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A DIGITAL CHILDHOOD: HOW ELECTRONIC TOYS IMPACT PARENT-CHILD INTERACTION AND CHILDREN'S SELF-REGULATION

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ABSTRACT

It only takes a glance around a restaurant or in a museum to observe that technology is becoming more prevalent in children's lives (Common Sense Media, 2014; Gray, Thomas, Lewis, & Tice, 2010) and that it impacts parent-child interactions (Radesky, Silverstein, Zuckerman, & Christakis, 2014). The question that has yet to be answered is how this increase in technology use is impacting children's cognitive and socioemotional development. Some research has suggested that this technology may decrease the quality of parent-child interactions. For instance, Woolridge and Shapka (2012) found that electronic toys reduce the amount of interaction between parents and toddlers; specifically, the mothers were less responsive to their toddlers while engaging in play with an electronic toy. Further, Parish-Morris, Mahajan, Hirsh-Pasek, Golinkoff, and Collins (2013) found that when parents read an electronic book with their child they use more directive language than content-focused language and that the youngest (3-year old) children exhibited impaired story comprehension relative to those who read a traditional, non-electronic book. Here, we examine whether the type of toy a parent-child (ages 3-5 years old) dyad plays with – either electronic (an iPad) or non-electronic toy impacts 1) the quality of the parent-child interaction as marked by the amount and type of language used and 2) children's ability to regulate their behavior using a classic self-regulation-task.

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Chapter 1: Introduction

In only a decade, the landscape of children's use of technology has changed dramatically. Simply glancing around a restaurant at children with their faces turned down towards the tablets and smart phones in their hands displays the prevalence of technology[1] in children's lives today. Indeed, research supports this impression. In 1998, only 55% of children had access to a computer at home (Newburger, 2001). Just a few years later in the year 2000, 65% of children had access to a computer at home (Newburger, 2001). By 2013, the type of technology expanded to include electronic devices similar to an iPad or tablet; 75% of children had access to one of these devices in 2013 (Common Sense Media, 2014). By 2015, 83% of children four and younger are reported to live in a home with a tablet device (Kabali et al., 2015). These data clearly shows the rapid growth in technology use by children. For children, eight years and younger, who typically use some sort of mobile device, such as a smart phone, tablet, or iPad, every day, the amount of time spent on the mobile device was at an average of one hour and thirteen minutes in 2013; this is an increase from just forty-three minutes in 2011 (Common Sense Media, 2014). Children ages eight years old to twelve years old spend an average of about six hours engaging in screen time per day (Rideout, 2015). Clearly, there has been an increase in the amount of mobile technology that is used by children. Research shows, however, that from 2011 to 2013, the amount of time that children eight years old and under spent using traditional

[1] Technology is a broad term that includes mobile media devices, such as iPhones and iPads, and traditional screen technology, such as television, video games, and computers

forms of technology such as video games and television shows decreased by thirty-one minutes (Common Sense Media, 2014). A likely reason for this may be the increase in use of mobile devices as a source of technology. While the overall technology use by children increases, the question has been raised as to how technology is impacting children.

To date, research has suggested at least two areas/domains that may be particularly impacted by this increasing pattern of technology use. First, research suggests that technology may be impacting the parent-child dyad (Parish-Morris, Mahajan, Hirsh-Pasek, Golinkoff, & Collins, 2013; Pempek, Demers, Hanson, Kirkorian, & Anderson, 2011; Wooldridge & Shapka, 2012). Secondly, preliminary work suggests that technology may be impacting children's abilities to self-regulate (Lilard & Peterson, 2011; Radesky, Silverstein, Zuckerman, Christakis, 2014); this may go on to have later repercussions in the child's life (Galinsky, 2010). This paper further explores how technology impacts the parent-child dyad, and how technology impacts children's abilities to self-regulate.

Parent-Child Interaction

Parent-child interaction is crucial to the development of a child and to the child's academic achievement (Eliot, 1999). From infants hearing their parents use infant directed speech to learn words (Thiessen, Hill, & Saffran, 2005) to the importance of creating a secure attachment with a caregiver (Osofsky & Fitgerald, 2000), parent-child interactions help shape both the cognitive and social development of children. Given that something as simple as an electronic toy can change the nature of a parent-child interaction (Zosh, Verdine, Filipowicz,

Golinkoff, Hirsh-Pasek, & Newcombe, 2015), it is important to examine how technology use impacts these interactions.

While data are scarce on this topic, what evidence we do have suggests that playing with electronic toys and viewing videos changes the way that a parent and child interact with each other (Pempek et al., 2011; Wooldridge & Shapka, 2012). The features of electronic toys change the ways that parents and children interact because each feature of the toy may elicit a different response from those playing with the toy (Bergen, Hutchinson, Nolan, & Weber, 2009). With electronic toy play, parents have been found to initiate most of the interaction (Bergen et al., 2009). Electronic toys have been found to encourage more exploratory play than extended elaborated play while a parent and child are interacting with a toy (Bergen et al., 2009). Another possible impact of electronic toys is that the features on electronic toys may cause parent-child interaction to occur in comments rather than directive speech (Bergen et al., 2009).

In one of the most well-controlled studies to date, Parish-Morris, Mahajan, Hirsh-Pasek, Golinkoff, & Collins (2013) conducted a two-part study on the impact that electronic and non-electronic books have on parent-child interactions and children's story comprehension. The first part of the study pertains to parent-child interactions. To study parent-child interactions, researchers asked each parent and child dyad to read either an electronic or non-electronic book. Five minutes of parent-child interaction while reading was recorded, transcribed, and coded. Researchers examined if the type of toy the parent-child dyad played with impacted the amount of behavior-focused speech and content-focused reading. The results of this part of the study found that the parents and children who interacted with the electronic book tended to use more behavior-focused speech than the parents and children who interacted with a non-electronic book. The parents and children with the non-electronic book engaged in more content-focused

reading. In other words, the electronic books distracted the parents and children from speaking about the actual story; the speech was more associated with the different interactions that could take place with the electronic book. The non-electronic books did not have this distraction of interacting with the book, so the focus was on the actual content of the story. Another result is that when the electronic interactive aspect of the electronic book was turned off, the parent-child interactions were more similar to those reading a non-electronic book. This suggests that the electronic features themselves distracted from parent-child interactions. The second aspect of the study investigated story comprehension when reading an electronic or a non-electronic book. Three year olds who engaged with an electronic book with their parent were less likely to be able to correctly list the events of the story in chronological order and were less likely to be able to correctly answer content questions about the story than the children who engaged with a non-electronic book with their parents. These results suggest that electronic books distract children from being able to recall details of the story and the story's structure. The results of both parts of the study show that electronic books can be distracting to some aspects of children's reading comprehension and parent-child interactions. By the time children were five years old, these negative impacts were not found in regards to story comprehension; this suggests that during the toddler and preschool years children may be particularly susceptible to the impacts of technology.

