy (Boyatzis, 1998; Strauss and Corbin, 1990; Thomas, 2006) to identify and label emerging themes. The two raters viewed videos until saturation in coding was attained (5 videos). Videos were coded for the number of times each theme occurred within the video. In addition to the emerging themes, all videos were also coded for the number of times the parent and the child each produced one of the ten gestures described in the survey. Inter-rater reliability was assessed by having each of the two raters independently code 20% of the remaining videos (*n* = 6). Two forms of inter-rater reliability were calculated. Overall, percentage agreement was 82.97% indicating high agreement. In addition, Cohen's Kappa supported moderate agreement between the two raters, Kappa = 0.47 ($p < .001$), 95% CI (0.435,0 .503). Disagreements were resolved through discussion. Given the reliability between raters, the remaining videos were coded by one of the two raters.

Five overarching themes emerged. Themes included interest and skill, what they did on the device, verbal interactions, physical interactions, and control of the device. In addition to analysis of the qualitative codes, the child's development and parents' ratings of comfort and interest in using the iPad® were also investigated.

It is important to note that two parents were unique in the way they presented their own device to their child. Specifically, one parent simply played music with the device and the other parent locked the device such that the child could only use it as an object (i.e., holding it to her ear like a phone). Given that the observational codes assessed interactions with the screen and the touch screen technology component of the device was not enabled in these two cases, these two cases were removed from any further analysis involving interactions with the touch screen.

Interest and Skill

The child's interest in the devices and skill in using the devices was coded through 5 categories. Each category was given a score out of three by the raters.

Interest in technology at the outset and end of session. The first two categories assessed how easy it was to initiate interest in using the device (*1 = easy, 2 = somewhat difficult, 3 = very difficult*) and how interested in using the device the child was at the end of the 5 minute session (*1 = not at all interested, 2 = somewhat interested, 3 = very interested*).

When using their own device. Of the 28 participants one parent was completely unable to initiate interest in using the device in their child. In 71.4% of the participants (n = 20) initiating interest in using the device was rated as easy, in 14.3% (n = 4) initiating interest was somewhat difficult, and 10.7% (n = 3) initiating interest was very difficult. When looking at interest by the end of the 5-minute session, 14.8% (n = 4) ended the session early because the child had no interest in continuing. Of the remaining 23 participants who completed all 5 minutes of the session, 21.7% (n = 5) had no interest at all by the end, 13.0% (n = 3) showed some interest still, and 65.2% (n = 15) were still very interested in using the device.

When using the iPad®. When using the iPad® in all 30 cases parents were able to initiate interest in their child. In 90% (n = 27) initiating interest was rated as easy, while in 10.0% (n = 3) of cases initiating interest was somewhat difficult. Of the 30 participants 10.0% (n = 3) ended the session early due to the child's lack of interest. Of the remaining 27 participants 7.4% (n = 2) showed no interest at all in the device by the end of the 5-minutes, 18.5% (n = 5) showed some interest while 74.1% (n = 20) were still very interested in using the iPad® by the end.

Sustained interest. Two categories assessed sustained interest in using the device throughout the 5-minutes. One category assessed how visually engaged the child was throughout the session (*1 = rarely, 2 = sometimes, 3 = most of the time*). A score of 1 was given if the child frequently disengaged from the screen and looked away. A score of 2 was given if the child periodically looked away from the screen. A score of 3 was given if the child very rarely looked away from the screen and was engaged in what was going on most of the time. A second category assessed how interested the child was in physically interacting with the device throughout the session (*1 = rarely, 2 = sometimes, 3 = most of the time*). This category was scored based on how frequently the child show interest in touching the screen of the device.

When using their own device. When using their own device, of the 27 children who interacted with the device, 18.5% (n = 5) 'rarely' showed visual engagement with the device, 22.2% (n = 6) 'sometimes' showed visual engagement with the device, and 59.3% (n = 16) showed visual engagement with the device most of the time. When assessing physical engagement, 11.1% (n = 3) of participants never touched the screen, 33.3% (n = 9) 'rarely' touched the screen, 7.4%% (n = 2) 'sometimes' touched the screen, and 48.1% (n = 13) touched the screen most of the time.

When using the iPad®. When using the iPad® 33.3% (n = 10) of the children were visually engaged with the device 'sometimes', while 66.7% (n = 20) of the children were visually engaged with the device most of the time. When investigating their interest in physically interacting with the device 20.0% (n = 6) 'rarely' showed an interest, 30.0% (n = 9) showed an interest 'sometimes', and 50.0% (n = 15) showed an interest to physically interact with the device most of the time.

Skill. One category assessed how skilled children were in using the device. This was scored through their ability to accurately execute the gestures on the touchscreen, necessary for progressing the game or activity. Scores were out of 3 (*1 = very poor, 2 = poor, 3 = good*). A child received a score of 1 if their physical interaction with the screen was mostly random. A score of 2 was given if the child showed some ability to use the necessary gestures, however, they were not accurate and often required many tries or eventually the assistance of the adult. A score of 3 was given if the child was reasonably accurate in their touchscreen gestures and able to progress throughout the game or activity fairly independently.

When using their own device. When using their own device in 22.2% (n = 6) of sessions the child did not touch the device frequently enough to accurately assess their skill. Of the remaining 21 participants, 42.9% (n = 9) were very poor in using the device, 38.1% (n = 8) showed some ability in using the device and only 19.1% (n = 4) were very skilled in using the device.

When using the iPad®. When using the iPad® in 6.7% (n = 2) the child touch the device so infrequently that an accurate assessment of their skill was not possible. Of the remaining 28 participants 42.9% (n = 12) were not very skilled at using the device, 46.4% (n = 13) were somewhat skilled in using the device, and only 10.7% (n = 3) were very skilled in using the device.

Comparisons of interest and skill. Repeated Measures ANOVAs were conducted to assess any potential differences in interest and skill while using their own device versus when they used the iPad® as well as any differences in age.

Interest at the outset and end of the session. Two Repeated Measures ANOVAs assessed ease of initiating interest and interest level at the end of the session between the devices and by age. There was a main effect of age; initiating interest was easier in older children ($M = 1.08$, $SE = .09$) than in younger children ($M = 1.36$, $SE = .09$), $F(1, 25) = 5.02$, $p = .034$. The main effect of device approached significance; initiating interest in the device was easier with the iPad® ($M = 1.07$, $SD = .27$) than when using their own device ($M = 1.37$, $SD = .69$), $F(1, 25) = 4.10$, $p = .054$. The interaction between device and age also approached significance suggesting that initiating interest in younger children was easier when using the iPad® than when using their own device, $F(1, 25) = 4.10$, $p = .054$. No significant effects of device or age were found when looking at interest at the end of the session (see Table 78 for complete results).

Sustained interest. Two Repeated Measures ANOVAs assessed visual engagement and physical engagement throughout the session between the devices and by age. With regard to visual engagement there was a main effect of device and age. Children showed more visual interest when using the iPad® ($M = 2.67$, $SD = .48$) than when using their own device ($M = 2.41$, $SD = .80$), $F(1, 25) = 5.16$, $p = .032$. Older children showed more visual interest ($M = 2.81$, $SE = .15$) than younger children ($M = 2.29$, $SE = .14$), $F(1, 25) = 6.44$, $p = .018$. When examining physical engagement the main effect of device and the interaction between device and age were significant. Children showed more physical engagement when using the iPad® ($M = 2.30$, $SD = .82$) than when using their own device ($M = 1.93$, $SD = 1.14$), $F(1, 25) = 4.56$, $p = .043$. Younger children showed more physical engagement when using the iPad® than when they used their own device, while older children showed the a similar amount of engagement for both devices $F(1, 25) = 4.56$, $p = .043$ (see Table 79 for complete results).

Skill. One Repeated Measures ANOVA assessed skill level between the devices and by age. There was no main effect of device, however, there was a main effect for age. Older children were more skilled (M = 1.81, SE = .19) than younger children (M = 1.21, SE = .19), $F(1, 25) = 4.89$, p = .036 (see Table 80 for complete results).

What did they do while using the device?

When using their own device parents were instructed to use the device in the manner they would normally use it with their child. As indicated above, only two parents chose not to use the touchscreen capabilities of the device with their child and one child did not use the device due to lack of interest. Of the remaining 27 participants, parents selected between 1 and 4 different games and/or applications (M = 1.67, SD = .96) to engage their child during the 5-minute observation session. In total, 10 unique programs/software were selected by parents. Most of these applications (n = 12) reflected games that were designed for use by children (e.g., nursery rhymes game, pictures and sounds game), followed by looking at pictures (n = 11). In addition, some parents selected videos appropriate for children (n = 8), and home videos (n = 5). Two parents opened the camera application to look at themselves through the camera, two used a piano application, and two parents introduced games that were not specifically geared towards children. Finally, activities that appeared only once included snap chat, Facebook, and exploring the app store.

Prior to using the iPad® with their child, parents were directed to select one of the 12 games loaded onto the iPad® to introduce to their child. During the observation session, parents were asked to start the session by introducing the game they had selected. Parents were instructed that they could do whatever they chose following the introduction of the first game and were not required to continue playing only that game. Overall, all 30 participants engaged in 1 to 5 different activities (M = 1.57, SD = .90) during the 5-minute session. Of the 12 games, two (i.e., Toca Band and Chugginton Ready to Build) were never played by any participants. The five games most frequently selected included: Animal Sounds (*n* = 10), The Wheels on the Bus (*n* = 8), Fish School HD (*n* = 7), Toddler Counting 123 (*n* = 6), and Tiny Hands Sorting (*n* = 4). Of the five remaining games (i.e., Peppa Pig Paintbox, Sago Mini, Alphabet Aquarium, Cute Nursery Rhymes, and Kids Train & Transportation) each was selected by only two parents. Additionally, one parent opened the camera application to allow the child and parent to look at themselves in the camera. One parent played a video appropriate for children for their child.

Verbal Interactions When using the Device

Verbal interactions during the observation sessions were examined. Parent verbal information and child verbal information were coded.

Parent verbal interactions. Five themes captured parental verbal input during the sessions: describing how to use the device, describing how to play the game or use the application, asking the child a question, talking about content on the screen, and making connections to the child's life.

How to use the device. Parents described how to use the device, for example, "push here" or "drag it over there". When using their own device, of the 27 parents, most (59.3%, *n* = 16) did not explain how to use the device while 40.7% (*n* = 11) provided at least one explanation regarding how to use the device during the session. Among those parents who did explain how to use the device, they provided between 1 and 15 instructions/directions for use with an average of just under 4 times per session (*M* = 3.73, *SD* = 4.25). When using the iPad®, however, the vast majority of parents (70.0%, *n* = 21) provided at least one explanation during the session and only 30.0% (*n* = 9) of parents did not explain how to use the device. When parents did explain how to use the device they did so between 1 and 18 times with an average of just over 4 times per session (*M* = 4.33, *SD* = 4.08).

How to play the game. Overall, when using their own device, 29.6% (*n* = 8) of parents provided some support by describing how to play a game or use an application, for example, “match it” or “pop the bubbles”. However, the remaining 70.4% (*n* = 19) of parents did not provide any verbal explanations. When explanations were provided, the number of explanations ranged between 1 and 15 times in a session with an average of *M* = 3.75 (*SD* = 4.65) for the parents device. When using the iPad®, most parents (66.7%, *n* = 20) did explain how to play the game or use the application with only 33.3% (*n* = 10) of the parents not providing any verbal explanation. The number of explanations provided ranged between 1 and 20 times within a session with an average of *M* = 5.10 (*SD* = 5.14).

Asking questions. This theme captured parents asking their child questions about what was on the screen, for example “what does that animal say?” or “who is that”. When using their own device, only 25.9% (*n* = 7) of the parents did not ask their child any questions. When the remaining 74.1% (*n* = 20) asked questions they did so between 1 and 20 times (*M* = 8.40, *SD* = 6.11). When using the iPad®, similarly, only 20.0% (*n* = 6) of the parents did not ask their child any questions. When the remaining 80.0% (*n* = 24) asked questions they did so between 1 and 24 times (*M* = 6.54, *SD* = 6.49).

Talking about content on the screen. Parents talked about content on the screen, for example, “train, choo choo” or “look, a cow”. When using their own device, 11.1% (*n* = 3) of the parents did not talk about any content on the screen. When the remaining 88.9% (*n* = 24) talked about content on the screen they did so between 1 and 29 times with an average of just over 8 times per session (*M* = 8.29, *SD* = 7.66). When using the iPad®, only 6.7% (*n* = 2) of the parents did not talk about any content on the screen. When the remaining 93.3% (*n* = 28) talked about content on the screen they did so between 1 and 45 times (*M* = 14.21, *SD* = 9.20).

Making connections. A few parents connected information on the screen to the child's life, for example "did we see a donkey at the zoo" or "that sounds like the dog across the street". When using their own device, 74.1% (n = 20) of the parents did not make any connections to the child's outside world. When the remaining 25.9% (n = 7) made connections they did so between 1 and 4 times (M = 1.86, SD = 1.22). When using the iPad®, 73.3% (n = 22) of the parents did not make any connections to the child's outside world. When the remaining 26.7% (n = 8) made connections they did so between 1 and 3 times (M = 1.63, SD = .92).

Child's verbal interactions. Children's verbalizations regarding what was happening on the screen were coded. Given that the children in this age group were at various levels of language development, and therefore could not always be clearly understood, any sounds made towards activities happening on the screen were considered to be a verbal interaction with the content. Thus coding was comprised of intentional sounds directed at the screen. When using their own device 18.5% (n = 5) of children made no verbal interactions with the device. The remaining 81.5% (n = 22) of children expressed between 1 and 24 verbalizations (M = 7.68, SD = 7.36) per session. When using the iPad®, 33.3% (n = 10) of children made no verbal interactions with the device. The remaining 66.7% (n = 20) of children expressed between 1 and 25 verbalizations (M = 9.05, SD = 7.16) per session.

Comparisons of verbal interactions.

Verbal interactions by device and age group. Repeated Measures ANOVAs compared overall parent and child verbalizations as well as specific parent verbal interactions: explanation of how to use the device, explanation of how to play the game, asking questions, discussion of content, and connections.

Overall verbalizations. Two Repeated Measures ANOVAs compared overall parent and child verbalizations, while using their own device as well as the iPad®, between younger and older children. There was a main effect of device; parents produced more verbalizations when using the iPad® (M = 26.26, SD = 16.12) than when using their own device (M = 16.70, SD = 14.23), $F(1, 25) = 12.18$, $p = .002$. Age was also significant. Parents of older children produced more verbalizations (M = 28.35, SE = 3.31) than parents of younger children (M = 15.11, SE = 3.19), $F(1, 25) = 8.32$, $p = .008$. When investigating child verbalizations there was no main effect of device, however the interaction between device and age group was significant, $F(1, 25) = 5.59$, $p = .026$. The increase in child verbalizations from younger to older children was greater when using their own device than when using the iPad®. There was a main effect of age, overall older children (M = 9.78, SE = 1.52) produced more verbalizations than younger children (M = 2.75, SE = 1.47), $F(1, 25) = 11.02$, $p = .003$ (see Table 81 for complete results).

Parent explanations. When parents explained how to use the device there was no effect of device or age. When parents explained how to play the game there was a main effect of device, overall parents provided more verbal explanations on how to play the game while using the iPad® (M = 3.63, SD = 5.03) than while using their own device (M = 1.11, SD = 2.98), $F(1, 25) = 7.62$, $p = .011$. There was also a main effect of age, overall parents of older children (M = 3.96, SE = .84) produced more explanations of how to play the game than parents of younger children (M = .89, SE = .81), $F(1, 25) = 6.94$, $p = .014$ (see Table 82 for complete results).

Parent – asking questions. When parents asked questions, there was no main effect of device, however, there was a main effect for age. Parents of older children (M = 8.92, SE = 1.47) asked more questions than parents of younger children (M = 2.79, SE = 1.42), $F(1, 25) = 9.05$, $p = .006$ (see Table 83 for complete results).

Parent – discussing content. When parents discussed content on the screen, there was a main effect of device. Parents provided more verbal discussions about the content when using the iPad® (M = 13.78, SD = 9.80) than while using their own device (M = 7.37, SD = 7.37), $F(1, 25) = 13.50$, $p = .001$. No significant effect of age was found (see Table 84 for complete results).

Parent – making connections. When parents made connections there was no effect of device or age (see Table 85 for complete results).

Relationship between overall verbal interactions. Four correlations assessed potential relationships between overall parent verbalizations and overall child verbalizations. All four showed significant positive relationships. Parents' verbalizations while using their own device were significantly related to child's verbalizations while using their own device $r(25) = .68$, p < .001, and while using the iPad®, $r(25) = .45$, $p = .018$. Parents' verbalizations while using the iPad® were significantly related to child's interactions while using their own device, $r(25) = .65$, $p < .001$, and while using the iPad®, $r(25) = .54$, $p = .004$.

Physical Interactions When using the Device

All videos were coded for both the parent and the child's gestures while interacting with the touchscreen technology. Videos were coded for all 9 gestures identified on the survey (see Study 2a): tap, flick, press and hold, drag, multi-finger swipe, pinch, spread, one-finger rotation, and two-finger rotation. Through viewing the videos one additional gesture emerged and was added, touching or hitting the device with an open hand. Additionally, the number of times participants pointed to the screen and pressed the home button was also recorded.

Parental physical interaction with their own device. Of the 10 potential gestures that could be coded when using their own device, 4 were never produced (i.e., open handed touch, multi-finger swipe, one-finger and two-finger rotation). Of the remaining 6 potential gestures, the most common ones were the tap and flick gestures. All 27 parents produced the tap gesture. The tap gesture was produced between 2 and 54 times (*M* = 17.82, *SD* = 14.73) per session. The flick gesture was produced by 25 parents between 1 and 89 times (*M* = 17.50, *SD* = 21.89) per session. Far less frequently were the drag, produced by 5 parents (*Range* = 2 to 20; *M* = 9.80, *SD* = 7.73), press and hold produced by 2 parents (*Range* = 2 to 3; *M* = 2.50, *SD* = .71), pinch produced by 2 parents (*Range* = 1 to 2; *M* = 1.50, *SD* = .71), and the spread produced by 1 parent just 1 time. In addition to these gestures, 21 parents pointed to the screen while using their own device (*Range* = 1 to 21; *M* = 5.86, *SD* = 5.87), and 18 parents pressed the home button (*Range* = 1 to 8; *M* = 3.33, *SD* = 2.28).

Parental physical interaction with the iPad®. Of the 10 potential gestures, parents never produced 6 (i.e., open handed touch, multi-finger swipe, pinch, spread, one-finger and two-finger rotation) while using the iPad®. Of the remaining 4 gestures the most common ones were the tap and flick gestures. All but 1 parent produced the tap gesture. The tap gesture was produced between 2 and 163 times by parents (*M* = 32.03, *SD* = 32.84) per session. The flick gesture was produced by 25 parents between 1 and 18 times per session (*M* = 5.72, *SD* = 4.84) per session. Far less frequently were the drag, produced by 17 parents (*Range* = 1 to 10; *M* = 3.59, *SD* = 2.87) and the press and hold produced by 3 parents (*Range* = 1 to 2; *M* = 1.67, *SD* = .58). In addition to these gestures, 25 parents pointed to the screen while using their own device (*Range* = 1 to 29; *M* = 7.44, *SD* = 7.33), and 16 parents pressed the home button (*Range* = 1 to 8; *M* = 2.44, *SD* = 2.10).

Child physical interaction with parents' own device. Of the 10 potential gestures identified in the survey (see Study 2a), five were never produced by any child while engaged with their parents' device (i.e., multi-finger swipe, pinch, spread, one-finger and two-finger rotation). Of the remaining 5 gestures the most common one was the tap gesture, which was produced by 24 of 27 children. The tap gesture was produced between 1 and 123 times by the child (*M* = 26.25, *SD* = 35.05) per session. Less frequently produced were the flick produced by 11 children (*Range* = 1 to 74; *M* = 9.00, *SD* = 21.61), the press and drag produced by 8 children (*Range* = 1 to 52; *M* = 16.38, *SD* = 17.68), the open-handed touch produced by 6 children (*Range* = 1 to 6; *M* = 2.83, *SD* = 1.84), and the press and hold produced by 5 children (*Range* = 1 to 3; *M* = 1.80, *SD* = .84). In addition to these gestures, 12 children pointed to the screen while using their parents' own device (*Range* = 1 to 8; *M* = 3.00, *SD* = 2.56), and 9 children pressed the home button (*Range* = 1 to 6; *M* = 3.44, *SD* = 2.07).

Child physical interaction with the iPad®. Of the 10 potential gestures, children never produced 4 of them (multi-finger swipe, spread, one-finger and two-finger rotation) while using the iPad®. Of the remaining 6 gestures the most common one was the tap gesture, which was produced by all children. The tap gesture was produced between 1 and 274 times by the child (*M* = 33.75, *SD* = 53.46) per session. The open-handed touch/bang of the screen and the drag were both produced by 16 children, the open-handed touch between 1 and 25 times (*M* = 6.06, *SD* = 7.79) and the drag between 1 and 30 times (*M* = 10.81, *SD* = 10.64). Less frequently were the press and hold produced by 12 children (*Range* = 1 to 9; *M* = 2.92, *SD* = 2.64), the flick produced by 8 children (*Range* = 1 to 7; *M* = 3.75, *SD* = 2.05), and the pinch produced by 1 child 3 times. In addition to these gestures, 12 children pointed to the screen while using the iPad® (*Range* = 1 to 14; *M* = 3.50, *SD* = 4.03), and 9 children pressed the home button (*Range* = 1 to 17; *M* = 6.00, *SD* = 5.94).

Comparisons of physical interactions. Most commonly produced gestures (i.e., tap and flick for parents and tap for children) were compared to see if any differences existed between the use of participants' own device versus the iPad®, and the number of gestures between young children versus older children. Correlations also examined the relationship between these physical interactions.

Physical interactions by device and age group. Three Repeated Measures ANOVAs compared the most common gestures (i.e., tap and flick for parents and tap for children), while using their own device as well as the iPad®, between younger and older children.

When assessing the frequency of the tap gesture displayed by parents, a main effect of age was found. Parents of younger children tapped significantly more (M = 33.68, SE = 4.75) than parents of older children (M = 16.21, SE = 5.13), $F(1, 24) = 6.26$, $p = .020$. The main effect for device showed a trend towards significance. Parents tapped more while using the iPad® (M = 32.85, SE = 34.29) than when using their own device (M = 18.39, Se = 14.71), $F(1, 24) = 3.98$, $p = .057$. A main effect of device was found for parents producing the flick gesture. Parents produced the flick gesture significantly more while using their own device (M = 13.82, SD = 4.75) than when using the iPad® (M = 5.73, SE = 5.10), $F(1, 20) = 10.40$, $p = .004$. The effect of age was not significant for the parent flick gestures or the child tap gesture. There was no significant effect for device with regard to the child tap gesture (see Table 86 for complete results).

Relationship between physical interactions. Pearson correlations were conducted to assess potential relationships between parental tap, parental flick, and child tap while using their own device and parental tap, parental flick, and child tap while using the iPad®. Two strong positive relationships were found between the parents use of the flick gesture while using their own device and when using the iPad®, $r(21) = .85$, $p < .001$, and between the child's use of the tap gesture while using their own device and when using the iPad®, $r(23) = .75$, $p < .001$ (see Table 87 for complete results).

Control of the Device

While investigating control of the device four factors were assessed. Specifically, who was holding the device for most of the session, how frequently hand-over-hand was used to guide the child, the number of times parents removed the child's hand from the screen or moved the device away from the child completely, and the number of times the child moved the device away from the parents.

