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Abstract

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There has long been debate about the use of screen technology with young children,

which has been renewed with the introduction of touch screen technologies like the iPad.

The novelty of this technology means that there has thus far been limited research on the

matter, especially in regard to how infants and toddlers may benefit or miss out by

playing with these devices. The first part of this paper reviews the literature currently

available, looking at previous research about television viewing as well as emerging

research about touch screens. The second part takes observation of three toddlers, ages

20-26 months, using iPads as well as playing with traditional toys and analyzes the

differences in play and the developmental skills demonstrated by each.

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Introduction

Technology has become an ever-increasing part of our lives. Not only is it more prevalent in society as a whole, but it has also begun to be designed for younger and younger audiences. One of the newest technologies to enter the market is the tablet computer, such as Apple's iPad, which is operated by using a touch screen instead of a mouse and keyboard. This makes it especially user-friendly, even for young children. With the advent of the tablet have come a bevy of applications (apps) to be used therein, including many marketed to infants and toddlers. Developers claim many of these apps are educational. This raises the question: What effect does tablet technology use have on children in the early years? The research so far is inconclusive, but by looking at studies that examine the benefits and drawbacks of television viewing and the recent research into what young children can understand from a touch screen, we can begin to answer that question.

Developmental Rationales about Infants, Toddlers, and Screens

There are iPad apps designed for children as young as six months. It is around this age that infants demonstrate the beginning of perceptual skills that will allow them to interact with a touch screen device. After six months of age, they can observe certain properties of an object just by looking at it, without the need to make a tactile exploration (Fogel, 2009). This is crucial when interacting with a two-dimensional image on a screen. Soon after, they can understand the depth with visual cues when looking at a photograph (2009). This coincides with an increased interest in books and television, and by extension, other screen devices. But, in their review of past studies, Courage and Howe (2010) found little evidence of children learning from electronic media before 18 months.

The fact that before the age of 18 months children learn significantly better from people than from technology has been called the video deficit (Guernsey, 2013). Before 18 months, children do not have enough symbolic thought to understand that television is representational, not real, making it difficult to use as an educational medium (Kirkorian, Wartella, and Anderson, 2008). After 18 months, there is some evidence of children learning from screens, but the research is still mixed (Guernsey, 2013). There is continuing research into the reason why the video deficit exists. A common attribution is representational inflexibility: the inability to recognize an object as both a two-dimensional image and a representation of a three-dimensional object at the same time (Kirkorian & Pempek, 2013). This, in turn, means that it is difficult for an infant or toddler to make the connection between two-dimensional pictures and their real world equivalents (Barr, 2013), which can limit how much a child can extend learning from a screen to the real world.

Zack, Barr, Gerhardstein, Dickerson, and Meltzoff (2009) sought to find an explanation for the video deficit phenomenon. They encouraged groups of 15-month-olds to imitate a seen-behavior, the pushing of a button, under three different conditions. Some children were given the same apparatus (either a real button or a touch screen with a button on it); some were given the opposite (i.e. they watched a button pushed on screen but were presented with a real button). Children who were given the same device as the demonstrator were more likely to reproduce the action than those who were given the other material. This is in keeping with the current theory of representational inflexibility; it was hard for the participants to move their knowledge from the two-dimensional to the three-dimensional or vice versa.

When looking at what children may get out of touch screen technology it is important to think about how children are interacting with the world in the first three years. There are several theories that attempt to explain how children learn. Often cited are Jean Piaget's theories of cognitive development. He breaks down the first two years of life into six stages (Fogel, 2009), with the over-arching theme of sensorimotor learning. In the first few months of life (which comprise the first two stages), children are learning how to use their bodies to interact with the world, a process that continues through childhood (2009). According to Piaget, from four to eight months, an infant can repeat an accidental action in order to get the now-expected outcome (2009). As the infant approaches the end of his first year, one can see the appearance of intentional goal-directed behavior (2009). In the first half of the second year of life, children develop active and purposeful trial and error (2009). Somewhere around 18 and 24 months is when Piaget notes the beginning of symbolic representational thought, that is to say when children can more obviously demonstrate these skills which they have been developing over the last year. They begin to demonstrate deferred imitation, symbolic play, and language (2009). This means that for most of the first two years of life, a child cannot plan their actions in their head; they must physically interact with an object in order to understand it and how to work with it.

Also popular are the social constructivist theories of Lev Vygotsky (See Miller, 2011). Vygotsky believed that people, including children, learn from their interactions with others; either by engaging with them or by observing their actions and attempting to repeat those actions (2011). In this way, children learn not only how to do these tasks but also learn about their own cultures, based on the value those around them placed on

specific tasks or actions (2011). Vygotsky also greatly valued language's role in development. Language is a type of symbolic thought. It is also a product of the child's culture, as well as a problem solving tool. He observed that young children use something called "private speech" while problem solving; where they talked aloud as they work (2011). Finally, Vygotsky explained a concept known as the Zone of Proximal Development (ZPD), which encompassed tasks that one had not yet mastered but could perform with the assistance of a more knowledgeable adult or peer (2011).

Later researchers have expanded upon Piaget's theories. They believe that children develop the skills he outlined far earlier than he theorized. Likely this is due to infants developing these skills but not always being able to demonstrate them in a way that Piaget could observe. For example, an infant may have developed object permanence; in that they know an item that disappeared from view stills exists. However, they cannot demonstrate this knowledge, because they do not know to search for it **(**Flavell, Miller, & Miller, 2002**).** Research indicates other instances of more advanced understanding than Piaget observed, though there is still a great deal of debate about just how much an infant or toddler understands at a given age. Piaget did not believe infants could use physical movements to try to change and control their physical world until four to eight months, but some studies suggest that a newborn can perform an action with that purpose (Berk, 2005). Likewise, research has found that children as young as eight-months-old can recall where an object is hidden, creating mental representations long before Piaget's theorized 18 months (2005). This is also demonstrated in deferred imitation studies. When a child imitates an action some time after they witness it, this shows the child is able to represent the experience. They store it in their mind for some

period of time without it being directly in front of them. Studies have found newborns to be able to immediately imitate a facial gesture (like sticking out the tongue) less than an hour after birth (Meltzoff, Kuhl, Movellan, & Sejnowski, 2009). Babies who are two- or three-weeks-old have been able to demonstrate deferred imitation of these facial gestures as much as a day later (Meltzoff & Williamson, 2010). By as early as six months, an infant can imitate an observed action on another object.

Piaget did not give much attention to the child's social world in his theories, but other researchers have declared this a critical aspect of cognitive development (Flavell et al., 2002). As Vygotsky pointed out, children learn a great deal by observing and imitating the behaviors of others. Imitation not only demonstrates a child's ability to create mental representations but also demonstrates an effective method of learning (Meltzoff et al., 2009). For young infants and toddlers, this social aspect seems especially important, as Meltzoff et al. explain, "infants are predisposed to attend to people and are motivated to copy actions they see others do" (2009, p. 285). This is another proposed explanation for the existence of the video deficit; a television show lacks the social interaction that other people provide and therefore the young child is less incentivized to attend to what is on screen in the same way they would a person (Meltzoff & Williamson, 2010).

Allison Gopnik (2012) expands on this when she states that children learn about their world using scientific methods. She presents observation of the actions of others as one of those methods. From birth, children have their own theories about the world and what they can expect to happen in a given circumstance. As they gain experience, they adjust these theories and gain new, more accurate understandings. Children also actively

experiment in their world, much like Piaget described, as they go through certain actions and observe the results.

Physically, the demands of a touch screen can be met earlier then those of a computer. Children under age three lack the fine motor skills required to really engage with a computer. Indeed, in 2012 38% of children younger than two years had used a mobile device, but only 10% had used a computer (Zero to 8, 2013). By six months, infants are experimenting with the physical manipulation of objects. (Connor, Williams & Siepp, 1977). Over the next few months, they typically develop increased wrist mobility, and the ability to use both hands to hold or manipulate an object as well as beginning to visually monitor their hand movements (1977). It seems that an infant under age one could to some degree use their hands to manipulate a touch screen. Between eight and twelve months, infants start using their index finger and thumb for grasping and they begin to slide and push an object on a flat surface (1977); this could be picking up a Cheerio, but it could also be a tapping or dragging motion on a touch screen. These newly developed abilities mean the child can further interact with a touch screen device. Children's play opportunities increase with the development of their fine motor skills both in the analog and the digital world.

Research about Television, Video, and DVDs

Tablet computers were first introduced to the wider public in 2010 with the introduction of Apple's iPad (Williams, 2015). Therefore, many of the current assumptions about the effects of touch screen media are extrapolated from research done about television and its effects on children.

There has been a great deal of research into how much young children can learn from television. Few studies have found benefits for children under two. In fact, there are known negative effects, especially from background television use as well as other potential negative effects from direct viewing (Council on Communications and Media, 2011). Background television specifically is problematic, because it can distract a parent from interacting with their child or a child from their parent. Even if the parent is not involved in the child's play, the child can still be distracted by the noise and light of a television in the background (2011). In terms of direct viewing, there have been many studies into the educational claims of infant television and video programming (such as Fenstermacher et al., 2010), but there has been little conclusive evidence of the benefits. Some negative effects have been found such as decreased language production and difficulty sleeping (Council on Communications and Media, 2011). Studies of children under two have correlated attention problems with increased television use, but it is difficult to state with certainty that there is causal link (2011). These concerns are important to keep in mind when thinking about how use of touch screen technology may affect development. Do the problems of television also apply or do the interactive features mitigate them?

The type of television that children are exposed to also matters. Zimmerman and Christakis (2007) had parents of children under the age of five record their children's activity on two randomly chosen days. All primary and secondary activities were recorded, including which television shows they watched. The researchers categorized the shows into three categories: educational, non-violent entertainment, and violent content. Five years later, potential attention problems were assessed with a parent

questionnaire. They found that viewing of educational programming did not have an effect on attention regulation. However, the viewing of non-educational programming (whether the intended audience was child or adult) before age three was highly correlated with later attention problems. Linebarger and Walker (2005) also found that the type of television show mattered, with some content being more educational than others. They had families document their child's television watching from six-months-old until 30 months, while also performing cognitive and language assessment on a regular schedule. The study found that children who watched *Dora the Explorer, Blue's Clues, and Arthur* did better on vocabulary assessments than those that watched *Barney, Sesame Street,* or *Teletubbies.* The difference in learning was most noticeable looking at specific shows than when comparing total viewing time. The authors posited that this might be due to the format of the programs. Shows that had characters speak directly to the "camera," like *Dora the Explorer*, and those that had more of a story narrative, like *Arthur,* seemed to lead to better vocabulary scores on the researchers' assessments. Therefore, it is not necessarily how much time a child spends with the screen that has the most effect; rather it is what the child is doing with that screen.

Also relevant is social meaningfulness. In a study of 21-month-old children, Lauricella, Gola, and Calvert (2011) found that children were more likely to replicate a character's actions when the character was familiar (Elmo versus a character from Asia). The researchers concluded that toddlers learn more from videos where the characters are meaningful to them. This is unsurprising, but does highlight the importance of social relationships in learning, an element that can often be lacking in screen time.

