The parent advantage in fostering children's e-book comprehension

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ABSTRACT

One potential advantage of e-books is that unlike traditional books, preschoolers can read independent of an adult by using the audio narration feature. However, little research has investigated whether children comprehend a story's content after using an e-book with audio narration. The current study compares preschoolers' comprehension of an e-book in three conditions: (1) parent reading, in which parents read the e-book to their children, (2) independent with audio, in which children see the e-book independently with audio narration, and (3) independent without audio, in which children see the e-book independently but do not have audio narration available. Our results suggest that children comprehend some content from e-books using audio narration, indicating that using e-books independently may be a worthwhile activity for preliterate children while caregivers are otherwise occupied. However, results also show that children recall the most information about the e-book after reading with a parent.

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1. Introduction

Picture a parent and child cuddled up in bed reading a book together. This image reflects a common tradition among families with young children of shared storybook reading. Ninety-one percent of parents with children under age 6 report reading books aloud at home (Scholastic Inc. & YouGov, 2015). However, many aspects of family life are evolving in the digital age. One recent observational study found that 40 out of 55 caregivers used a mobile device during a meal with their child at a fast food restaurant (Radesky et al., 2014). Furthermore, parents are often passing these devices to their children, with one survey of 810 U.S. parents showing that most parents at least occasionally allow their child to use their smart mobile device, most often when in the car. This device use by parents and children is likely taking the place of time that families would otherwise be interacting with each other. Will shared bedtime reading also be supplanted by technology?

Technology has made significant changes to book reading as tablets and e-readers have risen in popularity. In 2014, a nationally representative survey of over 1500 U.S. parents found that 62% of 2- to 10-year-olds had access to either a tablet or a dedicated e-reader for electronic reading at home, and parents reported that about half of those children were regularly engaged in electronic reading (Rideout, 2014). Similarly, a survey of over 1000 U.K. parents found that almost three-quarters of 3- to 4-year-olds have access to a touchscreen device at home, and parents reported that children use touch screens at least once a week (Formby, 2014). Even children with emergent literacy skills who cannot yet decode traditional written text are using this new technology for reading. The report showed that younger children (2- to 4-year-olds) use e-reading devices at similar rates as older children (Rideout, 2014), with children beginning to use e-books at an average of 5 years of age (Gilmore, 2015).

Although some of this e-book use with young children includes shared reading with a parent, one potential advantage of e-books is that children with emergent literacy skills who cannot yet decode traditional written text can interact with a book independent of an adult, using the audio narration feature available on many apps and devices. Indeed, many companies promote e-books' potential for independent reading, advertising their large selections of "read-to-me" books, which can be used either with or without the audio narration that reads a book's text to a listening child. This feature appears to be widely used. In a survey of 462 U.S. parents of 2- to 6-year-olds who have an iPad at home, more than 60% reported that their children use audio narration often/always when they read e-books alone, and an additional 28% reported that children some-

times do (Vaala & Takeuchi, 2012). Furthermore, children are likely to have opportunities to read independently: over 70% of parents reported sometimes or often giving their child an e-book to read alone if they were busy doing something else (Vaala & Takeuchi, 2012). Similar data from a survey of over 1500 parents of children under 8 in the U.K. showed that 68% of parents report that their child at least sometimes uses digital media so that the parent can get things done (Kucirkova & Littleton, 2016). Almost half of the parents also reported that their children read an e-book on their own at least once a week (Kucirkova & Littleton, 2016). Little published research has explored whether children comprehend a story's content after engaging with an e-book using audio narration or whether comprehension would be greater after reading with a parent.

Most research investigating children's engagement with e-books compares the effects of reading an e-book versus a traditional book. For example, Parish-Morris, Mahajan, Hirsh-Pasek, Golinkoff, and Collins (2013) had preschoolers and their parents read either an e-book (LeapFrog electronic console book) or a traditional book. Five-year-olds did well regardless of which book they were read. Three-year-olds could identify basic story characters and events from both e-books and traditional books. However, those who were read the e-book did more poorly than those who were read the traditional book on story content questions (e.g., "Did Dora and Boots climb Tall Mountain or Short Mountain?") and on a task requiring children to sequence story events. Krcmar and Cingel (2014) reported similar findings: preschoolers' comprehension was significantly better after reading a traditional book than after reading an e-book (see also de Jong & Bus, 2002; Ross, Pye, & Randell, 2016). However, other studies show few differences in comprehension between the two mediums (e.g., De Jong & Bus, 2004; Lauricella, Barr, & Calvert, 2014). Similarly, Willoughby, Evans, and Nowak (2015) found that e-books have a similar effect to traditional books on emergent literacy skills. That is, children who received training with an alphabet print book and an alphabet e-book gained a similar amount in alphabetic knowledge. Furthermore, some studies suggest that while enhanced or interactive e-books may be distracting and reduce comprehension, basic e-books do not reduce comprehension relative to traditional books (Chiong, Ree, Takeuchi, & Erickson, 2012; Hassinger-Das et al., 2017). E-books can also have positive effects, such as more child-initiated discourse and greater responsiveness to maternal talk (Korat & Or, 2010). Notably, much of this research has been conducted in U.S. contexts, and further research is needed to extend these findings to international settings.

How might children's understanding of an e-book using audio narration compare to reading with a parent? Research suggests that parents' behavior beyond simply reading the words on the page contributes to children's comprehension during shared book reading (Whitehurst et al., 1988). During shared book reading, parents may engage in 'dialogic reading' practices, including strategies to encourage a child to actively engage with the book's content. For example, parents offer praise, explanations, and corrections, build on the child's interests, and scaffold children's level of understanding by slowly increasing the complexity of the extratextual talk (Arnold & Whitehurst, 1994; Whitehurst et al., 1988; Zevenbergen & Whitehurst, 2003). Studies with children from a variety of ages and diverse backgrounds have found that dialogic reading is effective for supporting children's language and literacy development (e.g., Fielding-Barnsley & Purdie, 2003; Wasik & Bond, 2001; Zevenbergen & Whitehurst, 2003). For example, one study found that preschoolers learned more words from a book when adults read to them using dialogic reading practices compared to a more text-based reading approach (Hargrave & Sénéchal, 2000).

Dialogic reading strategies align with research in the learning sciences that identify four ideal properties that foster optimal

learning (Hirsh-Pasek et al., 2015). Although the term *learning* typically refers to a changed knowledge state, story comprehension is an important early educational activity, and storybook reading promotes later literacy and academic skills. Principles from the learning sciences may also apply to and foster story comprehension during e-book reading (National Early Literacy Panel, 2009). We use this learning sciences approach as a theoretical framework to guide this study. The first property is that children learn best when they are active rather than passive. During dialogic reading, adults encourage children to ask questions and make predictions about the story, promoting a "minds-on" approach in which the child has to mentally manipulate ideas and engage prior knowledge. Second, children learn best when they are engaged rather than distracted. Dialogic reading encourages engagement when parents help focus children's attention by pointing out different aspects of the story. Parents may also adapt their reading speed and tone to increase their child's attention if necessary. Third, children learn best in meaningful contexts. When parents connect something in the story to their children's lives – for example, noting that the train in the book is like the one they saw on vacation last week – they encourage children to link the book's content to experiences they have had. These "distancing prompts" are related to children's story comprehension (Hassinger-Das et al., 2017).