A similar study also found that children who engage in reading an electronic book with their parents do not comprehend as much of the story as children who read a non-electronic book with their parents (Krcmar & Cingel, 2014). This study, completed with two to five year olds, asked children and parents to read a story together, as they would at home, on either an iPad or a non-electronic paper book. After reading the story, the children were asked questions to test their

comprehension. Similar to the Parish-Morris et al. (2013) study, these researchers examined both parent-child interactions and story comprehension. The study also found significant differences in the interactions that took place between parent and child depending on which type of book the dyad used. The parents who read from the non-electronic paper book with their children used more questions and comments that evaluated what was happening in the story. The parents with the non-electronic paper books also focused more on the content of the story than the parents with the electronic book who tended to speak about topics not directly related to the story. As a result, the children who read a non-electronic paper book with their parents comprehended more about the story than the children who read from an electronic version of a book. It appears that when parents read electronic books they may be distracting their children from the content of the story and disrupting their children's comprehension. These results point to the importance in learning and recognizing how technology is impacting the interactions between children and their parents.

Just as there are differences in the interactions between parent and child while engaging in reading electronic and non-electronic paper books, there also may be a difference in interactions while the dyad plays with an electronic toy versus a non-electronic toy. A study by Zosh and colleagues (2015) compared parent-child interactions while playing with an electronic shape-sorter toy and a non-electronic shape-sorter toy. While parents spoke about the same rate of words per minute in both conditions, parents in the electronic toy condition used more spatial language. When the words spoken by the toy were accounted for, children in the electronic condition did indeed hear more overall language, but this language was of a lower quality due to decreased variability in the language used (e.g., the toy repeated the same phrases over and over again). These differences suggest that the nature of play is different depending on the type of toy.

The researchers suggest that electronic toy play may be surrounded by speech associated with what the toy can do rather than the main learning goal of the toy. Play with a non-electronic toy may encourage the main learning goal of the toy more than electronic toys. This study shows that there are differences in the interactions between parents and children while playing with an electronic toy versus a non-electronic toy.

Technology certainly seems to have an impact on the parent-child dyad. The impact can appear through the types of speech that are used by the parent and child (Bergen et al., 2009; Parish-Morris et al., 2013; Zosh et al., 2015). The impact can also be found through whether the parent or child initiates most of the interactions during play (Bergen et al., 2009). The study presented here will examine how electronic and non-electronic toys impact the interactions between the parent-child dyad. Here, we extend the results of this past research by also including educational (e.g., books and blocks) and non-educational (e.g., games with no educational purpose). While further research is needed to more thoroughly understand the impact that electronic toys have on the parent-child dyad, research is also needed to understand other ways that electronic toys impact children directly. Next, the impact of technology on another important aspect of development, the child's ability to self-regulate, is explored.

Self-Regulation

A second area ripe for investigation is the impact of technology on self-regulation. Included under the broad umbrella of executive functioning is self-regulation (Rothbart, Sheese, Rueda, & Posener, 2011). Self-regulation is a term given to people's ability to regulate their actions and thoughts in an intentional way (Florez, 2011; Rothbart et al., 2011). Self-regulation

can also be called inhibitory control or effortful control (Galinsky, 2010). Essentially, self-regulation is when a person wants to do one task but instead controls his thoughts and actions to undertake another task or enabling postponement or avoidance of the impulse task. Through self-regulation, children take in information from all of their senses and decide how to respond to a situation (Florez, 2011).

The roots of self-regulation begin during infancy (Galinsky, 2010). Initially, infants simply react to stimuli, such as a light or a noise, by turning away or startling; this is not yet considered self-regulation because there are automatic responses, but these responses are the beginning of the development of self-regulation. Helping an infant learn to calm down on his own can assist in teaching the infant that he can learn to control his emotions. Infants as young as three months old have been found to use self-regulation, such as sucking on their hand, to sooth themselves (Rothbart & O'Boyle, 1992). The shift to executive functioning usually occurs between the ages of three to four years old due to natural child development and through parent-child interactions (Rothbart et al., 2011). The developing prefrontal cortex is also a crucial component of the development of self-regulation (Galinsky, 2010). Developing the ability to self-regulate is clearly a process that lasts throughout development, with the full maturation of the prefrontal cortex not occurring until the young adult years (Diamond, 2002).

This development of self-regulation is not just important for children during childhood. Self-regulation in childhood has been linked to future achievement. Learning to self-regulate will help children throughout their academic careers (Galinsky, 2010). Children who are better at self-regulating tend to perform better on standardized tests than children who are not as good at self-regulating; the same pattern has been noticed pertaining to the subjects of mathematics and literature (Neuenschwander, Rothlisberger, Cimeli, & Roebers, 2012). It has also been found that

as abilities to self-regulate increase, the skill levels in the subjects of mathematics, literature, and vocabulary increase (McClelland et al., 2007). These studies point to self-regulation as an important ability for future school achievement.

When examining the factors that impact self-regulation, it appears that the environment can be a crucial factor. As children develop their ability to self-regulate, games that require the child to focus may help with the development of self-regulation (Galinsky, 2010). Hints and clues from parents and teachers as to how a child should act in a certain situation also help a child to develop his ability to self-regulate (Florez, 2011). Parents play a key role in influencing children's development of self-regulation (Bernier, Carlson, Whipple, 2010; Drake, Belsky, & Fearon, 2014; Sethi, Mischel, Aber, Shoda, Rodriguez, 2000). Maternal sensitivity, mind-mindedness, and autonomy support have all been found to help children develop their abilities to self-regulate (Bernier et al., 2010). Maternal sensitivity involves reacting appropriately to an infant's signals. Mind-mindedness involves the parent using mental terms, such as feelings, while interacting with the child. Autonomy support involves giving the child problems to solve on his own. Out of these three, autonomy support has been found to be the greatest supporter of developing children's abilities to self-regulate. As children go through their elementary school years, parents are able to continue to influence how well children are able to self-regulate by continuing to use autonomy support rather than other types of support (Grolnick & Ryan, 1989). Early attachment styles have also been found to impact children's self-regulation abilities (Drake et al., 2014; Sethi et al., 2000). A secure attachment style leads to better self-regulation abilities than other attachment styles (Sethi et al, 2000). Parents clearly have a significant role in helping their children self-regulate.

Given the impact of self-regulation on later development, it is crucial to examine factors that impact self-regulation in both positive and negative ways. Television has been found to impact children's abilities to self-regulate (Lilard & Peterson, 2011; Radesky et al., 2014). The more television that a child views as a two-year-old, the worse that child will be at self-regulating (Radesky et al., 2014). Specifically, those children who watched two or more hours of television daily were worse at self-regulating than children who viewed less than two hours of television. Even the pace of the television show can impact children's abilities to self-regulate (Lilard & Peterson, 2011). Preschool children who view fast-paced cartoon television shows were worse at self-regulating than children who viewed an educational television shows, which tend to be considered slow-paced (Lilard & Peterson, 2011). Television seems to be a factor in how well children are able to self-regulate.

Given that external and environmental factors impact self-regulation, it is essential to understand the ways in which technology might impact self-regulation in young children. Here, we examine children's ability to self-regulate during a task immediately following a play session between parents and children interacting with either an electronic or non-electronic toy.