Who held the device. For both their own device and the iPad® most parents held the device ($n = 15$ and $n = 17$, respectively). Less frequently the device was placed on a surface ($n = 8$ and $n = 11$, respectively). Only in a few cases did the child themselves hold the device ($n = 4$ and $n = 2$, for own device and iPad® respectively).

Hand over hand. While using their own device 10 parents used a hand-over-hand technique to help guide their child. Overall, this physical support was present between 1 and 11 times per session ($M = 3.50$, $SD = 3.28$). More parents adopted this physical support when using the iPad® ($n = 18$ parents) with a greater range in the presence of this support, 1 and 35 times per session ($M = 10.11$, $SD = 10.31$) than with the parent's own device.

Parents removing the child's hand. While using their own device, 15 parents either removed their child's hand from the screen or pulled the device away from the child completely. This occurred between 1 and 8 times ($M = 2.53$, $SD = 2.13$) per session. Similarly, when using the iPad®, 17 parents removed the child's hand or the device. This occurred between 1 and 11 times ($M = 3.59$, $SD = 3.43$) in iPad® sessions.

Child taking away the device from the parent. In contrast, during interactions involving parents own device and when using the iPad®, 7 children also took the device away from the parent. Children did this between 1 and 7 times (*M* = 2.29, *SD* = 2.23) while using their own device, and between 1 and 3 times (*M* = 1.57, *SD* = .98) while using the iPad®.

Development

Six areas of the child's development were measured using The Bayley Scales of Infant and Toddler Development (Bayley, 2006). Four areas were measured through interaction with the researcher (i.e., cognitive, expressive language, receptive language, and fine motor skills) while two areas required the parent to fill out a questionnaire (i.e., social-emotional skills, and adaptive behaviour). Raw scores were obtained for each measure and subsequently converted to a scaled score. Raw scores reflect the number of items within each test successfully completed by the child. Scaled scores reflect children's performance when compared to typically developing children of their age. Thus, the scaled score reflects how children are performing relative to peers rather than providing information regarding the number of skills achieved only. In the following sections, performance is assessed in relation to developmental milestones (through scaled scores) because these scores account for age.

Cognitive. Scaled cognitive scores ranged from 5 to 13 (*M* = 10.40, *SD* = 2.08). Of the 30 participants 26.7% (*n* = 8) scored below their age level, 10.0% (*n* = 3) scored at their age level and 63.3% (*n* = 19) scored above their age level.

Receptive language. Scaled receptive language scores ranged from 6 to 15 (*M* = 9.83, *SD* = 2.74). Of the 30 participants 40.0% (*n* = 12) scored below their age level, 23.3% (*n* = 7) scored at their age level and 36.7% (*n* = 11) scored above their age level.

Expressive language. Scaled expressive language scores ranged from 3 to 15 (*M* = 9.23, *SD* = 2.70). Of the 30 participants 36.7% (*n* = 11) scored below their age level, 26.7% (*n* = 8) scored at their age level and 36.7% (*n* = 11) scored above their age level.

Fine motor. Scaled fine motor scores ranged from 4 to 16 (*M* = 9.83, *SD* = 2.68). Of the 30 participants 43.3% (*n* = 13) scored below their age level, 6.7% (*n* = 2) scored at their age level and 50.07% (*n* = 15) scored above their age level.

Social-emotional skills. Two parents did not complete the social-emotional questionnaire. Among the remaining participants, scaled social-emotional scores ranged from 5 to 19 (*M* = 10.29, *SD* = 3.70). In summary, the present sample of children reflected a diverse sample of abilities with some below, at and above expectations for age. Unlike the other categories of the Bayley Scales of Infant and Toddler Development this measure is self-report and does not have scaled age expectations.

Adaptive behaviour. The adaptive behaviour questionnaire was subdivided into 10 sections including: communication, community use, functional pre-academics, home living, health and safety, leisure, self-care, self-direction, social, and motor. A total score provided a General Adaptive Composite (GAC), an overall measure of the child's adaptive behaviour. Two parents did not complete the adaptive behaviour questionnaire. Scaled scores for the remaining 28 participants ranged from 70 to 162 (*M* = 100.29, *SD* = 21.62). This measure is also a self-report and does not have scaled age expectations (see Table 88 for descriptive statistics of individual sections).

Comparisons of developmental scores.

Development by age. Six independent samples t-tests were used to assess potential age differences in scaled developmental scores. A Bonferonni corrected p-value of .008 was used. As would be expected when looking at the scaled scores[5] where only performance is considered and age is corrected for, there were no significant differences between older and younger children (see Table 89 for complete results).

Relationship between Bayley Scales of Infant and Toddler Development and the Ages and Stages Questionnaire. To compare parent-reported development (Ages and Stages Questionnaire) to observed development (Bayley Scales of Infant and Toddler Development) 6 correlations were conducted. Bayley cognitive score was compared to the Ages and Stages problem solving score. Bayley receptive and expressive language scores were compared to Ages and Stages Communication scores. Bayley fine motor score was compared to Ages and Stages fine motor score. Finally the Bayley Social-Emotional and Adaptive Behaviour scores were compered to the Ages and Stages Personal-Social scores (Bayley Social-Emotional and Adaptive Behaviour were also parent reported). No significant relationships were found for any of the observed Bayley scores completed by the researcher. However, both parent-reported Bayley scores, the social-emotional, $r(27) = .51$, $p = .006$, and adaptive behaviour, $r(27) = .46$, $p = .014$, were significantly related to the Ages and Stages personal-social score (see Table 90 for complete results).

Relationship between the Bayley Development and mobile technology use. Two regression analyses were used to assess the potential relationship between development and mobile technology use. For each regression the 6 developmental scores served as the independent variables while the frequency of smartphone use and amount of time using the smartphone (variables from the survey in Study 2a) served as the dependent variable. The overall model of smartphone use with developmental scores approached significance, R^2 .57, $F(6, 12) =$

[5] As a fidelity check, comparisons by age were conducted on the raw scores. As would be expected all scores were significantly higher for older children than for younger ones.

2.69, p = .068. One variable was significant. A higher frequency of smartphone use was related to lower fine motor scores, β = -.57, t = -2.38, p = .035 (see Table 91 for complete results).

Relationship between the Bayley Development and verbal interactions. Two sets of 8 correlations assessed potential relationships between overall parent and child verbalizations (when using their own device and when using the iPad®) and the Bayley Language, Social-emotional, and Adaptive Behaviour scores. Child verbalizations during the iPad® session was positively related to receptive language scores, $r(26) = .39$, p = .047 and expressive language scores expressive $r(26) = .38$, p = .049. Verbalizations made by the child while using their own device was positively related to social-emotional, scores $r(24) = .53$, p = .006. Overall parent verbalizations during the iPad® session were positively related to the child's expressive language scores, $r(26) = .39$, p = .047 as well as their social-emotional scores, $r(24) = .40$, p = .050 (see Table 92 for complete results).

Relationship between the Bayley Development and physical interactions. Two sets of 6 correlations assessed potential relationships between parent and child physical interactions when using their own device and when using the iPad® (parent tap, parent flick, child tap) and the Bayley Cognitive and Fine Motor scores. Two significant relationships were found. Frequency of parents displaying the tap and the flick gesture while using their own device was negatively related to the child's fine motor score, $r(24) = -.57$, p = .002, $r(24) = -.41$, p = .042, respectively (see Table 93 for complete results).

Familiarity, Comfort, Ease, Interest

At the end of the iPad® session parents were asked to complete a brief online survey to rate their own and their child's familiarity, comfort, ease and interest in using the iPad® (the device) as well as the software (the game). Each item was rated on a 5-point Likert-type scale with anchors of 1 (*not at all*) to 5 (*very*). Descriptive summaries are provided first , followed by comparisons for parent versus child ratings.

Familiarity. Parents rated their own familiarity with iPad® as fairly high (M = 3.83, SD = 1.34) and their child's familiarity quite a bit lower (M = 2.73, SD = 1.29). In addition, with respect to ratings of familiarity with the software parents rated both their own (M = 2.23, SD = 1.33) and their child's familiarity with the software as (M = 2.00, SD = 1.31) fairly low.

Comfort. Parents rated their comfort with the iPad® and the software on the iPad® as high (M_{device} = 4.27, SD_{device} = 1.05; $M_{software}$ = 4.17, $SD_{software}$ = .79) and their child's comfort slightly lower but still in the higher end of the scale (M_{device} = 3.37, SD_{device} = 1.10; $M_{software}$ = 3.27, $SD_{software}$ = 1.11).

Ease. Parents rated their ease with the iPad® and the software close to the top end of the scale (M_{device} = 4.60, SD_{device} = .77; $M_{software}$ = 4.40, $SD_{software}$ = .56) and their child's ease was rated slightly lower but still reflecting the higher end of the ease scale (M_{device} = 3.57, SD_{device} = 1.07; $M_{software}$ = 3.47, $SD_{software}$ = 1.20).

Interest. Parents rated their interest with the iPad® and the software high (M_{device} = 3.90, SD_{device} = .85; $M_{software}$ = 3.86, $SD_{software}$ = .90) and close to identical ratings for their child's interest (M_{device} = 3.90, SD_{device} = 1.06; $M_{software}$ = 3.83, $SD_{software}$ = 1.21).

Overall experience. Four aggregated scores were computed to permit assessment of experiences about technology. This aggregated experience measure involved adding the familiarity, comfort, and ease scores to create an overall average score. One aggregated score reflected overall parent experience in using the device, another reflected child experience in using the device; the remaining two aggregate scores reflected overall parent experience in using the software, and overall child experience in using the software. Overall, parent experience with the device ranged from 2 to 5 (M = 4.23, SD = .91). Overall child experience with the device ranged from 1 to 5 (M = 3.22, SD = 1.04). Overall parent experience with the software ranged from 2 to 5 (M = 3.60, SD = .63). Overall child comfort with software ranged from 1 to 5 (M = 2.91, SD = 1.05).

Comparisons in familiarity, comfort, ease, interest. Parents' ratings of their own comfort, familiarity, ease, and interest in using the iPad® were compared to how they rated their children. Furthermore, ratings were compared to the coded variables for interest and skill, verbal interactions and physical interactions.

Parent and child comparisons about the device. Four paired samples t-tests were used to assess differences in how parents rated their own familiarity, comfort, ease and interest in using the iPad® (the device) in comparison to how they rated their child's familiarity, comfort, ease and interest. A Bonferonni corrected p-value of .0125 was used. Three of the four comparisons were significant. Parents rated their own familiarity, comfort, and ease significantly higher than their child's $t(29) = 5.67$, $p < .001$, $t(29) = 4.79$, $p < .001$, $t(29) = 5.48$, $p < .001$, respectively. Parents did not rate their child's interest level significantly different than their child's (see Table 93 for complete results).

Parent and child comparisons about the software. Four paired samples t-tests were used to assess differences in how parents rated their own familiarity, comfort, ease and interest in using the Software (the game) in comparison to how they rated their child's familiarity, comfort, ease and interest. A Bonferonni corrected p-value of .0125 was used. Three of the four comparisons were significant. Parents rated their own comfort (M = 4.17, SD = .79), and ease (M = 4.40, SD = .56) significantly higher than their child's ($M_{comfort}$ = 3.27, $SD_{comfort}$ = 1.11; M_{ease} = 3.47, SD_{ease} = 1.20), $t(29) = 4.27$, $p < .001$, $t(29) = 4.16$, $p < .001$. Parents did not rate their child's familiarity or interest level significantly different than their child's (see Table 94 for complete results).

Overall experience and interest related to coded interest and skill scores.

The device. Twenty correlations were conducted to assess potential relationships between parent and child comfort and interest in using the device and interest, skill and engagement during the iPad® sessions. Only one correlation was significant. Parents' rating of their child' comfort in using the device was significantly related to their skill during the iPad® session, $r(26) = .40$, $p = .037$ (see Table 95 for complete results).

The software. Twenty correlations were conducted to assess potential relationships between parent and child comfort and interest in using the software and interest, skill and engagement during the iPad® sessions. No significant relationships were found (see Table 96 for complete results).

Overall experience comfort and interest in using the iPad® and verbal interactions. Two sets of 8 correlations were conducted to assess potential relationships between overall comfort and interest, and verbal interactions. Only one correlation was significant. Parents rating of interest in the software was negatively correlated to their verbalizations, $r(26) = -.51$, $p = .007$. Therefore, higher interest rating by the parent meant a lower number of verbalization by the parent during the iPad® session (see Table 97 for complete results).

Overall experience comfort and interest in using the iPad® and physical interactions. Two sets of 12 correlations were conducted to assess potential relationships between overall comfort and interest, and physical interactions. Only one correlation was significant. Frequency of parents tapping was negatively correlated to the child's comfort in using the device, $r(25) = -.42$, $p = .033$ (see Table 98 for complete results).

Discussion

This study provided an opportunity to examine parent perceptions in the context of direct observations of parent-child actions when examining early introduction to technology. The primary goal was to document and describe parent-child joint experiences with technology and first exposure to novel technology in such a young sample. Many important insights were found.

Interest and Skill

One of the most intriguing findings was that interest in using mobile technology did not appear to be inherent in the young children in the present study. In the current study it was fairly easy to initiate interest in most children (90%) when using the iPad® with only about 2/3 of participants still very interested by the end of the 5-minute session. However, this initial interest seems to be a novel effect and was only present when using a new device (in this case the iPad®) while playing a new game. When using their own device only about two thirds of the children were easily interested in the device and only about half finished and were still very interested by the end of the session. Despite the common belief that mobile technology is appealing, engaging and easy for children to use, only just over half of the participants were visually engaged in technology most of the time while using it, and only half showed an interest in physically interacting with the device most of the time. Given that mobile technologies, especially tablet devices like the iPad® are typically promoted as easy to use for even young children, it was interesting to find that, in general, children of this age group are not very skilled in using the technology. Nearly half of the children showed very poor skills in using both their own device and the iPad®, and extremely few were very skilled in using either device.

Although children do not demonstrate skill when using technology, they do appear to use mobile technology in ways that would be expected developmentally. Using a Piagetian lens, children in this age group would reflect the tertiary circular reaction stage where trial-and-error experimentation is key (Piaget, 1953). Children's actions, such as trial-and-error tapping until something on the screen changes, are consistent with developmental expectations. However, unlike other contexts where trial and error may have a clear, consistent and desired result, randomly tapping the touchscreen can present a diverse array of outcomes, some more desirable than others. This unpredictability in outcomes may make it more difficult for the child to learn how to use the device. Learning how to use mobile technology would likely be more efficient early in the preoperational stage when the child is capable of symbolic thinking (Piaget, 1953).

Interestingly, both interest and skill in using mobile technology seemed to increase with age. This finding is consistent with previous research suggesting beginning of a transition in attention span around 2 years of age (Ruff & Capozzoli, 2003). It is also possible that the increase in age relates to an increase in skill and interest because necessary cognitive and motor skills are more developed. However, it is also possible that the increase in skill and interest is a factor of longer exposure to mobile technology. This is an important finding, while there might be some initial interest because of novelty, it may actually be the repeated exposure to the device that is driving the interest and desire to keep using mobile technology. Support for this can be seen in the parents' ratings of their child's comfort and interest in using the device. While parents consistently rated their own comfort and ease in using the technology higher than their child's, they rated their child's interest level very high and similar to that of their own. In general, parents felt their child was as interested in using the device as they themselves were, which seems to be contrary to what was actually observed. Parents could potentially be displaying a false consensus (Ross, Greene, & House, 1977). They may be incorrectly assuming that their child's interest in the device is similar to their own which could result in offering the technology to their child more frequently, and therefore, developing that interest.

What are they doing with the Device?

Parents often did not use the devices to their potential especially with respect to the interactive opportunities that are afforded through mobile technologies. Consistent with Study 2, two of the most common tasks parents were doing with the device included showing videos and looking through pictures. Even when playing with the iPad® the most common game played was the animal sounds game. This game displays still pictures of animals along with the sound that the animal makes. Given the lack of skill and difficulty operating the devices at this young age, it may not be surprising that parents selected less interactive applications to use on mobile technology with their very young children. However, this choice for less interactive options goes against common misconceptions that parents would select highly interactive and engaging devices to extend children's learning opportunities beyond those available through other traditional media (i.e., print books or books on CD). Further investigation of selection criteria, especially for very young learners would be beneficial to understand whether parents' familiarity with available applications, preference for familiar media, or knowledge about their child drives their decisions to select less interactive options for their young children.

Interestingly, the next two most popular games played on the iPad® were Wheels on the Bus and Fish School HD, both of which have multiple activities within each game. Parents opened on average 1.5-2 applications during the 5-minute sessions (with some parents opening as many as 5 applications). Given that some of the most popular games had multiple activities within the one application and the sessions were only 5 minutes long, it is telling that parents still felt the need to change applications frequently. Although this most likely reflects a parent's desire to keep their child's attention and interest during the session, it also reflects the parent's perception that their child was losing interest or found the activity unengaging. Alternatively, the parent may not have selected or used the most engaging software or parts of the software for their child. These possibilities highlight the need for further investigation regarding parent choices when selecting software as well as parents' assessment of their child's interest in software.

Interactions with the Device

Given the lack of ability displayed by the child, it is interesting that parents so infrequently provided verbal explanations for how to use the device or play the game. On a similar note, parents themselves held the device for the most part and relatively infrequently provided supportive actions like hand over hand guidance. Given that the devices are not necessarily designed for use by young children, there were many opportunities for parents to scaffold their child to facilitate use of these technologies. Such scaffolding would allow the child to extend learning to a situation too difficult for them to learn in on their own (Barr et al., 2008; Strouse et al., 2013). Instead, parents actually removed their child's hand from the device or removed the device itself in order to take control of the device. Parents did not seem to be actively teaching their child about the device or the game. There was a trend beginning to emerge that parents were more likely to offer verbal explanations to older children than younger ones so perhaps parents feel that verbal instructions are not as beneficial to the child at such a young age. Importantly, there was a trend suggesting that parents were more likely to give instructions on the game when using the iPad® rather than their own device. This indicates that context or familiarity may impact when parents give instructions. Specifically, they provided more support for the novel game/device that they had not been exposed to in the past. This is discouraging given that social interaction while using mobile technology may be necessary to ensure the efficacy these devices as educational tools (Lauricella et al., 2010; O'Doherty et al., 2011; Strouse et al., 2013).

Some encouraging evidence emerged showing that parents did more frequently ask questions and talk about content on the screen, than giving explanations. Previous research investigating young children's viewing of television indicated that discussion of the content could negate the potential negative impact of watching television (Blankson et al., 2015; Zimmerman et al., 2009). Parents may already be providing supportive discussion to counteract negative effects from their child's use of mobile technology. Additionally, Flynn and Richert (2015) found that when parents focus their support on the content rather than the device children's skills on the device improve as well. It is important to remember that this additional support requires the parent to be sitting and interacting with the child while they are using the mobile technology, which is not always the case.

Age was a factor in the frequency of parent vocalizations during the sessions; parents were far more vocal with older children than with younger ones. This outcome was surprising and contradictory given expected patterns of child-parent exchanges outlined by Hart and Risley (as cited in McConnell, 2001). As Hart and Risley describe, it is vital that parents talk more when engaged with younger children to accommodate for the child's limited language skills until the child's language skills become more developed and allow them to take over the conversation (as cited in McConnell, 2001). This contradicts the results found in the current study, that parents were more verbal with the older children. Not surprisingly older children were more vocal during the sessions than younger children. In summary, parents seem to be consistently verbally interactive when introducing something new to their child, however, once the novelty wears off their behaviours with regard to vocal interactions seem to be driven by the child's age. Interestingly, parents' own interest seems to also have an impact on verbalizations. Fewer verbal interactions were produced by parents during the iPad® session and when they found the activities/games more interesting. It is possible that the limited verbal interactions in these contexts reflect parents becoming overly engaged or involved with the software to the extent that this engagement may result in negative outcomes regarding interactions with their child.

Despite all of the gestures available to use on mobile technology, parents themselves primarily used only two -- tap and flick. Similarly children were limited in the gestures they used with most children typically only using the tap function. Given that parents who completed the survey in Study 2 indicated four gestures that they felt their child used more frequently, there appears to be a disconnect between what parents believe and report is occurring when their children engage with technology and what actually occurs.

One important consideration when evaluating child gestures concerns the heavy reliance on the single gesture-tapping. Observations indicate that children's number of taps far exceeded those of the parent which might suggest greater engagement and perhaps fluency in that skill. However, this reliance may also be a reflection of children's lack of skill in using the device. Children used tapping gestures for two purposes. First, they frequently tapped on the screen to point out things of interest— consistent with the notion that were engaged and tapping intentionally assisted them in exploring the software. However children also seemed to engage in tapping randomly on the screen without any apparent goal in mind. When children were tapping in order to progress the game they often had to tap a number of times before touching it with enough accuracy. Thus, these infants seemed to be aware that tapping caused a change but they may not have had the knowledge or physical skill to effectively utilize tapping to move forward efficiently or effectively.

Consistent with effective scaffolding strategies (Vygotsky, 1978), parents tapped more frequently with younger children than older one. Parents may have been responding to the greater need for support in their young children to use the mobile technology than older ones. Interestingly, the scaffolding behaviour more frequently chosen by parents while using mobile technology, was to take over control of the device to assist the child in progressing, rather than other possible options such as hand over hand, or verbal explanations. The conclusion that parents were responding their child's need for assistance is supported by parents' ratings of their child's skill level which tended to be relatively accurate. In addition, observed skill level was related to the parents' rating of their child's comfort. Specifically, as parents rating of their child's comfort increased, the frequency at which parents' touched the device decreased. Parents who can more accurately assess their child's state and performance, therefore, appropriately supported their child.

Development

One of the most important contributions of the current study is the first look at the child's development in relation to mobile technology use from a standardized direct observational measure of development rather than self-report. While parent self-reports of the child's development were fairly consistent across the parent questionnaires within the current study, they did not relate to the objective observed measures of development. When looking at developmental implications, increase frequency of a smartphone was related to decreased fine motor skills. This is contrary to the results found in Study 2 when parent reports of fine motor skills were positively related to mobile technology use. It is therefore important to be cautious when using self-report data from parents who may be overly optimistic about their child's abilities. Although cause and effect cannot be determined, the link between lower fine motor skills and higher mobile technology use warrants further research.

Interactions during use of mobile technology seem to be related to the child's development. Increased verbalizations from both the parent and the child during mobile technology use were related to higher language and social-emotional scores. It may be the case that higher language proficiency allowed for higher levels of verbal interaction while using the technology, however, it may also be the case that the higher level of verbal interactions while using the device could positively impact the child's development.

Physical interactions with the technology also showed a connection to development. Higher use of gestures by parents was related to lower fine motor skills in children. Although cause and effect cannot be assumed, it is possible that parents contribute to this outcome when they take control of the device and limit opportunities for their child to practice fine motor skills. Alternatively, it is also possible that parents are aware of the child's fine motor limitations and compensate by performing the actions needed to allow the child to interact with the games.

In summary, the present study highlights variability in interest, engagement and skill among infants when involved with mobile technology. When parents and children engage with mobile technologies together, parents seem to be fairly accurate in gauging their child's comfort and skill level, and compensate accordingly. However, since children at this age still require a lot of assistance with operating the device parents typically provide support by taking control of the device rather than providing guidance. The child's inability to operate the device independently may also be part of the reason why parents select less interactive applications to use with their young child. There appears to be a novelty effect when children are initially introduced to a new device especially with regard to interest and engagement. Once the novelty wears off, interest is not necessarily sustained and parents seem to work at maintaining their child's interest; they do so by frequently changing activities or games. Increase in interest and engagement grows with age, which may be a factor of the child's increasing ability to operate the device more effectively, or because of repeated exposure. When we look objectively at children's development, this group of technology-using infants' parallel performance one would expect in typical samples, with some at, some below, and some above average in attainment of developmental milestones. However, when these milestones are examined in the context of technology use, decreases in fine motor skills are associated with increased use of mobile technology. Verbal interactions when parents and children engage with mobile technologies seem to coincide with the child's language abilities; therefore it is possible that mobile technology affords opportunities to foster language development provided parents engage with the technology together with their child and make an effort to maintain verbal interactions when using it. Together these global findings indicate that early introduction to technology is a complex issue that can yield both positive and negative outcomes depending upon context, individual differences of parents and children, and software design.