The importance of the social interactions with screen learning is shown by Roseberry, Hirsh-Pasek, and Golinkoff (2014). They had children between 24 and 36 months of age taught new verbs either by a static video, a Skype-based social interaction, or a physically present person. When the person on the screen could respond to that child specifically (i.e. Skype) it produced higher levels of acquisition similar to the in-person lessons. The video lessons resulted in a lower level of acquisition.

Indeed, it is conventional wisdom that young children learn best from social interactions. This is based on the theories of Vygotsky, described above, who believed that learning came through interactions with others. Similarly, Meltzoff and Kuhl (2016) found, in their review of current studies on children's cognition, that children under three learned more when there were back and forth interactions between child and caregiver.

It should come as no surprise that more social technology has more educational potential. This point is further proven with the emphasis researchers have placed on co-viewing: whether a parent is present and interacting with the child while using the relevant media. It is this interaction that can bring about positive effects. One study (DeLoache et al., 2010) looked at the effectiveness of educational DVDs for babies between 12 and 18 months. The researchers found that while a parent directly teaching vocabulary led to the most acquisition, a parent and child interacting while watching the DVD also led to acquisition. There was no difference in acquisition between those in the control group (who did nothing) and the group of children who watched the DVD on their own. This too demonstrates how learning for young children, even digitally, is a social act. They learned from interacting with their parent, not from passively observing a screen. A longitudinal study that tracked children from six months of age until 14 months

(Mendelsohn et al., 2010) found that mother-infant dyads that interacted while using electronic media had higher language skills than children with media exposure without the interactions. The formers' scores were only slightly lower than those children who had not been exposed to electronic media at six-months-old. This seems to indicate that screen time can be positive for a child if it is done in concert with an engaged parent.

What is Lost?

On the other hand, there is a lot of concern about what a child may miss out on because they are engaged with a screen. In 2006, Vandewater, Bickham, and Lee found that for each hour of television a one- to two-year-old watched on their own on a weekday, they spent approximately 52 less minutes with their parents and 20 fewer minutes in creative play. Children are social creatures; when quality time with a parent is replaced by screen time the child is missing out on valuable interactions that can help them develop language, interpersonal, and physical skills.

Although that study was based on television viewing, similar concerns exist for tablet use. In terms of social development, researchers have expressed concern that the tablets can become a so-called "shut-up toy" (Radesky, Silverstein, Zuckerman, & Christakis, 2014) for when a parent or caregiver needs their child to calm down, stop complaining, or be occupied by themselves. This can be helpful to caregivers in the short term, but also prevents children from a range of direct experiences including practicing self-regulation skills. One study (Radesky, Silverstein, Zuckerman, & Christakis, 2014) found that infants and toddlers with difficulties in self-regulation watched more television on average than those who had typical self-regulation skills. The researchers hypothesized that parents were habitually putting their "difficult" children in front of a

television. The Common Sense Media Survey (Zero to Eight, 2013) found that parents often used the various forms of media to occupy their children while parents did household chores. Seventeen percent of respondents said they did so often and 49% that they did so sometimes (Zero to Eight, 2013). Twenty-one percent said that they often or sometimes give their child a mobile device to occupy them while they are out running errands. This number is double the amount that responded similarly in a 2011 survey by the same researchers (Zero to Eight, 2011). On the one hand, these devices can give parents a valuable reprieve, but on the other, these children miss out on opportunities to practice self-regulation, social mores, and have real world experiences. Additionally, the research done on young children and television noted earlier only finds benefits of technology when they are used in a conjunction with social interaction. However, if the children are using these technologies when parents are specifically not interacting with them, what benefits do they have?

More broadly, depending on the amount of time involved, it is possible that there is no direct harm that comes from young children playing with touch screen devices (and no research currently suggests a negative impact) in the way that researchers believe that television time can lead to attention, sleep, or health problems. However, the time that a child spends on his/her iPad is time that they may not be spending with their family. It is time that they are not playing pretend, looking at a book, or engaging in sensory play; all activities that research agrees help children develop the requite skills they need to grow and succeed.

Current Research About Tablet Devices

Tablet computers are devices that provide many of the uses of a traditional computer with the added benefits of portability, being handheld, and allowing the use of a finger on the touch screen over a separate device (like a mouse or stylus) for interaction. In a short amount of time, they have become exceedingly popular. One survey (Zero to 8, 2013) found that 75% of parents surveyed had some type of touch screen device (phone, iPod, or tablet). Two years earlier that number was 52% (Zero to 8, 2011). Thirty-eight percent of children under two have used one of these devices (2013).

As new technologies were introduced to the modern family over the course of the late 20th century they have been followed with questions. Are they suitable for children? Of what age? Are they educational? Beneficial? Detrimental? In what ways? From TV use to personal computers, parents and experts have had to weigh the pros and cons of (especially young) children using them. Because they are so new, research about touch screen and tablet technology is sparse but growing.

In a review of current literature, (Radesky, Schumacher, & Zuckerman, 2014) looked at some possible implications of tablet use for infants, toddlers, and preschoolers. They point out that tablets are more responsive than previous technologies, which is critical to educational content for two and three-year-olds, possibly overcoming the screen deficit phenomenon. Digital apps can also offer additional scaffolding techniques, though narration, sound effects, or animation. However, these same elements can also become a distraction.

Geist (2011) observed a classroom of two-year-olds who were given a set of tablet computers. He observed that they could easily use the touch screen interface and

were able to use the tablets independently. The children had more control because the nature of the touch screen interface allowed them to work independently**.** Another study (Aziz, Sin, Batmaz, Stone & Chung, 2014) looked specifically at the fine motor demands of the touch screen and found that even two-year-olds could do a few basic gestures (tap, drag, and flick) and that by age four, most children has mastered the seven finger motions most often used for the devices. Although the study did not investigate how children under two used a tablet, the demands of the tablet do not prevent apps from being designed and used by children as young as 6 months. This is in keeping with the fine motor norms of young children as described earlier.

There are several types of apps that mimic popular toddlers activities and studies have compared how children work in a digital and real world medium for some of them. Crescenzi, Price, and Jewitt (2014) observed two-year-olds finger painting on paper and also painting on a touch screen. They found that the use of the touch screen correlated with a longer time spent at the activity and with children making more marks on the "page." The authors hypothesized that this was due to the ease of not having to move away from the painting to get more paint as the children worked. While this seems to demonstrate that touch screen may helped a child focus on an activity, one wonders if a screen can replicate the full painting experience. For instance, it replaces the messy stimulation of finger paint with a smooth screen. The limited size of the screen removes the opportunity for a variety of big arm movements. It may enhance some areas of an activity but it also diminishes others. In their follow-up study (Price, Jewitt, & Crescenzi, 2015), the authors touch upon these issues, observing that while a child might use different fingers and even their whole palm while finger-painting, painting on the screen

seemed to only call for a stiff index finger to make the desired marks. It was as if the finger was a tool instead a part of the child's body. Painting on the app seemed to reduce the activity to fine motor practice, as well as ignoring the prime benefit of finger painting; its sensory experience. Children of this age are in the borderlands between Piaget's Sensorimotor stage and his Preoperational stage. They are still doing a great deal of learning using their senses. In the case of finger-painting they can explore such concepts as touch and texture; feeling thick and thin, wet and dry, smooth and bumpy, variations that a touch screen lacks. Sensory play is vital to children's development; it helps them develop cognitive concepts and self-regulation (Cataldo, 1983). The authors briefly touched on this loss, while also mentioning the touch screen's great appeal to one child in the study who had dislike getting her hands messy during the paper part of the experiment.

Other studies have looked how children interact with books on their print and digital forms on tablets and e-readers. Enhanced electronic books are a popular category of application for iPads and the like. One study observed the interactions of parents with their children 17-26 months old while reading both e-books and paper books (Strouse & Ganea, 2015**).** This study found that the participant were more engaged while looking at the electronic version of the book than in the paper version and were more likely to point to the book and turn pages when viewing it on screen. Both parents and children talked more about the book during the reading when using the electronic form. However, when vocabulary acquisition was tested both formats scored equally. Interestingly when doing a similar study with three to six-year-olds (Chiong, Ree, Takeuchi, & Erickson, 2012) researchers found that that enhanced e-books negatively impacted the children's recall of

story details. At the same time, the e-books were still more engaging for the child than print books, because they allowed for a more interactive experience. In the infant/toddler study, the authors hypothesized that e-books directed to infants contain less interactive "enhancements" added to the e-book than books for preschool-aged children, which made the former more of a shared reading experience (Strouse & Ganea, 2015). These studies seem to imply that an enhanced book becomes a different type of experience; more a game to play or a show to watch than something to read. The beauty of many technology-free activities for children is that they are open-ended. An app may replicate some elements of the experience but it does not allow the same level of improvisation or wide range of actions that using paint or a real book does. In the case of books, it seems that age of the child-user greatly affects the benefits of the screen. While preschoolers did not get the book experiences that research values for them, like extension and comprehension (Chiong, Ree, Takeuchi, & Erickson, 2012), infants and toddlers did get experiences, like interactions with their caregivers that are important for emergent literacy at that age (McLane & McNamee, 1991).

In 2010, Woolridge and Shapka observed mothers and children, ages 16-25 months playing with traditional toys (like books and shape sorters) and their electronic counterparts (e-books, electronic shape sorters) and observed their interactions. They found that when the pair played with electronic toys, they interacted less, and the child produced less language. It is likely that even with the social benefits of co-viewing, a child could still be missing out on the richer exchanges with others that not-electronic toys provide.

On the other hand, one researcher has noted the many similarities between tablets and more traditional toys; similarities not found between either of them and television viewing. Christakis (2014) identified seven positive features that a child's toy should possess: reactivity, interactivity, tailorability, progressiveness, promotion of joint attention, portability, and being hands-on. He posits an iPad can do most of these; a television does none. Again, it goes to context, if a tablet is used so that these features are highlighted, Christakis believes it is a productive toy for children, though he still emphasized the importance of limiting use to a half hour per day.

Choi and Kirkorian (poster presentation, 2013) had children 24 to 36 months use a touch screen in one of three ways: where the video would continue to play if the child did nothing (non-contingent), where if the child touched the screen at all after a prompt the video would continue (general contingent), and where the child must have touched a specific prompted spot to continue (specific contingent). The child would then watch a sticker be hidden in the video and be told to find it on a felt board that was identical to the array they had seen on the screen. After age three, the children could learn from non-interactive video. Before that age, children who were shown methods that encouraged child interaction (i.e. by having to touch the screen) were more likely to find the sticker. A similar study (Kirkorian, Choi, & Pempek, 2013) found that two-year-old children were able to learn more vocabulary from contingent video, which required the child to interact with the screen to advance the videos, versus a non-contingent video when using e-media. Before 18 months, children absorb little from passive video. But these finding also suggest that the more interactive model of the touch screen could potentially be educational.

Most of what children are learning in the first years is physical and social. There are apps designed to help infants and toddlers learn animal sounds or colors, however those are not the skills that are most important for them to develop. For example, the New York Board of Health provides the following checklist of expected development for an 18-month-old:

- Like to push and pull objects
- Say at least six words
- Follow simple directions ("Bring the ball")
- Pull off their shoes, socks and mittens
- Can point to a picture that you name in a book
- Feed themselves
- Make marks on paper with crayons
- Walk without help
- Walk backwards
- Point, make sounds or try to use words to ask for things
- Say "no," shake their head or push away things they don't want (New York State Department of Health Early Intervention Program, 2011)

While some of these skills may be shown or even practiced on a tablet, most of them involve a more physical experience than technology can provide. It is the experiences that lead to these abilities that are crucial for very young children to have.