The Current Study

In this study, we wanted to answer two questions. First, we wanted to study how interacting with electronic versus non-electronic toys impacts the parent-child dyad. The purpose of the play session was to test our hypotheses that parents who played with an electronic toy with their children would use lower quality language than parents who played with a non-electronic version of the same toy. To answer the first question, we asked children and their parents to play

with an electronic or non-electronic toy as they normally would at home. During the play session the parent-child dyad interaction was recorded by video camera. After conducting the parent-child play session we analyzed the data to measure the quality and quantity of the parent-child interactions. We used a variety of variables to quantify interaction such as the use of directives, questions, praise, extensions, words, and off- versus on-task language. Second, we wanted to understand how electronic and non-electronic toys impact children's abilities to self-regulate. The purpose of the self-regulation session was to test our hypothesis that children who had played with a non-electronic toy with their parents would be less likely to wait the full amount of time for an increased reward. To answer the second question, we conducted a second phase of the study to test the children on their self-regulation abilities directly after playing with one of the provided electronic or non-electronic toys. We observed whether or not the children were able to regulate their behavior to wait for an increased reward.

Chapter 2: Method

Participants

Participants were 21 children (9 male) and their parents from families who visited the Delaware Children's Museum in Wilmington, DE, the on-campus Child Development Laboratory at The Pennsylvania State University Brandywine campus, and the Middletown Free Library in Media, PA; the participants took part in this study at one of these three locations. The families reported English as the primary language used at home. The children ranged in age from 26.6 months to 69.6 months (mean = 49.03 months). Fifteen additional children were tested but not included in the final sample (14 for pilot testing, 1 child refused to participate).

Stimuli and Procedure

Materials

During Phase 1, parent-child dyads were randomly assigned to play with either a non-electronic version of a toy, game, or book, or an electronic-iPad based version of the toy (See Table 1). The stimuli were selected so that some toys were educational (electronic and non-electronic books) and some were non-educational (e.g. blocks).[2] We matched non-electronic toys with a similar electronic versions (e.g., Fruit Ninja on the iPad and a fruit cutting non-electronic

[2] Separate analyses comparing educational toys versus non-educational toys were not completed de to the small sample of non-educational toys used (N = 4).

toy set). The books, both electronic and paper versions, were considered educational and the other toys were considered non-educational.

During Phase 2, the self-regulation phase, the children were seated at a table by themselves and presented with either goldfish crackers or mini marshmallows, and a bell. To time both phases of the study, the timer on an iPhone was used.

Table 1. Stimuli for phase 1

Toy	**Electronic vs. Non-electronic**	**Educational vs. Non-educational**
Blocks	Non-electronic	Non-educational
Melissa and Doug Fruit Cutting Set	Non-electronic	Non-educational
Block Builder App	Electronic	Non-educational
Fruit Ninja	Electronic	Non-educational
Pokey Little Puppy – paper	Non-electronic	Educational
Pokey Little Puppy – e-book	Electronic	Educational

Procedure

The study consisted of two phases, a play session and a self-regulation session

Play Session. Parents and children were randomly assigned to play with either an electronic or non-electronic toy. Whether the toy was considered to be educational or not was also selected at random. The electronic stimuli were presented on an iPad that was locked into the particular app that the dyad was assigned to interact with. After presenting the toy and asking

the parent to play with the child like they would at home, the researcher left the room and started the timer. The play session was timed using the timer on an iPhone standard clock app. After five minutes of play, the researcher returned and asked if the child had a fun time playing. The child was also asked if he or she is ready for the next game. The sessions were video recorded and later transcribed. There were seven variables of interest: words per minute, questions per minute, directives per minute, on-task utterances per minute, off-task utterances per minute, praise utterances per minute, and extension utterances per minute.

Self-Regulation Session. After the play trial, the child was asked if he would like goldfish crackers or marshmallows better (with parents permission obtained beforehand). The researcher would bring out a bag with ten pieces of the snack that the child chose. The researcher placed the bag on the table in front of the child alongside a bell. The researcher explained to the child that he or she could wait until the researcher and the parent came back to eat the snack or the child could eat the snack whenever he wanted or ring the bell to signal that the child did not want to wait any longer. The researcher explained that if the child waited until the researcher and the parent returned that he would receive a second bag of the snack. It was also explained to the child that if he did not wait then he or she would only receive the one bag of the snack. The researcher verified that the child understood before leaving the room. The instructions were repeated if necessary.

After explaining and ensuring that the child understood, the parent and the researcher stepped away from the table. When a five-minute time span passed or if the child rang the bell, or ate the snack, the researcher and the parent returned to the child. If the child had waited without eating the snack or ringing the bell, the researcher would praise the child for waiting and say that the child must really want that second bag of the snack. If the child rang the bell or

started eating the snack, the researcher would tell the child that he must have been super hungry. Regardless of whether the child waited or not, the child received the second bag of the snack as long as it was acceptable to the parent.

After the experiment, an additional coder transcribed seventeen of the twenty-one parent-child interactions. The inter coder reliability was 98%. The toy that the parents and children interacted with was also documented. The amount of time that the child waited before eating the snack, ringing the bell, or the researcher and parent's return was coded.

Chapter 3: Results

This study sought to answer two main questions. The first of these questions was how electronic toys impact parent-child interactions. This question was explored during the parent-child play session. The second question was how electronic toys impact children's abilities to self-regulate. This question was explored through the self-regulation-task.