General Conclusions

Overall, one of the most salient messages evident across the studies presented here is the early introduction to technology among today's infants. Although existing research indicated that children were introduced to mobile technology early in life (Kabali et al., 2015; Rideout, 2013), the current studies support even earlier onset times, often under one year of age. Factors that influence early exposure include parent beliefs and expectations, home and family contexts, and child characteristics.

In general, parents express some uncertainty or mixed opinions regarding the use of mobile technology with young children. Positive opinions are often supported with explanations endorsing developmental advantages such as the educational value of the device, while negative opinions express concerns regarding ramifications such as overexposure. Consistent with previous research, although uncertainty is present, concerns are not discouraging parental use of these devices with their very young children (Lauricella et al., 2015). This may suggest that parents are adopting a progressive approach. Specifically, in the absence of concrete evidence to dissuade them from introducing technology, parents introduce technology in the fear that they may withhold valuable learning opportunities if they do not make technology available. Alternatively, however, outcomes associated with television viewing suggest that parents may disregard concern for other reasons. When examining exposure to television, despite numerous and consistent studies identifying, describing and warning about the harmful effects of television on development, parents continue to introduce television to their children at very young ages. Thus, it may be that even in light of potential negative effects of using technology at too young an age, parents may find the ease, convenience or perceived positive reception of their child to be more compelling reasons for introduction. In any case, parents choose to introduce television and other mobile technologies to children prior to 2 years of age, thus understanding the short and long term impacts of introduction is critical.

Idealized views of children's abilities or outcomes were present in the series of studies conducted. Ratings by parents suggest greater competence and independence than direct observation supports. This belief is supported in popular media that suggests that technology is becoming increasingly intuitive and thus easier to use -- even for very young children (Holloway et al., 2013). In the current study 40% of parents indicated that their child could use mobile technology on their own. However, observational data indicate that most children this young lack the necessary cognitive and fine motor skills to effectively operate the mobile devices independently.

Two factors support parents' false impressions. First, parents appear to compensate for children's limitations by selecting passive activities (i.e., watching videos and looking at pictures) that require little interaction from the child. Second, parents typically assume control of devices and navigational demands when interactive opportunities would be greatest. Thus, parents behaviours, intentionally or unintentionally, allow their children to use devices with less apparent challenge than would be encountered without parental support. Interestingly, the latter scaffolding behaviours would typically be characterized as positive behaviours in other educational contexts. For example, if a child could not operate a microscope and a parent completed all of the mechanical operations to allow the child the experience of observing the amplified image, parents would be considered to be providing effective scaffolds to support learning (Vygotsky, 1978). In the present context, because parents indicated that providing technology serves an occupying or convenience function, parental behaviours may be interpreted less as scaffolding and more as acts to support personal interests. This may be an unfair judgement. Given that many studies have documented educational gains associated with effective software (Calvert et al., 2005; Calvert et al., 2007) it may be that parents are providing exactly the kinds of supports needed for their very young children to effectively engage with the software that is available through mobile technology regardless of their apparent rationale.

One interesting thing to note from the current studies is that, similar to other technologies, it appears that the learning potential from mobile technology for very you children, may best be supported through the interaction of the parent when using the device (Lavigne et al., 2015;

Nielsen et al., 2008). When parents engage jointly with their children while using technology, they maximize learning opportunities and outcomes (Lauricella et al., 2010). Thus, it may be important to stress joint-engagement with technology rather than focusing on independent use of technology with children. Enhancing the salience of joint-interactions and providing parents with supports that teach them how to engage effectively should be the focus of program design and policy messages, rather than fostering independence in technology use.

Recent research has shown that with lower cost and greater availability external factors such as income have a much smaller impact on the decision to use mobile technology with young children (Kabali et al., 2015). The present study suggests that family contexts, such as the presence of older children, enhance the likelihood of earlier exposure. This was an interesting finding given that parents of children who had older siblings were more inclined to have negative opinions about using mobile technology with young children. Another influential factor in the family context was the parents' own use of mobile technology in the presence of children. Parents indicated using mobile technology themselves either constantly or for many hours of the day for both work and personal use. Despite this presence of mobile technology, parents in general did not recognize themselves as models for technology use to their child. Knowing that these contextual variables impact development, invites further inquiry to better understand how these contextual variables effect change.

Potential developmental implications of using mobile technology with very young children were also assessed in the current study. First and foremost, since parents are using the technology somewhat as a portable television, it can be expected that if children are merely watching videos on the device, with no adult interaction, similar implications to that of the television viewing, such as language delays (Barr et al., 2010; Conners-Burrow et al., 2011; Lin et al., 2015; Christakis et al., 2004), will be seen. Examination of developmental outcomes in the present study, however, indicated an association between use and fine motor skills. This is not surprising given that operating mobile technology requires fine motor skills. What was surprising was that parents reported increased fine motor skills for those that used mobile technology while standardized measurement of fine motor development revealed the opposite. This outcome is important for two reasons. First, it reiterates a potential disconnect between parental beliefs and actual outcomes/reality as noted above. Second, this outcome has important implications for how parental reports should be considered in research involving technology use with very young children. Given that much of the extant research investigating early introduction has involved parent reports (i.e., Holloway et al., 2013; Rideout, 2013), there is a need to cautiously interpret findings given contradictory findings between parent reports and objective measures found in the present study. Future research clearly must incorporate direct objective measures in addition to, or in lieu of, parental reports.

Limitations and Future Research

One of the most salient limitations in the present study was that all child participants were already exposed to technology. Ideally, to understand the impact of technology on development, having an exposed group and non-exposed group would yield the best comparisons. However, given the prevalence of mobile technology in today's society the few children that have not been exposed would likely be unique in many ways and may not provide a good comparison.

One discovery that will be an important factor in future research, and may be an alternative to finding a non-exposed group, would be to find a clear way to quantify and define mobile technology exposure and use. Investigating both frequency and amount of time using technology, as was done in the current study, was a step in the right direction. However, parents were inconsistent in responding to whether or not their child had been exposed to mobile technology, how much they themselves and their child used mobile technology, and the types of tasks that they felt could be classified as mobile technology use. If a consistent definition of this concept could be identified, it would at least allow for better comparisons based on how much children are using the technology. With such a measure, true ‘low user’ versus ‘high user’ groups could be created and compared.

An additional limitation in the current research was the absence of analyses involving child gender. Child gender was not intended to be a primary focus of the current set of studies, however, it was initially planned as a possibility. Technical difficulties, however, led to the question regarding child gender being dropped from the survey before it was distributed to the participants. Future research could explore potential difference as a function of child gender and early introduction of mobile technology.

As noted at the outset, the present research provides an initial investigation into the study of infant use of technology. As a result the most critical goal was to describe how infants and toddlers are currently using mobile technology, and more specifically, what the interaction between parent and child looks like when they engage in mobile technologies together. The present study went beyond mere description and identified some connections between mobile technology use and the child’s development. Future research can now investigate specific areas such as fine motor skills in more depth to determine more specifically what the connection is. Getting an accurate assessment of how much time someone uses mobile technology is difficult. Since mobile technology may be used more frequently but for shorter durations than other technology such as the television, it is important to observe how mobile technology impacts the child differently. Since very few children in this age group showed great skill in using touchscreen technology it seems as though it may still be inappropriate for such young children. Further research should investigate at which age cognitive and motor skills become developed enough for the child to successfully use this type of technology.

In summary, the present series of studies has provided a descriptive account of very young children's introduction to mobile technologies. Significant insight into parents views, parent-child interactions, and developmental issues was demonstrated. Despite considerable hesitation to involve young children with screen exposure (American Academy of Pediatrics, 1999, 2011), the present studies indicate that research needs to be conducted to examine this issue as early introduction is occurring. Rather than ignoring this concern, research needs to carefully examine potential gains and losses associated with early exposure. These outcomes then need to be translated into public policy and/or evidence-based guidelines need to be developed to ensure that parents know how to maximize the benefits from mobile technology and minimize potential deficits for their young children.

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Table 1

Summary of Participants within each Group

	Group 1	Group 2
Age	Younger (*n* = 10)	Older (*n* = 10)
Older Sibling	No Older Sibling (*n* = 10)	Older Sibling (*n* = 10)
Parent Gender	Mothers (*n* = 20)	Fathers (*n* = 20)

Table 2

Introduction to Specific Mobile Devices and Use

	Age Groups						Older Siblings				
	Overall %	Younger Children %	Older Children %	X^2	*N*	*p*	Without Sibling %	With Sibling %	X^2	*N*	*p*
Introduced to Mobile Tech Overall	80%	65.0%	95.0%	5.63	40	.018	90.0%	70.0%	2.50	40	.114
Cellphone/ Smartphone	90.6%	92.3%	89.5%	.73	32	.787	88.9%	92.9%	.15	32	.702
Tablet/ iPad®	59.4%	38.5%	73.7%	3.97	32	.046	55.6%	64.3%	.25	32	.618
Children's device	12.5%	7.7%	15.8%	.46	32	.496	16.7%	7.1%	.65	32	.419
Rarely	21.9%	15.4%	26.3%	.54	32	.463	27.8%	14.3%	.84	32	.360
One to a few days a week	53.1%	61.5%	47.4%	.62	32	.430	55.6%	50.0%	.10	32	.755
Daily	21.9%	23.1%	21.1%	.02	32	.892	16.7%	28.6%	.65	32	.419
Use has increased	31.3%	15.4%	42.1%	2.57	32	.109	38.9%	21.4%	1.12	32	.290
Use has decreased	18.8%	15.4%	21.1%	.16	32	.687	22.2%	14.3%	.33	32	.568
Use has stayed same	43.8%	53.8%	36.8%	.91	32	.341	38.9%	50.0%	.40	32	.530

Table 3

Qualitative Codes - Opinions of Mobile Technology with Very Young Children

Code	Description	Example
General Positive	Overall positive opinion of mobile technology.	"I think if it's used sensibly I think it's a great tool"
General Negative	Overall negative opinion of mobile technology.	"I don't think a lot of technology with young kids is really necessary"
Positive and Negative	Overall both positive and negative opinion of mobile technology.	"I need to keep him busy for a while or something like that so it's good and bad"
Positive - moderation	Positive opinion of mobile technology but should be used in moderation.	"They're okay in moderation"
Positive - educational	Positive opinion of mobile technology because of educational benefits.	"If you're using it as a learning tool … I think that's fantastic"
Positive - confidence	Positive opinion of mobile technology but it encourages confidence.	"The confidence that I think she has because she can operate that I think it's really great"
Negative - overexposure	Negative opinion of mobile technology because of overuse or overexposure to the device.	"I think they get over used as babysitting devices"
Negative - takes away	Negative opinion of mobile technology because it takes away from other activities such as free play and social activities.	"I just think that kids need to develop their minds and stuff by doing things other than sitting in front of a screen"
Negative - too concrete	Negative opinion of mobile technology because it is too concrete rather than abstract.	"Need more abstract thinking and I think with uh iPad and everything else it's so concrete"
Negative -cannot appreciate	Negative opinion of mobile technology because children cannot appreciate the value or purpose of it.	"Wasted on children who don't know what the value or how to properly use them"

Table 4

Opinions of Mobile Technology with Very Young Children

		Age Groups					Older Siblings				
	Overall %	Younger Children %	Older Children %	X^2	*N*	*p*	Without Sibling %	With Sibling %	X^2	*N*	*p*
General Positive	30.0%	15.0%	45.0%	4.29	40	.038	45.0%	15.0%	4.29	40	.038
General Negative	35.0%	55.0%	15.0%	7.03	40	.008	20.0%	50.0%	3.96	40	.047
Positive and Negative	32.5%	25.0%	40.0%	1.03	40	.311	30.0%	35.0%	.11	40	.736
Positive - moderation	32.5%	15.0%	50.0%	5.58	40	.018	50.0%	15.0%	5.58	40	.018
Positive - educational	30.0%	10.0%	50.0%	7.62	40	.006	40.0%	20.0%	1.91	40	.168
Negative - overexposure	20.0%	15.0%	25.0%	.63	40	.429	15.0%	25.0%	.63	40	.429
Negative - takes away	25.0%	30.0%	20.0%	.53	40	.465	30.0%	20.0%	.53	40	.465

Table 5

Qualitative Codes - Reasons for Mobile Technology Use

Code	Description	Example
Distraction – avoid boredom	To occupy or distract the child (ie. To avoid boredom)	"Just to keep him happy… When he's bored"
Distraction – give adult time	To occupy or distract the child to give the adult time.	"you can watch it for 20 minutes while we get ready and doing something"
Distraction – travelling	To occupy or distract the child while travelling.	"Travelling right so in the car long car rides"
Calming tool	To calm the child when they are upset.	"stops him from screaming for a couple minutes"
Teaching tool	As a teaching tool.	"it like allows us a way to teach him things like animal sounds"
Babysitter	As an easy way for the parent to take a break.	"so I'll use it as a babysitter"

Table 6

Reasons for Mobile Technology Use

	Age Groups						Older Siblings					
	Overall %	Younger Children %	Older Children %	X^2	*N*	*p*	Without Sibling %	With Sibling %	X^2	*N*	*p*
Distraction - avoid boredom	46.9%	53.8%	42.1%	.43	32	.513	27.8%	71.4%	6.03	32	.014
Distraction – give adult time	40.6%	38.5%	42.1%	.04	32	.837	44.4%	35.7%	.25	32	.618
Distraction - travelling	21.9%	15.4%	26.3%	.54	32	.463	16.7%	28.6%	.65	32	.419
Calming tool	34.4%	38.5%	31.6%	.16	32	.687	33.3%	35.7%	.02	32	.888
Teaching tool	31.3%	15.4%	42.1%	2.57	32	.109	33.3%	28.6%	.08	32	.773

Table 7

Qualitative Codes - What Do Young Children do with Mobile Technology?

Code	Description	Example
Look at pictures	To look at pictures.	"he loves looking at pictures"
Manipulate as an object	Touch/manipulate the device as an object.	"she would copy us like she would see us on the phone then she would grab it and spin it around and touch the screen and stuff"
Uses as a phone	Uses the device as a phone.	"She talks on the phone with her grandparents"
Infant/Toddler apps	Applications designed for infants/toddlers.	"games on there for little kids so like it'll show like animals or animal sounds"
Educational apps	Applications intended to teach a concept or skill.	"alphabet song or something educational"
Games - free play	Playing free-play games without a specific goal/progression.	"so it's just these types of things see that yeah and you touch it and other shapes pop up… so he's not playing anything where it's like actual games"
Games – goal directed	Playing goal-directed games with a specific goal/progression.	"mostly I have them set to puzzle games, math and a bit of just connect the dots"
Watch videos or clips	To watch videos or clips (ie. YouTube clips)	"we just find YouTube videos like little 2 or 3 minute videos of singing"
Watch movies or shows	To watch movies or shows/episodes.	"here's a little Curious George or something like that and you can watch it"
Take pictures	To take pictures.	"we have our cellphones locked so the only thing they can get to is the camera so they can take pictures"

Table 8

What Do Young Children do with Mobile Technology?

	Age Groups						Older Siblings				
	Overall %	Younger Children %	Older Children %	X^2	*N*	*p*	Without Sibling %	With Sibling %	X^2	*N*	*p*
Look at pictures	40.6%	30.8%	47.4%	.88	32	.348	50.0%	28.6%	1.50	32	.221
Manipulate as an object	25.0%	46.2%	10.5%	5.23	32	.022	27.8%	21.4%	.17	32	.681
Uses as a phone	12.5%	7.7%	15.8%	.46	32	.496	16.7%	7.1%	.65	32	.419
Infant/Toddler apps	37.5%	38.5%	36.8%	.01	32	.926	55.6%	14.3%	5.72	32	.017
Educational apps	28.1%	7.7%	42.1%	4.52	32	.033	27.8%	28.6%	.00	32	.960
Games - free play	28.1%	30.8%	55.6%	.08	32	.783	33.3%	21.4%	.55	32	.457
Games – goal directed	9.4%	0%	15.8%	-	-	-	11.1%	7.1%	.15	32	.702
Watch videos or clips	46.9%	38.5%	52.6%	.622	32	.430	50.0%	42.9%	.16	32	.688
Watch movies or shows	34.4%	23.1%	42.1%	1.24	32	.266	22.2%	50.0%	2.69	32	.101

Table 9

Qualitative Codes - Setting and Reaction of First Introduction to Mobile Technology

Code	Description	Example
In the home	First introduction happened within the home.	“it would have been here at home so him and [my wife] sitting on the couch”
Outside of the home	First introduction happened outside of the home.	“for the movies it was the car for um the games it was church and like I said appointments”
With family around	First introduction happened with other family members around.	“I think the other kids were around and he needed to be occupied by something so I turned on a show”
Excitement/ Enjoyment	Child reacted positively with excitement or enjoyment.	“He really enjoyed it”
Frustration	Child reacted with frustration.	“he was frustrated because the games were a little bit well cause it was hard for us to explain in the middle of church”

Table 10

Setting and Reaction of First Introduction to Mobile Technology

	Age Groups						Older Siblings				
	Overall %	Younger Children %	Older Children %	X^2	N	p	Without Sibling %	With Sibling %	X^2	N	p
In the home	50.0%	53.8%	47.4%	.13	32	.719	50.0%	50.0%	.00	32	1.00
Outside of the home	15.6%	15.4%	36.8%	1.76	32	.185	22.2%	35.7%	.71	32	.400
With family around	28.1%	15.4%	15.8%	.00	32	.975	5.6%	28.6%	3.16	32	.075
Excitement/ Enjoyment	87.5%	92.3%	84.2%	.46	32	.496	88.9%	85.7%	.073	32	.788

Table 11

Qualitative Codes - Reasons for Introducing and Waiting to Introduce Mobile Technology

Reasons for Introducing		
Code	Description	Example
Intro - child directed	Child directed – child decided when device was introduced.	"she was probably 8 months old when she decided that it was something she had to have"
Intro - child sees adults	Chid directed – child grabbed the device after seeing an adult use it.	"not purposefully making a point of introducing it but he is so used to seeing us with our phones and being on the computer that he got interested quite early"
Intro - adult needs time	Adult introduced the device to preoccupy the child.	"the other kids were around and he needed to be occupied by something so I turned on a show"
Intro - necessity	Parent feels its necessary or inevitable part of the child's future.	"it's something that they're going to have to get to know to learn in order to—as they grow up because it's very much a digital world these days"
Intro - Natural	Introduced it because technology is naturally engaging.	"they naturally want to get involved and figure it out"
Reasons for Waiting to Introduce		
Wait - child's ability	Parent waited because of child's limited ability (i.e. Comprehension, attention span)	"He doesn't sit long enough to pay attention"
Wait - adult experience	Parent waited because of personal experience and upbringing.	"we're very non-technological people"
Wait - device damage	Parent waited to prevent damage to the device.	"I don't want them to damage the technological devices in question"

Table 12

Reasons for Introducing and Waiting to Introduce Mobile Technology

	Age Groups						Older Siblings				
	Overall %	Younger Children %	Older Children %	X^2	*N*	*p*	Without Sibling %	With Sibling %	X^2	*N*	*p*
	Who initiated the Introduction to Mobile Technology										
Child-directed	37.5%	53.8%	26.3%	2.50	32	.114	44.4%	28.6%	.85	32	.358
Adult-directed	53.1%	46.2%	57.9%	.427	32	.513	50.0%	57.1%	.16	32	.688
	Reasons for Introducing										
Intro - child grabbed	21.9%	30.0%	15.8%	1.02	32	.314	33.3%	7.1%	3.16	32	.075
Intro - child sees adults	37.5%	38.5%	36.8%	.01	32	.926	44.4%	28.6%	.85	32	.358
Intro - adult needs time	46.9%	30.8%	57.9%	2.28	32	.131	44.4%	50%	.10	32	.755
Intro - necessity	34.4%	30.8%	36.8%	.13	32	.722	27.8%	42.9%	.79	32	.373
Intro - Natural	21.9%	15.4%	26.3%	.54	32	.463	27.8%	14.3%	.84	32	.360
	Reasons for Waiting to Introduce										
Wait - child's ability	22.5%	40.0%	5.0%	7.03	40	.008	15.0%	30.0%	1.29	40	.256
Wait - adult experience	15.0%	30.0%	0%	-	-	-	15.0%	15.0%	.00	40	1.00
Wait - device damage	12.5%	15.0%	10.0%	.23	40	.633	0%	25.0%	-	-	-

Note: A dash indicates that no analyses were run due to zero participants within a cell

Table 13

Qualitative Codes - Assistance and Supervision during Mobile Technology Use

Code	Description	Example
Constant supervision	Parent is constantly supervising.	"I just don't let him play with when I'm not there"
Use together with adult	Parent uses device together with child.	"the flashcard app that I use with her um I change I change it and stuff"
Can use on their own	Child can use the device on their own/discovery learning.	"like I try and stay back as much as I Can and let them discover"
Nearby supervision	Parent supervises nearby.	"we're around we're not looking over her shoulder to make sure most of the time we can hear what she's watching and we know it's a familiar sound"
Navigate device	Parent navigates the device for their child (such as opens a game or puts on a video).	"So usually turn it on for him and then set it up"
Hold device for child	Parent holds the device for the child.	"for a long time I was the one actually holding the phone"
Show child how to use	Parent shows the child how to use the device.	"showing him how to flip so he could look at pictures"
Explain content to the child	Parent explains how to use the device or software on the device.	"then walk him through a game… kind of explain to him what he's seeing"
Unlock device	Parent unlocks the device for the child.	"I open up my password"

Table 13 Continued

Code	Description	Example
Child is too young	Reason for assistance is because the child is too young.	“he is you know just 3”
Child is destructive	Reason for assistance is because the child is too destructive.	“you just don’t want them damaging the technology”
Limited ability	Reason for assistance is because of the child’s limited ability.	“He likes any kind of buttons I still have to help him by keeping his hands away from certain buttons”

Table 14

Assistance and Supervision during Mobile Technology Use

	Age Groups						Older Siblings					
	Overall %	Younger Children %	Older Children %	X^2	*N*	*p*	Without Sibling %	With Sibling %	X^2	*N*	*p*
Overall Supervision	84.4%	76.9%	89.5%	.92	32	.337	72.2%	100.0%	4.61	32	.032
Overall Assistance	84.4%	84.6%	84.2%	.00	32	.975	77.8%	92.9%	1.36	32	.244
Constant supervision	68.8%	76.9%	63.2%	.68	32	.409	61.1%	78.6%	1.12	32	.290
Use together with adult	40.6%	38.5%	42.1%	.04	32	.837	33.3%	50.0%	.91	32	.341
Can use on their own	37.5%	23.1%	47.4%	1.94	32	.163	38.9%	35.7%	.03	32	.854
Nearby supervision	12.5%	0%	21.1%	-	-	-	5.6%	21.4%	1.81	32	.178
Navigate device	59.4%	53.8%	63.2%	.28	32	.598	55.6%	64.3%	.25	32	.618
Hold device for child	37.5%	53.8%	26.3%	2.50	32	.114	33.3%	42.9%	.31	32	.581
Show child how to use	21.9%	15.4%	26.3%	.54	32	.463	16.7%	28.6%	.65	32	.419
Unlock device	15.6%	0%	26.3%	-	-	-	11.1%	21.4%	.64	32	.425
Child is too young	12.5%	30.8%	0%	-	-	-	0%	28.6%	-	-	-
Child is destructive	25.0%	38.5%	15.8%	2.12	32	.146	22.2%	28.6%	.17	32	.681
Limited ability	25.0%	30.8%	21.1%	.39	32	.533	27.8%	21.4%	.17	32	.681