Recommendations from Policy Groups

Until recently, the American Academy of Pediatrics (AAP) has consistently recommended no screen time for children under the age of two as well as limiting electronic media use to under for two hours per day to older children (Pediatrics, 2013). Other organizations echoed these recommendations including the Fred Rogers Center and the National Association for the Education of Young Children (NAEYC) (2012). In a joint statement, NAEYC and the Fred Rogers Center note concerns about potential dangers to children's health with increased screen time and point out that the research

about potential benefits of technology in the lives of children are mixed, as well as the risk that it may be used in developmentally inappropriate ways; such as passive watching or as a replacement for active play or social experiences. Therefore, their recommendations, which are geared mostly toward educators, is that technology should only be used with children (specifically birth through age eight) in thought-out, informed, and developmentally meaningful ways. This includes being thoughtful about when to use technology over a real-world experience, avoiding the use of non-interactive technology for young children, and making sure the technology that is used supports interactions between child and caregiver. These recommendations seem to respond to many of the concerns that are invoked when talking about young children using screens and though the recommendations apply to children birth through are eight, the recommendations geared towards the under three set would limit the use of screen time to very specific circumstances.

These technologies have grown exponentially in popularity and have continued to rise (See Zero to 8, 2013). As such, the AAP (Brown, Shifrin, & Hill, 2015) recently convened a panel with the intent of updating their policies for this more digital world, acknowledging that media is no longer contained to a few controllable devices. Although their new recommendations have not yet been finalized, their preliminary findings indicate that they will no longer strictly advise against screen time for children under two. Instead, they are moving their focus from how much time to simply how, although they still encourage parents to put limits on how much screen time their child has. Also noted was the importance of modeling appropriate technology behaviors (such as when to put devices away) and reminding parents that even with technology children still learn best

from social interaction. They also stress the importance of thinking about what one's child is using the tablet for, focusing on high quality apps and fostering connections through programs like Skype. These choices, they conclude, are likely more crucial to children getting something positive from the medium than how long a child uses the technology at any given time. However, they and many other researchers note that the body of knowledge about children's use of tablets is still small and more research is needed to fully understand its possible ramifications.

Research Methodology

In order to examine on an individual level how newer forms of technology affect very young children, this paper looked at the differential play of a few children, aged 20-26 months, while using electronic touch screens and when playing without them. Two common concerns of researchers about touch screen use and young children are (1) that by using technology to the exclusion of direct life encounters, children are missing out on other opportunities for traditional play with accepted developmental benefits and (2) that children are missing out on social interactions by being so focused on the screen.

Observations of Children

Therefore, I intend to make comparisons on how three individual children, play with touch screen technology and how each child plays with other more traditional toys. It is my hope that by observing both I will be able to observe and articulate what benefits a child may receive from using technology use as well as what they may be missing out on by using said devices.

The intention was to observe each child on two separate occasions (due to family circumstances one child was only observed once). Assuming it was in keeping with each child's routine, each session consisted of an observation of that child using their tablet and one observation of that child engaging with their other toys. Later, each set of observations was analyzed for developmental skills demonstrated; focusing on five specific domains: Social, language, physical, cognitive, and attention.

Interviews with Parents of These Children

Secondly, because it is difficult to get a full view of a child's experiences from two observations, I also interviewed the parent(s) or guardian(s) of each child observed.

This allowed me to hear their views about what benefits of technology they see or concerns they have. It also provided additional information about how often and when their child is allowed access to said technology. The two observations for each child will be compared along with the information delivered in the parent interview in order to do some preliminary hypothesizing.

Participants

The participants for this study were found by word of mouth. I put out requests via social media and email for parents with children under age two-and-a-half who use iPads and who would be willing to participate in the study. From this, three subjects, in a six-month age range were chosen. By coincidence all three children selected were girls. They were 20, 22, and 26 months old. All came from households that were middle or upper middle class. They varied in the amount they used their touch screens ranging from once or twice a month to three to four times a week.

Limitations of this Research

This study is a small foray into the research on toddlers and technology. It may provide ideas for further investigation but one cannot draw conclusions from its findings. The design prevents this in several ways. Perhaps the most obvious way is the size of the study. One can gain insight by observing three children play, but it would be unwise to claim broad application. Secondly, although two sets of observations are better than one in terms of getting an idea of how a child plays, this limited sample makes it difficult to make broad claims about even that individual child. This study does not cover all the different uses a child may have for an iPad. I know of children who use the iPad exclusively to Skype with grandparents, who get it as incentive to use the potty, and

many who are allowed the iPad only while the family is travelling. These are just a few of the types of iPad experiences that are not represented. Finally, because each child engaged in different non-tablet activities, one cannot always draw true comparisons. This study, does, however give an interesting peek into the different styles of children's play and provide some real world examples to compare with the studies and their findings discussed in the previous section.

Findings: Initial Analysis

Child One: Beth[1], age 22 months.

Observations

Observation One:

Location: Her home on a day off from childcare
Others present: Three grandparents and older sister (age 4), Cora[2]
Time: 9:30-10:30

IPad Play
In the family room of her house, Beth, her two grandmothers, and her older sister sit around a large coffee table. They turn on the PBS Kids app on the iPad sitting on the table. Beth smiles and stands at the coffee table, watching the screen with her tongue slightly extended.

She holds a wind-up frog in her hand. Next to her, Cora stands playing with a stacking toy.
As Beth watches a PBS Kids video, one of the grandmothers is explaining the project to the sister. Beth looks up at the sound of her grandma's voice, looks at me, and then returns her attention to the iPad. She places the frog toy on the iPad. She yawns and twists the knob on the frog's back.

Cora spins her toy and Beth looks up and then looks back at the screen. Holding the frog she taps the screen to change the video. Beth repeatedly puts the frog on and off the iPad. Beth shows her frog to her grandma who admires it. Grandma begins narrating the video and Beth brings her face closer to the screen.

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[1] Pseudonym
[2] Pseudonym

Beth wiggles and she stands, watching the screen. She moves her hand across the screen, which starts a new video. She touches another part of the screen, which brings up a different video. Beth watches with her mouth slightly open. After a moment she taps an icon for a new video. She tries touching the screen, which stops the video, and another new one starts. She stares intently at the screen, eyes tracking back a forth as she watches. As she watches, her breathing becomes audible. She drops her toy on the ground, but does not move her eyes from the screen.

Beth takes a step back and picks up some Magnatiles® that are nearby. Grandma begins to speak, so Beth turns to look at her. Then Beth looks down at the Magnatiles® and begins to pull them apart. Meanwhile the video is still running and there is a loud cheering sound. Beth's eyes return to the screen and she is still fidgeting with the blocks in her hand. Then her eyes turn back to the Magnatiles® and she works hard to pull two of them apart. Her eyes go to the video and then back to the tiles. She tries to stick two edges together. Beth's other grandma walks into the room and Beth looks up and then goes back to the blocks. As she stacks them, her eyes return to the video on the iPad. Then she goes back to manipulating the Magnatiles®. Grandma's hands brush the iPad and Beth drops the blocks and looks at the screen without stopping. She glances at me and then looks back at the screen. She begins to hop in time to the music from the video. She brings her hands close to the iPad and then yawns and sinks to kneel on the ground so her head is just above the screen. She taps the screen and selects a new video. She bounces again. She walks away and then walks back, tapping again to choose a new video.

She taps the screen- nothing happens

She lays her hand on the screen nothing happens

She moves her finger and a new video comes up.

Her eyes move across the screen as she watches, without moving her head. She rests her head on her arms. The new video is about lights and she brings her face close to the screen, watching and tracking movement across the screen as the video plays. She remains watching the video for approximately two more minutes, until the video is almost over. Then, she begins to explore the case, placing her finger in the holes in the case. Her eyes move from screen to her hands to the screen. And she brings her head close again. She makes an utterance ("wapeh"?) She stands up, kneels down, and stands back up again. Beth begins exploring the legs of the table and then walks away from it.

Traditional Play

Beth walks a few steps away from the coffee table and observes her other grandma in the kitchen with Cora baking. She walks over and puts her body between the two of them as she watches. As they spoon the batter in to the pan, Beth eyes track the movement of the spoon. She pats her grandma and says "Hi"

She picks up a cupcake liner from the shelf. "Oh you'll help too?" Grandma asks her. Beth lifts up the liner and then replaces it in the pan. Beth again watches the spoon and then turns her eyes to Grandma as she talks Cora though how to put the batter in. She again picks up the liner and makes a noise, which Grandma responds to. Beth looks intently at her, and then turns her eyes back to the pan and the batter, as her eyes grow wide.

The pan is now full and Grandma gives her a spoon with batter, she licks it clean and hands the spoon back for more. She makes a sound that sound like 'calcious" The three of them go to the kitchen to find things to mix in. Grandma suggests nuts. "Nuts" Beth agrees. "Chocolate chips," says Grandma. "Chips" says Beth. "Chocolate chips here" says Beth and hands the bag to Grandma. The she points to the box on the table "crackers," says Beth as they bring their supplies back to the table to finish up.

Observation Two

Location: Her home on a day off from childcare
Others present: mother, Grandma, and older sister, Cora
Time: 8:00-8:45 AM

Traditional Play
While her sister watches, Beth is playing with a set of ramps for small cars. Beth stands over the toy and places cars on top. The car doesn't move so she repositions the car and watches it go down the ramp. Then she picks up another car and repeats. After a minute, her sister walks away.

The next car gets stuck "Ah" says Beth, as she picks is up and repositions it. She points to the bottom of the ramp and says "Here. Go." The car gets stuck at the bottom of the ramp. "Oh no" She continues sending cars down until she has used them all. She says "car" and picks them all up from the bottom and begins sending them down the ramp again. She finds a checker and drops it down the track "Uh-oh. Where go?" Beth says, when it does not reach the bottom.

Beth sees a plastic figure on the ground and picks it up. "That. Bus," she tells me and crawls on her hands and knees five feet away to her toy bus and places the figure inside, which activates a song, "The Wheels on the Bus." She reaches for and picks up another figure, places it in the bus, and bounces along, from a kneeling position, to the song as it plays again.

Her grandmother walks into the room and Beth stands up to follow her. Grandma walks into the kitchen and then Beth follows her back across the room. After Grandma goes upstairs Beth goes back to the track, "Down. Here" she says as she picks up a car. After a moment she announces "Puzzles" and walks a few feet over to the coffee table where there is a wooden farm animal puzzle. She picks up two pieces and bangs them against the table, while smiling wide. "Moo" she says holding a cow. "Moo. Moo" she looks at me as she says it.

Next to the puzzle are some finger puppets. Beth hands one to me, extends her index finger and says" finger" which I interpret as a request to help put it on and oblige. She hands me another and again says, "Finger." After I help her put it on she takes them off and puts all the puppets in a pile.