Play Session

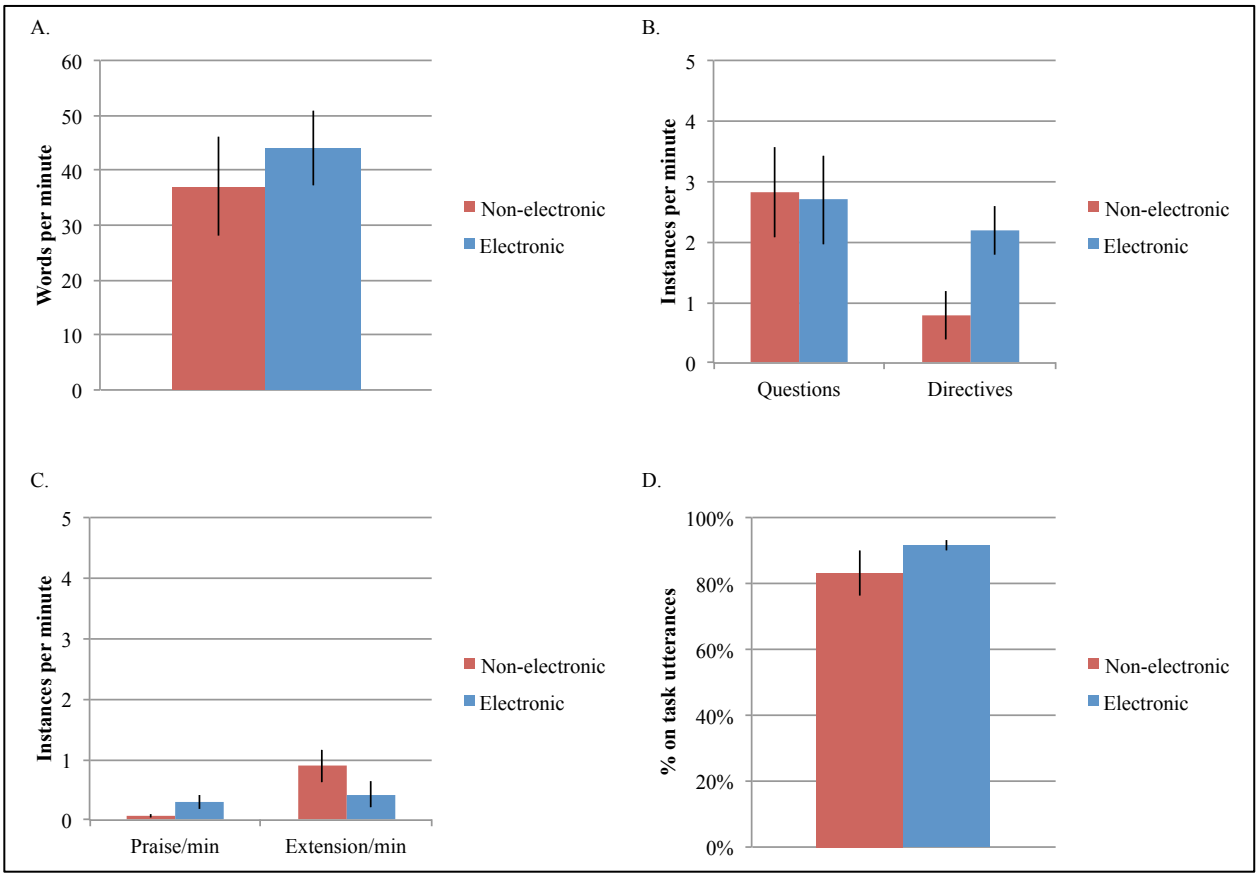
After transcribing the play sessions, we analyzed the utterances that were made by the parents. We first completed the analysis by considering both the educational and non-educational toys together. We calculated the average parent number of words per minute, questions per minute, directives per minute, praises per minute, extensions per minute, and the % of on-task utterances (see Table 2). The words that the parents read from the book were not included in the transcription and the parent word count; both the non-electronic book and e-book had the same number of words. First, we identified utterances that were a question ("What do you want to build?") or a directive ("Turn the page."). Then each utterance was coded as one of 4 classifications: praise, extension, off-task, or on-task. In the case that an utterance could be classified as two categories (e.g., "This one looks like a motorcycle."), praise and extension were prioritized over off-task and on-task, as these were the more meaningful classifications. Given that the play sessions ranged from 5-6 minutes, we calculated variables by minute rather than exact count to account for this variation. This analysis compared the averages of each category by whether the toy the parent-child dyad played with was electronic or non-electronic.

The analysis (see Figure 1) shows that the average number of words per minute that parents uttered while engaging with their child with a non-electronic toy was 37.03 while the average for the electronic toys was 43.97. For the number of questions per minute that were asked by the parent, we found that the parents with the non-electronic toy uttered an average 2.82 questions per minute while those in the electronic condition uttered 2.69 questions per minute. For the average number of directives that parents spoke, we found that with non-electronic toys parents uttered 0.79 directives per minute while they uttered 2.18 directives per minute with the electronic toy. Parents in the non-electronic condition uttered almost zero praise with an average of 0.07 praise utterances per minute which was significantly less than the 0.29 praise utterances per minute for electronic toys. The average number of extensions per minute that parents spoke with non-electronic toys was a relatively low 0.90 utterances per minute compared to 0.42 utterances per minute with the electronic toy.

Table 2. Play session analysis of parent speech (utterances per minute)

	Non-electronic				Electronic				t-test		
Study Factors	M	SE	Min	Max	M	SE	Min	Max	$t(1,19)$	$p=$	η_p^2
Entire sample											
Words	37.03	9.12	1.93	93.04	43.97	6.83	14.29	75.08	-.61	.55	.02
Questions	2.82	.74	.40	5.42	2.69	.54	.76	6.59	.14	.89	.00
Directives	.79	.40	.00	3.74	2.18	.77	.38	9.21	-1.57	.13	.12
On-task	6.52	1.70	.20	8.39	8.95	1.32	5.37	17.74	-1.14	.27	.06
Off-task	.75	.26	.00	2.47	.90	.23	.00	2.79	-.45	.66	.01
Praise	.07	.03	.00	.19	.29	.11	.00	1.07	-1.77	.09	.14
Extension	.90	.27	.00	1.89	.42	.22	.00	2.43	1.36	.19	.09
Books only											
Words	19.03	6.06	1.93	34.94	38.93	8.23	25.01	75.08	-1.95	.08	.28
Questions	1.75	.73	.18	4.94	2.76	0.60	1.67	5.35	-1.07	.31	.10
Directives	.38	.34	.00	2.09	1.12	0.23	.38	1.78	-1.79	.10	.24
On-task	3.14	1.16	.20	7.87	7.50	1.02	5.37	11.35	-2.81	.02	.44
Off-task	.66	.38	.00	2.47	.74	.19	.00	1.46	-.19	.85	.00
Praise	.03	.03	.00	.19	.32	.13	.00	.73	-2.17	.055	.32
Extension	.54	.29	.00	1.89	.59	.40	.00	2.43	-.012	.91	.00

Figure 1. Play session analysis with educational and non-educational toys



To get a better sense of the content of the parents' speech, we next calculated the proportion of utterances that were on-task, off-task, praise, or extension (see Table 3). This analysis showed that parents in the non-electronic condition (M = .11) were significantly more likely than parents in the electronic condition (M = 0.03) to provide extensions during the play session. There were no other significant effects.

Table 3. Proportional analysis of parent speech

	Non-electronic				Electronic				t-test		
Study Factors	M	SE	Min	Max	M	SE	Min	Max	$t(1,19)$	$p=$	η_p^2
Entire sample											
Off-task	.14	.05	.00	.50	.08	.01	.00	.15	1.14	.27	.06
On-task	.74	.07	.25	1.00	.87	.02	.71	1.00	1.73	.10	.14
Praise	.01	.00	.00	.03	.02	.01	.00	.09	-1.61	.13	.12
Extension	.11	.03	.00	.28	.03	.01	.00	.15	2.37	.03	.23
Books only											
Off-task	.20	.09	.00	.50	.08	.02	.00	.12	1.31	.22	.15
On-task	.69	.12	.25	1.00	.84	.03	.71	.97	-1.32	.22	.15
Praise	.00	.00	.00	.03	.03	.01	.00	.09	-1.92	.08	.27
Extension	.11	.11	.00	.28	.04	.03	.00	.15	1.24	.24	.13