Finally, children learn best from social interaction, which is the core of dialogic reading. Shared book-reading is inherently social: simply having an adult present may encourage children to pay more attention and even process the content of the story in a deeper way. When adults respond to children's queries and comments, and when they modulate the complexity of questions and explanations to the child's cognitive level, children profit (Blewitt, Rump, Shealy, & Cook, 2009). These examples suggest that shared book reading might engender a more active, engaged, meaningful, and socially interactive context, which could lead to better comprehension and learning than when a child independently listens to an audio e-book.

Shared e-book reading is an example of joint media engagement, in which parents and children engage with media together (Takeuchi et al., 2011). Some studies have suggested that children benefit more from educational media when a parent or another adult engages with them (Lauricella et al., 2016). Findings from educational television viewing support the importance of parental engagement. Strouse, O'Doherty, and Troseth (2013) trained parents to use dialogic questioning techniques during videos. Children of questioning parents learned more vocabulary than children whose parents did not receive the training (Strouse et al., 2013). Strouse et al. (2013) also showed another group of children a video that included an actress engaging in dialogic questioning. Although children learned compared to a control group, they did not learn as much as when a parent used the dialogic techniques. In another study, Strouse and Troseth (2014) found that when parents watching a video with their child made connections between objects in the video and their real life counterparts, children were more likely to demonstrate transfer of the new words from the video to reality. This type of joint media engagement with e-books may also promote comprehension and learning relative to children's use of e-books independently.

On the other hand, e-books may be exciting and engaging for children, leading to more attention and perhaps even better comprehension than when reading with a parent. Indeed, one study found that children's visual attention to a computer storybook was higher than visual attention to a traditional book (Lauricella et al., 2014), and another found that children's "persistence" was higher for an e-book, based on indicators such as points to the book, turning pages, positive commenting, and asking questions (Moody, Justice, & Cabell, 2010). A more recent study comparing reading an e-book with audio narration to reading a traditional book with an

adult also found that children were more engaged in the e-book condition, measured through visual attention, observer ratings, and child-reported preference for the e-book (Richter & Courage, 2017). Similarly, Strouse and Ganea (2017) reported increased attention, positive affect, and more spontaneous comments about story content when toddlers read an e-book with a parent compared to a traditional book. These high levels of engagement are in line with children's attention to and interest in digital and mobile technology more broadly.

Indeed, between 2011 and 2013, the average amount of time children under 8 spent using mobile devices tripled, according to a survey of over 1000 parents in the U.S. (Common Sense Media, 2013). Apps and mobile media may be especially engaging for children: a survey of 810 U.S. parents found them saying they have to make their child stop playing with the iPhone by taking it away rather than children getting bored or choosing another activity (Chiong & Shuler, 2010). If read-to-me e-books maintain children's attention and engagement more so than reading with an adult, this effect may compensate for, or even overcome, any advantage of parent reading for comprehension. That is, perhaps increased engagement when using an e-book with audio narration could lead children to comprehend the story better than when being read to by a parent.

Additionally, young children have many opportunities to engage with electronic devices at times when their parents are not available to interact with them. In a survey of U.S. parents of children under 8 ($N = 1463$), 44% reported *sometimes* or *often* letting their child play with a smartphone or tablet while they are out running errands, and 55% reported *sometimes* or *often* using media to keep their child occupied while they do chores around the house (Common Sense Media, 2013). Given that children are already using screen media during these times, reading an e-book with audio narration may be a valuable educational opportunity, even if parent reading is more effective. In fact, in a nationally representative survey of over 2000 U.S. parents of children under 8, 61% said they are very likely to give their child a book when they want to them engage in an educational activity, whereas only 10% said they are very likely to give the child a smartphone or iPad. Thus, read-to-me e-books may be seen as a middle ground offering a potentially educational activity.

The audio narration feature might also prove useful for parents who do not speak the language used in their children's books. A 2014 report showed that 47% of foreign-born parents of children under 8 years of age had limited English proficiency (Park & McHugh, 2014). These families could benefit immensely from the use of e-book audio narration for children, because it could provide opportunities for children to hear English-language books at home, an activity their parents might otherwise avoid.

There is also evidence that the language exposure children receive from e-book audio narration may not be dramatically different from reading with a parent. Studies of parents' typical reading behaviors found that many do not normally employ dialogic reading techniques (Whitehurst et al., 1988). More commonly, parents simply read the text as printed and do not engage children in the story (Huebner & Meltzoff, 2005). This reading style is similar to what children experience when they interact with many currently available audio-narrated e-books, suggesting that children's story comprehension may also be similar.

Research is needed to investigate how children understand e-book audio narration. One early study showed that audio narration e-books can promote phonological awareness in children with reading difficulties (Chera & Wood, 2003), whereas another found that audio alone without visuals led to poor story comprehension (Ricci & Beal, 2002). In one recent study, Richter and Courage (2017) found that 3- to 5-year-olds answered a similar number of comprehension questions correctly after reading an e-book using audio

narration and after hearing an experimenter read a traditional book. These results suggest that preschoolers may comprehend some content from e-books using audio narration, providing important insight into this understudied area, but the study also leaves several questions unaddressed. First, in Richter and Courage's audio narration condition, an experimenter sat next to children providing some support to direct attention towards the tablet. This circumstance does not reflect children's independent e-book reading in real-world conditions. Furthermore, independent e-book reading using audio narration is compared to a condition in which an experimenter reads a traditional book, but does not provide any extratextual talk, whereas in naturalistic parent–child shared book reading, there are opportunities for discussion outside of the book's text. In the current study, we included more ecologically valid conditions to assess story comprehension under circumstances that better reflect children's everyday experiences. We also hold book format constant by comparing parent e-book reading to independent e-book reading. Additionally, Richter and Courage (2017) only assess comprehension using multiple-choice questions, whereas tasks asking children to retell the story independently may be more sensitive measures of children's understanding. We include two such tasks in the current study, in addition to specific questions, to capture different levels of comprehension. Finally, unlike Richter and Courage (2017), we used a book without interactive features such as hot spots, games, and sound effects, as previous research has suggested that these features may be distracting for children and reduce story understanding (Parish-Morris et al., 2013).

Thus, the current study examines two primary questions. First, do preschoolers understand a story's content after reading an e-book independently using audio narration? Second, does parent reading promote children's comprehension more than independent reading with audio narration? We answer these questions through a quantitative study design comparing preschoolers' comprehension of an e-book's content in three reading conditions: (1) parent reading, in which parents read the e-book to children, (2) independent with audio, in which children see the e-book independently with the audio narration, and (3) independent without audio, in which children see the e-book independently but do not have the audio narration feature available.

To test our first question, we compare the two independent conditions. The only difference between these conditions is whether children have access to the audio narration feature, allowing us to compare the effect of having access to the story text versus simply looking at the pictures. Here, if we find that children's comprehension is equivalent after hearing the audio narration and after reading without the audio narration, it would suggest that the read-to-me functionality is not any more beneficial than looking at the pictures. On the other hand, if we find that children understand the e-book's content better after hearing the audio narration, it would suggest that there is some benefit to read-to-me e-books and that they may be a worthwhile activity for preliterate children.