"More puzzles" she says. She picks up a piece and tries to place it in its spot, "Here?" she asks. "Horsie" she tells me holding the goat piece. She looks over at on "Old MacDonald" book on the table. "Horsie" she says again pointing to the illustration of a horse on the cover. "Book. Duck here" she adds. She moves to the next book over and points to various pictures. "Girl. This"

Then she picks up the goat piece again and places it in a stack of cupcake liners also on the table. "Cake. Horse go in there."

IPad Play
The iPad is on the coffee table. It is open to its home screen. Beth drags her finger across the screen bringing up the next page of icons. She taps one, selecting Netflix and looks confused. She looks at me and I show her PBS Kids at her mother's suggestion.

Beth runs her finger over the iPad screen and taps the image of Daniel Tiger, which starts a cartoon, complete with theme music. Beth smiles and dances to the music. The video automatically becomes full screen and Beth taps it to return to regular view, now there is a row of icons for other videos on the side. Beth taps a button, which restarts the video and then runs her finger up and down the scrolling menu. This causes the video to stop and a loading sign to appear. She taps the sign three times and smiles. "This" she says. Soon a new video starts. She looks down keeping, her eyes on the screen. She briefly touches the screen and then pulls her hand back and stares. Her sister comes over to watch and Beth holds her hand for minute before the sister goes back to the kitchen to eat. Beth runs her fingers over the screen and then holds the hand of a doll that is lying on the table. She lays the doll down next to the iPad and runs her fingers over the holes and indentations on the iPad case. Then she takes the doll's hands and tries to put one in one of the holes. Beth touches the doll's mouth then touches the screen. She runs her finger down the menu and selects a new video, and then she taps another, then another, each immediately starting a new video. Beth watches a video in which two cartoons talk to each other about Chicago. She watches; eye constantly on the screen with one had holding the doll's hand. She scratches her leg, not moving her eyes from the screen. The doll slips off the table, and Beth bends down to pick her up. She begins to undress the doll starting with the Velcro® closure at the back. "Baby" she says. "What happen?" she adds as she continues to try to take off the doll's dress, iPad forgotten.

Analysis

Of the three children I observed, Beth was the one who was least experienced with touch screen technology. According to my interview with her mother, Beth only used the iPad about once a month, often while the family was getting ready and dressed in the morning. This was apparent in her level of skill in using the iPad. She used only a few actions; specifically just tapping and scrolling. According to her mother, Beth had more exposure to regular television than touch screen technology. Even when she did use the iPad, it was primarily to use the PBS Kids app, which streams short videos for children to watch. In any event, when her grandmother took out the iPad, Beth seemed very eager to use it. At the beginning, I could tell that she was nervous about my presence, but once she was confident that the familiar people were also there, she was able to focus on the activity in front of her.

Social Interactions

Though Beth had many people around her; two grandmothers and her older sister, Beth stayed fairly focused on the iPad and only occasionally acknowledged the activity and people around her. Indeed about halfway through the iPad observation, one of the grandmothers and Beth's older sister walked into the dining room to make cupcakes and it was not until her iPad time was done that Beth went over to join them. As she played, she would look up when a family member said something, but would not respond, instead returning her attention to the videos playing on the screen in front of her. Even when her grandmother attempted to talk about what was playing on the screen, Beth continued to watch and did not respond. In the second observation, Beth held hands with her sister

when Cora came to stand next to her, but both of their attentions were focused on the screen, not each other and after a moment, Cora went back to kitchen to eat breakfast.

When the iPad was not present, Beth seemed more interested in other people, especially the first time I observed her. When she walked in to the dining room, she immediately put her body between her sister and Grandmother. She focused her attention on the two of them filling the cupcake tin. She touched all the different components and seemed eager to be a part of the activity, even though she did not get to do any of the actual filling of the cups. She was especially excited when they put away the bowl and went to the kitchen to find the 'mix-ins.' This gave her an opportunity to be a more active participant.

In the second observation, Beth's family was in the dining room eating breakfast while Beth played. They were visible, but not involved in the play. When I was the only one close by, she tried to engage me in her play; telling me about her cars, showing the various farm animals to me and requesting my help when she tried to put on the finger puppets. For the brief part of the time that her sister was in the room, this narration was instead focused towards Cora, not me. And when her Grandmother entered the room, Beth followed her around, a marked difference from not reacting when Grandma and Cora left the room in the first iPad observation. In all, it showed me a much for interactive side of Beth than what I saw when she was using the iPad.

Language

When I first watched Beth's use of the iPad, I wondered briefly how much language Beth had. In those 20 minutes, I heard her say only one thing, which sounded like "wapeh," but which neither her grandmother nor I could interpret. The remainder of

her communication was nonverbal: she showed a toy to her grandmother, she would look up when she heard people speaking around her, but she did not respond verbally. Likewise, in the second iPad observation, it was not until the very end, when her attention turned to the doll that I heard a full sentence from her ("Baby. What happen?") Before that she had only said "this" while pointing to the iPad.

Once Beth moved away from the iPad, there was a dramatic shift. While helping her family make cupcakes she made five intelligible comments; some echoing Grandma's words but also some original phrases. In the second play observation, she spoke in 17 independent instances; almost all of them narrating her play or naming the toys she was using. Some were single words, i.e. "horsie" or "puzzle." Several of them were also full sentences ("Horse goes in there." Or "Where go?"). The second play observation was especially interesting because just like with the iPad, Beth was playing independently. When she had the iPad she was almost entirely silent, but with the cars, the puzzles, and even the books, Beth wanted to talk as she played. I wonder if this was because Beth was narrating her own actions, which is why she said "this" at one point as she touched something on the iPad screen or more broadly, that the traditional toys lent themselves more to language.

The iPad time did give Beth some time to explore music. In my interview with her mother, she mentioned that Beth really loved music, so they tried to find music related apps for her. Beth was not specifically using a music app, but it was clear that she was enjoying the music playing in the videos. She hopped and danced when music played on the tablet during both observations.

Physical

For the most part, Beth stayed in one place while she used the iPad; there were some instances of her standing up, kneeling down, and dancing while still staying in the same spot. Once or twice when Beth was distracted, she would walk slightly away from the table. In all, there was very little gross motor action involved in her tablet-based play.

The tablet did require her to keep her hands active. There were multiple instances of Beth manipulating what she saw on the screen using her hands. She tapped on the screen to select a new video at least a dozen times. She also tapped to stop the video, and swiped and scrolled on down or across the screen to see what other videos were available so that she could select one. Beside these traditional uses of the iPad. Beth spent several minutes in both iPad observations just physically exploring the iPad and its case. She tried sticking her fingers in some holes around the case and just feeling the case in general. On a related note, in the first observation, Beth stopped playing with the iPad because she was distracted feeling the legs of the coffee table. For Beth, the sensations of the physical world created a strong pull away from the traditional uses of a tablet. Her mother mentioned something similar when she discussed her personal feelings about iPad use with young children. She said that she believed in the importance of exploring the physical world and making sure her children had plenty of time to do so. Then she added that Beth in particular was interested in physically exploring the world and would often spend time just touching objects, like chairs.

In addition to her fingers, it seemed that Beth's eyes were also working hard. I noted constantly both times I observed that Beth's eyes were quite fixed on the iPad and rarely looked away from the screen, though I watched her eyes move and track as figures

moved across the screen. I also noticed this focused tracking when Beth was baking with her family. As the grandmother and Cora used a large spoon to place the batter in the cupcake tin, Beth's eye stayed focused on the spoon watching as it moved from mixing bowl to tin and back again.

The eye tracking was one of just a few overlaps between Beth's technological play and her traditional play. In her traditional play, Beth had opportunities for both fine and gross motor play. Even in baking she was walking around and carrying ingredients as well as exploring the feel of the cupcake liners as she picked them up and put them back in the tin.

When I watched Beth play with her toys, I saw a lot of physical activity. She stood, crouched, walked, and crawled around the room as picked up cars and sent them down the ramp, moved the school bus, and explored other toys in the room. She even danced to the bus's rendition of "The Wheels on the Bus." With her hands, she demonstrated pointing when showing the animals on the books and was able to take puzzle pieces out of the puzzle and replace them; to name two examples of fine motor work that Beth demonstrated. In short, all of her traditional play provided her with a range of chances to move all her body, whereas the tablet gave her only stationary small motor opportunities.

Cognitive Skills

Cognitively, I observed Beth demonstrate her understanding of how an iPad works, as well as do what seemed to be trial and error explorations to learn more about the device. Beth seemed very confident in tapping on the screen. There was no hesitancy to her movements and the one time that the video did not change immediately upon her

tap, she tapped the screen twice more in quick succession in attempt to make the video play. Beth also seemed confident with scrolling.

I did on a few occasions observe what seemed like more hesitant movements on the screen. There were times when she would place her whole palm on the screen and then look at her hand and then to the screen. Other times she would run her hand across and, after observing no change in the screen, she would try a similar motion with her finger. This seemed to imply to me that she was observing cause and effect in relation to the iPad.

In her traditional play, Beth practiced a number of different intellectual concepts. While sending the cars and other objects down her ramp toy, Beth was able to practice cause and effect, but also think about relative size (the car went down differently than the checker), ramps, and gravity. She was also able to make the symbolic connection between the animal puzzle pieces and their real life counterpart, while also practicing special awareness as she moved the puzzle pieces into other objects on the table and then back to the puzzle.

Attention

Even though Beth looked very intently at the iPad while she was using it, play seemed to hold her attention better. There were several times when Beth was using the iPad that she would notice a toy nearby, like the frog, the magna tiles and the doll, and began to explore that toy. This likely goes back to Beth's mother observation that Beth was a very tactile person. Her hands wanted to do something more than the screen allowed and so she would begin to pull apart and bring back together the tiles or take care of the doll while nominally still using the iPad. Sometimes her attention would return to

the screen after a moment or two and sometimes the toy would completely pull her focus. Whereas when Beth was baking with her grandma, she stayed watching or helping and did not get distracted. In this case, that was at least partially due to the fact that there were many less distracting toys in the dining room and kitchen than in the living room where Beth was previously playing. In the second observation, Beth played with a few different toys, but she stayed with most of them for a long time before moving on to the next and the next. The iPad held her gaze for a long time, but it did not seem to hold her attention the same way her other toys did. In fact even when she was using the iPad, she would a watch a video for perhaps 30 seconds and then select a new one. There were very few videos that held Beth's attention for more than a minute.

Child Two[3]: Anna, age 20 months

Observations

Because Anna's mother was almost 9 months pregnant with her second child, I

was only able to schedule one visit with her.

Observation One

Location: Her home
Others present: Her mother
Time: 8:15-9:15 am

Traditional Play
Anna is sitting at a child-size table with two chairs; her mother is perched on the other
one. There is a basket with three containers of play dough and some drawing materials in
it on the table.
Anna attempts to take the lid off the play dough, after trying unsuccessfully, she hands it
to her mother, who removes the lid. Anna takes the container back and bangs it upside
down on the table until the play dough comes out.