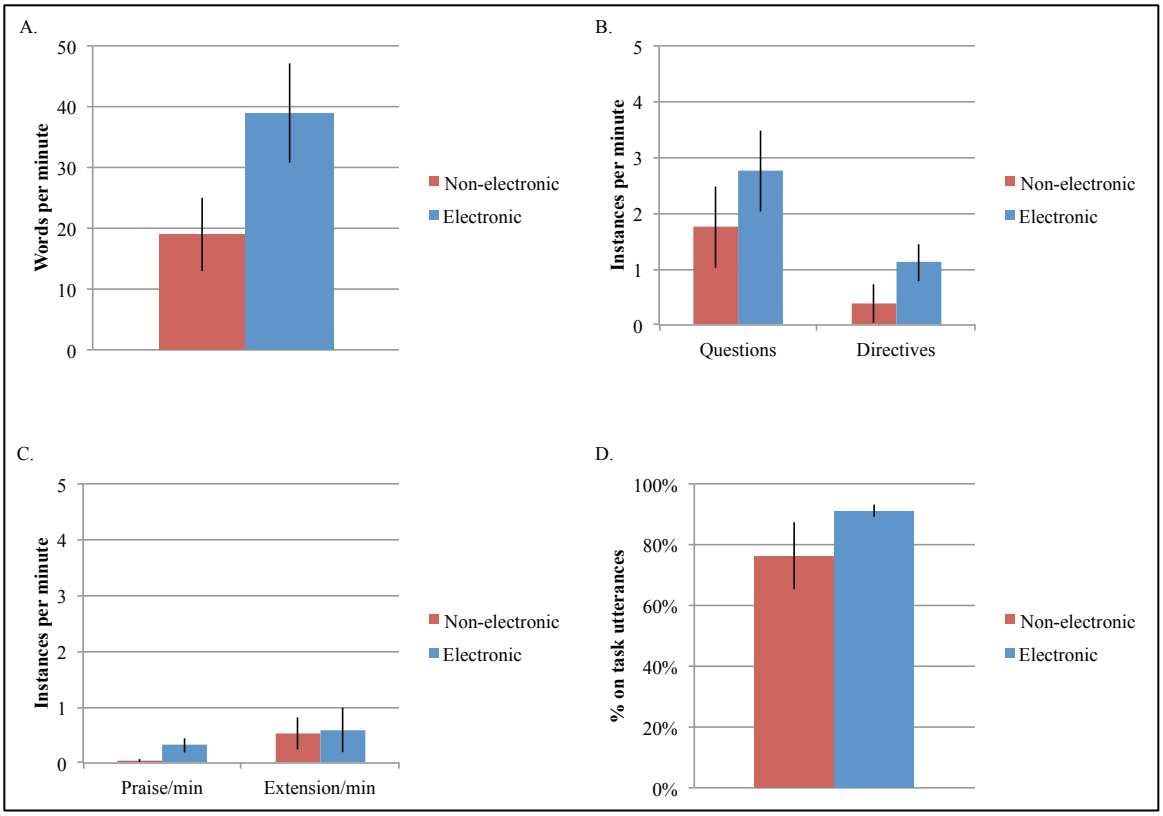
A second set of analyses was completed on the play session transcription for only the electronic book and the non-electronic book. This analysis was completed to replicate other studies that used electronic and non-electronic books and our sample for the book stimuli was our largest group. The same categories of the average number of words per minute, questions per minute, directives per minute, praises per minute, extensions per minute, and the % of on-task utterances were analyzed (see Table 2).

The analysis (see Figure 2) shows that the number of words, on average, per minute that parents uttered while engaging with their child with a non-electronic book (M = 19.03) was marginally significantly less than those with the electronic book (M = 38.93). Parents did not ask significantly different numbers of questions per minute (non-electronic book M = 1.75; electronic book M = 2.76. For the average number of directives per minute, we found a marginally significant effect of the condition with parents in the non-electronic book condition using 0.38 directives per minute while those in the electronic book condition used 1.12 directives per minute. There was also nearly significant (p = 0.55) effect of condition on the rate of praise with parents using the non-electronic uttering almost zero praise utterances per minute (M =

0.03) while parents in the electronic condition used praise more frequently (M = 0.32). There was no impact of condition on the average number of extensions per minute (non-electronic M = 0.54; electronic M = 0.59). Finally, those using the electronic book uttered significantly more on-task utterances per minute (M = 7.5) compared to those using the non-electronic book (M = 3.14). This effect is likely due to the fact that parents in the electronic book condition said more words in general. There was no effect of condition on the number of off-task utterances per minute (non-electronic M = 0.66; electronic = 0.74)

To get a better sense of the content of the parents' speech, we again calculated the proportion of utterances that were on-task, off-task, praise, or extension (Table 3). This analysis showed that parents in the non-electronic condition (M = 0.00) used no praise while those in the electronic condition (M = 0.03) provided some praise. There were no other significant effects.

Figure 2. Play session analysis (using books only)

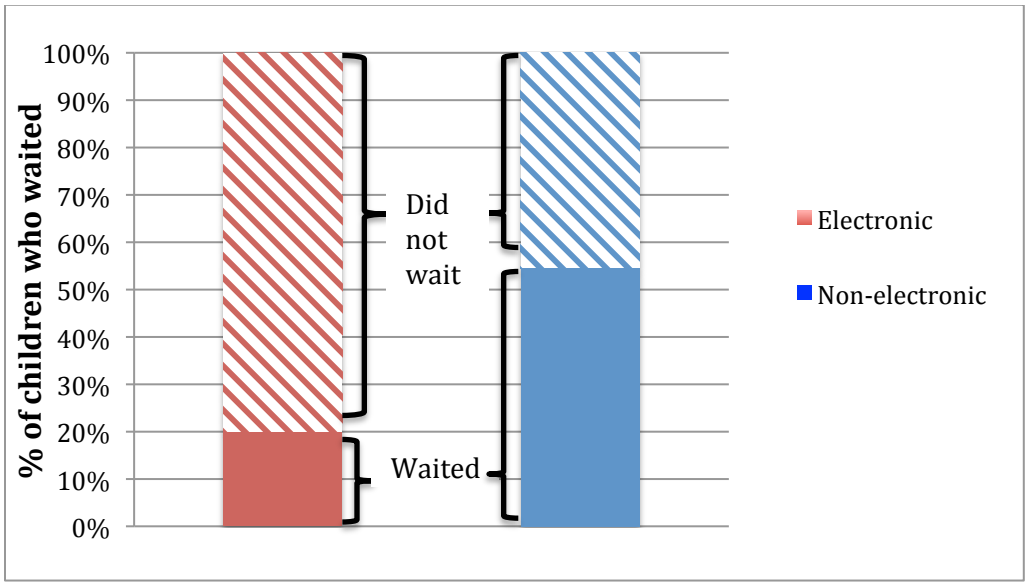


Self-regulation

After the self-regulation phase was recorded, we coded for the length of time the child waited before ringing the bell or eating the snack. In other words, we observed whether the children waited the full five minutes for the increased reward or if they rang the bell or ate the snack before the five-minute wait time was completed. We analyzed whether the children who had played with an electronic toy with their parents were more likely to wait the full time to earn the increased reward. We also performed this analysis on the children who played with the non-electronic toys with their parents. First, we examined the average length of time that children waited. We found that the children who played with the non-electronic toys waited, on average,