To test our second question, we compare the "Parent reading" and "Independent with Audio" conditions. Children in both conditions have access to the story text, so we can isolate the effect of reading with a parent compared to being read to by the e-book's audio narration. If we find that children comprehend an e-book's content just as well after hearing a read-to-me e-book than after reading with a parent, it would suggest that this new technology has potential to promote children's story comprehension. On the other hand, if we find that children understand more from reading with a parent, it would suggest that read-to-me e-books are not an equivalent substitute for engagement with a caregiver.

Additionally, we explore whether any differences in children's comprehension across conditions are moderated by demographic variables (parental educational and race/ethnicity) or child background characteristics (time spent reading, watching TV, and

playing on electronic devices). Significant effects may indicate that the effect of e-book audio narration may differ for subgroups of children. For example, audio narration e-books may be more effective for children from high SES backgrounds or for children who spend more time reading at home. Testing and acknowledging any boundary conditions that apply to our overall results will be important for understanding the practical implications of the findings. Notably, power analyses indicate that the design has sufficient power to detect medium or large effects, but not small ones, so these analyses should be considered exploratory.

Finally, we coded videos for the quality of parent–child interactions during reading to descriptively understand the reading experience children have in the parent condition. We also conducted analyses examining relations between interaction quality and comprehension to explore what features of parent reading may be helpful for promoting story understanding. However, due to the smaller sample available for these analyses (only the "Parent reading" condition), we were underpowered to detect small- or medium-sized effects. As aforementioned, these analyses should be considered exploratory and secondary to the primary research questions focusing on the differences between the conditions in comprehension.

2. Method

2.1. Participants

A total of 135 four- and five-year-old children (67 girls) participated (M_{age} = 59.4, SD_{age} = 7.9). Fourteen additional participants were tested but excluded due to failure to complete the procedure (n = 6), distraction (n = 2), experimenter error (n = 1), being out of the age range (n = 1), or because they appeared to be readers (i.e., were sounding out words, n = 4). We tested 4- and 5-year-old children because most children of this age are still pre-readers, but they are more likely than younger preschoolers to have the attention skills to engage with an e-book independently and the verbal ability to report on their comprehension in a story retell task. Participants were recruited by telephone and email from databases of families willing to participate in research at laboratories based at two mid-Atlantic universities. Participants were predominately white, middle-class, and monolingual. Demographic information about the sample is provided in Table 1.

Parents provided written informed consent, and children provided verbal assent before entering the testing room. This project was approved by the Institutional Review Boards at the University of Delaware and Temple University. All children received a certificate of appreciation and a sticker after completing the study.

2.2. Procedure

Participants were randomly assigned to one of three conditions: Parent reading (Parent, n = 51), Independent with Audio Narration (Independent Audio, n = 44), and Independent without Audio Narration (Independent No Audio, n = 40). After book reading, children were asked to (a) freely recall the story, (b) retell the story page by page, and (c) answer story comprehension questions. At the end of the procedure, children were also asked three questions about the moral of the story, but performance on this measure was uniformly poor, and it will not be discussed further here.

2.2.1. Book reading

All children regardless of condition were exposed to the same e-book, *The Busy Beaver*, by Nicholas Oldland. We chose this book because it was available both with and without audio narration and represented a simple e-book without additional features such as games, sound effects, and hot spots, which may detract from parent–child interaction and reduce children's comprehension (Parish-Morris et al., 2013). The book was provided on an iPad using the app *Epic!*, a popular children's e-book subscription service. In the *Parent* condition, parents were instructed to read the e-book aloud to their children as they would at home. Children and parents sat next to each other in child-sized chairs with a table in front of them where the iPad was placed by the researcher. While the children and parents read the e-book, the researcher waited in an adjacent room.

In the *Independent Audio* condition, children were shown how to use the e-book (i.e., how to flip the page). The audio narration played automatically on each page and each page would turn after the completion of the audio. Children were also free to turn the page to progress and could skip around, either hearing a page multiple times or passing over pages without hearing the audio. A researcher sat behind the child and pretended to busy herself with other work while the child engaged with the book. Parents were not in the room during independent book reading.

In the *Independent No Audio* condition, children looked at the e-book by themselves without a parent and without the audio narration features. Children were shown how to use the e-book features (i.e., how to flip the page) and told that they could look at the pictures. Children could skip around and look at the pages in any order. A researcher sat behind the child and pretended to busy herself with other work while the child engaged with the book. As in the "Independent Audio" condition, parents were not in the room during book reading.

Minimum and maximum times were set for the two independent conditions. The minimum time was 4 min and 10 s, based on the time it took the audio narration to read the book if it was allowed to progress linearly. If children told the researcher that they were finished reading before the minimum time elapsed, they were asked to keep reading for a little longer; most children then continued looking at the book. Then, after 4 min and 10 s had elapsed, the researcher moved to sit at the table across from the child and began the next task. The maximum time was 6 min, based on piloting showing that most parents finished reading within this amount of time. If children never spontaneously reported that they were finished reading, then after 6 min elapsed, the researcher moved to sit at the table across from the child and began the next task.

2.2.2. Free recall

Upon completion of the story, the researcher asked the children to tell a stuffed animal everything that they remembered about the story that they just read. If needed, children were given specific prompts in a set order (e.g., 'What happened first in the story?" "Can you tell me one thing that happened in the story?'). Prompts were ambiguous and did not include specific information about the story's content or characters. Responses were coded by counting how many of a predetermined set of possible elements children recalled from the story. Elements were determined by breaking down the story text into fundamental discrete ideas. For example, in one part of the story, the main character makes a vase for his friend Bear, and children could receive one point for "made/gave," one point for "Bear," and one point for "vase." Synonyms and closely related words were also accepted (e.g., flower pot for vase). To examine inter-coder reliability, a second trained coder coded a randomly selected 20% of the data. The second coder was blind to the original coding. We then counted the number of elements that the coders agreed on and the number of elements that one coder counted as present and the other coder counted as absent. We then calculated the percentage of agreed elements out of all elements coded by either coder. Coders agreed on 83% of the story elements coded across children. Where there were disagreements, the original coder's decision was retained.

Table 1
Demographic characteristics of sample by condition.

	Independent No Audio	Independent Audio	Parent
Age in months (SD)	60.2 (8.2)	58.5 (7.8)	59.6 (7.9)
Site			
Site 1	29	31	32
Site 2	11	13	19
Gender			
Female	22	21	24
Male	18	23	27
Primary caregiver education			
Less than Bachelor's degree	4	1	8
Bachelor's degree	11	10	13
Graduate degree	18	22	25
No response	7	11	5
Secondary caregiver education			
Less than Bachelor's degree	6	6	13
Bachelor's degree	9	19	17
Graduate degree	16	13	15
No response	9	6	6
Race/ethnicity			
White	34	32	43
Black	3	2	1
Hispanic	0	1	0
Asian	1	1	0
Other/multiple races	1	3	6
No response	1	5	1

2.2.3. Page-by-page retell

After the free recall period, children were given a further opportunity to describe the story in a page-by-page retell task. The researcher showed children screenshots of the book's pages with the text removed on the iPad and asked children to retell what happened on each page of the story. On the first page, researchers would say "I'll get you started. . . There once was a. . .". If needed, children were given prompts in a set order (e.g., "What happened here?" or "Do you remember anything else?"). If children pointed, were vague, or said "this" or "that," researchers would prompt them to verbalize (e.g., "Who?" "What is that?"). Researchers did not include any specific information in their prompts or give children any feedback.