She hands a chunk to her mother, "ball" she requests. Mom obliges by rolling the play
dough into a ball and handing it back to Anna. Anna hands another piece to her mother
and again requests "ball." When she receives the second one, Anna places the balls inside
a mailbox slot that is behind her on the wall. Then she opens it up and takes them back
out. She hands one ball back to her mother, who wraps it around her thumb. "Where did
my finger go?" she asks. Anna pulls the play dough off of her mother's thumb and sticks
her own finger inside. Then she takes it off and hands it to me "Sara's turn" I place the
play dough over one of my fingers and she pulls it off and tries to on her own finger
again. She takes it back off and says, "I make a ball" and rolls the play dough between
her hands. She puts down her ball, picks up the play dough container, and pretends to
drink from it. She picks up the play dough again and pretends to eat it, "num, num"
Then she announces, "Cut play dough" and her mother takes her to the kitchen to pick
out a knife. She comes back with a utensil, but then drops it. And begins to crawl on the
floor. She crawls under a chair in front of the fireplace. She crawls back out and around
to the back and under again. She touches the cover behind her and her mother says it's
the fireplace cover. "Fireplace" she responds and she runs her hands over the cover,
looking at the screen, she crawls out from the bench and over to a chair next to it, running
her hands over the chair leg.

She says "Hi Bumpa. Hi Bailey dog" and Mom explains that Bumpa is her grandfather
and Bailey is his dog and they often talk on the phone.

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[3] Pseudonym

"Ride" Anna announces. And she goes over to her rubber bouncy horse. She climbs on and begins to bounce as Mom sings the *Bonanza* theme song. "Riding," Anna narrates. Then she bends forward and mouths each ear of her horse. Anna stops by her activity table. She pushes the switch, which turns it off. Then she touches each button, going in a circle around the table.

IPad Play
Anna brings her baby doll with her to play iPad. She puts the doll on the couch. "Baby climb up" Then she climbs up beside the doll. Mom turns on the iPad and asks, "What would you like to do?
"This" she replies and points to an icon. Her mother selects the app, which is the Sesame Street website. There is a video playing and a horizontal scroll line of other videos to watch. Anna stares intently at the screen. After about 30 seconds, she touches an image from the bottom; selecting a new video. She taps it three times emphatically when the video does not immediately change. Anna moves her finger across the screen to scroll and selects another video. As she does this mom explains to me that she enjoy Sesame Street and also watching YouTube Kids which she calls "babies laughing" Anna looks up from the screen and requests, "babies laughing." Then Anna hits the home button and uses her index finger to select the correct icon for the requested app. She watches the video that comes up with her pointer finger in her mouth, still staring entirely at the screen. The video goes to full screen and a few second later, she touches the screen, which returns it to normal view with the scroll menu at the bottom. Then she selects a new video. 20 seconds later, she scrolls and selects a different video. She watches a video of young girls playing with dolls and says, "Baby sleep" she then moves her finger to scroll and select a new video. She watches with her finger in her mouth and runs her tongue over finger. She looks up briefly when she hears her mother say scary. Then she immediately returns her attention to the video on the screen. She selects a new video to watch.
"What are the kids doing?" Her mother asks. Anna does not respond, so Mom asks again, this time also rubbing Anna's back but Anna remains focused on the screen.
She watches one video of elementary aged boys looking for giant eggs for 2-3 minutes before switching videos.
She presses the home button. Mom asks if she wants to look at pictures. Anna selects the picture app without assistance and opens it. She touches the screen to select a video of herself, where she is in a high chair, eating. "Ellie[4] high chair" she says, referring to a younger cousin who still uses a high chair.

After the video, she selects an alphabet game app, which asks the user to trace a letter on the screen. Anna tries to run her finger down the line of the letter A, but the screen does not read it. She tries again, then she requests "Mom help you" Mom obliges and using hand over hand helps Anna trace the letter. "Anna trace" Anna says. She pushes the arrow that calls up the next scene. "Bunny. B" Anna says and Mom again helps her trace. After another minute, Anna announces "bye-bye iPad" and Mom says "ok" and turns it

[4] Pseudonym for Anna's baby cousin

off. Anna then begins to cry. "Phone. IPad. Kick" she says before, crying laying face down on the floor and Mom goes down to comfort her.

Analysis

Anna was much more confident in her use of the iPad than Beth; likely due to the fact that Anna uses her device two to three times a week, usually to be occupied while her mother cooks in the kitchen.

Social Interactions

Much like Beth, Anna interacted with the people around her very little while she used the iPad. Usually, Anna's mom would be elsewhere while Anna used the iPad, but this time, they both sat on the couch in their family room together. However, Anna did not try to interact with her mother and responded minimally to her mother's attempts to engage her. When Anna's mother watched the video along with Anna and asked, "What are the kids doing?" Anna did not respond to either the verbal or physical cue (back rub) and instead she continued to watch the video on the screen. She could hear the words her mother was saying, as evidenced by Anna's reaction, when her mother told me about the "babies laughing," in that she immediately asked for it.

Of the three children I observed, Anna had the hardest time putting the iPad away. While the other children became distracted by toys and separated themselves from their tablet, Anna's mother needed to take the iPad away, even though Anna said she was done. At which point, Anna threw herself to the floor and began kicking and crying. She did not cry for too long, but was clearly upset for the rest of the visit. During my interview with Anna's mother, she mentioned that Anna needed a lot of help putting away the iPad and that while she did not do this during my observation, usually before she allows Anna to use the iPad, they talk about what will happen when it is time to say goodbye.

The interactions between mother and daughter were very different in the two scenarios. While Anna did not seemed interested in playing with her mother while the iPad was available, when she used play dough, Mom was an equal participant in the play. Together they rolled play dough into balls, hid their finger in the play dough. At times, Anna would ask her mother for help and her mother would oblige. I also observed that each of them would occasionally narrate their actions to the other. For example, Anna's mother sang the *Bonanza* theme song when Anna hopped on her riding toy. It was a marked difference between this and the little girl who seemed so engrossed in her screen that she did not respond to her mother's question. It was only at the end of iPad time, when Anna was trying out the alphabet tracing app, that she asked for help, saying "Mom help you." But it seemed clear that Anna was accustomed to using the iPad for solitary play.

Language

Anna talked a lot while she and her mother played together. I observed Anna speak 11 different times while they work with the play dough and as she played around the living room. She spoke about seven times while using the iPad, and those instances were spread further apart. During the traditional play Anna used her words to make requests of her mother, for example asking Mom to make her a ball from the dough. Anna also spoke as part of her play, announcing, "I make a ball" or "riding" when she later got on her riding toy. She also repeated her mother's words when Anna explored the area around the fireplace and her mother named the objects she interacted with.

While using her iPad, Anna mostly spoke to make requests, or on two occasions to describe what she saw on the screen. When her mother mentioned 'babies laughing'

(which is Anna's name for short videos of babies that are available through the YouTube app) Anna immediately repeated the phrase as a request. While Anna was watching the baby videos, she observed, "Baby sleeping," sharing what was happening in that video.

Anna also received some practice in the letters of the alphabet when she played the letter game and it seemed that this was a game she was familiar with. When the screen moved from letter A to letter B she was able to say, "Bunny. B," just as the screen did. This indicated her knowledge of the game and the small introduction it provided to the connection between letters and the sounds they make. However, from this instance it seemed that Anna was more interested in the letter tracing aspect of the game as she spent far more time attempting to 'write' the letters than saying them.

Physical

Just like Beth, Anna was stationary while she used the iPad; she remained seated on the couch and did not shift from her original position. Other than attempting to get on the couch, there was not any gross motor work evident. Perhaps the iPad provided Anna some practice in sitting and staying in one place for a longer interval.

There was much to observe about her fine motor work. Her actions on the iPad screen were very intentional. She was able to tap and scroll on the screen. However, she did have difficulty tracing the letters when she pulled up the game app. This is not unusual for a child who is Anna's age, because it requires more dexterity than the simple drag across the screen that scrolling requires. I was also able to observe more of Anna's fine motor skills while she played with the play dough. That activity required a larger range of motions than the iPad did on that day. Anna worked hard trying to open the lid on the containers, putting the play dough on her fingers and pulling it back off, and

rolling it into balls. She had opportunities to use both her fingers and her whole hands as she played. Additionally, the play dough gave her a great deal more sensory input, instead of a smooth flat screen; she was able to sink her finger into a soft, flexible material.

Although, like the iPad, this was also nominally a sitting activity, Anna found many reasons to get up, placing play dough in the mail slot and going into the other room to find a knife with which to cut her play dough. And indeed after about ten minutes of play dough time, Anna was eager to play in ways that allowed her whole body to move. She crawled around the floor, under the chair, and past the fireplace screen; touching the various pieces of furniture as she moved about. She finished off by bouncing up and down on her rubber horse. Together, these activities provided her with a lot of sensory input on various parts of her body.

Cognitive Skills

Anna drew on her own knowledge of her family in both parts of the observation. At one point during her circuit around the living room, she stopped to take a pretend phone call from her grandfather, "Hi Bumpa. Hi Bailey dog." As Anna's mother explained, her grandfather does not live in town so many of their interactions are over the phone. In this instance, Anna was thinking about this dynamic through her play. While watching an old video of herself sitting in a high chair on the iPad, Anna said, "Ellie high chair." She saw the image of a baby in a high chair and this brought to mind her young cousin, who had recently visited Anna's home. Looking at photos and videos on the iPad allowed Anna to see herself when she was younger, it also demonstrated her ability to

make mental connections between what she sees on the screen and what she has experienced in her own life.

Anna demonstrated a lot of pretend play while she worked with play dough. She pretended to drink from the play dough container as if it was a cup and she pretended to eat the play dough, with an enthusiastic, "num, num." It was immediately after this that Anna decided that she needed a knife so perhaps it was part of her plan to extend the eating game she had begun. This is only speculation, because when she came back from getting the knife, she immediately became interested in different toys and did not use the play dough any more. Pretend play like this is important for a myriad of reasons not limited to the ability to act out and better understand events or activities a child has experienced, the opportunities to develop symbolic thought which is the foundation upon which most academic learning is built, and practicing social norms.

Most of Anna's iPad time seemed to demonstrate what she had learned about how she could affect the iPad by her actions. It seemed that Anna had already developed a great deal of familiarity with the device. Her actions seemed confident, without the hesitancy that might imply an experiment. As I noted in discussing her physical activity during this observation, Anna was able to tap the screen and scroll through menus therein to find what she wanted. When her mother asked if Anna wished to look at pictures, Anna was able to close out of the YouTube app and find the photo app independently.

Attention

Anna stayed very focused when she was using the iPad. Even though she brought a baby doll to the couch with her, once Anna had the iPad in her hand, she did not interact with the doll again until a few minutes after the iPad was put away. Her attention

stayed entirely on the screen, with the exception of a few reactions to her mother speaking. Though even these only seemed to pull her focus when it was related to the iPad itself, like when she requested laughing babies. This is something that her mom touched on in the interview. She was concerned about how "zoned in" Anna is when she has the iPad and whether or not that was good for her.

Anna was able to maintain attention for about ten minutes while she playing with the play dough. She spent less time at other activities she engaged in during that time, but overall displayed a developmentally appropriate level of focus in her play. Even though Anna stayed focused on the iPad the whole time she was using it, she was constantly changing what she saw on the screen. She selected new videos, sometimes just a few seconds after she had started the previous one. So while the device held her attention, not everything she was watching on it did.