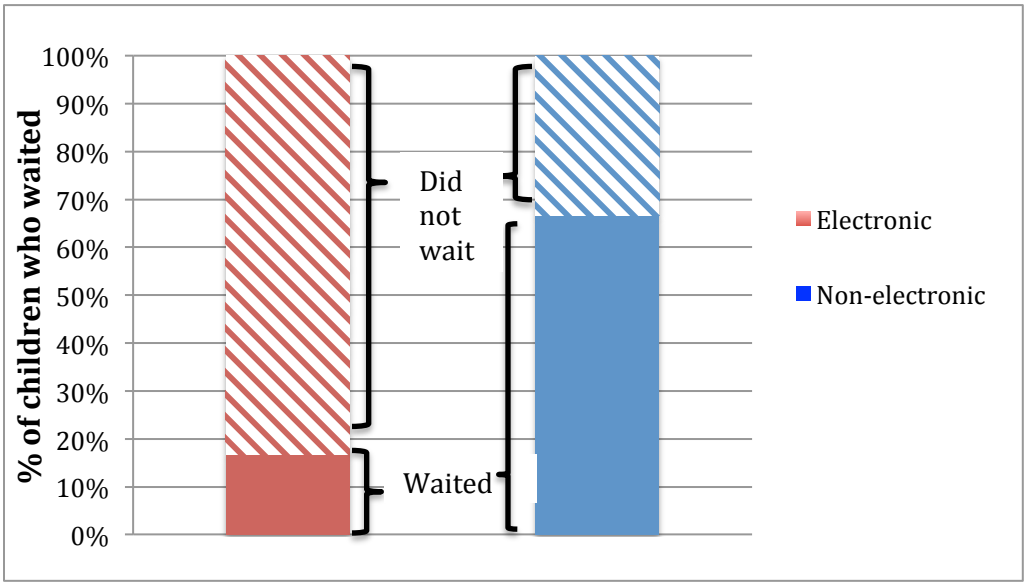
147.10 seconds while in the non-electronic condition waited 182.55 seconds. This difference was not significant, I(1,19) = -0.63. However, when we explored the percentage of children who were able to wait for the full five minutes versus being unable to wait, it is revealed that 20% of the children who had interacted with a non-electronic toy were able to wait while 54% the children who had interacted with an electronic toy waited for the full five minutes (see Figure 3).

Figure 3. Self-regulation-task with all toys



We then asked about books only. We found similar results. We found that the children who played with the non-electronic toys waited, on average, 151.67 seconds while in the non-electronic condition waited 209.33 seconds. This difference was not significant, $t(1,10) = -0.76$. However, when we analyzed the percentage of children who were able to wait for the full five minutes versus being unable to wait, it is revealed that 17% of the children who had interacted with a non-electronic book were able to wait while 67% the children who had interacted with an electronic book waited for the full five minutes (see Figure 4). This effect neared significance, X^2 (1, N = 21) = 2.65, p = .11.

Figure 4. Self-regulation-task (using books only)



Chapter 5: Discussion

With the continuously increasing use of technology by young children, the debate continues as to how technology is impacting children (Common Sense Media, 2014). Some studies have found that technology use by young children and their parents disrupts the quality of parent-child interactions (Bergen et al., 2009; Eliot, 1999; Pempek et al., 2011; Petkovski, 2014; Wooldridge & Shapka, 2012). Other research has found that technology use is negatively impacting children's abilities to self-regulate, which is an important skill for success later in life (Galinsky, 2010, Lilard & Peterson, 2011; Radesky et al., 2014). Research has not been able to stay up to date with the rapidly changing and developing world of technology. Continuous research is needed to discover how technology is impacting parent-child interactions and children directly.

The research presented in this study seeks to add to our understanding of the impacts of technology. Here, during the first phase of the experiment, we asked how electronic toys impact the quality and quantity of parent-child interactions. The quality of parent-child interactions was analyzed based on the amount of questions, directives, praises, extensions, and on-task and off-task utterances the parents spoke. We hypothesized that parents and children who interacted with an electronic toy would have a poorer quality interaction than the parents and children who interacted with a non-electronic toy. This general hypothesis was based on previous studies that analyzed the impact that electronics have on the parent-child dyad (Parish-Morris et al., 2013; Pempek, Demers, Hanson, Kirkorian, & Anderson, 2011; Wooldridge & Shapka, 2012). Our hypotheses were only partially supported. After analyzing the data for all of the toys, we found marginally significant differences in the amount of praise and the proportion of on-task language,

and a significant difference in the proportion of extension utterances. Parents using the electronic toys used more praise and were slightly more on-task than parents using the traditional toys. However, this is likely due to the significant pattern of increased extension use by parents in the non-electronic condition. Parents using the non-electronic toy connected the experience with children's lives and other information, which likely lessened the opportunity for praise. This aligns with previous research finding that parents reading a non-electronic book with their child used more extensions and asked children to connect what they were reading with their everyday lives and emotions (Parish-Morris et al., 2013).

When just considering the non-electronic books and the e-books, other indicators of quality became significant. We found that there was a marginally significant impact on number of utterances per minute with parents using the electronic book using more words per minute than the parents with the non-electronic book. These parents also had significantly more on-task utterances and produced more praise. However, we also found a marginally significant increase in the use of directives with the electronic book. These results are not entirely unexpected and may be related. When a parent tells a child to do something, a common response would be to praise the child once they do it (e.g., "Swipe there. Good job"). Further, the increased use of directives also aligns with our hypothesis and previous research (Parish-Morris et al., 2013). A study that asks the parent's and child's familiarity with playing on a tablet is needed to better understand if an abundance of time is spent teaching a child how to use the electronic toy. A study with a larger sample size is needed to more fully analyze the impact that electronic and non-electronic toys have on parent-child interactions.

During the second phase of the study, the investigation asked how electronic toys might impact children's abilities to self-regulate directly after playing with a particular toy. We hypothesized that children who played with an electronic toy with their parent directly before the self-regulation-task would be less likely to wait for an increased reward than the children who had played with a non-electronic toy. This hypothesis was developed based on previous studies that suggested that fast-paced television and electronics impact children's abilities to self-regulate (Lillard & Peterson, 2011; Radesky et al., 2014). The preliminary results presented here suggest that our hypothesis may not be correct. The children who interacted with an electronic toy were actually more likely to wait the full five minutes to receive the increased reward. It is not clear from this data or study why this occurred. We based our hypothesis on the assumption that interacting with a tablet is more like watching fast-paced television (shown by Lillard & Peterson, 2011), which has been shown to negatively impact self-regulation. However, recently published research reports that 65% of parents give young children electronic devices with the explicit intention to keep them calm (Kabali et al., 2015). This suggests that using electronic devices may have had the opposite effect than what we intended. Future research should explore the stimulating or calming effects of technology on children. Another possibility is that parents may use electronics as a reward at home, so this may make children more likely to wait when electronics are an option. In fact, Wartella, Rideout, Lauricella and Connell (2013) report that children do use technology as a reward. Future research should explore whether or not technology has different impacts on self-regulation for children whose parents do or do not use technology as a reward at home.