Responses were coded by counting how many of a predetermined set of possible elements children recalled from the story—the same set of elements was used for the previously mentioned free retell task. To examine intercoder reliability, a second trained coder coded a randomly selected 20% of the data. The second coder was blind to the original coding. For each of the predetermined possible elements children could retell, agreement between the two coders was examined. Of the 129 possible elements, 33 were never coded as correct by either coder for the 28 participants recoded for reliability. That is, none of the double-coded participants remembered those 33 details. Thus, these elements were not included in the percentages reported here, because they would have artificially increased agreement. Across the remaining elements, average agreement was 94.3%. Thus, if the original coder counted the element as present in a child's retell, the second coder also counted that element as present 94.3% of the time. Where there were disagreements, the original coder's decision was retained.

2.2.4. Comprehension questions

Children were asked a total of 12 multiple-choice comprehension questions about the content of the story with two response options, such as "How did the beaver get better at saying I'm sorry? A) He read a book about it. B) He practiced in the mirror." Questions were developed to assess children's understanding of basic story events and were designed to be approximately evenly distributed across the book. The first and second authors generated possible questions by examining the book and writing questions relating to story events. Seventeen questions were piloted originally, and five were discarded for floor or ceiling effects. These questions were designed to require understanding of the book's text, rather than simply the illustrations, in order to avoid ceiling effects. For example, the e-book included both a picture of the beaver reading a book and a picture of the beaver looking in the mirror. To get the answer correct, children had to remember that the text described the beaver practicing saying he was sorry in the mirror. Other questions were represented by the pictures but asked about the order of events, so children needed to remember, for example, what the beaver did first when he got back to the forest out of two options that were both actions he performed at some point in the story. If needed, questions were repeated to make sure that the child understood the question and the response options. Children who were unsure or reluctant to provide an answer were told to give their best guess. The order of the two response options for each question was counterbalanced by gender and condition.

2.2.5. Parent questionnaire

During the visit, parents completed a questionnaire including information about parental education and race/ethnicity, as well as estimates of the amount of time children spend daily reading, watching TV, and playing games on electronic devices.

2.2.6. Affect and involvement coding

Only for the "Parent" condition, videotapes were coded for parent affect and involvement. Based on research by Beatty et al. (2011), Dodici and Draper (2001), and Laible and Song (2006), videos were coded with five global Likert scale ratings (ranging from 1 to 5). The first was Parental Responsiveness—the extent to which caregiver notices and responds in a timely way to verbal/nonverbal cues. Also coded was Parental Sensitivity, or the extent to which parent responses align with child cues. Parental Warmth—the extent to which caregiver demonstrates affection and caring, through verbal (e.g., praise) or nonverbal (e.g., affectionate touch)—was then coded. Parental Guidance was rated based on

verbal statement(s): either the parent provided much choice and limited direction at one end, or the parent provided much direction and limited choice. An example of a statement providing much direction would be, "Say 'moose,'" while a statement offering much choice would be, "What do you think that is?" (pointing to the moose). Finally, Dyadic Intersubjectivity, or the sense of togetherness, shared meaning, and unity in the book reading experience, was noted. Low scores on each scale represented negative behaviors while higher scores represented more positive parent actions. The average of all five rating scales had acceptable internal consistency with this particular sample, $\alpha = .75$.

One main coder, who was blind to study hypotheses, coded all videos. A second coder coded 20% of the videos to check for reliability. The two coders agreed 85% of the time. The original coder's ratings were retained in all disagreements.

3. Results

To assess the effect of condition on comprehension, regression models were estimated using the function lm in the R software environment (R Development Core Team, 2014). Several variables were included as covariates in initial models predicting children's comprehension. First, book reading time was included, as children in the "Parent" condition had longer book reading times ($M = 341$ s, $SD = 65$ s) than children in the "Independent Audio" condition ($M = 252$ s, $SD = 33$ s), $B = -88.2$, $p < .0001$, $d = 1.81$, and children in the "Independent No Audio" condition ($M = 271$ s, $SD = 35$ s), $B = -69.1$, $p < .0001$, $d = 1.4$. There was also a trend-level effect for longer reading times in the "Independent No Audio" condition than in the "Independent Audio" condition, $B = 19.1$, $p = .07$, $d = .56$. Testing for effects of book reading time in the analyses ensures that any differences in comprehension are due to condition rather than increased time focused on the book content. However, results are similar if we do not control for book time, as book time was not predictive of either of the outcomes where we found condition difference and was thus dropped from the final models.

Second, preliminary results showed that children's performance on dependent variables differed by data collection site; so site was included as a covariate in all initial models. Finally, age was included in all initial models to account for expected age differences in children's performance. Thus, the initial models predicted each dependent variable from condition, book reading time, site, and age. Nonsignificant predictors were systematically removed resulting in a final model with only significant predictors. Although differences between all three conditions were examined simultaneously in single models, we report analyses organized by research question for ease of presentation. We report Cohen's d as a measure of effect size, where $d = .20$ is small, $d = .50$ is medium, and $d = .80$ is large (Cohen, 1988).

Before presenting the primary main analyses, we first note that on the free recall task, there were no significant differences between conditions, controlling for age, $B = .20$, $p = .0007$; site, $B = 3.5$, $p = .0003$; and book reading time, $B = .02$, $p = .03$. All children did relatively poorly on this task, being able to report very few elements ($M = 4.4$, $SD = 4.5$) when asked to retell the whole story. However, it is clear that children did remember story elements, given their performance on the page-by-page retell task. Asking children in this age range to retell a whole story heard a single time seems to have been too difficult.

Our first research question asks whether preschoolers understand a story's content after reading an e-book independently using audio narration. To answer this question, we compared the two independent conditions, examining whether children who heard the audio narration had better comprehension than those who simply looked at the pictures. On the page-by-page retell task, chil-
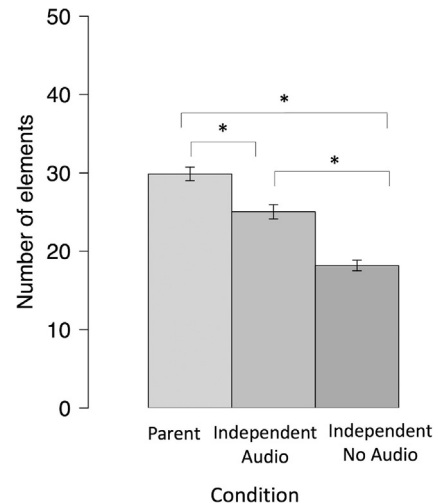

Fig. 1. Effect of condition on the number of elements recalled in the page-by-page retell task. *Indicates significant differences between conditions at $p < .05$.
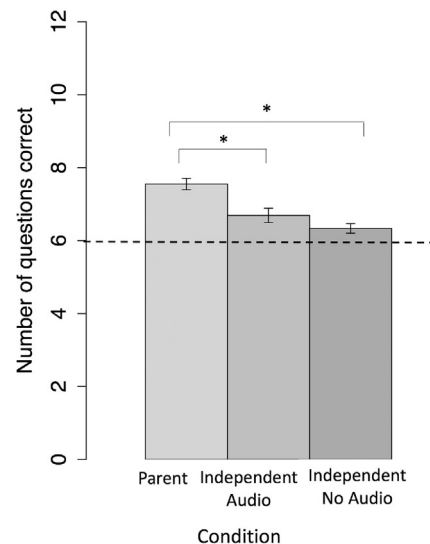