Child Three: Sofia[5] age 26

      Observations

      Observation One:

Location: Her home
Others present: her mother and her baby brother
Time: 4:00-5:00 pm

Traditional Play
Sofia places a jack-in-the box toy on the ground. "Bear" she says pointing to it (there is a bear in there and not a traditional clown). Then she picks up a rattle with different colored ribbons on it. "Pink" she says pointing to the pink ribbon, "blue" as she points to the blue ribbon. She places that on a small chair next to the toy shelf and picks up a baby bottle for a doll. "Shake it," she says and she does.

Then she looks to a small piano keyboard on her toy shelf. "Keyboard" she says as she takes it down and lays it on the floor. "Mommy" she asks to her mother, Jane[6], on the other side of the room. Her mother replies, " You know how to turn it on." Sofia then turns the knob that turns on the keyboard. She claps in delights and then hits one of the piano keys; this begins of medley of songs beginning with ABCD. "It's ABCD" Sofia announces. She bounces her head along to the music. As the songs progress, she claps to the music. She pushes the various keys, which make sounds but do not change the songs playing. As another new song begins, Sofia says "whoa" in surprise. Then she adds, "It's happy and know it." Sofia is still sitting, but she moves her body to the music.

The song on the keyboard changes. "Row, row" Sofia observes. She claps her hands on her knees. "It's not row, row, it's twinkle twinkle," Sofia notices and begins to sing along. She shakes the bear in a box as she hums along.

A minute or two later, Sofia points to her pants. "My jeans" she describes and then begins to point to all the colors on her outfit and say their names. "Pink. Blue. Red."

The song changes to do your ears hang low. She claps her hands and bounces while sitting. "Key board," she says. The song changes to "ba ba black sheep." "Yes sir. Ba ba" she announces as she claps her hands. She glances over at me with my notebook and then moves to her shelf and takes out a magna doodle, while the keyboard continues to play. As she sits down the keyboard plays, "Old MacDonald" and Sofia says, "my favorite."

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[5] Pseudonym
[6] Pseudonym

She begins to work on the Magna Doodle, drawing with the pen back and forth across the board. "Mommy" she tells her mother. "Oh did you draw a picture of me?" "Jacob[7]" Sofia replies.

She continues to listen to the music as she draws. Then she points to the screen and says, "Yay Mommy!" She pulls out one of the stamps and drags it across the screen. She picks up another and moves both stamps across the screen, one in each hand.

After a movement, she looks at my notebook again and says, "More homework. Tyler[8]. Homework." As Jane explains to me who Tyler is (the nanny's son) Sofia adds "Nina. Nanny. Mommy. Nanny." She goes back to the magna doodle. "My homework" she says as she draws on the screen. She clears the screen, lays the board across her lap, and begins to draw lines across. She clears the screen again, picks up the bunny stamp and this time presses it down. "Rabbit. Bunny rabbit" she says. She sticks the stamp her in mouth then shakes her head and takes it back out. "I eat it," she says with a giggle.

IPad Play

Sofia holds her mother's iPad as she sits on the floor. She selects an icon for an app, YouTube, and then lays the iPad across her lap. She taps a cartoon gorilla image on the iPad, which begins a video, "Jungle Boogie." "Mommy's iPad," she says as she listens to the music and watches the video. "Off " she says to her mother and her mother takes the case off of the iPad. Sofia then reselects the YouTube app and continues to watch the video, holding it with two hands on her lap. "Loud" she says and then changes the volume, adding "this button," as she finds the volume button. Sofia rotates the iPad and then rotates it again so it is back in its original position. She looks up and smiles and then returns her gaze to the iPad. The video ends and an ad appears for another video. "See owl," she says to her mother.

Then Sofia selects a pig video, about a pig's tail. "Piggy" she says, holding the iPad and staring without taking her eyes off the screen. Mom, from the couch where she is holding her baby, says, "I haven't seen this video before. Is it a new one?" Sofia looks up and then looks back at the video without responding.

As the video ends, new video suggestions appear on the screen. Sofia picks the next video. Less then a minute later, She then picks a new video from the menu below the video; it is the pigtail video from earlier. She watches through to the end, and then says, "a new one." She takes the video from full screen to regular view and scrolls down the side menu to select a new video. She giggles and points as she does so. She selects her next choice, but after about 30 seconds, she takes the iPad off her lap, she sits on top of her magna doodle, which has a cushion attached to the bottom, and lays the iPad between her feet. The video plays a song multiple times and she sings a few phrases along with it, "Play with me," "Scissors," "1,2,3." After the second time the song plays, she stops speaking and just watches the screen in silence.

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[7] Pseudonym
[8] Pseudonym

After this, Sofia selects a new video. As the video begins an owl flies across the screen, "An owl" Sofia observes. Then, the video plays the song "Itsy Bitsy Spider" and Sofia chants along with the video. In the same video, the scene changes to one of rain "It's raining" Sofia says. She then begins singing "Rain, rain go away" a few seconds before that song begins to play in the video.

Then Sofia scoots back and picks up the stamp from her Magna Doodle. The video continues to play and she sings along as she uses the stamps on the Magna Doodle.

Observation Two

Location: Her home
Others present: her mother and her sleeping baby brother
Time: 4:00-5:00 PM

Traditional Play
At Sofia's request, Sofia's mom brings a Minnie Mouse backpack down from the wall shelf before she walks into the kitchen to check on dinner. "Open it. Zipper." She says as she tries to unzip it. "I see Minnie there." After struggling for a minute, Sofia turns to me "Sara. Help me" and I start the zipper for her. She turns the bag upside down and out come a set of bristle blocks. She looks inside the bag and begins pulling out stray pieces. She sits down amidst the toys and then stands back up again. "Lady. Lady" she says looking around until she finds a female figure, "I find her." She points to a car in the set and remembers "Mommy fix it." "Mommy. Coming. Mommy," Sofia calls and her mother comes in from the kitchen and offers to help her build the house (the block set comes together as a small barn frame), saying, "Let's find all the pieces for the house." Sofia picks up a piece with clock on it and pushes it onto a large flat piece. Her mother shows her where the clock piece is supposed to go and Sofia hands her mother another piece, asking, "Need this, Mommy?" Mom continues to construct the house while Sofia stacks some smaller bristle blocks. She picks up a small bench, "I need this Mommy." She tells her mother, who replies. "Ok what is it? A bench?" Sofia responds. "No. A bench. Bench goes there. I share Mommy."
Mom: "You're doing a great job."

By this point Mom has finished making the barn. Sofia asks her, "Mommy close the door?"
Mom tries and realizes the door doesn't close all the way, "Should we try to fix it?" she asks.
Sofia watches her mother takes some pieces off and repositions them, and says, "Yeah Mommy does work." Then Sofia picks up the bench piece again and places on the floor of the house, "bench goes here," she narrates. Sofia picks up a sheep figure, "I need this Mommy," she says a she places it in the house. She picks up another animal, "A rooster" she observes before putting the rooster inside as well. "Daddy build house" Sofia recalls.

Sofia picks up a sign on a pole and tries to place it on the house. "No" she says when she cannot get it on. "Where does it go?" she wonders out loud as she tries other spots.

Sofia opens the door of the house. "It's open," she tells her mother. "You opened it" Mom replies. "Close" Sofia says as she closes the door. "It's open." While Sofia is doing this, her mother walks away to check on food. "Good job" Mom responds to Sofia's door narration. Sofia picks up the rooster figure again. "Cock a doodle do." Mom repeats, "cock a doodle do" and then Sofia says it one more time.

Sofia begins to take pieces off the house and then reattaches them, "I fix already," she says.
She pulls the pieces apart again. "Door working now," she announces. Sofia picks up a horse figure from the set and observes, "horse." She walks him a across a long flat block. "Going out" she narrates.

Then Sofia begins to cough. "Mommy, need water." Mom takes her into the kitchen to get water. When she returns she giggles and says, "came back!" She sits back down and asks, "Mommy build house again?" Her mother comes over and Sofia asks again. "Mommy build house" and her mother reassembles the house. Mom picks up the male figure from the set and puts a tool in his hands. Sofia asks, "Lady have one" as she picks up the female figure. "Mommy do it," she adds. Mom encourages Sofia to try, but Sofia insists, "no. Mommy" so her mother shows her how to do it. Then the phone rings and Mom walks away to another room to answer it. Sofia picks up the man and tries to put the shovel back in his hands. She continues playing with the bristle block for a few more minutes. Then she runs out of the room to her mother and requests, "Mommy. IPad?" Mom agrees and comes back into the room. Her mother helps her clean up the bristle block and then has Sofia sit down on the floor and hands her the iPad.

IPad Play
Sofia turns the iPad around so that the screen flips and then turns it back. She scrolls along the home screens to select an app: Candy Crush. "It's coming" she says as she taps the screen while the app loads. "It's coming. No it's not coming. Wait." Finally, the app finishes loading. She taps menu items on the side one by one so that they open a pop-up window and then she closes them. Sofia uses her finger to scroll along the map that fills the main screen. She touches one icon, which pops up a window, "Ah!" she says in an excited tone. She pushes the button below it, and the pop-up window takes a few seconds to load, "Oh. Wait," Sofia says. As she is playing, her mother has returned to the other room to do some work. Sofia's keyboard is nearby and suddenly makes a noise. Sofia giggles and looks up briefly and then returns her attention to the screen. "It makes noise," she says.

She looks at the screen, "It's yellow" she says looking at the color of the game's background.
She touches an icon that brings up a spinning wheel, "It spinning around. My horsie." Sofia observes. In the corner of the screen is an image of a sleeping owl. "Owl sleeping" Sofia observes as she taps the image, the screen changes and the owl is now awake. "No, owl eyes open," say Sofia as she touches the image again and the screen reverts back, "This owl sleeping."

She returns to the menu of icons on the other side of the screen; there are three. She touches each in turn opening the popup windows and then closing them, by touching the x in the corner to the window. After this, she uses her finger to scroll along the map. "Games," she says in a loud voice, "games," she repeats in a quieter voice. She closes the Candy Crush app, by touching the home button on the bottom of the iPad.

Sofia places her finger at the top of the screen and drags down, opening the search feature. She explores the keypad for a moment, typing different letters. The search brings up the YouTube icon and she tries to touch it. "It's coming. Yeah it's coming!" Sofia selects a video. As it begins, she observes "That's Rabbi Jake," she says naming the main character of the video, "I hear it," she says as the theme song begins. She laughs, and touches the spot on the iPad that brings the video to full screen, "I bigger" she says. As the cartoon plays, she bops her head in time to the music, for a brief second and then stops, keeping her eyes focused on the screen, after about 30 seconds she begins moving her body to the music again. She places her finger on the time tracker for the video and moves her finger back, rewinding the video, "I start again." However, the video does not go all the way back to the beginning. So she tries again. Still unsuccessful, she hits the home button on the iPad. Then she taps the YouTube icon to restart the app. The video is still in the middle so she again drags her finger to rewind. When this does not work, she picks another video from the menu next to the video. As that video begins, Sofia uses her finger to scroll down the side menu. "I sing hookie-pokie" she says and picks a new video. As that video begins, she selects another video and then another. This video, she begins to watch, bopping her head to the music. In the video, a cartoon monkey sings about getting dressed. She continues to watch the video, occasionally moving her toes to the music. As she looks at the screen, one hand is fiddling with the carpet. Her eyes remain on the screen for the entirety of the video.