While as many variables as possible were removed from this study, this study still has several limitations that may have had some impact on the results. One limitation is that we did

not look at the utterances of the children. This may be an area of future study. We did not complete an analysis of the utterances made by the children because our sample included children ages two to five years old. In this age span the children have a wide variety of language development so it would have been difficult to fully examine the utterances made by the children. This leads into another possible limitation; based on the age range of the children, some parents may have interacted differently with their children based on the age of the child. Due to the small sample size, which is another limitation, we were not able to look at smaller age categories. The parents were not asked to provide their socio-economic status, their own and their child's familiarity with technology, their own education level, or their own age so we were not able to analyze the data with these variables taken into consideration. Further research is needed to see if any of these categories would impact parent-child interactions with an electronic or non-electronic toy. Another possible limitation is that some of the children and parents may have already been familiar with the toy that they interacted with; we did not ask if either were familiar with the toy so we were not able to analyze based on familiarity. Future research should be completed to eliminate this variability. Just as we did not ask about familiarity with a particular toy, we also did not ask about children's typical technology use at home; this could possibly have a factor in parent-child interaction with a toy. One last limitation is the location that we ran the study was not consistent across all participants. Some participants came into the Child Development Lab at the Pennsylvania State University, Brandywine Campus, which was a very controlled environment with as many distractions eliminated as possible. Other participants were ran at the Middletown Free Library or at the Living Lab at the Delaware Children's Museum. The latter two locations were not as controlled as the Child Development Lab so

children and parents may have experienced environmental distractions. Future investigations with more children will be able to determine whether the location was a significant factor.

While this study shows that technology has some limited impact on parent-child interactions and children's abilities to self-regulate, the question may be raised as to why electronic play is so attractive to children in the first place. While this question may be a possible direction for future research, there is a theory that relates to this topic that is called the Flow Theory (Rieber, 1996). The Flow Theory provides eight guidelines to ascertain if an activity will become enjoyable to an individual. One of the guidelines is that challenge must be optimized; this is one of the most important guidelines. A second guideline is that the individual has to have all of their attention enmeshed in the activity. The third guideline is that the goals have to be clear. Another guideline is that the individual has to be temporarily free of worries and frustrations while engaged in the activity. The individual must also be in control of the activity. Another guideline is that the individual must not feel self-conscious while engaged in the activity. The last guideline under the Flow Theory is that time must pass unnoticed while the individual is engaged in the activity. The more guidelines that are included in a game, the more likely children are to be attracted to that particular electronic play form. If electronic game and toy developers are considering the Flow Theory or unknowingly applying some of the guidelines of the theory, the Flow Theory could be one of the reasons why electronic play has become so popular with children. By understanding why children are so drawn to electronics and what aspects of electronics intrigue children the most, toy developers may be able to change or guide the way that electronic toys are impacting parent-child interactions and children directly. Further investigation is needed to see why technology is so attractive to children and if the Flow Theory is applied to any electronic toys that are developed for children.

Researchers are not only concerned with how technology is impacting parent-child interactions and children's abilities to self-regulate. There are some fears about the impact that the shift from a high amount of active play to a high amount screenplay may have on children. Plowman, McPake, and Stephen (2010) classified the possible impacts that increased screen time may have on young children into three categories. The three categories were sociocultural, cognitive, and well-being. Under the category of sociocultural, one of the concerns is that when participating in screen time, children are playing alone and not interacting with other children. Another concern in the sociocultural category is that children are only having secondhand experiences, and not firsthand experiences. In the cognitive category, a concern is that intellectual development is at risk. Linguistic development may be negatively impacted by excessive screen time. One last concern from the cognitive category is that imagination will be reduced. There are several concerns under the well-being category. One such concern is that children spend too much time indoors when they are participating in screen time. Often with screen time, children are not participating in a high level of active moving, which puts children at risk for obesity and related issues. Mentally, children may be able to become addicted to technology. A study in Singapore found that children who are addicted to video games have poorer school achievement than children who are not addicted to video games (Skoric, Teo, & Neo, 2009). Also, not only are children missing out on engaging in play with one another, but children are also missing out on engaging with family members (Plowman et al., 2010). Future research will be able to more fully examine how technology is impacting children and what can be done to reduce any possible negative impacts that technology may have.

In sum, this study represents the first step to a comprehensive investigation of electronic versus non-electronic toys and their impact on both parent-child interactions and self-regulation.

More data will be needed to draw firm conclusions but this study begins to inform our understanding of this ‘culture change’ of technology in childhood and its possible impacts.

Appendix

Description of research and overview of participant interaction

Explanation of research to parent. Hello! We are from Penn State Brandywine. Today we are running a study with children ages two through five. For this study we are looking at how parents and children interact while playing with a particular toy and how children wait for a reward after playing with a particular toy. So for the first part we have you and your child play together for five minutes. For the second part we offer the child goldfish crackers or marshmallows. Do you have a preference of which one the child has? We give the child one bag of the snack and explain that he or she can have this snack now or wait to receive a second bag. Whether the child waits or not he or she will be given a second bag. Here we have our consent form. *Hand the parent or guardian a copy of the consent form*. This gives an outline of the study that I just explained to you. We will be videotaping so that we can go back and analyze the study. On this back page you have the option of consenting to allow us to use the video footage for academic purposes only, such as at academic conferences, or if you do not want the video to be shown that is totally fine too. Take your time reading over and feel free to ask me any questions you may have and then sign when you are ready.

To parent or guardian you can sit here *direct to chair facing the camera*. *To the child*. You can sit here. *Direct to chair with child's left side facing thru camera*. Here is a toy for you both to play with. *Place toy on table*. I ask that you just play together like you would at home until I return. *Researcher leaves*.

Researcher returns. Did you have fun playing? *To child*. Are you ready for the next game? Do you prefer marshmallows or goldfish crackers? *Place the snack that the child chooses*

in front of the child. Here I have one bag of snack for you. You can eat this snack whenever you would like but if you wait to eat the snack until your *use name that the child uses for the parent or guardian* and I return then I'll give you a second bag of the snack. *Place bell next to snack*. If you decide you want the snack before we return then just ring this bell and we'll return. Do you understand? *Parent or guardian and researcher leave*.

After 5 minute waiting period or when child starts eating the snack or when child rings the bell the parent or guardian and the researcher return. If the child waited until the researcher returns the researcher says wow you did a great job waiting! You must really want that second bag. *Give child second bag of the snack*.

If the child rang the bell or started eating the snack the researcher says wow you must really be hungry! Here is a second bag for you. *Give child second bag of the snack*.

Give child certificate. Here is a special certificate for you saying that you participated in science with us today. Thanks for playing with us. Bye.