Fig. 2. Effect of condition on the number of comprehension questions answered correctly. *Indicates significant difference between conditions at $p < .05$. Dashed line indicates chance performance.

dren in the "Independent Audio" condition recalled significantly more elements than children in the "Independent No Audio" condition, $B = -7.6$, $p = .0002$, $d = .74$, which is a large-sized effect (see Fig. 1). The final model predicting page-by-page retell also included age, $B = .51$, $p < .0001$, and site, $B = 8.2$, $p < .0001$ (see Table 2). Conversely, on the comprehension questions, there was no significant difference between the "Independent Audio" condition and the "Independent No Audio" condition, $p = .4$ (see Fig. 2 and Table 2). Given the forced choice nature of the questions, we can also compare children's performance in each condition to chance. Children in the "Independent Audio" condition, $t(43) = 2.2$, $p = .03$, $d = .33$, answered more questions correctly than would be expected by chance, which is a small- to medium-sized effect. On the other hand, children in the "Independent No Audio" condition did not, $p = .18$.

Our second research question asked whether parental reading promotes children's comprehension more than independent reading with audio narration. Comparing the "Parent reading" and "Independent with Audio" conditions allowed us to answer this question. On the page-by-page retell task, children in the "Parent" condition recalled significantly more elements ($M = 29.9$,

Table 2
Results of regression analyses.

	B	p	F	df	p	Adjusted r^2
Page-by-page retell			17.7	4, 109	<.0001	.37
Condition						
Parent vs. independent no audio	−12.2	<.0001				
Parent vs. independent audio	−4.6	.02				
Independent audio vs. independent no audio	−7.6	.0002				
Age	.51	<.0001				
Site	8.2	<.0001				
Comprehension questions			4.1	2, 116	.02	.05
Condition						
Parent vs. independent no audio	−1.2	.006				
Parent vs. independent audio	−.9	.05				
Independent audio vs. independent no audio	−.4	.40				

Table 3
Descriptive statistics for affect and involvement coding.

	Mean	SD	Median	Mode
Parental responsiveness	3.98	.96	4.00	4.00
Parental sensitivity	3.64	1.01	4.00	4.00
Parental warmth	3.16	.92	3.00	4.00
Parental guidance	3.62	1.09	4.00	4.00
Dyadic intersubjectivity	3.98	.86	4.00	4.00
Total affect/involvement	3.67	.69	3.60	3.40

$SD = 10.2$) than children in the "Independent Audio" condition ($M = 25.0$, $SD = 10.6$), $B = −4.6$, $p = .02$, $d = .47$, which is a medium-sized effect (see Fig. 1). The final model predicting page-by-page retell also included age, $B = .51$, $p < .0001$, and site, $B = 8.2$, $p < .0001$ (see Table 2). On the comprehension questions, children in the "Parent" condition answered significantly more questions correctly ($M = 7.6$, $SD = 1.8$) than children in the "Independent Audio" condition ($M = 6.7$, $SD = 2.3$), $B = −.9$, $p = .05$, $d = .44$, which is a small to medium-sized effect (see Fig. 2 and Table 2). Comparisons of children's performance to chance indicated that both children in the "Parent" condition, $t(37) = 5.2$, $p < .0001$, $d = .89$, and children in the "Independent Audio" condition, $t(43) = 2.2$, $p = .03$, $d = .33$, answered more questions correctly than would be expected by chance, which is a large-sized and a small- to medium-sized effect, respectively.

We then examined whether any of the measures from the parent questionnaire predicted the dependent variables or interacted with condition. Neither parental education, race/ethnicity, time spent watching TV, nor time spent playing with electronic devices was related to the dependent variables. Although we were underpowered to detect small effects, these analyses indicate that any relationship between these variables, and comprehension in this sample is relatively small in size. However, there was a significant interaction between time spent reading daily at home and condition in a model predicting page-by-page retell, $B = 9.9$, $p = .01$. Examining the simple effects for each condition showed that in the "Independent No Audio" condition, but not the other conditions, more time spent reading at home was related to remembering more story elements, $r = .36$, $p = .03$. This result may suggest that children who are read to more at home are better at inferring the story from viewing the pictures. Importantly, reported time spent reading at home was not related to parent education or income in this sample, and including these variables in the model did not influence the interaction between reading and condition.

Finally, to assess the quality of parent–child interactions during parent reading, we examined descriptive statistics for the 51 dyads in the "Parent" condition on our affect and involvement scales (see Table 3). Using a 1–5 point scale, the median for three of the individual scales was four (the other median was three). Additionally, the mode of the 5 individual ratings was also four. This suggests that the majority of parents demonstrated high levels of positive affect and

involvement. We also conducted exploratory analyses examining relations between affect/involvement and children's comprehension, and no correlations were significant. However, due to the smaller sample available for these analyses (only the "Parent" condition), we were underpowered to detect small- or medium-sized effects. A larger sample is needed to examine possible relationships between these variables.

4. Discussion

The goal of this study was to examine whether preschoolers can comprehend an e-book using audio narration. We also wished to understand how comprehension from e-book audio narration compares to reading with a parent. We tested children in three conditions. In the "Parent" condition, parents read an e-book to children. In the "Independent Audio" condition, children saw the e-book while sitting by themselves and listening to audio narration that played as the children turned the pages. In the "Independent No Audio" condition, children saw the e-book in silence as they looked at the pictures while turning the pages. Our results suggest that children can understand some content from e-books using audio narration, indicating that using e-books independently may be a worthwhile activity for preliterate children while caregivers are otherwise occupied or perhaps for children whose parents do not speak the language represented in the book. However, results also show that children recall the most information about the content of the e-books when their parents read to them. These findings have important practical implications, given the growing availability and use of touchscreen devices and e-books by young children.

Many parents report that their children read e-books alone, and the current study suggests that children seem to understand some content from e-books using this feature: they remembered an average of 40% more story elements on page-by-page retell than children who looked at the pictures without audio, which represents a large effect ($d = .78$, Cohen, 1988). This suggests that read-to-me e-books have an advantage over simply looking at the story's pictures. That is, children can comprehend and retain at least some of the story's details after hearing the audio narration that they do not get from looking at the pictures alone. This finding may be promising for parents who need an activity to keep children occupied while they are busy with other tasks. Similarly, e-books may be used in classroom settings when teachers cannot engage with children directly. Our findings suggest that reading an e-book with audio narration may be worthwhile during such times.

On the other hand, we found that reading with a parent promotes children's comprehension of a story more so than audio narration: children whose parents read to them answered 13% more comprehension questions correctly than children who heard the audio narration, which is a small- to medium-sized effect ($d = .39$), and remembered an average of 20% more story elements

on page-by-page retell than children who heard the audio narration, a medium effect ($d = .45$, Cohen, 1988). These findings suggest that e-book audio narration is not an equivalent substitute for having a parent interact directly with a child during shared book reading.