Note: A dash indicates that no analyses were run due to zero participants within a cell

Table 15

Qualitative Codes - Limits and Boundaries

Code	Description	Example
Limits - no boundaries	Some general limits but no hard boundaries.	"I mean we try to limit it to some point"
Limits on screen time	Limitations on overall screen time in general.	"like screen time like being really aware of screen time and making sure that we have only so much of that in the day"
No boundaries - not necessary	Did not set limits/boundaries because they are not necessary.	"I don't know at this age I don't know if its relevant"
No tech during meal times	No technology during meal times.	"we don't allow it during meal times"
Limits on content access	Limits on what the child can access/do on the device.	"he can't go and choose whatever he wants to watch or play its games or movies that we've downloaded and put there specifically for him"
No tech outside of home	No technology outside of the home.	"this is something that she gets at home it's not something that she ever gets to have in the grocery store or at the doctor's office"
No tech with company over	No technology while company is over.	"I don't allow it when we have company over"
No tech during tantrum	No technology when the child is having a tantrum.	"[don't allow access when…] he's having a temper tantrum"
Limits on content access	Limits on what the child can access/do on the device.	"he can't go and choose whatever he wants to watch or play its games or movies that we've downloaded and put there specifically for him"
Child ask permission	The child must ask for permission to use the device.	"they always have to ask permission"
Physically out of reach	Prohibiting use by physically placing the device out of reach.	"we have to put [the iPad] somewhere up and the phone we keep it in our pocket"

Code	Description	Example
Limits - right away	Limitations were set right away.	“[boundaries were set] Pretty much right away”
Limits after watching child	Limitations were set after watching child use the device.	“we kind of let him try it and then that’s when we learned okay he’s got a real problem with any kind of um screens so we have to really limit screen time”
More freedom with age	Less limitations as age increased.	“I think it’s as [the child] ages the rope gets a little bit longer he gets a bit more freedom”

Table 16

Limits and Boundaries

	Age Groups						Older Siblings				
	Overall %	Younger Children %	Older Children %	X^2	*N*	*p*	Without Sibling %	With Sibling %	X^2	*N*	*p*
Limits - no boundaries	40.6%	46.2%	36.8%	.28	32	.598	44.4%	35.7%	.25	32	.618
Limits on screen time	37.5%	23.1%	47.4%	1.94	32	.163	44.4%	28.6%	.85	32	.358
No boundaries - not necessary	18.8%	23.1%	15.8%	.27	32	.604	22.2%	14.3%	.33	32	.568
No tech during meal times	21.9%	23.1%	21.1%	.02	32	.892	16.7%	28.6%	.65	32	.419
Limits on content access	18.8%	7.7%	26.3%	1.76	32	.185	16.7%	21.4%	.12	32	.732
No tech outside of home	12.5%	15.4%	10.5%	.17	32	.683	16.7%	7.1%	.653	32	.419
Child ask permission	18.8%	30.8%	10.5%	2.08	32	.150	11.1%	28.6%	1.58	32	.209
Physically out of reach	16.6%	7.7%	21.1%	1.05	32	.307	5.6%	28.6%	3.16	32	.075
Limits - right away	46.9%	38.5%	52.6%	.622	32	.430	50.0%	42.9%	.16	32	.688
Limits after watching child	28.1%	23.1%	31.6%	.28	32	.599	27.8%	28.6%	.00	32	.960
More freedom with age	12.5%	7.7%	15.8%	.46	32	.496	11.1%	14.3%	.07	32	.788

Table 17

Qualitative Codes - Television Use

Code	Description	Example
No television	Child generally does not watch television on a regular basis.	“[does he watch television?] rarely if any”
Background Television	Television is on in the background.	“It’s on in the background when he’s like playing around”
4+ hours/day	Television is on 4+ hours a day.	“I’d say it’s on for him maybe 4 hours a day”
3 hours/day	Television is on around 3 hours a day.	“about 3 hours a day”
2 hours/day	Television is on around 2 hours a day.	“I’ve used [the television] for a couple of hours for sure”
1 hour/day	Television is on around 1 hour a day.	“I’d say an hour a day”
Under 1 hour per day	Television is on under 1 hour a day.	“maybe like half an hour to an hour a day I think “
Before bed	Child watches television before bed.	“we’ll sit and snuggle before bed and watch TV”
Only on weekends	Child watches television only on weekends.	“most days she gets none, if like on Saturdays and Sundays she gets to watch cartoons”
Child content	Child watches children’s content on television such as cartoons.	“well a lot of cartoons um mainly”
Treehouse	Child watches Treehouse.	“we watch a lot of um treehouse PBS”
PBS	Child watches PBS.	“we keep it to either Treehouse or PBS”

Table 17 Continued

Code	Description	Example
Not YTV	Child does not watch YTV.	"we try and stay away from YTV"
What older sibling watches	Child watches whatever older sibling watches on television.	"he will watch whatever if [older sibling] is watching other cartoons he will watch those"
Educational shows	Child watches educational shows on television.	"so just little kid educational shows"
Constant Supervision	Child is constantly supervised when watching television.	"Yeah so he wouldn't watch it unsupervised one of us is always around"
Nearby Supervision	Child is supervised nearby when watching television.	"yeah like I'm literally like I guess this would be what? like 5, 10 feet away"
Not Supervised	Child watches television unsupervised.	"not usually, usually that's when we are able to get things done"

Table 18

Television Use

		Age Groups				Older Siblings			
	Overall %	Younger Children %	Older Children %	X^2	p	Without Sibling %	With Sibling %	X^2	p
Background Television	25.0%	25.0%	25.0%	.00	1.00	35.0%	15.0%	2.13	.144
2 hours/day	17.5%	20.0%	15.0%	.17	.677	10.0%	25.0%	1.56	.212
1 hour/day	17.5%	20.0%	15.0%	.17	.677	20.0%	15.0%	.17	.677
Under 1 hour per day	45.0%	55.0%	35.0%	1.62	.204	60.0%	30.0%	3.64	.057
Only on weekends	15.0%	0%	30.0%	-	-	10.0%	20.0%	.78	.376
Before bed	12.5%	10.0%	15.0%	.23	.633	10.0%	15.0%	.23	.633
Child content	82.5%	80.0%	85.0%	.17	.677	75.0%	90.0%	1.56	.212
Treehouse	12.5%	10.0%	15.0%	.23	.633	10.0%	15.0%	.23	.633
What older sibling watches	10.0%	15.0%	5.0%	1.11	.292	0%	20%	-	-
Constant Supervision	65.0%	70.0%	60.0%	.44	.507	70.0%	60.0%	.44	.507
Nearby Supervision	17.5%	10.0%	25.0%	1.56	.212	10.0%	25.0%	1.56	.212
Not Supervised	15.0%	15.0%	15.0%	.00	1.00	10.0%	20.0%	.78	.376

Note: A dash indicates that no analyses were run due to zero participants within a cell

Table 19

Qualitative Codes - Television Comparison to Mobile Technology

Code	Description	Example
TV is less interactive	Television is less interactive than mobile technology.	“mobile technology is more interactive then television”
TV is less beneficial	Television is less beneficial than mobile technology.	“there’s not as much of a benefit there”
TV is easier to control	Television is easier to control than mobile technology.	“it’s easier for us to control because they don’t know how to operate the TV”
TV one way reception	Television is a one way reception.	“television you’re you’re sitting and you’re receiving”
TV & tech are same thing	Television and mobile technology are the same thing and often used for the same reasons.	“I’d say its similar”
More cautious of mobile tech	Need to be more cautious of mobile technology.	“mobile technology it scares me because you have to watch it a lot a lot more there’s a lot of bad stuff out there its harder to supervise”

Table 20

Television Comparison to Mobile Technology

		Age Groups					Older Siblings				
	Overall %	Younger Children %	Older Children %	X^2	*N*	*p*	Without Sibling %	With Sibling %	X^2	*N*	*p*
TV is less interactive	32.5%	25.0%	40.0%	1.03	40	.311	35.0%	30.0%	.11	40	.736
TV is less beneficial	22.5%	20.0%	25.0%	.14	40	.705	20.0%	25.0%	.14	40	.705
TV is easier to control	22.5%	30.0%	15.0%	1.23	40	.256	10.0%	35.0%	3.58	40	.058
TV one way reception	15.0%	10.0%	20.0%	.78	40	.376	10.0%	20.0%	.78	40	.376
TV & tech are same thing	10.0%	10.0%	10.0%	.00	40	1.00	10.0%	10.0%	.00	40	1.00
More cautious of mobile tech	10.0%	15.0%	5.0%	1.11	40	.292	5.0%	15.0%	1.11	40	.292

Table 21

Qualitative Codes - Older sibling introduction and amount of use in comparison to target child.

Code	Description	Example
Introduction was same for both	Introduction was the same for both children.	" [with] my oldest … it was the same thing same discovery process same process we went through with her as [with my youngest]"
Older sibling was introduced later	Older sibling was introduced to mobile technology at a later age than the younger one.	"we didn't have iPhones when [older child] was first born so he may have been a bit older"
Older sibling was introduced later but progressed faster	Older sibling was introduced at a later age, but therefore progressed faster.	"still start out with the same type of games but progress pretty quickly beyond to some more complex games"
Increased age = increased use	As age increases so does use.	"[older child] I would say he uses it more than more than [younger child]"
Increased age = increased attention span	As age increases so does the child's attention span to actually use the device.	"[younger child] gets too distracted he doesn't pay any attention to it"
Increased age = increased independence	As age increases so does independence in using the device.	"[older child] has a little more independence with it"
Older sibling sparked interest in younger child	Seeing the older sibling use the device is what sparked the younger one to use it.	"if he sees [older child] playing a game he will crawl up beside [older child] and want to watch and try to do it too"
Older sibling uses tech for school	Older sibling uses mobile technology for schoolwork.	"well [the oldest] use[s] it for school, school activities and stuff"

Table 22

Older sibling introduction and amount of use in comparison to target child.

	Age Groups					
	Overall %	Younger Children %	Older Children %	X^2	*N*	*p*
Introduction was same for both	50.0%	58.3%	37.5%	.83	20	.361
Older sibling was introduced later	30.0%	16.7%	50.0%	2.54	20	.111
Older sibling was introduced later but progressed faster	15.0%	16.7%	12.5%	.07	20	.798
Increased age = increased use	50.0%	58.3%	37.5%	.83	20	.361
Increased age = increased attention span	35.0%	41.7%	25.0%	.59	20	.444
Increased age = increased independence	30.0%	25.0%	37.5%	.36	20	.550
Older sibling sparked interest in younger child	35.0%	33.3%	37.5%	.04	20	.848
Older sibling uses tech for school	15.0%	8.3%	25.0%	1.05	20	.306

Table 23

Qualitative Codes - Adult use of Mobile Technology

Theme	Description	Example
Constantly	Adult uses the technology all of the time.	"constantly so um I'm on my phone like I couldn't even tell you how many times a day"
Couple hours a day	Adult uses the technology at least a couple of hours a day.	"probably a couple hours a day"
Too much	Adult indicates they use the technology too much.	"we use it often… probably more than we should"
Use technology for work	Adult uses mobile technology for work.	"I'm using mobile technology to do my job"
Use technology for personal use	Adult uses mobile technology for personal use.	"constantly throughout the day for different things, Pinterest, looking up recipes, keeping in contact with people"
Use technology for texting	Adult uses mobile technology for texting.	"Well I have my phone on me for texting"
Use technology for email	Adult uses mobile technology for emails.	"so for texting and email and Facebook"
Use technology for Facebook	Adult uses mobile technology for Facebook.	"and going on Facebook or whatever"
Adults as models	Adult is aware that the children are watching or seeing adults use the technology.	"they see us interacting with it"

Table 24

Adult use of Mobile Technology

		Age Groups					Older Siblings				
	Overall %	Younger Children %	Older Children %	X^2	*N*	*p*	Without Sibling %	With Sibling %	X^2	*N*	*p*
Constantly	65.0%	61.5%	68.4%	.162	32	.687	72.2%	57.1%	.794	32	.373
Couple hours a day	28.1%	38.5%	21.1%	1.16	32	.282	22.2%	35.7%	.71	32	.400
Use tech for work	25.0%	30.8%	21.1%	.39	32	.533	22.2%	28.6%	.17	32	.681
Use tech for personal use	21.9%	23.1%	21.1%	.02	32	.892	16.7%	28.6%	.65	32	.419
Use tech for texting	18.8%	30.8%	10.5%	2.08	32	.150	11.1%	28.6%	1.58	32	.209
Use tech for email	12.5%	7.7%	15.8%	.463	32	.496	11.1%	14.3%	.07	32	.788
Use tech for Facebook	12.5%	15.4%	10.5%	.17	32	.683	11.1%	14.3%	.07	32	.788
Adults as models	15.6%	23.1%	10.5%	.92	32	.337	11.1%	21.4%	.64	32	.425

Table 25

Analysis of All Codes by Gender

	Fathers *M (SD)*	Mothers *M (SD)*	*t*	*df*	*p*
Age of Introduction	16.68 (10.64)	13.81 (8.61)	.88	33	.385

	Fathers %	Mothers %	X^2	*N*	*p*
Introduced to Mobile Tech Overall	80.0%	80.0%	.00	40	1.00
Cellphone/ Smartphone	93.8%	87.5%	.37	32	.544
Tablet/ iPad®	56.2%	62.5%	.13	32	.719
Children's device	12.5%	12.5%	.00	32	1.00
Rarely	31.2%	12.5%	1.65	32	.200
One to a few days a week	43.8%	62.5%	1.13	32	.288
Daily	25.0%	18.8%	.18	32	.669
Use has increased	31.2%	31.2%	.00	32	1.00
Use has decreased	18.8%	18.8%	.00	32	1.00
Use has stayed same	43.8%	43.8%	.00	32	1.00

Table 25 Continued

	Fathers %	Mothers %	X^2	*N*	*p*
General Positive	35.0%	25.0%	.48	40	.490
General Negative	12.5%	37.5%	2.67	40	.102
Positive and Negative	30.0%	35.0%	.11	40	.736
Positive - moderation	30.0%	35.0%	.11	40	.736
Positive - educational	30.0%	30.0%	.00	40	1.00
Negative - overexposure	25.0%	15.0%	.63	40	.429
Negative - takes away	30.0%	20.0%	.53	40	.465
Distraction - avoid boredom	56.2%	37.5%	1.13	32	.288
Distraction - give adult time	37.5%	43.8%	.13	32	.719
Distraction - travelling	18.8%	25.0%	.18	32	.669
Calming tool	31.2%	37.5%	.14	32	.710
Teaching tool	31.2%	31.2%	.00	32	1.00
Look at pictures	31.2%	50.0%	1.17	32	.280
Manipulate as an object	12.5%	37.5%	2.67	32	.102
Uses as a phone	6.2%	18.8%	1.14	32	.285

Table 25 Continued

	Fathers %	Mothers %	X^2	*N*	*p*
Infant/Toddler apps	37.5%	37.5%	.00	32	1.00
Educational apps	18.8%	37.5%	1.39	32	2.38
Games - free play	31.2%	25.0%	.16	32	.694
Games – goal directed	12.5%	6.2%	.37	32	.544
Watch videos or clips	37.5%	56.2%	1.13	32	.288
Watch movies or shows	43.8%	25.0%	1.25	32	.264
In the home	50.0%	50.0%	.00	32	1.00
Outside of the home	25.0%	31.2%	.16	32	.694
With family around	18.8%	12.5%	.24	32	.626
Excitement/ Enjoyment	93.8%	81.2%	1.14	32	.285
Child-directed	37.5%	37.5%	.00	32	1.00
Adult-directed	43.8%	62.5%	1.13	32	.288
Intro - child grabbed	6.2%	37.5%	4.57	32	.033
Intro - child sees adults	43.8%	31.2%	.53	32	.465
Intro - adult needs time	37.5%	56.2%	1.13	32	.288
Intro - necessity	25.0%	43.8%	1.25	32	.264
Intro - Natural	25.0%	18.8%	.18	32	.669

Table 25 Continued

	Fathers %	Mothers %	X^2	*N*	*p*
Wait - child's ability	25.0%	20.0%	.14	40	.705
Wait - adult experience	15.0%	15.0%	.00	40	1.00
Wait - device damage	15.0%	10.0%	.23	40	.633
Overall Supervision	81.2%	87.5%	.24	32	.626
Overall Assistance	75.0%	93.8%	2.13	32	.144
Constant supervision	62.5%	75.0%	.58	32	.446
Use together with adult	25.0%	56.2%	3.24	32	.072
Can use on their own	43.8%	31.2%	.53	32	.465
Nearby supervision	18.8%	6.2%	1.14	32	.285
Navigate device	43.8%	75.0%	3.24	32	.072
Hold device for child	31.2%	43.8%	.53	32	.465
Show child how to use	31.2%	12.5%	1.65	32	.200
Unlock device	25.0%	6.2%	2.13	32	.144
Child is too young	12.5%	12.5%	.00	32	1.00
Child is destructive	18.8%	31.2%	.67	32	.414
Limited ability	25.0%	25.0%	.00	32	1.00

Table 25 Continued

	Fathers %	Mothers %	X^2	*N*	*p*
Limits - no boundaries	43.8%	37.5%	.13	32	.719
Limits on screen time	31.2%	43.8%	.53	32	.465
No boundaries - not necessary	25.0%	12.5%	.82	32	.365
No tech during meal times	18.8%	25.0%	.18	32	.669
Limits on content access	18.8%	18.8%	.00	32	1.00
No tech outside of home	6.2%	18.8%	1.14	32	.285
Child ask permission	25.0%	12.5%	.82	32	.365
Physically out of reach	18.8%	12.5%	.24	32	.626
Limits - right away	43.8%	50.0%	.13	32	.723
Limits after watching child	25.0%	31.2%	.16	32	.694
More freedom with age	18.8%	6.2%	1.14	32	.285
Background Television	25.0%	25.0%	.00	40	1.00
2 hours/day	20.0%	15.0%	.17	40	.677
1 hour/day	20.0%	15.0%	.17	40	.677
Under 1 hour per day	45.0%	45.0%	.00	40	1.00
Only on weekends	15.0%	15.0%	.00	40	1.00
Before bed	10.0%	15.0%	.23	40	.633

Table 25 Continued

	Fathers %	Mothers %	X^2	*N*	*p*
Child content	85.0%	80.0%	.17	40	.677
Treehouse	10.0%	15.0%	.23	40	.633
What older sibling watches	10.0%	10.0%	.00	40	1.00
Constant Supervision	65.0%	65.0%	.00	40	1.00
Nearby Supervision	20.0%	15.0%	.173	40	.677
Not Supervised	15.0%	15.0%	.00	40	1.00
TV is less interactive	35.0%	30.0%	.11	40	.736
TV is less beneficial	35.0%	10.0%	3.58	40	.058
TV is easier to control	25.0%	20.0%	.14	40	.705
TV one way reception	15.0%	15.0%	.00	40	1.00
TV & tech are same thing	5.0%	15.0%	1.11	40	.292
More cautious of mobile tech	5.0%	15.0%	1.11	40	.292
Introduction was same for both	40.0%	60.0%	.80	20	.371
Older sibling was introduced later	30.0%	30.0%	.00	20	1.00
Older sibling was introduced later but progressed faster	10.0%	20.0%	.39	20	.531
Increased age = increased use	50.0%	50.0%	.00	20	1.00
Increased age = increased attention span	30.0%	40.0%	.22	20	.639
Increased age = increased independence	40.0%	20.0%	.95	20	.329

Table 25 Continued

	Fathers %	Mothers %	X^2	*N*	*p*
Older sibling sparked interest in younger child	20.0%	50.0%	1.98	20	.160
Older sibling uses tech for school	10.0%	20.0%	.39	20	.531
Constantly	68.8%	62.5%	.14	32	.710
Couple hours a day	18.8%	37.5%	1.39	32	.238
Use tech for work	31.2%	18.8%	.67	32	.414
Use tech for personal use	6.2%	37.5%	4.57	32	.033
Use tech for texting	18.8%	18.8%	.00	32	1.00
Use tech for email	12.5%	12.5%	.00	32	1.00
Use tech for Facebook	12.5%	12.5%	.00	32	1.00
Adults as models	25.0%	6.2%	2.13	32	.144

Table 26

Summary Table of Significant Results from Study 1

	Younger vs. Older	Sibling vs. No Sibling
Introduced to Mobile Tech Overall	SIG.	X
Cellphone/Smartphone	X	X
Tablet/ iPad®	SIG.	X
Children's device	X	X
Rarely	X	X
One to a few days a week	X	X
Daily	X	X
Use has increased	X	X
Use has decreased	X	X
Use has stayed same	X	X
General Positive	SIG.	SIG.
General Negative	SIG.	SIG.
Positive and Negative	X	X

26 Continued

	Younger vs. Older	Sibling vs. No Sibling
Positive - moderation	SIG.	SIG.
Positive - educational	SIG.	X
Negative - overexposure	X	X
Negative - takes away	X	X
Distraction – avoid boredom	X	SIG.
Distraction – give adult time	X	X
Distraction – travelling	X	X
Calming tool	X	X
Teaching tool	X	X
Look at pictures	X	X
Manipulate as an object	SIG.	X
Uses as a phone	X	X
Infant/Toddler apps	X	SIG.
Educational apps	SIG	X
Games - free play	X	X
Games – goal directed	-	X

26 Continued

	Younger vs. Older	Sibling vs. No Sibling
Watch videos or clips	X	X
Watch movies or shows	X	X
In the home	X	X
Outside of the home	X	X
With family around	X	X
Excitement/ Enjoyment	X	X
Child-directed	X	X
Adult-directed	X	X
Intro - child grabbed	X	X
Intro - child sees adults	X	X
Intro - adult needs time	X	X
Intro - necessity	X	X
Intro - Natural	X	X
Wait - child’s ability	SIG.	X
Wait - adult experience	-	X
Wait - device damage	X	-

26 Continued

	Younger vs. Older	Sibling vs. No Sibling
Overall Supervision	X	SIG.
Overall Assistance	X	X
Constant supervision	X	X
Use together with adult	X	X
Can use on their own	X	X
Nearby supervision	-	X
Navigate device	X	X
Hold device for child	X	X
Show child how to use	X	X
Unlock device	-	X
Child is too young	-	-
Child is destructive	X	X
Limited ability	X	X
Limits - no boundaries	X	X
Limits on screen time	X	X
No boundaries - not necessary	X	X

26 Continued

	Younger vs. Older	Sibling vs. No Sibling
No tech during meal times	X	X
Limits on content access	X	X
No tech outside of home	X	X
Child ask permission	X	X
Physically out of reach	X	X
Limits - right away	X	X
Limits after watching child	X	X
More freedom with age	X	X
Background Television	X	X
2 hours/day	X	X
1 hour/day	X	X
Under 1 hour per day	X	X
Only on weekends	-	X
Before bed	X	X
Child content	X	X
Treehouse	X	X
What older sibling watches	X	-

26 Continued

	Younger vs. Older	Sibling vs. No Sibling
Constant Supervision	X	X
Nearby Supervision	X	X
Not Supervised	X	X
TV is less interactive	X	X
TV is less beneficial	X	X
TV is easier to control	X	X
TV one way reception	X	X
TV & tech are same thing	X	X
More cautious of mobile tech	X	X
Introduction was same for both	X	-
Older sibling was introduced later	X	-
Older sibling was introduced later but progressed faster	X	-
Increased age = increased use	X	-
Increased age = increased attention span	X	-
Increased age = increased independence	X	-
Older sibling sparked interest in younger child	X	-
Older sibling uses tech for school	X	-