After the song is done, the screen shows images of other videos, which Sofia continues to watch. Then she begins to scroll down the video menu to the side until she selects a new one. At this point, her brother who has been sleeping nearby wakes and cries. "Pacifier" Sofia says as her mother returns to the room to check on the baby. Sofia lays the iPad on the ground and rotates her body around it so the screen is now upside down to her. While it is still upside down, she selects a new video. It is called "Awesome Toy Surprise." After 15 second, Sofia selects another toy video and then another. Finally, she stays on one about a Mickey toy for about a minute. In the video, the speaker mentions a necklace. Sofia immediately stands up and requests, "My necklace" to her mother. Her mother brings down Sofia's jewelry collection and Sofia begins to try them on as the video finishes up in the background.

Analysis
Sofia demonstrated the most command on the iPad of the three children. This

could be due to her slightly older age, as she had turned two about two months before this

observation. It as also likely due to the fact that Sofia had the most experience with iPads; she had used them approximately three or four days a week for a year.

Social Interactions

When I arrived for my first visit with Sofia, her mother was feeding Sofia's baby brother and watching Sofia play. This limited the opportunities for Sofia to engage in social activities, though her mother would occasionally ask her questions as Sofia played and responded whenever Sofia called to her. So in that first visit, there was little difference in the amount of socialization between the iPad and non-iPad play. In the second observation there was a marked difference. Sofia and her mom played with the bristle blocks together for about 15 minutes until Jane had a work call and walked out the main room to answer it. Sofia played alone with the bristle blocks for about five more minutes and then went to her mother to request the iPad and her mother came back to help set it up. This time, even though Sofia's mom left the room a few minutes later to return to her work, Sofia continued to play with the iPad for another 15 minutes before she decided to play with her necklaces instead.

Language

Sofia demonstrated a great deal of language in all of the observations. While using the iPad, she spoke 12 phrases in the first observation and 20 in the second. She used her words for several purposes: to make requests, such as when she asked her mom to take the case of the iPad; to narrate as she performed various actions on the iPad (for example, "loud" and "this button" as she adjusts the volume); to observe what she saw on the screen, like when she announced "owl sleeping" after seeing an owl with closed eyes in the Candy Crush app; and to sing along to the songs playing on the iPad. Apart from

the occasional request, Sofia was not talking to anyone in particular; she was talking as she played independently. While she was not using her language to be social, she still was using her language as part of her play. This is in keeping with Vygotsky's "private speech." By narrating her play, Sofia was demonstrating her thought process and planning as she used her iPad.

Sofia used even more language while she played with her other toys; there were 27 distinct phrases in the first observation and 34 in the second. In the first observation, where Sofia mostly played with her piano, most of the language was again naming, narration, and singing along to the music on her electronic piano, which leads to some interesting questions about how the older generations of electronic toys compare with the contemporary iPad. But in any case, Sofia was exploring her language skills through the music; particularly her listening as she tried to ascertain what song was playing (the keyboard provided the melody, but not the lyrics). But in the second observation, at least half of Sofia's phrases were directed towards her mother. She talked to her mom about their bristle block play, what pieces go where, what to do with the various figures, and the need to build and then fix the barn. In this observation, I could see not only the extent of Sofia's vocabulary, but also how she used her language in a social setting and how it allowed her to practice sharing a material with another person.

Sofia also showed her emergent writing interest over the course of these observations. In my first visit, she noticed me writing in my notebook and made a connection to when her nanny's son does homework. She then brought down her Magna Doodle and began to 'write' with the attached stylus. As she continued to draw she said "my homework," lest there be any doubt about her thought process. As she used the

Magna Doodle, she named her drawings after her mother and baby brother, indicating her ability to connect symbols to real world objects, an important pre-literacy skill.

As I was saying goodbye to the family for both visits, Sofia sat on the couch next to her mother and asked "e-mail?" at which point, Mom would open the iPad to a word processing app and Sofia would tap various keys on the keyboard. As I learned in our interview, Sofia's mother is on maternity leave and therefore is often working at home. This means that Sofia sees Jane using the iPad much more, particularly typing. Sofia's "emails" give her another opportunity to explore written language.

Physical

Most of the time I was observing Sofia she was sitting. Other than pulling toys down from the shelves, the play I observed did not provide much in the way of gross motor opportunities. The other exception was when Sofia was using her piano. Just as when she was using the iPad, she had an electronic toy on her lap as she sat, however she did move her body around to the music that was playing. This was certainly different from the level of stillness she showed with the iPad.

The rest of her play provided her with a variety of ways to uses her hands. Sofia had the fine motor control to do more than tap and scroll on the screen. She could also use the small volume control button on the side to adjust the sound. She could rewind the video that was playing on the YouTube app, by selecting the small dot on the play progression line and moving it backwards. This was the only place that she wasn't immediately successful in an action, because it was the one that required the most hand and finger control. Her finger needed to provide enough pressure on a very small spot

while also moving that finger across the screen. Still, she was able to partially perform the action, which shows a great deal of skill and control.

Sofia demonstrated similar skill in using her other toys. She was able to turn on her small keyboard, which required the turning of a small knob (about the circumference of a quarter). Likewise, the magna doodle required her to hold the thin stylus, manipulate the stamps, and then pull the eraser tab down to clear the screen, each of which requires a different grip. The bristle blocks that she used during the second visit are a classic manipulative, which allow children to gain hand strength as they play. Sofia was trying to stick the blocks together and pull them apart. Sometimes she was able to do so independently and other times she needed her mother to help, placing the use of these toys in her zone of proximal development (as described by Vygotsky (Miller, 2011)). She also found a challenge in the play that she seemed to enjoy. The figures had small c-shaped hands that were made to hold the farming tools (like a rake). Sofia was determined to have both figures hold tools, and worked very hard to snap the thin tools into the small hands. Although she eventually needed help to complete her intention, the practice with manipulating very small objects will help improve hand coordination and strength.

Cognitive Skills

Sofia was greatly skilled in manipulating the objects in her environment; she knew what to do the make her toys do as she wished. As to be expected, this was especially clear in her use of the iPad. She knew how to select apps, videos within the app, and could scroll through the menus. In fact, on at least two occasions after Sofia selected something on the screen, it did not immediately load. But she was experienced

enough with the concept of the iPad that she knew she needed to wait, at one point even saying, "It's coming. No, it's not coming. Wait." Sofia knew how to adjust the volume when it was too loud, take the video to and from full screen, and restart an app when it wasn't doing what she wanted (this was when she tried to rewind a video to the beginning). These additional actions require a more extensive knowledge of the iPad than the other subjects exhibited, likely because Sofia was both the oldest and the most experienced with the iPad.

During the second observation, I was able to see Sofia practice some trial and error experimenting. She explored the Candy Crush app, which her mother said she had found by chance a few days earlier. Sofia would tap various icons on the screen in turn and observe what would happen. There were three such icons in a vertical column on the side of the screen. And she went down the line; observing what would pop up on the screen, then closing that window and moving on to the next, going through all of them twice. She also experimented with the owl on the top right corner of the screen, discovering that it would shift from sleeping to awake with a tap (this would also change the rest of the screen to reflect whether it was day or night). Once she discovered this, she demonstrated it several times joyfully.

The iPad also demonstrated Sofia's memory on a few occasions. During the second observation she was excited to select a video of "Rabbi Jake," a cartoon series developed by a musical Rabbi whom she immediately recognized. In fact, that was the video that she tried to rewind, in hopes of seeing it again from the beginning. In the first observation, while she was watching videos of nursery rhymes, Sofia noticed that it was

raining in the video and began singing "it's raining, its pouring" before the song actually began on the video.

At the beginning of the first session, Sofia played mainly with two toys: the piano and the Magna Doodle. The piano was a more passive toy; since it was on a setting where it just played music, though it did provide Sofia with some feedback. The songs would continue to play even when Sofia touched a key, but the note would play as well. In many ways it was even more passive then the iPad; it required a simple tap to get a response. There were fewer actions to explore than in the Candy Crush app where there were lots of different types of reactions to her tap depending on where it fell. With the piano, Sofia sat, moved to the music, and sang the songs; very similar to how she acted while listening to nursery rhymes later with the iPad.

On the other hand, the Magna Doodle allowed many more avenues for play. Not only did it allow her to write and draw, precursors for literacy and symbolic thought in general, Sofia also used it for pretend play. She originally took out the toy after she noticed me writing in my notebook and named that my "homework". She then began writing on it and calling it her homework; she was using it so that she could feel like she was part of a ritual she has seen others do. In addition to myself, she was familiar with her nanny's son doing homework. Sofia did something similar with the iPad, when she would sit next to her mother and "email." In this instance, she was using the iPad for pretend play as she tried out her mother's activities.

Attention

There was little of note in comparing the attention Sofia paid to her various toys. Almost all of them she stayed with for sustained periods of time before moving onto her next chosen activity.

Overall Analysis

In observing these three girls at play, there were some striking similarities as well as many differences that perhaps provide some food for thought on how toddlers use iPads and what that means about the role of electronic screens in such young children's lives.

Social Interactions

All three subjects used their iPads independently; this was true both in my observations and from what their mothers told me in their interviews. The iPad was a convenient tool for parents who needed to get something done and needed their child to be safe and occupied while they did it, such as cooking dinner or getting ready in the morning. This is in keeping with the research done by Common Sense Media (Zero to Eight, 2013), which found that over 50% of parents used touch screen to occupy children as the parents performed household chores. These solitary uses struck me almost immediately during the observations because so many of the studies that support iPad use encourage it to be done in tandem with a parent (Mendelsohn, et al., 2010; Vandewater, et al., 2006). Beth and Sofia's mothers both pointed out that for most of the day they are in childcare and playing with other children, not technology. So while there were these brief interludes of solitary play, the children still had plenty of opportunities

for social play. Additionally, even though the iPad was a solitary toy during my observations, it also had other uses that were described to me in the parent interviews. Anna liked to look at photos of herself and her friends on her tablet. Sofia and Anna would sit with their parents and Skype with out-of-town family members. In these circumstances, the iPad was actually enabling social interactions.

Language

There was notable decrease in the amount of language the children used with their iPad versus their more traditional play. This was most noticeable with Beth, who, in her two iPad experiences, used only a handful or words, but when she was engaged in other play used a total of 22. I also found a difference in Sofia's language and to a lesser extent, Anna's. These children, who narrated their play with bristle blocks, cars, and play dough, stayed almost silent as they used the iPads; "zoned in" as Anna's mother described it. All of them ignored attempts by their family members to converse with them in favor of watching whatever video was playing at the screen in that moment. This is especially important in view of Woolridge and Shapka, (2010)'s work. In their study, mother-child dyads were using an electronic toy (not an iPad) together and still the children produced less language. In my observations the children were using their electronic toy alone and produced less language than they did either playing with a parent or by themselves in traditional play.

On a more positive note, the iPad did give the children some exposure to music. Both Sofia and Beth really enjoyed listening to the music on the tablet and dancing to it and occasionally singing along. Music is a valuable part of development in the early years, it helps children develop listening skills, exposes them to language in a way that is

especially appealing and brings them joy (Kemple, Batey, & Hartle, 2004). There are many different ways to engage in music, but listening and dancing are two critical ones and in these observations the iPad proved to be a vehicle though which to deliver them.