This finding has important implications for the use of e-books both in home and in classroom settings. The marketplace for educational apps has been described as the Digital Wild West (Guernsey, Levine, Chiong, & Severns, 2014; Hirsh-Pasek et al., 2015), with very few apps that are marketed as "educational" actually reporting any benchmarks of educational quality, including child development expertise or research testing (Vaala, Ly, & Levine, 2015). Despite this lack, a survey of almost 1000 early childhood educators showed that more than half reported using tablets for instructional purposes at least once a week (Center on Media and Human Development, 2015). The results of the current study highlight the idea that teachers cannot rely on tablets and apps, including e-books that may appear educational, to teach children on their own. Rather, children need interactive and social experiences to optimally benefit from even well-designed digital materials. However, our findings also show that children do understand some story content from e-book audio narration, suggesting that children might benefit from the use of e-books as educational supplements during noninstructional time. In addition, as Strouse and Ganea (2017) showed, children may be more engaged with e-books, and those higher levels of engagement may increase their enjoyment of reading.

Another important implication of this finding is that the "digital divide" between low- and middle-SES families does not necessarily put children without access to tablets at a disadvantage when it comes to e-book reading. A 2013 survey of over 1000 U.S. parents with children under 8 showed that while 63% of higher-income children had access to a tablet at home, only 20% of lower-income children did (Common Sense Media, 2013). Similar data from a U.K. survey of over 1000 parent of 3- to 5-year-olds found that the gap is smaller but still significant, 75.2% compared to 67% (Formby, 2014). However, the current results suggest that children who do not have access to a device for e-book reading with audio narration but who have a regular reading time with an adult will benefit just as much or more than children who spend time reading e-books independently on tablets. On the other hand, if e-book audio narration is supplanting time passively watching television or engaging in entertainment-based apps and games, rather than replacing parent–child reading time, additional time spent with e-books may be a boon for development across the SES spectrum. The U.K. survey cited previously also found that, of children who have a touchscreen at home, children from lower-SES backgrounds were twice as likely to look at or read stories on a touchscreen daily compared to children from upper-SES families (Formby, 2014), suggesting that these children may be in a position to benefit from e-book reading when they have access to the technology.

Although this study clearly shows a parent advantage in e-book comprehension, it does not address the specific reasons for this parent advantage. Indeed, several factors may contribute jointly. However, several of the most plausible explanations line up with the previously described four characteristics that foster optimal learning (Hirsh-Pasek et al., 2015). For one, parent reading may promote story comprehension by encouraging children to be active rather than passive participants. While reading with a parent, children can ask questions about difficult words or make comments about what they think will happen next. Parents can also encourage children to be active by asking the child questions and using other dialogic reading practices (e.g., Fielding-Barnsley & Purdie, 2003; Hargrave & Sénéchal, 2000; Wasik & Bond, 2001; Zevenbergen & Whitehurst, 2003). Our exploratory findings from the affect and involvement coding do support the idea that parents may be fos-

tering high levels of involvement with their children during e-book reading. Currently available e-books do not include opportunities for dialogic reading, so children reading independently miss out the comprehension-promoting potential of extratextual talk. However, some digital technology may go part of the way to creating an interactive experience for children. For example, Smeets and Bus (2014) found that children learned more vocabulary from an e-book that included hotspots that defined target words when children clicked on them compared to an e-book without this feature. Although these features may still lag behind one-on-one interaction with an adult, they could promote more comprehension and learning from e-books than noninteractive versions.

Reading with a parent may also be beneficial because it encourages children to be engaged rather than distracted, leading to better attention to the story and therefore higher levels of comprehension. Indeed, we found that children in the "Independent No Audio" condition performed better on the comprehension questions when they spent more time reading at home. It may be that these children learned how to engage with a story—even simply with the pictures—through repeated book reading experiences with their parents. These engagement skills might then transfer to the children's experience looking at the e-book pictures without any accompanying reading of the text. Future research might address whether simply adding a noninteractive, colistening adult might be enough to improve engagement and reduce distraction, thus improving comprehension from audio narration.

Parents may also promote engagement by responding to children's behavior in ways that currently available technology cannot. For example, a parent who realizes that a child is distracted may start a page over again or begin reading in a more animated manner. Similarly, if the text seems too complex for their child's level, parents could slow their reading speed to aid comprehension. Parents can also follow children's pointing gestures and eye gaze to focus on aspects of the story that are of most interest to the child. We did find that most parents in our study demonstrated high levels of sensitivity to children's behaviors during the book reading. These small adjustments could encourage engagement and have important consequences for children's comprehension. In contrast, these features are not available when reading an e-book with audio narration.

The parent advantage in the present study may also be reflective of parents' engagement in dialogic reading practices, which provide a meaningful context for learning when parents go beyond the text and link the story content to their children's lives. Research shows that making connections to the real world may promote comprehension from books (Hassinger-Das et al., 2017). Although e-book audio narration reads out loud to children, they currently do not include opportunities to relate the story to children's lives.

Finally, parent reading might promote comprehension more than audio narration because children learn best from social interaction (Hirsh-Pasek et al., 2015). This aspect of parent–child reading is unlikely to be replicable by digital technology, given that the possible emotional benefits of reading a storybook while cuddling with a parent are not offered by a tablet. The close relationship developed through parent–child book reading is an important goal of reading for parents (Audet, Evans, Williamson, & Reynolds, 2008). Reflective of this, dyads in our study scored highly on the rating of the sense of togetherness, shared meaning, and unity in the book reading experience. Some books may also involve fun routines that parents and children can engage in together. For example, in a book by Robert Kaplan, children and parents can repeat the phrase "Jump, Frog, Jump!över and over again to help the frog escape from being eaten. These engaging social activities may promote children's attention to and comprehension from parent–child storybook reading.

Throughout all of these possible explanations for the parental advantage in story comprehension, there is one salient theme.

Because parents know a great deal about their children's development and knowledge base, they are in a better position than a standard e-book to adjust in many ways to their child's level. They can adjust their reading speed, connect the story to their child's interests and experiences, and adapt to their child's background knowledge or lack thereof. Past research has shown that personalizing a storybook can promote children's learning (Kucirkova, Messer, & Sheehy, 2014). Similarly, first to third grade children seem to profit from individualized literacy instruction (Connor et al., 2013). Despite much excitement about the potential of computers and tablets to offer individualized education (e.g., de Jong & Bus, 2003; Moody, 2010), for activities such as storybook reading, a caring and observant adult, who is knowledgeable about the child's abilities and interests, may be best positioned to offer a child a beneficial individualized reading experience.

The current study provides a stringent test of the two questions we set out to address. Our "Independent No Audio" condition provided a strong control by giving children access to the same visuals that children had in the other conditions. As such, we were able to compare relatively ecologically valid situations, rather than comparing the audio narration condition to an inactive control group. In fact, our design actually gave the "Independent No Audio" condition an advantage by requiring children to look at the book for a minimum set time, when in actuality many children lost interest earlier and in a real-life situation would likely have moved on to another activity. Even with this rigorous test of our research question, children seem to gain some knowledge from the audio narration that they were not able to pick up from simply looking at the pictures for the same amount of time.

Furthermore, unlike many past studies comparing traditional books vs. e-books, all of our conditions used the same e-book on a tablet, so we can be confident that the differences between conditions are not due to any difficulty that children have in learning from a touchscreen device. Although we set maximum and minimum book reading times for the two independent conditions to equate children's exposure to the e-book, children did read for longer in the "Parent" condition than when they read alone. However, we measured and controlled for book reading time in our models, and it was not predictive of children's performance on the page-by-page retell task or comprehension questions. Thus, longer exposure to the book does not appear to account for the parent advantage in comprehension.