26 Continued

	Younger vs. Older	Sibling vs. No Sibling
Constantly	X	X
Couple hours a day	X	X
Use tech for work	X	X
Use tech for personal use	X	X
Use tech for texting	X	X
Use tech for email	X	X
Use tech for Facebook	X	X
Adults as models	X	X

Table 27

Frequency of access to technology

	N	Never	Less than once a week	1-2 days a week	3-4 days a week	5-6 days a week	Daily	*Mean*	*SD*
Tablet	73	36 (49.3%)	13 (17.8%)	8 (11.0%)	5 (6.8%)	4 (5.5%)	7 (9.6%)	2.30	1.69
Smartphone	85	19 (22.4%)	19 (22.4%)	13 (15.3%)	9 (10.6%)	10 (11.8%)	15 (17.6%)	3.20	1.81
Television	88	15 (17.0%)	15 (17.0%)	6 (6.8%)	9 (10.2%)	8 (9.1%)	35 (39.8%)	3.97	2.00
Background Television	87	11 (12.6%)	10 (11.5%)	4 (4.6%)	13 (14.9%)	6 (6.9%)	43 (49.4%)	4.40	1.89
Desktop Computer	61	53 (86.9%)	3 (4.9%)	3 (4.9%)	1 (1.6%)	0	1 (1.6%)	1.28	0.86
Laptop Computer	77	61 (79.2%)	11 (14.3%)	2 (2.6%)	0	1 (1.3%)	2 (2.6%)	1.38	0.99
iPod	60	56 (93.3%)	2 (3.3%)	1 (1.7%)	0	0	1 (1.7%)	1.15	0.71
eReader	61	60 (98.4%)	0	0	1 (1.6%)	0	0	1.05	0.38
Children’s Tablet	61	47 (77.0%)	7 (22.5%)	2 (3.3%)	2 (3.3%)	3 (4.9%)	0	1.48	1.06
Handheld Gaming	53	52 (98.1%)	0	0	0	1 (1.9%)	0	1.08	0.55
Screen Time in General	86	4 (4.7%)	19 (22.1%)	10 (11.6%)	7 (8.1%)	9 (10.5%)	37 (43.0%)	4.27	1.79

Table 28

Amount of time the child spends each time they access technology

	N	Under 5 Minutes	6 to 10 Minutes	11 to 20 Minutes	21 to 30 Minutes	31 to 60 Minutes	61 + Minutes	*Mean*	*SD*
Tablet	34	9 (26.5%)	7 (20.6%)	4 (11.8%)	9 (26.5%)	4 (11.8%)	1 (2.9%)	2.85	1.52
Smartphone	63	23 (36.5%)	26 (41.3%)	6 (9.5%)	6 (9.5%)	1 (1.6%)	1 (1.6%)	2.03	1.12
Television	74	6 (8.1%)	16 (21.6%)	11 (14.9%)	16 (21.6%)	14 (18.9%)	11 (14.9%)	3.66	1.56
Background Television	74	6 (8.1%)	4 (5.4%)	6 (8.1%)	14 (18.9%)	17 (23.0%)	27 (36.5%)	4.53	1.57
Desktop Computer	8	4 (50.0%)	2 (25.0%)	1 (12.5%)	1 (12.5%)	0	0	1.88	1.13
Laptop Computer	22	16 (72.7%)	1 (4.5%)	4 (18.2%)	0	1 (4.5%)	0	1.59	1.10
iPod	4	2 (50.0%)	1 (25.0%)	0	1 (25.0%)	0	0	2.00	1.41
								-	-
Children's Tablet	12	4 (33.3%)	4 (33.3%)	2 (16.7%)	1 (8.3%)	0	1 (8.3%)	2.33	1.50
Handheld Gaming	1	1 (100%)	0	0	0	0	0	1.00	-
Screen Time in General	69	9 (13.0%)	9 (13.0%)	13 (18.8%)	9 (13.0%)	12 (17.4%)	17 (24.6%)	3.83	1.75

Table 29

Technology Use Compared by Age Group

	Younger Children		Older Children				
	n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
Frequency of Use							
Tablet	36	1.89 (1.47)	37	2.70 (1.81)	-2.11	71	.039
Smartphone	41	3.15 (1.91)	44	3.25 (1.74)	-.26	83	.794
Television	42	3.90 (2.16)	46	4.02 (1.87)	-.27	86	.786
Background Television	41	4.85 (1.62)	46	4.00 (2.03)	2.15	85	.035
Screen Time in General	40	4.25 (1.82)	46	4.28 (1.79)	-.08	84	.933
Amount of Use							
Tablet	12	2.92 (1.51)	22	2.82 (1.56)	.18	32	.860
Smartphone	31	2.06 (1.24)	32	2.00 (1.02)	.23	61	.822
Television	33	3.73 (1.63)	41	3.61 (1.53)	.32	72	.750
Background Television	41	4.71 (1.44)	33	4.30 (1.72)	1.10	72	.275
Screen Time in General	35	3.60 (1.68)	34	4.06 (1.81)	-1.09	67	.279

Note: Bonferonni corrected p-value of .01

Table 30

Age of introduction for Target Child Compared by Device

	Device 1		Device 2				
	n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
Television vs Tablet	27	9.59 (5.37)	27	9.85 (6.08)	-.23	26	.818
Tablet vs Smartphone	25	9.88 (6.77)	25	8.88 (4.78)	.74	24	.469
Smartphone vs Television	43	9.70 (4.33)	43	8.19 (5.31)	1.77	42	.084

Table 31

Age of introduction for Target Child Compared by Age Group

	Younger Children		Older Children				
	n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
Target Child							
Tablet	16	8.19 (6.00)	14	12.35 (6.54)	-1.82	28	.079
Smartphone	25	8.44 (3.64)	23	10.43 (4.89)	-1.61	46	.114
Television	25	7.96 (4.85)	24	8.71 (5.74)	-.49	47	.634
First and Second Child							
Tablet (child 1)	26	13.50 (14.20)	24	12.54 (6.57)	.30	48	.764
Tablet (child 2)	9	10.33 (5.57)	10	10.90 (6.92)	-.20	17	.848
Smartphone (child 1)	17	12.94 (15.16)	15	17.40 (10.88)	-.94	30	.353
Smartphone (child 2)	5	16.40 (12.20)	6	13.67 (11.83)	.38	9	.715
Television (child 1)	26	10.81 (8.71)	24	10.71 (6.96)	.04	48	.965
Television (child 2)	9	9.44 (8.73)	10	5.60 (3.37)	1.29	17	.214

Table 32

Paired Samples t-test for Age of Introduction for First and Second Child

	First Child		Second Child				
	n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
Television	18	12.39 (10.05)	18	6.17 (3.79)	3.33	17	.004
Tablet	10	24.90 (17.31)	10	14.40 (11.96)	2.33	9	.045
Smartphone	19	15.53 (10.12)	19	10.63 (6.15)	2.35	18	.030

Table 33

How Mobile Technology was introduced

	N	Minimum	Maximum	*Mean*	*SD*
I consciously decided when to introduce the *tablet* to my child.	38	1	5	2.50	1.35
I consciously decided when to introduce the *smartphone* to my child.	51	1	5	2.76	1.27
My child's introduction to the *tablet* was unplanned.	36	1	5	3.25	1.48
My child's introduction to the *smartphone* was unplanned.	49	1	5	3.06	1.38
When introducing the *tablet* I... (Showed vs. explore)	30	1	5	3.13	1.38
When introducing the *smartphone* I... (Showed vs. explore)	47	1	5	3.36	1.47
My child's interest from initial introduction to the *tablet* to now.	31	1	5	3.35	1.43
My child's interest from initial introduction to the *smartphone* to now.	48	1	5	3.40	1.48

Table 34

How Mobile Technology was Introduced Compared by Age Group

	Younger Children		Older Children				
	n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
I consciously decided when to introduce the *tablet* to my child.	18	2.44 (1.20)	20	2.55 (1.50)	-.24	36	.814
I consciously decided when to introduce the *smartphone* to my child.	25	2.64 (1.32)	26	2.88 (1.24)	-.68	49	.499
My child's introduction to the *tablet* was uplanned.	18	3.33 (1.41)	18	3.17 (1.58)	.33	34	.741
My child's introduction to the *smartphone* was uplanned.	23	3.00 (1.45)	26	3.12 (1.34)	-.29	47	.773
When introducing the *tablet* I... (Showed vs. explore)	15	2.93 (1.58)	15	3.33 (1.50)	-.71	28	.482
When introducing the *smartphone* I... (Showed vs. explore)	23	3.70 (1.55)	24	3.04 (1.33)	1.55	45	.128
My child's interest from initial introduction to the *tablet* to now.	15	2.87 (1.25)	16	3.81 (1.47)	-1.93	29	.064
My child's interest from initial introduction to the *smartphone* to now.	23	3.61 (1.41)	25	3.20 (1.56)	.952	46	.346

Note: Bonferonni corrected p-value of .017

Table 35

Overall Scores within each Section of the Ages and Stages Questionnaire

	N	Minimum	Maximum	Mean	SD	Near/Below Cut-off	Above Cut-off
Communication	116	10	60	47.38	12.27	11.2%	88.8%
Gross Motor	116	0	60	54.24	11.77	11.2%	88.8%
Fine Motor	116	20	60	50.15	9.59	16.4%	83.6%
Problem Solving	116	10	60	45.09	12.54	23.5%	76.5%
Personal-Social	116	25	60	47.28	8.91	14.7%	85.3%

Table 36

Descriptive Statistics for each of the five Temperament Subsections.

	N	Minimum	Maximum	Mean	SD
Temper – Social	90	1.50	5.00	3.60	.89
Temper – Emotional	90	1.00	4.60	2.50	.76
Temper – Activity	90	2.00	5.00	4.23	.67
Temper – Attention	90	1.80	4.60	3.34	.72
Temper – Sooth	90	1.40	5.00	3.45	.68

Table 37

Developmental Scores, Temperament and Shyness Compared by Age

	Younger Children		Older Children				
	n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
Communication	62	44.89 (12.58)	54	50.24 (11.35)	-2.39	114	.018
Gross Motor	62	52.45 (14.76)	54	56.30 (6.46)	-1.77	114	.079
Fine Motor	62	49.32 (10.64)	54	51.09 (8.22)	-0.99	114	.323
Problem Solving	62	43.60 (12.98)	54	46.80 (11.90)	-1.38	114	.171
Personal-Social	62	44.35 (8.85)	54	50.65 (7.77)	-4.04	114	.000
Social	43	3.74 (.82)	47	3.48 (.93)	1.38	88	.170
Emotionality	43	2.43 (.79)	47	2.57 (.74)	-.87	88	.388
Activity	43	4.25 (.66)	47	4.22 (.69)	.22	88	.830
Attention	43	3.40 (.70)	47	3.29 (.74)	.77	88	.442
Soothability	43	3.51 (.65)	47	3.39 (.71)	.87	88	.387
Shyness	43	3.05 (.78)	47	3.28 (.79)	-1.39	88	.168

Table 38

Participants Below/Near and Above the Cut-off Compared by Age

	Overall		Younger Children		Older Children			
	% near/ below	% above	% near/ below	% above	% near/ below	% above	X^2	*p*
Communication	11.2%	88.8%	16.1%	83.9%	5.6%	94.4%	3.24	.072
Gross Motor	11.2%	88.8%	16.1%	83.9%	5.6%	94.4%	3.24	.072
Fine Motor	16.4%	83.6%	19.4%	80.6%	13.0%	87.0%	.86	.353
Problem Solving	23.5%	76.5%	29.0%	71.0%	17.0%	83.0%	2.31	.129
Personal-Social	14.7%	85.3%	17.7%	82.3%	11.1%	88.9%	1.02	.314

Table 39

Pearson Correlations Tablet, Smartphone and Television Use

	Tablet	Smartphone	Television	Background Television
Frequency of Technology Use				
Tablet	-	.453***	.210	.067
Smartphone	.453***	-	.451***	.318***
Television	.210	.451***	-	.464***
Background Television	.067	.318***	.464***	-
Amount of Time Using Technology				
Tablet	-	.733***	.615***	.331
Smartphone	.733***	-	.428**	.101
Television	.615***	.428**	-	.604***
Background Television	.331	.101	.604***	-

* p < .05, **p < .01, ***p < .001

Table 40

Age of Introduction Predicting Frequency of Use and Amount of Time Using

Dependent Variable	Independent Variable	*N*	*β*	*t*	*p*
Frequency of Tablet Use	Age of Tablet Introduction	29	-.10	-.55	.590
Amount of Time Using the Tablet	Age of Tablet Introduction	21	-.32	-1.45	.164
Frequency of Smartphone Use	Age of Smartphone Introduction	48	-.018	-1.25	.217
Amount of Time Using the Smartphone	Age of Smartphone Introduction	45	.07	.46	.649
Frequency of Television Use	Age of Television Introduction	48	-.32	-2.31	.025
Amount of Time Watching Television	Age of Television Introduction	46	-.35	-2.44	.019

Note: Bonferonni corrected p-value of .025

Table 41

Temperament and Development.

Dependent Variable	Independent Variable	*N*	*β*	*t*	*p*
Communication	temper_social	90	.03	.25	.804
	temper_emotional	90	-.06	-.54	.592
	temper_activity	90	.07	.68	.497
	temper_attention	90	1.88	1.88	.064
	temper_sooth	90	.05	.43	.671
Gross Motor	temper_social	90	.13	1.21	.231
	temper_emotional	90	-.03	-.26	.793
	temper_activity	90	.35	3.55	.001
	temper_attention	90	-.07	-.63	.530
	temper_sooth	90	.09	.82	.413
Fine Motor	temper_social	90	.10	.97	.334
	temper_emotional	90	-1.95	-1.95	.054
	temper_activity	90	.07	.67	.502
	temper_attention	90	.26	2.54	.013
	temper_sooth	90	.12	1.15	.252
Problem Solving	temper_social	90	-.04	-.35	.727
	temper_emotional	90	-.03	-.26	.794
	temper_activity	90	.17	1.61	.112
	temper_attention	90	.21	2.02	.046
	temper_sooth	90	.17	1.66	.102
Personal-Social	temper_social	90	0	0	.999
	temper_emotional	90	.09	.88	.381
	temper_activity	90	.20	1.92	.058
	temper_attention	90	.25	2.38	.019
	temper_sooth	90	-.01	-.08	.936

Note: Bonferonni corrected p-value of .01

Table 42

Shyness and Development

Dependent Variable	Independent Variable	*N*	*β*	*t*	*p*
Shyness	Communication	90	-1.60	-1.60	.113
	Gross motor	90	-.64	-.64	.523
	Fine motor	90	-1.85	-1.85	.068
	Problem-solving	90	-.05	-.46	.648
	Personal-social	90	-.12	-1.17	.245

Table 43

Introduction to Mobile Technology and Development

	Introduction to Mobile Technology				
	Yes *M (SD)*	No *M (SD)*	*t*	*df*	*p*
Communication	47.95 (13.06)	46.94 (10.06)	.38	87	.708
Gross Motor	56.21 (7.96)	51.61 (15.51)	1.85	87	.068
Fine Motor	52.12 (8.78)	47.26 (9.30)	2.44	87	.017
Problem Solving	46.78 (10.52)	44.65 (14.53)	1.11	87	.429
Personal-Social	49.05 (8.24)	46.45 (9.59)	1.34	87	.184
Social	3.66 (.86)	3.52 (.96)	.66	87	.507
Emotional	2.51 (.79)	2.45 (.69)	.38	87	.706
Activity	4.29 (.63)	4.10 (.74)	1.27	87	.208
Attention	3.36 (.68)	3.33 (.78)	.22	87	.828
Soothability	3.47 (.69)	3.45 (.61)	.14	87	.888
Shyness	3.20 (.84)	3.10 (.71)	.54	87	.594

Table 44

Frequency and Amount of Mobile Technology Use in Relation to Development

Dependent Variable	Independent Variable	*N*	*β*	*t*	*p*
Communication	Tablet Use (Frequency)	73	.15	1.23	.222
	Smartphone Use (Frequency)	85	-.02	-.17	.863
	Tablet Use (Amount)	34	-.10	-.10	.920
	Smartphone Use (Amount)	63	.02	.18	.855
Gross Motor	Tablet Use (Frequency)	73	-.03	-.26	.799
	Smartphone Use (Frequency)	85	.20	1.85	.068
	Tablet Use (Amount)	34	-.10	-.54	.594
	Smartphone Use (Amount)	63	.10	.75	.455
Fine Motor	Tablet Use (Frequency)	73	.18	1.54	.129
	Smartphone Use (Frequency)	85	.19	1.72	.089
	Tablet Use (Amount)	34	.09	.53	.602
	Smartphone Use (Amount)	63	-.23	-1.84	.071
Problem Solving	Tablet Use (Frequency)	73	.29	2.60	.011
	Smartphone Use (Frequency)	85	.05	.41	.680
	Tablet Use (Amount)	34	.29	1.70	.099
	Smartphone Use (Amount)	63	.08	.59	.559
Personal Social	Tablet Use (Frequency)	73	.21	1.85	.069
	Smartphone Use (Frequency)	85	.12	1.11	.270
	Tablet Use (Amount)	34	1.46	1.46	.155
	Smartphone Use (Amount)	63	.002	-.02	.986

Note: Bonferonni corrected p-value of .025

Table 45

Frequency and Amount of Mobile Technology Use in Relation to Temperament

Dependent Variable	Independent Variable	*N*	*β*	*t*	*p*
Temperament - Social	Tablet Use (Frequency)	73	.16	1.40	.165
	Smartphone Use (Frequency)	85	.15	1.40	.165
	Tablet Use (Amount)	34	.35	2.12	.042
	Smartphone Use (Amount)	63	.11	.87	.386
Temperament - Emotional	Tablet Use (Frequency)	73	.10	.81	.419
	Smartphone Use (Frequency)	85	.04	.40	.692
	Tablet Use (Amount)	34	.08	.44	.663
	Smartphone Use (Amount)	63	-.01	-.10	.923
Temperament - Activity	Tablet Use (Frequency)	73	.29	2.54	.013
	Smartphone Use (Frequency)	85	.32	3.06	.003
	Tablet Use (Amount)	34	.47	3.04	.005
	Smartphone Use (Amount)	63	.23	1.80	.077
Temperament - Attention	Tablet Use (Frequency)	73	-.04	-.37	.714
	Smartphone Use (Frequency)	85	-.10	-.88	.379
	Tablet Use (Amount)	34	-.01	-.03	.973
	Smartphone Use (Amount)	63	-.10	-.76	.453
Temperament - Soothability	Tablet Use (Frequency)	73	.15	1.25	.214
	Smartphone Use (Frequency)	85	-.11	-1.03	.308
	Tablet Use (Amount)	34	.21	1.22	.233
	Smartphone Use (Amount)	63	-.04	-.27	.785

Note: Bonferonni corrected p-value of .025

Table 46

Frequency and Amount of Mobile Technology Use in Relation to Shyness

Dependent Variable	Independent Variable	*N*	*β*	*t*	*p*
Shyness	Tablet Use (Frequency)	73	-.14	-1.17	.248
	Smartphone Use (Frequency)	85	-.13	-1.19	.239
	Tablet Use (Amount)	34	.04	.21	.839
	Smartphone Use (Amount)	63	.16	1.27	.207

Note: Bonferonni corrected p-value of .025

Table 47

Descriptive Statistics for each Parenting Style

	N	Minimum	Maximum	Mean	SD
Authoritative (Self)	87	3.30	5.00	4.31	.40
Authoritative (Spouse)	87	1.30	4.90	3.97	.65
Authoritarian (Self)	87	1.00	2.36	1.38	.31
Authoritarian (Spouse)	87	1.00	2.55	1.39	.32
Permissive (Self)	87	1.00	3.60	2.00	.53
Permissive (Spouse)	87	1.20	3.60	2.02	.51

Table 48

Factor Analysis for Parental Tasks on Mobile Technology

	Factor 1	Factor 2	Factor 3	Factor 4
During an average day how often do YOU take pictures	**0.78**	0.11	0.09	0.15
During an average day how often do YOU look at pictures	**0.84**	0.16	0.16	0.10
During an average day how often do YOU take home movies	**0.82**	0.31	0.02	0.17
During an average day how often do YOU look at home movies	**0.87**	0.10	0.07	0.13
During an average day how often do YOU use email	0.19	**0.81**	-0.10	0.17
During an average day how often do YOU browse the internet	0.00	**0.73**	0.30	0.03
During an average day how often do YOU receive notifications	0.31	**0.68**	0.15	0.05
During an average day how often do YOU play games online	0.12	0.20	**0.89**	0.06
During an average day how often do YOU play app games	0.16	0.08	**0.91**	0.05
During an average day how often do YOU read books	0.13	-0.16	-0.01	**0.79**
During an average day how often do YOU read news	0.10	0.28	0.07	**0.81**
During an average day how often do YOU use text messaging	0.41	0.28	0.23	-0.17
During an average day how often do YOU play music	0.37	0.49	0.15	-0.06
During an average day how often do YOU watch videos	0.17	0.40	0.34	0.45

Table 49

Descriptive Statistics for Parental Tasks on Mobile Technology

	N	Minimum	Maximum	Mean	SD
Communication Tasks	80	1	5	3.79	0.88
Personal Memories	80	1.5	5	3.50	0.89
Reading	80	1	5	2.67	1.06
Games	78	1	5	1.93	1.11
Texting	78	1	5	4.09	.93
Listening to Music	79	1	5	2.79	1.12
Watching Videos	76	1	5	2.51	1.04

Table 50

Concerns about Mobile Technology Use

	Tablet					Smartphone				
	N	*Min.*	*Max.*	*M*	*SD*	*N*	*Min.*	*Max.*	*M*	*SD*
Concerns about the child using the technology too much when using the device.	43	1	5	3.07	1.62	45	1	5	3.69	1.33
Concerns about repair cost if child should damage the device.	44	1	5	2.86	1.46	44	1	5	3.57	1.56
Concerns about the child deleting something important on the device.	43	1	5	2.72	1.62	44	1	5	3.45	1.36
Concerns about the child seeing inappropriate content on the device.	44	1	5	2.41	1.58	45	1	5	2.47	1.59
Concerns about the child seeing advertisements on the device.	43	1	5	2.33	1.64	44	1	5	2.36	1.62
Concerns that the child can navigate the technology without you being there for the device.	43	1	5	2.30	1.49	44	1	5	2.52	1.50

Table 51

Parenting Styles Compared by Age

	Younger Children		Older Children				
	n	*M* (*SD*)	*n*	*M* (*SD*)	*t*	*df*	*p*
Authoritative (Self)	42	4.28 (.40)	45	4.34 (.41)	-.75	85	.456
Authoritative (Spouse)	42	3.99 (.47)	45	3.96 (.79)	.22	85	.827
Authoritarian (Self)	42	1.37 (.26)	45	1.40 (.35)	-.50	85	.621
Authoritarian (Spouse)	42	1.39 (.33)	45	1.39 (.31)	-.02	85	.985

Table 52

Parenting Use of Mobile Technology Compared by Age

	Younger Children		Older Children				
	n	*M* (*SD*)	*n*	*M* (*SD*)	*t*	*df*	*p*
Communication Tasks	38	3.71 (.87)	42	3.87 (.89)	-.81	78	.422
Personal Memories	38	3.55 (.96)	42	3.46 (.83)	.46	78	.646
Reading	38	2.50 (.98)	42	2.82 (1.11)	-1.37	78	.175
Games	37	2.15 (1.19)	41	1.73 (1.01)	1.67	76	.099
Texting	38	4.16 (.92)	42	4.02 (.95)	.64	78	.523
Listening to Music	36	2.83 (1.18)	42	2.76 (1.08)	.28	76	.781
Watching Videos	37	2.49 (1.10)	42	2.52 (.99)	-.16	77	.874