References

Bergen, D., Hutchinson, K., Nolan, J. T., & Weber, D. (2009). Effects of infant-parent play with a technology-enhanced toy: Affordance-related actions and communicative interactions. *Journal of Research in Childhood Education*, *24*(1), 1–17. doi:10.1080/02568540903439342

Bernier, A., Carlson, S. M., & Whipple, N. (2010). From external regulation to self-regulation: Early parenting precursors of young children's executive functioning. *Child Development*, *81*(1), 326–339. doi:10.1111/j.1467-8624.2009.01397.x

Common Sense Media. (2014). Zero to eight: Children's media use in america 2013. *The Education Digest*, *79*(6), 59–63. Retrieved from http://search.proquest.com.ezaccess.libraries.psu.edu/docview/1496698428?pq-origsite=summon

Diamond, A. (2002). Normal development of prefrontal cortex from birth to young adult: Cognitive functions, anatomy, and biochemistry. *Principles of Frontal Lobe Function*, 466–503.

Drake, K., Belsky, J., & Fearon, R. M. P. (2014). From early attachment to engagement with learning in school: The role of self-regulation and persistence. *Developmental Psychology*, *50*(5), 1350–1361. doi:http://dx.doi.org/10.1037/a0032779

Eliot, L. (1999). *What's Going on in There?* New York: Bantam Books.

Florez, I. R. (2011). Developing young children's self-regulation through everyday experiences. *Young Children*, *66*(4), 46–51.

Galinsky, E. (2010). *Mind in the making: The seven essential life skills every child needs*. New York: HarperCollins.

Grolnick, W. S., & Ryan, R. M. (1989). Parent styles associated with children's self-regulation and competence in school. *Journal of Educational Psychology*, *81*(2), 143–154. doi:http://dx.doi.org/10.1037/0022-0663.81.2.143

Hughes, M., & Hutt, C. (1979). Heart-rate correlates of childhood activities: play, exploration, problem-solving and day-dreaming. *Biological psychology*, *8*(4), 253-263.

Kabali, H. K., Irigoyen, M. M., Nunez-Davis, R., Budacki, J. G., Mohanty, S. H., Leister, K. P., & Bonner, R. L. (2015). Exposure and use of mobile media devices by young children. *Pediatrics*, peds.2015–2151. http://doi.org/10.1542/peds.2015-2151

Krcmar, M., & Cingel, D. P. (2014). Parent–child joint reading in traditional and electronic formats. *Media Psychology*, *17*(3), 262–281. http://doi.org/10.1080/15213269.2013.840243

Levin, D. E., & Rosenquest, B. (2001). The increasing role of electronic toys in the lives of infants and toddlers: Should we be concerned? *Contemporary Issues in Early Childhood*, *2*(2), 242–247. http://doi.org/10.2304/ciec.2001.2.2.9

Lillard, A. S., & Peterson, J. (2011). The immediate impact of different types of television on young children's executive function. *Pediatrics*, *128*(4), 644–649. doi:10.1542/peds.2010-1919

McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology*, *43*(4), 947–959. doi:http://dx.doi.org/10.1037/0012-1649.43.4.947

Neuenschwander, R., Röthlisberger, M., Cimeli, P., & Roebers, C. M. (2012). How do different aspects of self-regulation predict successful adaptation to school? *Journal of Experimental Child Psychology*, *113*(3), 353–371. doi:10.1016/j.jecp.2012.07.004

Newburger, E. C. (2001). Home computers and internet use in the United States: August 2000. *U.S. Department of Commerce*.

Osofsky, J., & Fitzgerald, H. (2000). *Handbook of infant mental health* (Vol. World association for infant mental health). New York: Wiley.

Parish-Morris, J., Mahajan, N., Hirsh-Pasek, K., Golinkoff, R. M., & Collins, M. F. (2013). Once upon a time: Parent–child dialogue and storybook reading in the electronic era. *Mind, Brain, and Education*, *7*(3), 200–211. doi:10.1111/mbe.12028

Pempek, T. A., Demers, L. B., Hanson, K. G., Kirkorian, H. L., & Anderson, D. R. (2011). The impact of infant-directed videos on parent–child interaction. *Journal of Applied Developmental Psychology*, *32*(1), 10–19. doi:10.1016/j.appdev.2010.10.001

Petkovski, M. (2014). *Parent-Child Interaction in Shared-Computer Activities: An Exploratory Study Examining Parent-Child Interaction with a Mobile Device*. Wilfrid Laurier University, Waterloo, ON.

Plowman, L., McPake, J., & Stephen, C. (2010). The technologisation of childhood? Young children and technology in the home. *Children and Society*, *24*(1), 63–74. doi:10.1111/j.1099-0860.2008.00180.x

Radesky, J. S., Silverstein, M., Zuckerman, B., & Christakis, D. A. (2014). Infant self-regulation and early childhood media exposure. *Pediatrics*, *133*(5), e1172–e1178. doi:10.1542/peds.2013-2367

Rideout, V. (2015). The common sense census: Media use by tweens and teens.

Rieber, L. P. (1996). Seriously considering play: Designing interactive learning environments based on the blending of microworlds, simulations, and games. *Educational technology research and development*, *44*(2), 43-58.

Rothbart, M. K., & O'Boyle, C. G. (1992). Self-regulation and emotion in infancy. *New Directions for Child and Adolescent Development*.

Rothbart, M. K., Sheese, B. E., Rueda, M. R., & Posner, M. I. (2011). Developing mechanisms of self-regulation in early life. *Emotion Review*, *3*(2), 207–213. doi:10.1177/1754073910387943

Sethi, A., Mischel, W., Aber, J. L., Shoda, Y., & Rodriguez, M. L. (2000). The role of strategic attention deployment in development of self-regulation: Predicting preschoolers' delay of gratification from mother–toddler interactions. *Developmental Psychology*, *36*(6), 767–777. doi:http://dx.doi.org/10.1037/0012-1649.36.6.767

Skoric, M. M., Teo, L. L. C., & Neo, R. L. (2009). Children and video games: Addiction, engagement, and scholastic achievement. *CyberPsychology and Behavior*, *12*(5), 567–572. doi:10.1089/cpb.2009.0079

Thiessen, E. D., Hill, E. A., & Saffran, J. R. (2005). Infant-directed speech facilitates word segmentation. *Infancy*, *7*, 53–71.

Wartella, E., Rideout, V., Lauricella, A., & Connell, S. (2013). Parenting in the age of digital technology. *Report for the Center on Media and Human Development School of Communication Northwestern University*.

Wooldridge, M. B., & Shapka, J. (2012). Playing with technology: Mother–toddler interaction scores lower during play with electronic toys. *Journal of Applied Developmental Psychology*, *33*(5), 211–218. doi:10.1016/j.appdev.2012.05.005

Zosh, J. M., Verdine, B. N., Filipowicz, A., Golinkoff, R. M., Hirsh-Pasek, K., & Newcombe, N. S. (2015). Talking shape: Parental language with electronic versus traditional shape sorters. *Mind, Brain, and Education*, *9*(3), 136–144. http://doi.org/10.1111/mbe.12082

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