4.1. Limitations and future directions

One limitation of the current study is that we did not have a formal measure assessing children's early reading skills. Most children in this age range are not yet able to read words independently, although they may have emergent literacy skills, including letter knowledge, turning pages, etc. We expect that even advanced children in our sample who may have been early readers would have been unable to accurately decode and comprehend the relatively complex text of the e-book, which is at a 5th grade reading level (Flesch-Kincaid Grade Level = 5.3). However, future studies should include a measure of children's reading ability. Similarly, we did not have a formal assessment of whether children were familiar with the book. Although anecdotally, parents and children did not comment on having seen the book before; future studies should include a question about familiarity.

It should also be noted that our sample was restricted to primarily white children from highly educated families. Future research should investigate whether similar patterns are seen in more diverse samples. Additional studies could also examine the role of children's experience with e-book reading and the use of audio narration specifically. Perhaps children with more experience using read-to-me e-books would understand more from the audio narration feature. Although our parent questionnaire had some background information on children's overall time spent reading at home, we did not have more detailed information about children's e-book use.

Additionally, the affect and involvement coding during "Parent reading" condition did not detect meaningful relationships between parent/child behavior and children's comprehension, likely due to sample size. Future research should use a larger sample to assess the extent to which these behaviors may be related to child outcomes. The behaviors that promote comprehension during parent reading could be informative in designing more effective e-book audio narration.

Relatedly, this study focuses on comprehension, but there may be important emotional benefits that accrue from storybook reading with a parent, which are not present in children's independent interactions with e-books. Potential emotional advantages of parent–child interactions compared to independent e-book reading have not been addressed by previous research. Children may feel more positive emotions during e-book reading with a parent compared to reading an e-book independently with audio narration, a potential limitation of e-books, perhaps because of the physical proximity and intimacy. This is a possibility we are currently testing in ongoing research.

5. Conclusions

Overall, our results suggest that although preschoolers may understand some content from an e-book using audio narration independently, or just from looking at the pages alone without narration, comprehension is better after shared parent–child e-book reading. Thus, e-books' read-to-me functionality may be beneficial for times in which parents are unavailable, but audio narration cannot take the place of meaningful adult interaction in supporting children's story comprehension.

Notably, these findings have implications for policy and practice. For one, they indicate that families without access to tablet technology for e-book reading are not at a disadvantage as long as parents spend time reading with children. Our results also highlight the importance of testing the effectiveness of educational digital materials. Ed tech is becoming increasingly commercialized, and research should explore whether and in what contexts digital media can be beneficial for children's learning. Parents and teachers cannot simply rely on apps and e-books that claim to be educational. In the absence of solid data on the educational benefits of such technology, adults should focus on providing the types of interactive and social experience that we know help children learn. Future research should capitalize on the findings of the current study to consider potential features that could promote the educational potential of currently available e-books. However, regardless of future advances, it is likely that engaging and interactive caretakers will always win out over technology.

References

Arnold, D. S., & Whitehurst, G. J. (1994). Accelerating language development through picture book reading: A summary of dialogic reading and its effect. In D. K. Dickinson (Ed.), *Bridges to literacy: Children, families, and schools*. Malden: Blackwell Publishing.

Audet, D., Evans, M. A., Williamson, K., & Reynolds, K. (2008). Shared book reading: Parental goals across the primary grades and goal–behavior relationships in junior kindergarten. *Early Education & Development*, 19(1), 112–137. http://dx.doi.org/10.1080/10409280701839189

Beatty, J. R., Stacks, A. M., Partridge, T., Tzilos, G. K., Loree, A., & Ondersma, S. J. (2011). LoTTS parent–infant interaction coding scale: Ease of use and reliability in a sample of high-risk mothers and their infants. *Children and Youth Services Review*, 33(1), 86–90. http://dx.doi.org/10.1016/j.childyouth.2010.08.016

Blewitt, P., Rump, K. M., Shealy, S. E., & Cook, S. (2009). Shared book reading: When and how questions across young children's word learning. *Journal of Educational Psychology*, 101(2), 294–304. http://dx.doi.org/10.1037/a0013844

Center on Media and Human Development, School of Communication, N.U. (2015). *Technology in the lives of educators and early childhood programs: Trends in access, use, and professional development from 2012 to 2015*.

Chera, P., & Wood, C. (2003). Animated multimedia 'talking books' can promote phonological awareness in children beginning to read. *Learning and Instruction*, 13, 33–52.

Chiong, C., Ree, J., Takeuchi, L., & Erickson, I. (2012). *Print books vs. E-books*. pp. 1–5. The Joan Ganz Cooney Center, Spring. http://www.guardian.co.uk/books/2012/jun/07/enhanced-ebooks-bad-for-children

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). NJ: Erlbaum: Hillsdale.

Common Sense Media. (2013). *Zero to eight: Children's media use in American*.

Connor, C. M., Morrison, F. J., Fishman, B., Crowe, E. C., Otaiba, S. A., & Schatschneider, C. (2013). A longitudinal cluster-randomized controlled study on the accumulating effects of individualized literacy instruction on students' reading from first through third grade. *Psychological Science*, 24(8), 1408–1419. http://dx.doi.org/10.1177/0956797612472204

de Jong, M. T., & Bus, A. G. (2002). Quality of book-reading matters for emergent readers: An experiment with the same book in a regular or electronic format. *Journal of Educational Psychology*, 94(1), 145–155. http://dx.doi.org/10.1037/0022-0663.94.1.145

de Jong, M. T., & Bus, A. G. (2003). How well suited are electronic books to supporting literacy? *Journal of Early Childhood Literacy*, 3(2), 147–164. http://dx.doi.org/10.1177/14687984030032002

De Jong, M. T., & Bus, A. G. (2004). The efficacy of electronic books in fostering kindergarten children's emergent story understanding. *Reading Research Quarterly*, 39(4), 378–393. http://dx.doi.org/10.1598/RRQ.39.4.2

Dodici, B. J., & Draper, D. C. (2001). *Parent-infant/toddler interaction coding system*. Ames, Iowa: Iowa State University.

Fielding-Barnsley, R., & Purdie, N. (2003). Early intervention in the home for children at risk of reading failure. *Support for Learning*, 18(2), 77–82. http://dx.doi.org/10.1111/1467-9604.00284

Formby, S. (2014). *Parents' perspectives: Children's use of technology in the early years*.

Gilmore, N. (2015). *Nielsen summit shows the data behind the children's book boom*. Publisher's Weekly.

Guernsey, L., Levine, M. H., Chiong, C., & Severns, M. (2014). *Pioneering literacy in the digital wild west: Empowering parents and educators*. http://www.joanganzcooneycenter.org/publication/pioneering-literacy/

Hargrave, A. C., & Sénéchal, M. (2000). A book reading intervention with preschool children who have limited vocabularies: The benefits of regular reading and dialogic reading. *Early Childhood Research Quarterly*, 15(1), 75–90. http://dx.doi.org/10.1016/S0885-2006(99)00038-1

Hassinger-Das, B., Mahajan, N., Metz, R., Ramsook, K. A., Margulis, K., Hirsh-Pasek, K., Golinkoff, R. M., & Parish-Morris, J. (2017, June). Reading in the digital age: Investigating differences between traditional and electronic books. In: B. Hassinger-Das, R. Dore, & R. M. Golinkoff (Chairs), Taming technology: Making evidence-based decisions regarding digital media. Symposium conducted at the annual meeting of the Jean Piaget Society, San Francisco, California.