Table 53

Parental Opinion of how Mobile Technology Impacts Development Compared by Age

	Younger Children		Older Children				
	n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
Cognitive	34	3.41 (1.28)	41	3.32 (1.21)	.33	73	.095
Language	33	3.39 (1.17)	41	3.29 (.96)	.41	72	.683
Motor	33	3.15 (1.15)	40	3.03 (1.07)	.49	71	.629
Social	35	3.00 (1.24)	41	2.59 (1.20)	1.48	74	.144

Table 54

Concerns about Mobile Technology Use By Age

	Younger Children		Older Children				
	n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
Tablet							
about repair cost if child should damage the Tablet.	25	2.72 (1.65)	19	3.05 (1.18)	-.75	42	.459
about the child seeing inappropriate content on the Tablet.	25	2.12 (1.56)	19	2.79 (1.55)	-1.41	42	.165
about the child seeing advertisements on the Tablet.	24	2.04 (1.55)	19	2.68 (1.73)	-1.28	41	.207
about the child using the technology too much when using the Tablet.	24	2.67 (1.71)	19	3.58 (1.39)	-1.88	41	.067
about the child deleting something important on the Tablet.	24	2.42 (1.56)	19	3.11 (1.66)	-1.40	41	.170
that the child can navigate the technology without you being there for the Tablet.	24	2.08 (1.44)	19	2.58 (1.54)	-1.09	41	.284
Smartphone							
about repair cost if child should damage the Smartphone.	25	3.64 (1.44)	20	3.75 (1.21)	-.27	43	.786
about the child seeing inappropriate content on the Smartphone.	25	2.28 (1.62)	20	2.70 (1.56)	-.88	43	.385
about the child seeing advertisements on the Smartphone.	24	2.17 (1.55)	20	2.60 (1.70)	-.88	42	.382
about the child using the technology too much when using the Smartphone.	24	3.21 (1.47)	20	3.75 (1.16)	-1.33	42	.190
about the child deleting something important on the Smartphone.	24	3.29 (1.68)	20	3.90 (1.37)	-1.30	42	.202
that the child can navigate the technology without you being there for the Smartphone.	24	2.33 (1.47)	20	2.75 (1.55)	-.92	42	.366

Table 55

Frequency and Amount of Mobile Technology Use in Relation to Parenting Style

Dependent Variable	Independent Variable	*N*	*β*	*t*	*p*
Tablet Use (Frequency)	Authoritative - Self	70	-.06	-.50	.619
	Authoritative - Spouse	70	-.14	-1.13	.261
	Authoritarian - Self	70	.32	2.76	.007
	Authoritarian - Spouse	70	.23	1.91	.060
Smartphone Use (Frequency)	Authoritative - Self	82	.04	.32	.754
	Authoritative - Spouse	82	-.07	-.59	.555
	Authoritarian - Self	82	.23	2.08	.040
	Authoritarian - Spouse	82	.23	2.12	.037
Tablet Use (Amount)	Authoritative - Self	33	.06	.34	.737
	Authoritative - Spouse	33	.11	.62	.542
	Authoritarian - Self	33	.42	2.58	.015
	Authoritarian - Spouse	33	.18	1.00	.325
Smartphone Use (Amount)	Authoritative - Self	61	-.02	-.14	.889
	Authoritative - Spouse	61	.18	1.37	.177
	Authoritarian - Self	61	.10	.74	.463
	Authoritarian - Spouse	61	.05	.38	.706

Note: Bonferonni corrected p-value of .0125

Table 56

Frequency and Amount of Mobile Technology Use in Relation to Parental Use of Mobile Technology

Dependent Variable	Independent Variable	*N*	*β*	*t*	*p*
Tablet Use (Frequency)	Communication Tasks (Scale)	67	.08	.64	.525
	Personal Memories (Scale)	67	.13	1.04	.302
	Reading (Scale)	67	.14	1.14	.258
	Games (Scale)	67	-.08	-.65	.518
	Texting (Item)	67	-.03	-.21	.835
	Listening to Music (Item)	66	-.05	-.38	.705
	Watching Videos (Item)	66	.09	.76	.451
Smartphone Use (Frequency)	Communication Tasks (Scale)	77	.17	1.51	.134
	Personal Memories (Scale)	77	.20	1.79	.078
	Reading (Scale)	77	-.04	-.32	.750
	Games (Scale)	76	.02	.13	.894
	Texting (Item)	77	.11	.99	.324
	Listening to Music (Item)	75	.04	.38	.708
	Watching Videos (Item)	76	.14	1.21	.230
Tablet Use (Amount)	Communication Tasks (Scale)	31	.11	.57	.576
	Personal Memories (Scale)	31	.07	.38	.710
	Reading (Scale)	31	-.04	-.19	.853
	Games (Scale)	30	.17	.91	.370
	Texting (Item)	31	.13	.68	.500
	Listening to Music (Item)	31	-.14	-.78	.442
	Watching Videos (Item)	31	.16	.88	.386
Smartphone Use (Amount)	Communication Tasks (Scale)	55	.17	1.26	.212
	Personal Memories (Scale)	55	.002	.01	.989
	Reading (Scale)	55	-.01	-.05	.961
	Games (Scale)	54	.47	3.86	.000
	Texting (Item)	55	.09	.66	.510
	Listening to Music (Item)	53	.07	.48	.636
	Watching Videos (Item)	54	.22	1.62	.112

Table 57

Mobile Technology Use in Relations to Parental opinion of how mobile technology impacts development

Dependent Variable	Independent Variable	*β*	*t*	*p*
Tablet Use (Frequency)	cognitive	-.53	-.53	.599
(*N* = 61)	language	1.88	1.88	.066
	motor	.13	.13	.896
	social	-.39	-.39	.698
Smartphone Use (Frequency)	cognitive	.58	2.69	.009
(*N* = 69)	language	-.16	-.84	.403
	motor	.05	.31	.760
	social	-.20	-1.21	.231
Tablet Use (Amount)	cognitive	.23	.73	.475
(*N* = 30)	language	.28	1.09	.287
	motor	.34	1.79	.085
	social	-.09	-.39	.698
Smartphone (Amount)	cognitive	.04	.17	.866
(*N* = 51)	language	.26	1.39	.170
	motor	.35	2.55	.014
	social	.01	.08	.935

Table 58

Frequency and Amount of Mobile Technology Use in Relation to Parental Concerns

Dependent Variable	Independent Variable	*N*	*β*	*t*	*p*
Tablet Use (Frequency)	Overall Concerns about the Tablet	40	.19	1.17	.248
Tablet Use (Amount)	Overall Concerns about the Tablet	20	-.04	-.16	.878
Smartphone Use (Frequency)	Overall Concerns about the Smartphone	45	.17	1.14	.259
Smartphone Use (Amount)	Overall Concerns about the Smartphone	40	.19	1.19	.244

Table 59

What Children are doing on Mobile Technology

	N	Minimum	Maximum	*M*	*SD*
Device tasks					
Held/touched the device	51	2	5	3.49	0.97
Had the phone unlocked for them	50	1	5	3.10	1.56
Navigated the device (ie. opened an app)	51	1	5	2.08	1.25
Unlocked the phone themselves	50	1	5	1.58	1.11
Personal Tasks					
Looked at pictures	51	1	5	3.22	1.06
Video phone calls	50	1	5	2.88	1.30
Watched home videos	50	1	5	2.72	1.37
Audio only phone calls	49	1	5	2.63	1.01
Taken pictures	49	1	5	2.18	1.35
Taken home videos	47	1	5	1.98	1.33
Watching Videos					
Watched short video clips (under 5 min.)	51	1	5	2.67	1.19
Watched shows or episodes	50	1	5	2.30	1.36
Watched YouTube	51	1	5	2.18	1.26
Watched movies	49	1	5	1.57	1.12
Applications					
Used for apps for education	49	1	5	2.39	1.44
Used for apps for entertainment	50	1	5	2.18	1.22
Played free-play games	48	1	5	2.27	1.43
Played goal-directed games	49	1	5	1.47	1.02
Played games on the internet	49	1	5	1.18	0.81
Music and Books					
Listened to music	51	1	5	2.65	1.29
Read/looked at books	50	1	5	1.84	1.39
Listened to books	51	1	5	1.55	1.12

Table 60

Gestures on Touchscreen Technology

	N	Minimum	Maximum	*M*	*SD*
One-finger tap	51	1	5	3.71	1.08
Press	51	1	5	3.31	1.09
Flick	51	1	5	3.10	1.33
Swipe	51	1	5	2.90	1.36
Press and drag	51	1	5	2.80	1.33
Bangs on screen	51	1	4	2.51	1.07
One-finger rotation	49	1	5	1.61	1.08
Pinch	51	1	5	1.55	1.01
Two-finger rotation	49	1	5	1.51	1.00
Spread	51	1	5	1.43	0.90
Average number of gestures	51	0	9	4.39	2.10

Table 61

Factor Analysis of Mobile technology in specific situations.

	Factor 1	Factor 2	Factor 3
Restaurant	**0.90**	-0.04	0.03
Medical appointments	**0.77**	0.26	0.29
Grocery store	**0.89**	-0.02	-0.13
Waiting room	**0.68**	0.26	0.43
Other people's houses	0.09	**0.85**	0.08
During family outings	0.37	**0.61**	0.33
During siblings activities	-0.11	**0.84**	-0.05
Short car rides	0.06	0.00	**0.87**
Long car rides	0.30	0.47	**0.67**
Church	0.01	0.05	**0.67**

Table 62

Factor Analysis of Why Parents Give their Child Mobile Technology to Use

	Factor 1	Factor 2
As a distraction when you need time	**0.76**	0.41
To calm your child when they are overactive	**0.74**	0.16
To calm your child when they are upset	**0.80**	0.02
To keep your child quiet	**0.77**	0.04
To occupy your child	**0.75**	0.27
As an educational tool	0.30	**0.73**
As a reward	0.21	0.46
To settle them before bed	0.45	-0.63

Table 63

Factor Analysis of How much the Tablet Encourages Activities

	Factor 1	Factor 2	Factor 3
Structured Play	**0.90**	0.24	0.01
Imaginative Play	**0.74**	0.33	-0.19
Creative Play	**0.86**	0.23	-0.25
Active Play	**0.77**	0.12	0.30
Social Interaction	**0.64**	0.35	-0.07
Entertainment	0.16	**0.86**	0.19
Interactivity	0.29	**0.81**	-0.09
Engagement	0.32	**0.86**	-0.07
Passiveness	-0.08	0.01	**0.95**
Education	0.58	0.56	-0.21

Table 64

Factor Analysis of How much the Smartphone Encourages Activities

	Factor 1	Factor 2	Factor 3
Structured Play	**0.77**	0.19	0.29
Imaginative Play	**0.90**	0.09	-0.09
Creative Play	**0.90**	0.17	0.04
Active	**0.74**	0.09	0.09
Entertainment	0.23	**0.77**	-0.25
Engagement	0.22	**0.81**	0.41
Social Interaction	0.13	-0.06	**0.88**
Interactivity	0.07	0.61	0.64
Education	0.67	0.45	-0.04
Passiveness	-0.55	-0.15	-0.18

Table 65

How much mobile technology encourages activities by age

	N	Minimum	Maximum	*M*	*SD*
Tablet					
Play (5-item scale)	47	1	3.8	1.77	.75
Engagement (3-time scale)	47	1	5	3.06	1.15
Education	46	1	5	3.17	1.18
Passiveness	48	1	5	2.85	1.38
Smartphone					
Play (4-item scale)	46	1	4	1.82	.82
Engagement (2-item scale)	46	1	5	3.50	.95
Social Interaction	46	1	5	2.04	1.15
Interactivity	46	1	5	3.09	1.21
Education	46	1	5	3.17	1.18
Passiveness	46	1	5	2.89	1.30

Table 66

How much mobile technology encourages activities: Tablet versus the Smartphone

	Device 1		Device 2				
	n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
Structured Play							
Tablet vs. Smartphone	45	1.89 (1.03)	45	1.76 (1.00)	1.43	44	.160
Smartphone vs. Television	46	1.76 (.99)	46	1.50 (.96)	1.57	45	.123
Television vs. Tablet	47	1.49 (.95)	47	1.85 (1.02)	-2.23	46	.031
Imaginative Play							
Tablet vs. Smartphone	44	1.95 (.89)	44	1.95 (1.01)	.00	43	1.000
Smartphone vs. Television	45	1.96 (1.00)	45	2.27 (1.29)	-1.71	44	.095
Television vs. Tablet	47	2.19 (1.26)	47	1.91 (.88)	1.35	46	.185
Creative Play							
Tablet vs. Smartphone	45	2.18 (1.17)	45	2.11 (1.17)	.65	44	.519
Smartphone vs. Television	46	2.11 (1.16)	46	2.15 (1.21)	-.23	45	.819
Television vs. Tablet	47	2.06 (1.19)	47	2.13 (1.17)	-.35	46	.730
Active Play							
Tablet vs. Smartphone	45	1.42 (.69)	45	1.42 (.66)	.00	44	1.000
Smartphone vs. Television	46	1.43 (.66)	46	1.78 (1.11)	-2.43	45	.019
Television vs. Tablet	47	1.74 (1.11)	47	1.40 (.68)	2.43	46	.019
Interactivity							
Tablet vs. Smartphone	45	2.80 (1.25)	45	3.11 (1.21)	-1.61	44	.114
Smartphone vs. Television	46	3.09 (1.21)	46	2.24 (1.25)	4.37	45	.000
Television vs. Tablet	47	2.21 (1.25)	47	2.79 (1.27)	-2.37	46	.022
Engagement							
Tablet vs. Smartphone	45	2.91 (1.20)	45	3.13 (1.18)	-1.37	44	.176
Smartphone vs. Television	46	3.13 (1.17)	46	2.67 (1.14)	2.90	45	.006
Television vs. Tablet	47	2.60 (1.17)	47	2.87 (1.21)	-1.30	46	.199

Table 66 Continued

	Device 1		Device 2				
	n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
Passiveness							
Tablet vs. Smartphone	46	2.91 (1.38)	46	2.89 (1.30)	.13	45	.896
Smartphone vs. Television	46	2.89 (1.30)	46	3.43 (1.33)	-2.78	45	.008
Television vs. Tablet	48	3.40 (1.35)	48	2.85 (1.38)	-2.74	47	.009
Entertainment							
Tablet vs. Smartphone	44	3.59 (1.37)	44	3.89 (1.06)	-2.05	43	.046
Smartphone vs. Television	46	3.87 (1.05)	46	4.04 (1.05)	-1.48	45	.146
Television vs. Tablet	46	3.96 (1.15)	46	3.54 (1.39)	-2.29	45	.027
Education							
Tablet vs. Smartphone	44	3.23 (1.16)	44	3.11 (1.17)	.93	43	.359
Smartphone vs. Television	46	3.87 (1.05)	46	4.04 (1.05)	-1.48	45	.146
Television vs. Tablet	46	3.13 (1.15)	46	3.17 (1.18)	.27	45	.789
Social Interaction							
Tablet vs. Smartphone	45	1.60 (.81)	45	2.04 (1.17)	-2.71	44	.009
Smartphone vs. Television	46	2.04 (1.15)	46	1.74 (.95)	1.76	45	.085
Television vs. Tablet	47	1.70 (.95)	47	1.57 (.80)	-1.00	46	.323

Note: Bonferonni corrected p-value of .005

Table 67

Actions Parents have seen Children do during Tablet Use

	Factor 1	Factor 2
Dancing	**0.92**	0.22
Singing	**0.88**	0.21
Clapping	**0.87**	0.28
Pointing	**0.53**	**0.69**
Lying	**0.41**	**0.50**
Standing Still	0.15	**0.81**
Sitting Still	0.17	**0.90**

Table 68

Actions Parents have seen Children do during Smartphone Use

	Factor 1	Factor 2
Dancing	**0.85**	0.06
Singing	**0.79**	0.12
Clapping	**0.82**	0.11
Pointing	**0.67**	0.02
Lying Down	0.22	**0.67**
Standing Still	0.01	**0.61**
Sitting Still	0.01	**0.85**

Table 69

Comparison of actions parents have seen children do during mobile technology use by device

		Device 1		Device 2				
		n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
Dancing	Tablet vs. Smartphone	44	1.86 (1.25)	44	2.41 (1.17)	-2.74	43	.009
	Tablet vs. Television	46	1.83 (1.24)	46	3.35 (1.27)	-6.87	45	.000
	Smartphone vs. Television	46	2.43 (1.15)	46	3.43 (1.22)	-4.69	45	.000
Singing	Tablet vs. Smartphone	44	1.80 (1.29)	44	2.05 (1.26)	-1.25	43	.220
	Tablet vs. Television	46	1.83 (1.27)	46	2.61 (1.47)	-4.14	45	.000
	Smartphone vs. Television	46	2.09 (1.24)	46	2.70 (1.47)	-3.96	45	.000
Clapping	Tablet vs. Smartphone	43	2.14 (1.27)	43	2.47 (1.18)	-1.48	42	.146
	Tablet vs. Television	46	2.11 (1.25)	46	3.17 (1.32)	-4.48	45	.000
	Smartphone vs. Television	45	2.49 (1.16)	45	3.27 (1.23)	-3.83	44	.000
Pointing	Tablet vs. Smartphone	42	2.74 (1.50)	42	3.21 (1.26)	-1.79	41	.082
	Tablet vs. Television	45	2.71 (1.47)	45	3.27 (1.23)	-2.25	44	.030
	Smartphone vs. Television	44	3.20 (1.23)	44	3.30 (1.21)	-.45	43	.656
Standing Still	Tablet vs. Smartphone	43	2.07 (1.10)	43	2.58 (1.12)	-3.18	42	.003
	Tablet vs. Television	45	2.53 (1.25)	45	3.22 (1.28)	-3.67	44	.001
	Smartphone vs. Television	45	2.60 (1.12)	45	3.24 (1.17)	-2.78	44	.008
Sitting Still	Tablet vs. Smartphone	43	2.56 (1.26)	43	3.23 (1.13)	-3.44	42	.001
	Tablet vs. Television	45	2.53 (1.25)	45	3.22 (1.28)	-3.67	44	.001
	Smartphone vs. Television	44	3.23 (1.12)	44	3.16 (1.26)	.37	43	.710
Lying Down	Tablet vs. Smartphone	42	1.79 (1.14)	42	2.05 (1.31)	-1.48	41	.147
	Tablet vs. Television	46	1.72 (1.11)	46	2.24 (1.45)	-2.73	45	.009
	Smartphone vs. Television	44	2.00 (1.29)	44	2.18 (1.42)	-.93	43	.358

Table 70

What Children are doing on Mobile Technology by Age

		Younger Children		Older Children				
		n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
Device tasks	Held/touched the device	26	3.35 (1.02)	25	3.64 (.91)	-1.09	49	.282
	Had the phone unlocked for them	26	2.58 (1.60)	24	3.67 (1.31)	-2.62	48	.012
	Navigated the device (ie. opened an app)	26	1.62 (.90)	25	2.56 (1.39)	-2.90	49	.006
	Unlocked the phone themselves	26	1.46 (.91)	24	1.71 (1.30)	-.78	48	.437
Personal Tasks	Looked at pictures	26	3.00 (1.02)	25	3.44 (1.08)	-1.49	49	.142
	Video phone calls	25	2.88 (1.36)	25	2.88 (1.27)	.00	48	1.000
	Watched home videos	25	2.32 (1.44)	25	3.12 (1.20)	-2.14	48	.038
	Audio only phone calls	25	2.56 (1.04)	24	2.71 (1.00)	-.51	47	.614
	Taken pictures	25	2.12 (1.33)	24	2.25 (1.39)	-.33	47	.740
	Taken home videos	24	1.83 (1.24)	23	2.13 (1.42)	-.76	45	.449
Watching Videos	Watched short video clips (under 5 min.)	26	2.38 (1.06)	25	2.96 (1.27)	-1.76	49	.085
	Watched shows or episodes	25	1.72 (1.06)	25	2.88 (1.39)	-3.31	48	.002
	Watched YouTube	26	2.12 (1.37)	25	2.24 (1.17)	-.35	49	.728
	Watched movies	24	1.21 (.66)	25	1.92 (1.35)	-2.33	47	.024
Applications	Used for apps for education	24	2.29 (1.40)	25	2.48 (1.50)	-.45	47	.652
	Used for apps for entertainment	25	2.08 (1.35)	25	2.28 (1.10)	-.57	48	.569
	Played free-play games	24	2.25 (1.48)	24	2.29 (1.40)	-.10	46	.921
	Played goal-directed games	24	1.38 (1.01)	25	1.56 (1.04)	-.63	47	.532
	Played games on the internet	24	1.00 (.00)	25	1.36 (1.11)	-1.58	47	.120
Music and Books	Listened to music	26	2.42 (1.24)	25	2.88 (1.33)	-1.27	49	.210
	Read/looked at books	26	1.77 (1.34)	24	1.92 (1.47)	-.37	48	.712
	Listened to books	26	1.38 (.85)	25	1.72 (1.34)	-1.07	49	.289

Table 71

Gestures on Touch Screen Technology by Age

	Younger Children		Older Children				
	n	*M* (*SD*)	*n*	*M* (*SD*)	*t*	*df*	*p*
One-finger tap	26	3.46 (1.03)	25	3.96 (1.10)	-1.67	49	.101
Press	26	3.19 (1.17)	25	3.44 (1.00)	-.81	49	.421
Flick	26	2.85 (1.32)	25	3.36 (1.32)	-1.39	49	.170
Swipe	26	2.46 (1.39)	25	3.36 (1.19)	-2.48	49	.017
Press and drag	26	2.58 (1.36)	25	3.04 (1.27)	-1.25	49	.216
Bangs on screen	26	2.77 (.99)	25	2.24 (1.09)	1.81	49	.076
One-finger rotation	24	1.42 (.93)	25	1.80 (1.19)	-1.25	47	.216
Pinch	26	1.46 (.86)	25	1.64 (1.15)	-.63	49	.532
Two-finger rotation	24	1.42 (.93)	25	1.60 (1.08)	-.64	47	.528
Spread	26	1.31 (.55)	25	1.56 (1.16)	-1.00	49	.322
Average number of gestures	26	3.85 (1.91)	25	4.96 (2.17)	-1.95	49	.057

Table 72

Mobile technology in Specific Situations by Age

	Younger Children		Older Children				
	n	*M* (*SD*)	*n*	*M* (*SD*)	*t*	*df*	*p*
Common Errands	26	1.91 (.81)	25	2.21 (.89)	-1.25	49	.219
Social Situations	26	1.47 (.67)	25	1.61 (.70)	-.69	49	.494
Travelling	26	1.60 (.84)	25	2.02 (.91)	-1.74	49	.089
Church	26	1.08 (.27)	22	1.23 (.61)	-1.13	46	.264

Table 73

Why Parents Give their Child Mobile Technology to Use by Age

	Younger Children		Older Children				
	n	*M* *(SD)*	*n*	*M* *(SD)*	*t*	*df*	*p*
Unplanned	26	2.28 (1.08)	25	2.39 (.72)	-.42	49	.679
Educational Tool	26	2.42 (1.30)	25	2.60 (1.38)	-.47	49	.640
Reward	26	1.15 (.46)	25	1.48 (.82)	-1.75	49	.086
Settle before Bed	26	1.23 (.65)	25	1.24 (.52)	-.06	49	.956