Physical

In my observations, the iPad gave many opportunities for fine motor work, but none for gross motor. This is not a flaw and there are many traditional toys for which the same can be said. However, even in terms of fine motor, the muscles used seemed minimal. The iPad requires the work of one finger or two fingers to tap, swipe, scroll, etc. The apps that I observed the children using gave no opportunities to use other parts of the hand, much less the whole hand. This is similar to the observations made by Price, Jewitt, and Crescenzi (2015) in their finger paint observations. Just as in that study, the non-iPad activities the participants chose when I observed their traditional play; the cars, bristle blocks and play dough; gave them many opportunities to use different parts of their hands and even their whole bodies, if they wanted to. All three subjects are at an age where they are developing more advanced grips, as well as the ability to use both hands in concert while they play (Connor, Williams & Siepp, 1977). The design of the iPad makes it easy for even a toddler to use, which gives them the ability to control the device. In iPad use, one hand is usually passive, or holding the iPad while the other hand is mostly doing pointing actions, providing less opportunity for muscle development.

Cognitive Skills

I believe that an iPad most differs from a television in terms of its cognitive demands and control that the child has over the device. Unlike a television that is turned on and watched passively, a child has the ability to directly affect what they see on the

screen. All the children are able to select video after video that they could watch and in most cases, seemed to enjoy the act of choosing even more than the video itself, if the speed at which they switched videos was any indication.

For all of the children using the iPad was a mix of demonstrating previous knowledge and using trial and error to learn new skills. All of the children knew that if they tapped the picture/icon in their video app it would play a video and that to see a new video they needed only tap another space. After demonstrating that, I observed Beth find out what happened when she put her hand on the screen or moved her hand across it. In just the two times I watched her I saw Beth become more comfortable with her movements as she selected videos; she knew more of what would happen and was expecting it. Sofia could manipulate the video in many more ways due to her age and experience but even she took opportunities to experiment; exploring what happened when she pressed different parts of the new-to-her app Candy Crush and showing her delight when she discovered something new. Trial and error exploration is a crucial way that toddlers learn (Fogel, 2009), and helps them plan future actions. This is also in keeping with Gopnik's theory of cognitive development (2012). These children were experimenting with an object in their world in order to learn more about it and what effect their actions have on it. With each attempt, they learned more about the iPad and what it could do. At times, each child seemed to be more interested in their effect on the tablet then any particular app. In this way, a touch screen becomes more valuable than television because it provides feedback and helps the children learn about cause and effect and how to explore their environment.

Attention

All three children stayed very focused on the iPad while I observed them. They were not distracted by attempts by their loved ones to engage with them, instead preferring to focus on the screen. Both Anna and Beth stayed with the iPad longer than they did with other toys. With Sofia, the time spent on either seemed equal. However, all three girls were not always focused on the video aspect of their tablets and instead seemed to enjoy the act of changing the video and what appeared on the screen as much as, if not more than watching the videos themselves. Researchers (Ruff & Capozzoli, 2003) describe two types of attention; one that is prevalent in infancy where a child is attracted to novelty (like a constantly changing screen) and the second, which begins to emerge in the second year of life, which is more intrinsic and goal-oriented. In iPad use this second type of attention would be demonstrated by paying attention to the content of the video or focusing on the goal of an activity app. While each of the participants showed glimmers of this second attention in their tablet-use (Beth's increased focus during the electricity video, Anna's attempt to trace the letters, and Sofia's attempt to rewind the Rabbi Jake video), for much of the time they demonstrated more interest in novelty of the changing screen then its contents (unless one thinks of changing the iPad as the activity). This is contrast to their attention to their traditional toy play, which stayed on the same task without attempts of constant change, demonstrating more mature attention skills.

Summation

For the most part, all of the children used the iPad to watch videos from apps like

PBS Kids, YouTube Kids, and Sesame Street. From my interviews, it seemed these

parents chose these apps because they felt secure in the content, an important factor.

Obviously, one cannot assume that these three children represent the universal uses for

this age range. A search of Apple's App Store reveals plenty of games designed for

toddlers, and this does not include apps available on other types of tablets. However, if

the children are just using the tablet like a portable television that they watch by

themselves, it erases many of the distinction researchers place between tablets and

traditional television (excluding, of course, any cognitive demands). In these

circumstances an iPad can be useful to help a parent manage the household for a few

minutes, but it is does not present a marked developmental advantage over the television.

One of the initial questions used to design this study was "Are children missing

out on social interactions by being so focused on the screen?" Based on my observations

of these subjects, it seems likely that yes, children are missing out on social interactions

because of screen time. There is, however, one caveat: many children also use the iPad to

Skype with grandparents and other relatives that live far away (this was true for both

Anna and Sofia) and in this use children are in fact gaining a valuable social interaction

with their extended family that they might otherwise miss out on.

The second question that formed my study was: By using technology to the

exclusion of direct life encounters, are children missing out on other opportunities for

more beneficial play? The answer to this question is less clear. Yes, the iPad use does not

result in the same linguistic, social, or motor practice that traditional play often does, although there can be some clear cognitive benefits. And if there were a belief that a child should play with an iPad for a long period of time or to the exclusion of other activities, those children would miss out on play and interactions that were crucial to their development; across all domains. However, I would go back to the recommendations of the AAP (Brown, Shifrin, & Hill, 2015) and even Christakis (2014), who reminded parents of the importance of moderation. These children I observed used their iPads for at most twenty minutes a day. The rest of the time they were exploring play dough, blocks, cars, and cooking. I saw no evidence that these children were missing out, while parents took a little time to take care of the household.

Christakis believes that an iPad could be just as valuable to a child's learning as blocks or books. Under ideal circumstances (with a caretaker nearby and with carefully curated apps) perhaps that could be true. Other researchers hypothesize great value in parent-child dyads co-viewing on a tablet. But my observations found little to support these ideas and much to disprove it. The iPad seemed to deter language, socialization, and physical activity, as least for these three toddlers. But there are years of research to come in this field. It would be interesting to do a similar study with parent-child dyads who do use iPads in those ideal circumstances and see if experience formed use. That is to say would children who mostly used their iPad in a social setting, be as focused on the screen?

Similarly, one could also look into the experience of multiple children playing with an iPad. I admit when Beth's mother mentioned that Cora would also be there for the observations, I wondered if the iPad would be a toy they used together or might be a

source of contention. While Cora was interested in the iPad, she did not make an attempt to play with it, but I do wonder what might happen in other peer dyads and how this might inform the social effects of screen use.

Indeed, this study brought up many questions that could be explored in future work. Another idea that could be further explored is whether previous electronic toys, like Sofia's keyboard, might have different effects from a touch screen device. There have been studies that compare electronic toys to non-electronic toys **(**Wooldridge & Shapka, 2012; Sosa, 2016), but to my knowledge there has not been one where they have been compared to the newest electronic toy, the touch screen device. Those studies also found less language use when playing with electronic toys, even in concert with parents, but it would interesting to see how these results compared with those of iPad use.

There is also the question of distractibility and attention when using these devices as opposed to traditional toys. There are many studies that look at distractibility in toy play (Ruff & Lawson, 1990) or television watching (Gola & Calvert, 2011). Some even touch on the various levels of attention a child may have on a specific toy (1990), but to my knowledge there is not one that compares these different venues especially in regards to the level of attention. It would also be informative to look specifically into the difference between eye contact and focus that these observations suggested.

I also wonder about the circumstances of use. As noted, these children mostly used the tablet to watch videos; does tablet use look or feel different when it is a vehicle for interactive apps? For contact with loved ones who are far away? As an extrinsic motivator?

As promised in the methods section, this study provides many questions but few answers. In short, there is a great deal more information that is needed before we can definitively conclude the value of touch screen use for toddlers. It may be, as some researchers suggest, that context is crucial and that in those circumstances, children playing with iPads will be using a valuable developmental tool. It is likely that as the AAP suggests that all is good in moderation and there is no large loss in young children using their tablet for a short amount of time. But until researchers explore these ideas, it will be hard to determine whether the theories seen in the review of literature hold true to the real lives of toddlers with iPads and whether reality can hold true to researchers' ideas. One point all three parents I interviewed agreed on was that it was nearly impossible to have no iPad time for their child. So will we see a growth in the amount of co-viewing versus solitary play with iPads? Or more parents setting limits in keeping with the recommendations of the AAP? Perhaps, in this new higher-tech reality, maybe the question we should ask is, what are the positive roles an iPad can play in a child's life, not whether a young child should have one.

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Appendix A

Institutional Research and Review Board Response Form

Research Application: Touch Screen Use in the First Three Years.

Author: Sara Baumgarten

This application is accepted without conditions.

As per the IRRB guidelines, the following areas have been considered in this review:

Informed Consent: In both the study description and the consent form, the participants have been provided with detailed information regarding the purpose of the study and their role in the process. They are aware that their consent can be withdrawn at any time, and they can select for omission any information that is uncomfortable for them.

Assent: Young children are direct participants in this study. Assent in writing has been provided by parents.

Confidentiality: As per the consent form, all identifying information will be omitted, unless the participant wishes to be known. The measures for storing the data in the office of the author represent the best possible practices. It is a given that in this era, it is not possible to store information on a computer with unimpeachable security.

Benefits: The benefit for the researcher, as well as the participants and readers is academic and philosophical enrichment.

Risk: With confidentiality and consent protections well described, there is no risk for participants. There is certainly no risk of harm.

Privacy: There is no threat to privacy, as indicated above.

Debriefing: Debriefing will occur during the scheduled interviews.

Secondary Data Sources: The use of secondary data sources is not a part of this research.

Comment: This proposal meets all IRRB requirements.

Approved: May 11, 2016

Sean O'Shea, Ed.D

Member, Bank Street College Institutional Research and Review Board

Sample Permission Letter

Dear Parent or Guardian,

My name is Sara Baumgarten and I am a graduate student in Infant and Family Development and Early Intervention at Bank Street College of Education in New York. I am currently conducting research for my Master's thesis and will be acting as the principal investigator for this study. The goal of my thesis is to look at the use of iPad and other touchpad technology by children under the age of three. As part of my research, I wish to observe children in this age group; both when they are playing with tablets and when they are engaging in non-technology-based play.

As a part of this study, you will be asked to participate in a short interview about your views in regards to children and technology. Additionally, I will do a series of observations of your child. Your participation is voluntary and you can refuse to answer any questions or terminate your participation at any time. Please note that if the information that you share during this time is included in the thesis, your name will be changed to protect your privacy. Please also note that the master's thesis will be submitted as a PDF to the Bank Street Library where it will be catalogued as part of the Library collection and downloadable via a live link on the catalog entry. It will also be entered into an international database for wider circulation.

Please sign on the lines below to indicate that you grant permission for the information that you provide to be used for the purpose of this study. Please also indicate whether you agree to allow your child to be observed for the purpose of this study.

Thank you for taking the time to share you insights with me. If you have any questions or concerns about the research, please feel free to contact me at Sbaumgarten@bankstreet.edu.

Sincerely,

Sara Baumgarten

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I agree to participate in this study.

Name of Participant (please print)_____

I grant permission for my child to participate in this study.

Name of Child (please print)_____

Signature (parent/guardian)_____

Date _____