Hirsh-Pasek, K., Zosh, J. M., Golinkoff, R. M., Gray, J. H., Robb, M. B., & Kaufman, J. (2015). Putting education in educational apps: Lessons from the science of learning. *Psychological Science in the Public Interest*, 16(1), 3–34. http://dx.doi.org/10.1177/1529100615569721

Huebner, C. E., & Meltzoff, A. N. (2005). Intervention to change parent–child reading style: A comparison of instructional methods. *Journal of Applied Developmental Psychology*, 26(3), 296–313. http://dx.doi.org/10.1016/j.appdev.2005.02.006

Korat, O., & Or, T. (2010). How new technology influences parent–child interaction: The case of e-book reading. *First Language*, 30(2), 139–154. http://dx.doi.org/10.1177/0142723709359242

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

Kucirkova, N., & Littleton, K. (2016). *The digital reading habits of children: A national survey of parents' perceptions of and practices in relation to children's reading for pleasure with print and digital books*. http://www.booktrust.org.uk/news-and-blogs/news/1371

Kucirkova, N., Messer, D., & Sheehy, K. (2014). Reading personalized books with preschool children enhances their word acquisition. *First Language*, 34(3), 227–243. http://dx.doi.org/10.1177/0142723714534221

Laible, D., & Song, J. (2006). Constructing emotional and relational understanding: the roles of affect and mother–child discourse. *Merrill-Palmer Quarterly*, 52, 44–69. http://dx.doi.org/10.1353/mpq.2006.0006

Lauricella, A. R., Barr, R., & Calvert, S. L. (2014). Parent–child interactions during traditional and computer storybook reading for children's comprehension: Implications for electronic storybook design. *International Journal of Child–Computer Interaction*, 2(1), 17–25. http://dx.doi.org/10.1016/j.ijcci.2014.07.001

Lauricella, A. R., Blackwell, C. K., & Wartella, E. (2016). The "new" technology environment: The role of content and context on learning and development from mobile media. In R. Barr, & D. N. Linebarger (Eds.), *Media Exposure During Infancy and Early Childhood: The Effects of Content and Context on Learning and Development* (pp. 1–23). Springer International Publishing. http://dx.doi.org/10.1007/978-3-319-451

Moody, A. K. (2010). Using electronic books in the classroom to enhance emergent literacy skills in young children. *Journal of Literacy and Technology*, 11(4), 22–52.

Moody, A. K., Justice, L. M., & Cabell, S. Q. (2010). Electronic versus traditional storybooks: Relative influence on preschool children's engagement and communication. *Journal of Early Childhood Literacy*, 10(3), 294–313. http://dx.doi.org/10.1177/1468798410372162

National Early Literacy Panel. (2009). *Developing early literacy: Report of the national early literacy panel*. Jessup, MD: NELP.

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. http://dx.doi.org/10.1111/mbe.12028

Park, M., & McHugh, M. (2014). *Immigrant parents and early childhood programs: Addressing barriers of literacy, culture, and systems knowledge*. https://doi.org/10.1080/01440350500223800.

R Development Core Team, 2014 R: A Language and Environment for Statistical Computing, R Foundation for Statistical Computing, Vienna, Austria.

Radesky, J. S., Kistin, C. J., Zuckerman, B., Nitzberg, K., Gross, J., Kaplan-Sanoff, M., et al. (2014). Patterns of mobile device use by caregivers and children during meals in fast food restaurants. *Pediatrics*, 133(4), e843–e849. http://dx.doi.org/10.1542/peds.2013-3703

Ricci, C. M., & Beal, C. R. (2002). The effect of interactive media on children's story memory. *Journal of Educational Psychology*, 94(1), 138–144. http://dx.doi.org/10.1037//0022-0663.94.1.138

Richter, A., & Courage, M. L. (2017). Comparing electronic and paper storybooks for preschoolers: Attention, engagement, and recall. *Journal of Applied Developmental Psychology*, 48, 92–102. http://dx.doi.org/10.1016/j.appdev.2017.01.002

Rideout, V. (2014). *Learning at home: Families educational media use in America*. The Joan Ganz Cooney Center.

Ross, K. M., Pye, R. E., & Randell, J. (2016). Reading touch screen storybooks with mothers negatively affects 7-year-old readers' comprehension but enriches emotional engagement. *Frontiers in Psychology*, 7(November), 1–17. http://dx.doi.org/10.3389/fpsyg.2016.01728

Strouse, G., O'Doherty, K., & Troseth, G. L. (2013). Effective coviewing: Preschoolers' learning from video after a dialogic questioning intervention. *Developmental Psychology*, 49(12), 2368–2382. http://dx.doi.org/10.1037/a0032463

Strouse, G. A., & Troseth, G. L. (2014). Supporting toddlers' transfer of word learning from video. *Cognitive Development*, 30, 47–64.

Strouse, G. A., & Ganea, P. A. (2017). Toddlers' word learning and transfer from electronic and print books. *Journal of Experimental Child Psychology*, 156, 129–142. http://dx.doi.org/10.1016/j.jecp.2016.12.001

Takeuchi, B. L., Stevens, R., Barron, B., Branch-ridley, E., Brooks, M., Cooperman, H., et al. (2011). *The new coviewing: Designing for learning through joint media engagement*. http://www.joanganzcooneycenter.org/wp-content/uploads/2011/12/jgc_coviewing_desktop.pdf

Vaala, S., & Takeuchi, L. (2012). *Parent co-reading survey*. http://www.joanganzcooneycenter.org/wp-content/uploads/2012/11/jgcc_ereader_parentsurvey_quickreport.pdf

Vaala, S., Ly, A., & Levine, M. H. (2015). *Getting a read on the app stores: A market scan and analysis of children's literacy apps*. New York, NY: The Joan Ganz Cooney Center at Sesame Workshop.

Wasik, B., & Bond, M. A. (2001). Beyond the pages of a book: Interactive book reading and language development in preschool classrooms. *Journal of Educational Psychology*, 93(2), 243–250. http://dx.doi.org/10.1037/0022-0663.93.2.243

Whitehurst, G. J., Falco, F. L., Lonigan, C. J., Fischel, J. E., DeBaryshe, B. D., Valdez-Menchaca, M. C., et al. (1988). Accelerating language development through picture book reading. *Developmental Psychology*, 24(4), 552. http://psycnet.apa.org/journals/dev/24/4/552/

Willoughby, D., Evans, M. A., & Nowak, S. (2015). Do ABC eBooks boost engagement and learning in preschoolers? An experimental study comparing eBooks with paper ABC and storybook controls. *Computers & Education*, 82, 107–117. http://dx.doi.org/10.1016/j.compedu.2014.11.008

Zevenbergen, A. A., & Whitehurst, G. J. (2003). Dialogic reading: A shared picture book reading intervention for preschoolers. In A. van Kleeck, & S. A. Stahl (Eds.), *On reading books to children: Parents and teachers* (pp. 177–200). Malwah, NJ: Lawrence Erlbaum Associates Publishers. http://dx.doi.org/10.4324/9781410607355