Table 74

How much mobile technology encourages activities by age

	Younger Children		Older Children				
	n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
Tablet							
Play (5-item scale)	26	1.94 (.79)	21	1.57 (.66)	1.70	45	.097
Engagement (3-time scale)	26	3.00 (1.11)	21	3.13 (1.22)	-.37	45	.711
Education	26	3.31 (1.26)	20	3.00 (1.08)	.88	44	.386
Passiveness	26	2.85 (1.38)	22	2.86 (1.42)	-.04	46	.966
Smartphone							
Play (4-item scale)	26	1.96 (.85)	20	1.63 (.77)	1.39	44	.172
Engagement (2-item scale)	26	3.56 (.88)	20	3.43 (1.07)	.46	44	.645
Social Interaction	26	2.23 (1.24)	20	1.80 (1.01)	1.26	44	.213
Interactivity	26	3.12 (1.31)	20	3.05 (1.10)	.18	44	.858
Education	26	3.31 (1.16)	20	3.00 (1.21)	.88	44	.386
Passiveness	26	3.08 (1.35)	20	2.65 (1.23)	1.10	44	.276

Table 75

Actions Parents have seen Children do during Mobile Technology Use by Age

	Younger Children		Older Children				
	n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
Tablet							
Active actions	26	1.68 (1.06)	20	2.23 (1.24)	-1.64	44	.109
Passive actions	26	1.90 (1.05)	20	2.45 (.94)	-1.83	44	.075
Pointing	26	2.46 (1.48)	19	3.05 (1.43)	-1.34	43	.186
Lying	26	1.50 (1.03)	20	2.00 (1.17)	-1.54	44	.131
Smartphone							
Active actions	26	2.54 (.99)	20	2.63 (.99)	-0.30	44	.770
Passive actions	26	2.34 (.90)	19	3.02 (.57)	-2.88	43	.006

Table 76

Mobile technology in Specific Situations and Temperament

Dependent Variable	Independent Variable	*N*	*β*	*t*	*p*
Common Errands	temper_social	51	-.01	-.10	.920
	temper_emotional	51	.02	.15	.882
	temper_activity	51	.34	2.54	.014
	temper_attention	51	-.04	-.28	.781
	temper_sooth	51	.20	1.41	.165
Social Situations	temper_social	51	.01	.07	.943
	temper_emotional	51	-.18	-1.30	.199
	temper_activity	51	.23	1.63	.109
	temper_attention	51	.04	.29	.775
	temper_sooth	51	-.24	-1.72	.091
Travelling	temper_social	51	-.05	-.37	.716
	temper_emotional	51	.07	.52	.604
	temper_activity	51	.16	1.10	.277
	temper_attention	51	-.22	-1.55	.128
	temper_sooth	51	-.28	-2.01	.050
Church	temper_social	48	-.30	-2.10	.041
	temper_emotional	48	.06	.44	.665
	temper_activity	48	.02	.16	.878
	temper_attention	48	.14	.95	.348
	temper_sooth	48	-.13	-.91	.368

Note: Bonferonni corrected p-value of .01

Table 77

Mobile technology in Specific Situations and Temperament

		N	*β*	*t*	*p*
Unplanned	temper_social	51	.08	.58	.562
	temper_emotional	51	.17	1.19	.241
	temper_activity	51	.36	2.69	.010
	temper_attention	51	-.20	-1.40	.169
	temper_sooth	51	-.22	-1.56	.125
Educational Tool	temper_social	51	.26	1.91	.062
	temper_emotional	51	.06	.40	.689
	temper_activity	51	.32	2.38	.021
	temper_attention	51	-.07	-.51	.615
	temper_sooth	51	-.03	-.18	.857
Reward	temper_social	51	.14	.99	.328
	temper_emotional	51	.16	1.15	.254
	temper_activity	51	.24	1.74	.088
	temper_attention	51	-.21	-1.53	.132
	temper_sooth	51	.22	1.56	.125
Settle before Bed	temper_social	51	.08	.58	.565
	temper_emotional	51	.05	.33	.742
	temper_activity	51	.19	1.35	.184
	temper_attention	51	.01	.05	.964
	temper_sooth	51	.04	.28	.780

Note: Bonferonni corrected p-value of .01

Table 78

Interest at the onset and end of the session Compared by Device and Age

	MS	*df*	*F*	*p*
Initial Interest				
Device	1.10	1	4.10	.054
Device x Age	1.10	1	4.10	.054
Error	.27	25		
Intercept	79.87	1	378.57	.000
Age	1.06	1	5.02	.034
Error	.21	25		
Interest at the End				
Device	1.44	1	2.86	.103
Device x Age	.40	1	.80	.379
Error	.50	25		
Intercept	308.41	1	320.35	.000
Age	.27	1	.28	.605
Error	.96	25		

Table 79

Sustained Interest Compared by Device and Age

	MS	*df*	*F*	*p*
Visual Engagement				
Device	.86	1	5.16	.032
Device x Age	.42	1	2.50	.127
Error	.17	25		
Intercept	349.75	1	613.47	.000
Age	3.67	1	6.44	.018
Error	.57	25		
Physical Engagement				
Device	1.72	1	4.56	.043
Device x Age	1.72	1	4.56	.043
Error	.38	25		
Intercept	242.57	1	165.77	.000
Age	3.75	1	2.56	.122
Error	1.46	25		

Table 80

Skill Compared by Device and Age

	MS	*df*	*F*	*p*
Skill				
Device	.86	1	1.63	.213
Device x Age	.42	1	.79	.382
Error	.53	25		
Intercept	123.12	1	126.91	.000
Age	4.75	1	4.89	.036
Error	.97	25		

Table 81

Overall Verbal Interactions by Device and Age

	MS	*df*	*F*	*p*
Overall Parent				
Device	1208.98	1	12.18	.002
Device x Age	72.31	1	.73	.401
Error	99.24	25		
Intercept	25455.59	1	89.63	.000
Age	2362.92	1	8.32	.008
Error	284.02	25		
Overall Child				
Device	1.69	1	.106	.747
Device x Age	88.95	1	5.59	.026
Error	15.91	25		
Intercept	2112.97	1	35.07	.000
Age	664.23	1	11.02	.003
Error	60.26	25		

Table 82

Verbal Interactions - Parent Explanations by Device and Age

	MS	*df*	*F*	*p*
Explanation of How to Use the Device				
Device	33.29	1	2.53	.124
Device x Age	4.40	1	.34	.568
Error	13.15	25		
Intercept	296.83	1	21.35	.000
Age	38.61	1	2.78	.108
Error	13.90	25		
Explanation of How to Play the Game				
Device	88.19	1	7.62	.011
Device x Age	15.08	1	1.30	.264
Error	11.57	25		
Intercept	317.69	1	17.36	.000
Age	126.95	1	6.94	.014
Error	18.31	25		

Table 83

Verbal Interactions - Parent Asking Questions by Device and Age

	MS	*df*	*F*	*p*
Asking Questions				
Device	13.04	1	1.25	.274
Device x Age	4.15	1	.40	.533
Error	10.41	25		
Intercept	1848.25	1	32.92	.000
Age	507.81	1	9.05	.006
Error	56.14	25		

Table 84

Verbal Interactions - Parent Discussing Content by Device and Age

	MS	*df*	*F*	*p*
Asking Questions				
Device	537.79	1	13.50	.001
Device x Age	82.24	1	2.06	.163
Error	39.84	25		
Intercept	6084.58	1	53.16	.000
Age	91.25	1	.80	.380
Error	114.50	25		

Table 85

Verbal Interactions – Making Connections by Device and Age

	MS	*df*	*F*	*p*
Asking Questions				
Device	.001	1	.001	.975
Device x Age	.668	1	.747	.396
Error	.893	25		
Intercept	12.25	1	13.00	.001
Age	.92	1	.97	.333
Error	.94	25		

Table 86

Physical Interactions by Device and Age

	MS	*df*	*F*	*p*
Parent Tap				
Device	2679.08	1	4.42	.046
Device x Age	670.56	1	1.11	.303
Error	606.12	25		
Intercept	32417.49	1	53.08	.000
Age	3804.38	1	6.23	.020
Error	610.75	25		
Parent Flick				
Device	688.07	1	10.20	.004
Device x Age	49.46	1	.73	.402
Error	67.48	21		
Intercept	4153.57	1	20.26	.000
Age	26.62	1	.130	.722
Error	204.99	21		
Child Tap				
Device	2431.12	1	2.81	.108
Device x Age	200.46	1	.231	.635
Error	866.06	22		
Intercept	56660.53	1	14.45	.396
Age	5743.86	1	1.47	.062
Error	3921.79	22		

Table 87

Relationship between Physical Variables and Mobile Technology Use

Measure	1	2	3	4	5	6
1. Own - Parent tap	-					
2. Own - Parent flick	.065	-				
3. Own - Child tap	-.061	.001	-			
4. iPad® - Parent tap	.128	.126	-.171	-		
5. iPad® - Parent flick	.025	.844**	.222	.135	-	
6. iPad® - Child tap	.001	-.081	.751**	-.142	-.024	-

** Correlation is significant at the 0.05 level (2-tailed).*
*** Correlation is significant at the 0.01 level (2-tailed).*

Table 88

Adaptive Behaviour Descriptive Statistics for Individual Sections

	N	Minimum	Maximum	Mean	SD
Communication	28	7	15	10.32	2.53
Community Use	28	8	19	11.14	2.31
Functional Pre-Academics	28	5	19	10.21	3.11
Home Living	28	6	17	10.82	2.91
Health and Safety	28	4	18	9.75	3.26
Leisure	28	2	19	11.18	4.02
Self-Care	28	2	12	7.57	2.22
Self-Direction	28	5	16	10.71	3.05
Social	28	7	17	10.93	3.08
Motor	28	5	19	11.14	2.88
TOTAL	28	70	162	100.29	21.62

Table 89

Development Scaled Scores by Age

	Younger Children		Older Children				
	n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
Cognitive	15	10.13 (2.26)	15	10.67 (1.92)	-.70	28	.492
Receptive Language	15	8.87 (2.39)	15	10.80 (2.80)	-2.03	28	.052
Expressive Language	15	8.80 (3.10)	15	9.67 (2.26)	-.88	28	.389
Fine Motor	15	9.33 (3.04)	15	10.33 (2.26)	-1.02	28	.315
Social-Emotional	14	8.93 (3.73)	14	11.64 (3.25)	-2.05	26	.050
Adaptive Behaviour	14	96.64 (24.22)	14	103.93 (18.86)	-.89	26	.383

Note: Bonferonni corrected p-value of .0125

Table 90

Relationship between the Bayley Scales of Infant and Toddler Development and the Ages and Stages Questionnaire

	N	*r*	*p*
Bayley Cognitive vs A&S Communication	28	.297	.125
Bayley Receptive vs A&S Communication	28	.310	.108
Bayley Expressive vs A&S Communication	28	.341	.076
Bayley Fine Motor vs A&S Fine Motor	28	.212	.278
Bayley Social-Emotional vs A&S Personal-Social	28	.508**	.006
Bayley Adaptive vs A&S Personal-Social	28	.460*	.014

** Correlation is significant at the 0.05 level (2-tailed).*
*** Correlation is significant at the 0.01 level (2-tailed).*

Table 91

Development and Frequency of Mobile Technology Use

Dependent Variable	Independent Variables	*N*	*β*	*t*	*p*
Frequency of Smartphone Use	Cognitive	19	.41	1.60	.135
	Receptive	19	.11	.41	.689
	Expressive	19	.12	.50	.625
	Fine Motor	19	-.57	-2.38	.035
	Social-Emotional	19	.63	2.01	.067
	Adaptive	19	-.46	-1.87	.087
Amount of time using Smartphone	Cognitive	20	-.30	-.82	.428
	Receptive	20	.02	.06	.957
	Expressive	20	.17	.57	.579
	Fine Motor	20	.62	1.80	.096
	Social-Emotional	20	.34	.77	.458
	Adaptive	20	-.29	-.69	.505

Table 92

Relationship between Bayley Developmental scores and Verbalizations.

	Bayley Receptive	Bayley Expressive	Bayley Social-Emotional	Bayley Adaptive Behaviour
Own - Parent Verbal	.194	.123	.373	.172
Own - Child Verbal	.361	.232	.534**	.386
iPad® - Parent Verbal	.248	.385*	.397*	.242
iPad® - Child Verbal	.386*	.383*	.391	.251

** Correlation is significant at the 0.05 level (2-tailed).*
*** Correlation is significant at the 0.01 level (2-tailed).*

Table 93

Relationship between Bayley Developmental scores and Physical Interactions.

	Bayley Cognitive	Bayley Fine Motor
Own - Parent Tap	-.330	-.574**
Own - Parent Flick	.103	-.410*
Own - Child Tap	.179	.125
iPad® - Parent Tap	.135	.135
iPad® - Parent Flick	.062	-.177
iPad® - Child Tap	.132	.114

** Correlation is significant at the 0.05 level (2-tailed).*
*** Correlation is significant at the 0.01 level (2-tailed).*

Table 94

Parent and Child Ratings of Familiarity, Comfort, Ease, and Interest

	Parent Rating		Child Rating				
	n	*M (SD)*	*n*	*M (SD)*	*t*	*df*	*p*
Ratings							
iPad® Familiarity	30	3.83 (1.34)	30	2.73 (1.29)	5.67	29	.000
iPad® Comfort	30	4.27 (1.05)	30	3.37 (1.10)	4.79	29	.000
iPad® Ease	30	4.60 (.77)	30	3.57 (1.07)	5.48	29	.000
iPad® Interest	30	3.90 (.85)	30	3.90 (1.06)	.00	29	1.000
Software Familiarity	30	2.23 (1.33)	30	2.00 (1.31)	1.37	29	.182
Software Comfort	30	4.17 (.79)	30	3.27 (1.11)	4.27	29	.000
Software Ease	30	4.40 (.56)	30	3.47 (1.20)	4.16	29	.000
Software Interest	30	3.87 (.90)	30	3.83 (1.21)	.21	29	.839

Note: Bonferonni corrected p-value of .0125

Table 95

Overall experience and interest in the device related to coded interest and skill scores.

	Parent Comfort	Child Comfort	Parent Interest	Child Interest
Initial Interest	.225	.192	.192	.140
End Interest	.018	.182	.352	.345
Skill	.113	.402*	.098	.152
Visual Engagement	-.076	.227	-.033	.336
Physical Engagement	-.011	.313	-.041	-.139

** Correlation is significant at the 0.05 level (2-tailed).*
*** Correlation is significant at the 0.01 level (2-tailed).*

Table 96

Overall experience and interest in the software related to coded interest and skill scores.

	Parent Comfort	Child Comfort	Parent Interest	Child Interest
Initial Interest	-.347	-.228	.034	-.119
End Interest	-.060	-.106	.256	.298
Skill	-.149	-.021	-.214	-.145
Visual Engagement	-.161	.094	.000	.190
Physical Engagement	-.026	.200	-.106	.012

** Correlation is significant at the 0.05 level (2-tailed).*
*** Correlation is significant at the 0.01 level (2-tailed).*

Table 97

Overall experience and interest in the software related to Verbal Interactions.

	Parent Verbalizations	Child Verbalizations
Parent Comfort - Device	.023	.065
Child Comfort - Device	.083	.162
Parent Interest - Device	-.236	-.231
Child Interest - Device	-.061	-.132
Parent Comfort - Software	.176	.210
Child Comfort - Software	.120	.062
Parent Interest - Software	-.507**	-.311
Child Interest - Software	-.336	-.034

* *Correlation is significant at the 0.05 level (2-tailed).*
** *Correlation is significant at the 0.01 level (2-tailed).*

Table 98

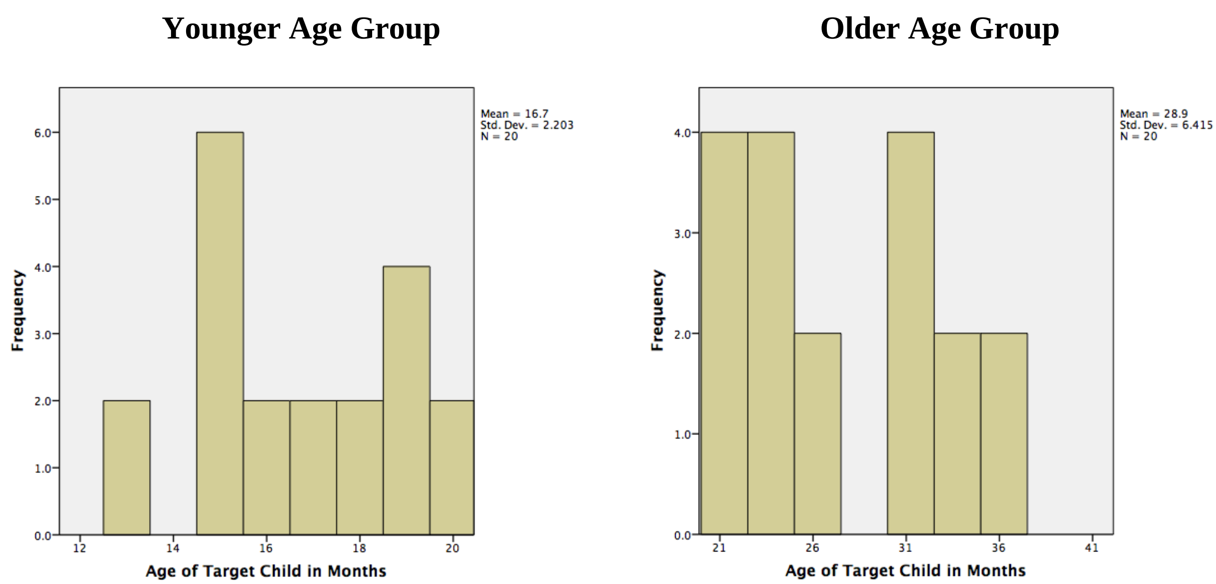
Overall experience and interest in the software related to Physical Interactions.

	Parent Tap	Parent Flick	Child Tap
Parent Comfort - Device	-.111	-.160	.013
Child Comfort - Device	-.420*	-.042	.231
Parent Interest - Device	.133	.128	.083
Child Interest - Device	-.229	-.409	-.289
Parent Comfort - Software	-.271	-.298	-.164
Child Comfort - Software	.021	-.166	.088
Parent Interest - Software	.010	.102	.035
Child Interest - Software	-.111	-.160	.013

** Correlation is significant at the 0.05 level (2-tailed).*
*** Correlation is significant at the 0.01 level (2-tailed).*

Figure 1

Distribution of Ages in Months for the Two Age Groups (Younger/Older)



Appendix A

Examining the Introduction of Mobile Technology to Infants and Toddlers.
Interview Questions

I am going to start the recording right now. *(Start recording)*
Read Participant Code out loud

1. What do you think about technology such as iPads, smartphones and laptops with very young children?

Think of your child between the ages of 12 months and 36 months. If you have more than one child within this age range pick one. How old (in months) is the child you are thinking of? Please answer the following questions specifically with this child in mind.

2. Have you introduced mobile technology to your child?

If yes:

a. What mobile technology did you introduce to your child?
b. How old was your child when you introduced them to _______________?
c. Why did you introduce it then?
d. Can you tell me a bit about the setting for when you introduced it? (Where were you? What was going on? Who was present? Things like that)
e. How did your child react?
f. What kinds of assistance did you provide to make it possible for your child to use the ____________?
g. How often/when does your child use the mobile technology?
h. In general, now, how often does your child use mobile technologies? What kinds?
i. What does your child do on the mobile technology?
j. Do you or someone else (sibling, caregiver, etc.) provide assistance when using mobile technology?
k. What are the main reason(s) that you give your child mobile technology to use?
l. How frequently would you say you use and/or other adults in the house use mobile technology?
m. Are there any older siblings in the house that use mobile technology?
    - If yes, how much do they use it?
    - Do you feel mobile technology was introduced the same way to the older sibling as to the younger one? If not how/why was it different?
    - Do you feel mobile technology is used the same way for the children? If not how/why do they differ?
    - Are the rules/boundaries the same for the children? If not how/why are they different?

If no:

a. What factors did you consider when deciding when to introduce mobile technology? (*You may have to give examples iPad, iPod, Smartphone, Laptop, Tablet, etc.)*
b. When would you introduce mobile technology to your child? (Only ask if not answered by question 1)
c. What mobile technologies would you introduce first? Why?
d. Who would make the decisions about when your child is introduced and what your child is introduced to?

3. Are there situations in which you do not allow access to the technology?

If yes:

a. In what situations do you not allow access?
b. When did you set these boundaries?
c. Have the boundaries changed at all since you initially implemented them?

If no:

a. Why do you not have boundaries?
b. Do you feel you will have boundaries and if so in what type of situation?

Ask these questions of all parents

4. Does your child watch television?

If yes:

a. How often/how much—in a day?
b. What does your child watch?
c. Do you or someone else (sibling, caregiver, etc.) watch television with the child?
d. In your opinion what do you feel the television compares to mobile technology for your child? Specifically, what do you feel are the positives and negatives when comparing?

5. Does your child use a desktop computer?

If yes:

a. How often/how much?
b. What does your do on the computer?
c. Do you or someone else (sibling, caregiver, etc.) provide assistance when your child is using the computer?
d. In your opinion how does the computer compare to mobile technology for your child?

6. I am trying to find out about early introduction to mobile technologies with children. Is there a question or piece of information that I have not asked about that you would like to share?

Appendix B

Demographics Information

1. **Gender**
   - ☐ Male
   - ☐ Female
   - ☐ Other

2. **What is your age?**

3. **Marital Status?**
   - ☐ Single
   - ☐ Common Law
   - ☐ Married
   - ☐ Divorced/Separated/Widowed

4. **Please indicate your highest level of education?**
   - ☐ No formal Education
   - ☐ Some Elementary School
   - ☐ Completed Elementary School
   - ☐ Some High School
   - ☐ High School Diploma
   - ☐ Some Post Secondary Education
   - ☐ College Diploma
   - ☐ Bachelor Degree
   - ☐ Masters Degree
   - ☐ Doctorate
   - ☐ Post Doctorate

5. **What is your first language?**
   - ☐ English
   - ☐ French
   - ☐ Other: Please Specify ______________________

6. **What language(s) are spoken at home (Check all that apply)?**
   - ☐ English
   - ☐ French
   - ☐ Other: Please Specify ______________________

7. **How many children do you have?**

8. **Please list the age and gender of all children in order of birth. Place a checkmark beside the child you were thinking of while responding to the interview questions.**

☐ 1st Born: *Gender:* Male/Female *Age:* # of Years ____ # of Months ____
☐ 2nd Born: *Gender:* Male/Female *Age:* # of Years ____ # of Months ____
☐ 3rd Born: *Gender:* Male/Female *Age:* # of Years ____ # of Months ____
☐ 4th Born: *Gender:* Male/Female *Age:* # of Years ____ # of Months ____
☐ 5th Born: *Gender:* Male/Female *Age:* # of Years ____ # of Months ____
☐ 6th Born: *Gender:* Male/Female *Age:* # of Years ____ # of Months ____

Appendix C

INVITATION TO PARTICIPATE IN A STUDY EXAMINING THE INTRODUCTION OF MOBILE TECHNOLOGY TO INFANTS AND TODDLERS

Wilfrid Laurier University, 75 University Avenue West,
Waterloo, ON, N2L 3C5 Department of Psychology
(519) 884-1970
REB#4569

Researchers: Dr. Eileen Wood and Karin Archer

Dear Parent,

You have been invited to participate in this research study conducted by Dr. Eileen Wood and doctoral student Karin Archer. This study looks at when and how parents introduce mobile technology to their children. While mobile technology is appearing in many homes and becoming an important part of children's lives, we know very little about how these technologies are used with young children. This study will help us understand more about how the technology is used with young children and how parents support them when using the technology. The results of this study will be important for parents, educators and care providers, as it will give us an idea of parents' perceptions and personal experiences when introducing mobile technology to infants and toddlers. We are recruiting 40 parents (mother and fathers) who are 16+ years of age, who have a child between 12 and 36 months of age (i.e., 1 – 3 years).

There is no compensation for participating in this study. Your participation in this study is completely voluntary. Parents in this study will be asked to take part in a face-to-face, one-on-one interview at a mutually agreed upon location. Questions will involve when and how mobile technology was introduced your child, how it is used, and what factors parents consider in the role mobile technology plays in their children's lives. The interview will be audio recorded to allow for analyzing later on and will take approximately 25 minutes to complete. One of the following researchers or research assistants will organize and run the interview. Dr. Eileen Wood, Karin Archer, Domenica De Pasquale, Megan Dodds, Harmanpreet Chauhan.

There are few foreseeable risks associated with participating in this study. You might feel uncomfortable answering some of the questions during the interview. You can choose not to answer any questions that you don't feel comfortable answering. You also have the option of stopping the interview completely at any time and for any reason without penalty. If you withdraw from the study before data collection is completed your data will be removed from the study and destroyed. Your data cannot be withdrawn once data collection is complete because the data will be stored without identifiers.

All information collected during this study will be securely stored in locked cabinets and on password protected computers within Dr. Eileen Wood's lab at Wilfrid Laurier University. The answers provided during the interview are completely anonymous. You will be provided with a code prior to the beginning of the interview. This code will be used on the audio recording and no personal information will be recorded. Once the audio recording is transcribed into a written document, the recording will be destroyed. Only the researchers and research assistants listed above will have access to the data. De-identified data will be retained indefinitely and may be shared with other researchers in the lab for academic research purposes only. These data may also be reanalyzed and included in future projects. All other forms of data will be destroyed by the researchers no later than June 30, 2023. At the conclusion of the study, results will be reported as anonymous group data in scientific journals, academic presentations and Karin Archer's doctoral dissertation. The results may also be available via Open Access.

If you have questions at any time about the study or the procedures (or you experience adverse effects as a result of participating in this study), please email one of the researchers:

Dr. Eileen Wood, ewood@wlu.ca (519) 884-0710 x3738
Karin Archer, arch4790@mylaurier.ca (519) 884-0710 x3359

This project has been reviewed and approved by the University Research Ethics Board (REB #4569), which receives funding from the Research Support Fund. If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact

Dr. Robert Basso, Chair, Wilfrid Laurier University Research Ethics Board, (519) 884-1970, ext. 4994 or rbasso@wlu.ca.

Sincerely,
Dr. Eileen Wood & Karin Archer, Department of Psychology, Wilfrid Laurier University

---

CONSENT

I have read and understand the above information. I have received a copy of this form.

☐ I agree to participate in the interview.

The questions asked during the interview are open-ended. Sometimes people provide very important information that we would like to share with others. We would like to ask your permission to be able to use a quote if we believe it would contribute greatly to explaining a point. You will not be provided with an opportunity to review your quotations before they are used, but we would ensure that the quote could not be traced back to you (we would remove all names, institutions and personal sayings to make sure it is anonymous). Use of quotations is not mandatory; you can still participate if you do not give us permission to quote you.

☐ I agree to have quotes from the interview used (providing they remain anonymous).

Participant's Signature: ___________________________ Date: _____________________

Researcher's Signature: ___________________________ Date: _____________________

_ _

STUDY FEEDBACK

A summary of the results will be posted in the psychology department at Wilfrid Laurier University by November 30, 2016. If you would like to receive a copy the results, please provide your email address below (note: email addresses will be stored separate from the data and will be destroyed by the researchers by November 30, 2016):

____

Appendix D

EXAMINING THE INTRODUCTION OF MOBILE TECHNOLOGY TO INFANTS AND TODDLERS

Debriefing Letter

Wilfrid Laurier University, 75 University Avenue West, Waterloo, ON, N2L 3C5
Department of Psychology
(519) 884-1970
REB#4569

Researchers: Dr. Eileen Wood and Karin Archer

Thank you for taking part in this study! Your participation is sincerely appreciated, and we hope that you have found your experience to be interesting.

The purpose of the current study was to examine when and how parents introduce mobile technology to their children. Particularly, how do parents assist their children when they are first learning, and what factors do parents consider when deciding to introduce the technology.

Findings from the current study will assist in developing possible guidelines for parents to use when introducing mobile technology to their children.

If you have any questions or concerns regarding the study you may contact Dr. Eileen Wood at ewood@wlu.ca or (519) 884-0710 ext.3738, or at room N2074D in the Science Building or Karin Archer at arch4790@mylaurier.ca or (519) 884-0710 ext.3359 or at room SR111 in the Science Research Building. This project has been reviewed and approved by the Research Ethics Board at Wilfrid Laurier University. If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact Dr. Robert Basso, Chair, University Research Ethics Board, Wilfrid Laurier University, (519) 884-0710, extension 4994 or email at rbasso@wlu.ca.

For feedback about the results of the study, please check the study feedback board opposite of N2006 on the second floor of the Science Building at Wilfrid Laurier University. Alternatively if you provide an email address results can be sent to you via email. Study results will be posted as soon as they are available, by November 30, 2016. Thank you again for your participation!

Appendix E

Complete Survey

Demographics

1. What is your gender?
   - Female
   - Male
   - Other

2. What is your age ________?

3. What is your marital status?
   - Single
   - Common Law
   - Married
   - Divorced/Separated/Widowed

4. Please indicate your highest level of education.
   - No formal Education
   - Some Elementary School
   - Completed Elementary School
   - Some High School
   - High School Diploma
   - Some Post Secondary Education
   - College Diploma
   - Bachelor Degree
   - Masters Degree
   - Doctorate
   - Post-Doctorate

Pick ONE child that is between 12 months and 24 months of age (or close to that age range) and think about that child when answering the questions in the remainder of the survey. Please enter the 1st initial of the 1st name of the child that you are thinking about _______

5. What is the age of the child you are thinking of in months ________?

6. What is your relationship to the child?
   - Mother
   - Father
   - Other

7. What is YOUR first language?

- English
- French
- Other: Please Specify ____________________

8. What is your CHILD'S first language?
    - English
    - French
    - Other: Please Specify ____________________

9. What language(s) are spoken at home (Check all that apply)?
    - English
    - French
    - Other: Please Specify ____________________

10. How many children do you have? _______________

Development (Ages & Stages)

Based on the age of the child (Response to Question 9) the appropriate ages and stage questionnaire will be presented. *Below is an **example** of the questions presented for a child that is 12 months old.*

12 Month Questionnaire (11 Months 0 days through 12months 30 days) On the following pages are questions about activities babies may do. Your baby may have already done some of the activities described here, and there may be some your baby has not begun doing yet. For each item, please indicated whether your baby is doing the activity regularly, sometimes or not yet.

COMMUNICATION

	Yes	Sometimes	Not Yet
Does your baby make two similar sounds, such as "ba-ba," "da-da," or "ga-ga"? *(The sounds do not need to mean anything.)* If you ask your baby to, does he play at least one nursery game even if you don't show him the activity yourself (such as "bye-bye," "Peekaboo," "clap your hands," "So Big")?			
Does your baby follow one simple command, such as "Come here," "Give it to me," or "Put it back," without your using gestures?			
Does your baby say three words, such as "Mama," "Dada," and "Baba"? *(A "word" is a sound or sounds your baby says consistently to mean someone or something)*			
When you ask, "Where is the ball (hat, shoe, etc.)?" does your baby look at the object? *(Make sure the object is*			

present. Mark "yes" if she knows one object.)			
When your baby wants something, does he tell you by pointing to it?			

GROSS MOTOR

	Yes	Sometimes	Not Yet
While holding onto furniture, does your baby bend down and pick up a toy from the floor and then return to a standing position.			
While holding onto furniture, does your baby lower herself with control (without falling or flopping down)?			
Does your baby walk beside furniture while holding on with only one hand?			
If you hold both hands just to balance your baby, does he take several steps without tripping or falling? *(If your baby already walks alone, mark "yes" for this item.)*			
When you hold one hand just to balance your baby, does she take several steps forward? *(If your baby already walks alone, mark "yes" for this item.)*			
Does your baby stand up in the middle of the floor by himself and take several steps forward?			

FINE MOTOR

	Yes	Sometimes	Not Yet
After one or two tries, does your baby pick up a piece of string with his first finger and thumb? *(The string may be attached to a toy.)*			
Does your baby pick up a crumb or Cheerio with the tips of her thumb and finger? She may rest her arm or hand on the table while doing it.			
Does your baby put a small toy down, without dropping it, and then take his hand off the toy?			
Without resting her arm or hand on the table, does your baby pick up a crumb or Cheerio with the tips of her thumb and finger?			
Does your baby throw a small ball with a forward arm motion? *(If he simply drops the ball, mark "not yet" for this item.)*			
Does your baby help turn the pages of a book? (You may lift a page for him to grasp.)			

PROBLEM SOLVING

	Yes	Sometimes	Not Yet
When holding a small toy in each hand, does your baby clap the toys together (like "Pat-a-cake")?			
Does your baby poke at or try to get a crumb or Cheerio			

that is inside a clear bottle (such as a plastic soda-pop bottle or baby bottle)?			
After watching you hide a small toy under a piece of paper or cloth, does your baby find it? *(Be sure the toy is completely hidden.)*			
If you put a small toy into a bowl or box, does your baby copy you by putting in a toy, although she may not let go of it? *(If she already lets go of the toy into the bowl or box, mark "yes" for this item.)*			
Does your baby drop two small toys, one after the other, into a container like a bowl or box? *(You may show him how to do it)*			
After you scribble back and forth on paper with a crayon (or pencil or pen), does your baby copy you by scribbling? *(If she already scribbles on her own, mark "yes" for this item.)*			

PERSONAL-SOCIAL

	Yes	Sometimes	Not Yet
When you hold out your hand and ask for his toy, does your boy offer it to you even if he doesn't let go of it? *(If he already lets go of the toy into your hand, mark "yes" for this item.)*			
When you dress your baby, does she push her arm through a sleeve once her arm is started in the hole of the sleeve?			
When you hold out your hand and ask for his toy, does your baby let go of it into your hand?			
When you dress your baby, does she lift her foot for her shoe, sock or pant leg?			
Does your baby roll or throw a ball back to you so that you can return it to him?			
Does your baby play with a doll or stuffed animal by hugging it?			

Parenting Style

Spouse exhibits behavior 1 = Never 2 = Once in a while 3 = About half of the time 4 = Very often 5 = Always		**I exhibit this behavior** 1 = Never 2 = Once in a while 3 = About half of the time 4 = Very often 5 = Always
Spouse	I	
		1. [He is] [I am] responsive to our child's feelings or needs.
		2. [He uses] [I use] physical punishment as a way of disciplining our

		child.
		3. [He takes] [I take] our child's desires into account before asking the child to do something.
		4. ~~When our child asks why he or she has to conform, [he states] [I state]: because I said so, or I am your parent and I want you to.~~
		5. [He explains] [I explain] to our child how we feel about the child's good and bad behavior.
		6. [He spanks] [I spank] when our child is disobedient.
		~~7. [He encourages] [I encourage] our child to talk about the child's troubles.~~
		8. [He finds] [I find] it difficult to discipline our child.
		9. ~~[He encourages] [I encourage] our child to freely express him/herself even when disagreeing with parents.~~
		10. [He punishes] [I punish] by taking privileges away from our child with little if any explanations.
		11. [He emphasizes] [I emphasize] the reasons for rules.
		12. [He gives] [I give] comfort and understanding when our child is upset.
		13. [He yells or shouts] [I yell or shout] when our child misbehaves.
		14. [He gives praise] [I give praise] when our child is good.
		15. [He gives] [I give] in to our child when the child causes a commotion about something.
		16. [He explodes] [I explode] in anger toward our child.
		17. [He threatens] [I threaten] our child with punishment more often than actually giving it.
		18. [He takes] [I take] into account our child's preferences in making plans for the family.
		19. [He grabs] [I grab] our child when being disobedient.
		20. [He states] [I state] punishments to our child and [does] [do] not actually do them.
		~~21. [He shows] [I show] respect for our child's opinions by encouraging our child to express them.~~
		~~22. [He allows] [I allow] our child to give input into family rules.~~
		23. [He scolds and criticizes] [I scold and criticize] to make our child improve.
		24. [He spoils] [I spoil] our child.
		25. [He gives] [I give] our child reasons why rules should be obeyed.
		26. [He uses] [I use] threats as punishment with little or no justification.
		27. [He has] [I have] warm and intimate times together with our child.
		28. [He punishes] [I punish] by putting our child off somewhere alone with little if any explanations.
		~~29. [He helps] [I help] our child to understand the impact of behavior by encouraging our child to talk about the consequences of own actions.~~

		30. [He scolds or criticizes] [I scold or criticize] when our child's behavior doesn't meet our expectations.
		31. [He explains] [I explain] the consequences of the child's behavior.
		32. [He slaps] [I slap] our child when the child misbehaves.

Temperament

	Not at all like the child 1	2	3	4	A lot like the child 5
Sociability					
The child makes friends easily					
The child is very friendly with strangers.					
The child takes a long time to warm up to strangers *(reversed)*					
The child tends to be shy. *(reversed)*					
Emotionality					
The child gets upset easily.					
The child tends to be somewhat emotional.					
The child reacts intensely when upset.					
The child cries easily.					
The child often fusses and cries.					
Activity					
The child is very energetic					
The child is always on the go.					
The child prefers quiet, inactive games to more active ones. *(reversed)*					
The child is off and running as soon as he wakes up in the morning.					
When the child moves about, he usually moves slowly. *(reversed)*					
Attention Span-Persistence					
Plays with a single toy for long periods of time.					
The child persists at a task until successful.					
The child goes from toy to toy quickly. *(reversed)*					
The child gives up easily when difficulties are encountered. *(reversed)*					
With a difficult toy, the child gives up quite easily. *(reversed)*					
Soothability					
Whenever the child starts crying, he can be easily distracted.					

When upset by an unexpected situation, child quickly calms down.					
The child stops fussing whenever someone talks to him or picks him up.					
If talked to, the child stops crying.					
The child tolerates frustration well.					

Shyness

	Never 1	Very rarely 2	Less than half the time 3	About half the time 4	More than half the time 5	Almost always 6	Always 7	Does not apply N/A
When approached by an unfamiliar person in a public place (for example, the grocery store), how often did your child								
remain calm? *(reverse)*								
pull back and avoid the person?								
cling to a parent?								
When approaching unfamiliar children playing, how often did your child								
watch rather than join?								
approach slowly?								
seem uncomfortable?								
In situations where s/he is meeting new people, how often did your child								
turn away?								

become quiet?								
seem comfortable? *(reverse)*								
While visiting relatives or adult family friends s/he sees infrequently, how often did your child								
stay back and avoid eye contact?								
hide his/her face?								
"warm up" to the person within a few minutes? *(reverse)*								

Technology and Use

1. How frequently does your child access the following technologies? (Please select N/A if the technology is not available to the child)

	Daily	5-6 days a week	3-4 days a week	1-2 days a week	Less than once a week	Never	N/A
Desktop Computer							
Laptop Computer							
Television							
Background television							
Tablet							
Smartphone							
iPod							
eReader							
Children's Learning Tablet (Ex. Leapfrog, vTech)							
Handheld gaming system (Ex. Nintendo DS)							
Other: Please specify							
Screen time in							

general							

2. On average, each time your child accesses the following technologies, how much time do they spend using them? (Please select N/A if the technology is not available to the child)

	Under 5 minutes	6 to 10 minutes	11 to 20 minutes	21 to 30 minutes	31 to 60 minutes	61 minutes or more	N/A
Desktop Computer							
Laptop Computer							
Television							
Background television							
Tablet							
Smartphone							
iPod							
eReader							
Children's Learning Tablet (Ex. Leapfrog, vTech)							
Handheld gaming system (Ex. Nintendo DS)							
Other: Please specify							
Screen time in general							

Introduction to Mobile Technology

3. Please list the age (in months) of each of your children when they were introduced to the following technologies. (Pleas write N/A if they have not been introduced yet)

	1st child	2nd child (age in months _______)	3rd child (age in months _______)	4th child (age in months _______)	5th child (age in months _______)	6th child (age in months _______)
Television						
Laptop						
Tablet						
Smartphone						

4. Please rate how much the following statements apply.

	Strongly Agree (1)	(2)	Neither agree nor disagree (3)	(4)	Strongly Disagree (5)	N/A
I consciously decided when to introduce the TABLET to my child.						
I consciously decided when to introduce the SMARTPHONE to my child.						
My child's introduction to the TABLET was unplanned.						
My child's introduction to the SMARTPHONE was unplanned.						

5. When introducing the following new technologies I…

	Showed my child exactly how to use it. (1)	(2)	I showed my child what to do while also allowing them to explore on their own (3)	(4)	I allowed my child to explore and learn on their own (5)	N/A
Tablet						
Smartphone						

6. Please rate interested your child is in mobile technology compared to when they were first introduced to it.

	There are far less interested now than when they were first introduced (1)	(2)	There interest is the same as when they were first introduced (3)	(4)	They are far more interested now than when they were first introduced (5)	N/A
Tablet						
Smartphone						

Mobile Technology Use

7. Please mark how frequently your child uses mobile technology for the following.

	Never	Rarely	Sometimes	Often	Always	N/A
Held/touched the device						
Listened to Music						
Looked at pictures						
Taken pictures						
Watched home videos						
Taken home videos						
Watch short video clips (under 5 minutes in length)						
Watch shows (episodes)						
Watch movies						
Watch YouTube						
Used apps for entertainment						
Used apps for education						
Played games on the internet						
Played free-play games (Ex. Touch an animal to hear a sound)						
Played goal-directed games (Ex. Must complete tasks to continue to next level)						
Unlocked the phone themselves						
Had the phone unlocked for them						
Read/looked at books						
Listened to books						
Watched movies						
Watched videos						
Audio ONLY phone call						
Video phone call (Ex. Skype/Face Time)						
Navigated the device (Ex. Opened app, etc.)						
Other: Please specify						

8. How frequently have you seen your child perform the following gestures on a touchscreen device?

	Never	Rarely	Sometimes	Often	Always	N/A
bang on screen (with an open hand)						
tap (quick one finger touch)						

flick (quickly brush surface with a fingertip, as if turning a book page)						
press (touch and hold for an extended period of time)						
press and drag (touch with one finger and while holding down, move finger slowly)						
swipe (touch with multiple fingers and while holding down, move them slowly)						
pinch *(Scale down)* (touch surface with two fingers and move them together, e.g., to zoom out while viewing a photograph)						
spread *(Scale up)* (touch surface with two fingers and move them apart, e.g., to zoom in while viewing a photograph)						
One finger rotation						
Two finger rotation						

9. How much does your child use the mobile device at various locations?

Always at Home			Equally for Both			Always Outside of the Home
1	2	3	4	5	6	7

10. How likely would you be to give your child the mobile technology in the following situations?

	Never	Rarely	Sometimes	Often	Always
Restaurant					
Medical appointments					
Grocery store					
Short car rides					
Long car rides					
Other people's houses					
Church					
Waiting room					
During family outings					
During sibling's activities					
Other: Please specify					

11. How frequently do you use mobile technology for the following?

	Never	Rarely	Sometimes	Often	Always
As a reward					
As an educational tool					
As a distraction when you need time					
To calm your child when they are over active					
To calm your child when they are upset					
To keep your child quiet					
To settle them before bed					
To occupy your child					
Other: Please specify					

Device Attributes

12. Please rate how much you feel each device encourages the following.

	Not at all 1	2	3	4	A lot 5
Passivity					
Television					
Tablet					
Smartphone					
Interactivity					
Television					
Tablet					
Smartphone					
Engagement					
Television					
Tablet					
Smartphone					
Structured play					
Television					
Tablet					
Smartphone					
Imaginative play					
Television					
Tablet					
Smartphone					
Creative play					

Television					
Tablet					
Smartphone					
Active play					
Television					
Tablet					
Smartphone					
Entertainment					
Television					
Tablet					
Smartphone					
Education					
Television					
Tablet					
Smartphone					
Social Interaction					
Television					
Tablet					
Smartphone					

13. For each device please select how frequently you have seen your child do each action.

	Never	Rarely	Sometimes	Often	Always
Dancing					
Television					
Tablet					
Smartphone					
Singing					
Television					
Tablet					
Smartphone					
Clapping					
Television					
Tablet					
Smartphone					
Pointing					
Television					
Tablet					
Smartphone					
Standing Still					
Television					
Tablet					
Smartphone					
Sitting Still					
Television					

Tablet					
Smartphone					
Lying down					
Television					
Tablet					
Smartphone					

Concerns and Boundaries for Technology

14. Please rate how concerned you are about each situation when your child is using the device.

	Not at all concerned				Extremely concerned	N/A
	1	2	3	4	5	
Repair cost if child should damage the device						
Television						
Tablet						
Smartphone						
Child seeing inappropriate content						
Television						
Tablet						
Smartphone						
Child seeing advertisements						
Television						
Tablet						
Smartphone						
Child using the technology too much						
Television						
Tablet						
Smartphone						
Child deleting something important						
Television						
Tablet						
Smartphone						
That the child can navigate the technology without you being there						
Television						
Tablet						
Smartphone						
Other: Please specify						
Television						
Tablet						
Smartphone						

Parental Opinion and Use

15. During an average day how often do YOU perform the following on MOBILE technology?

	Never	Rarely	Sometimes	Often	Always	N/A
Use text messaging						
Use email						
Play music						
Receive notifications						
Browse the Internet						
Play games online						
Play app games						
Watch videos						
Take pictures						
Look at a pictures						
Take home movies						
Look at home movies						
Read books						
Read news						
Other: Please specify						

16. How much do you use mobile technology for personal use versus for work?

Always for Work			Equally for Both			Always for Personal Use
1	2	3	4	5	6	7

17. How much time do you use mobile technology versus your spouse/significant other?

I use mobile technology far more than my spouse			We both use it equally			My spouse uses mobile technology far more than me	N/A
1	2	3	4	5	6	7	

18. Please rate the impact you feel MOBILE TECHNOLOGY has on your child's development in each of the following areas.

	Extremely Harmful (1)	(2)	Not Harmful nor Helpful (3)	(4)	Extremely Helpful (5)	Haven't thought about it	N/A
Cognitive Development							
Language Development							
Motor Skills Development							
Social Development							

Appendix F
Post-Observation Survey

For each of the following items please respond to how YOU felt with the iPad® we asked you to use.

	Not at all	Not very	Neither nor	Some-what	Very
How familiar were you with the iPad®					
How comfortable were you using the iPad®					
How easy was the iPad® to use					
How interesting did you find the iPad® to use					

For each of the following items please respond to how YOUR CHILD felt with the iPad® we asked you to use.

	Not at all	Not very	Neither nor	Some-what	Very
How familiar were they with the iPad®					
How comfortable were they using the iPad®					
How easy did they feel the iPad® was to use					
How interesting did they find the iPad® to use					

For each of the following items please respond to how YOU felt with the SOFTWARE we asked you to use.

	Not at all	Not very	Neither nor	Some-what	Very
How familiar were you with the software					
How comfortable were you using the software					
How easy was the software to use					
How interesting did you find the software to use					

For each of the following items please respond to how YOUR CHILD felt with the SOFTWARE we asked you to use.

	Not at all	Not very	Neither nor	Some-what	Very
How familiar were they with the software					
How comfortable were they using the software					
How easy did they feel the software was to use					
How interesting did they find the software to use					