

Technology Support for Adults and Children Reading Together: Questions Answered and Questions Raised



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Abstract This chapter examines the possibility of building technology supports to scaffold effective adult interaction strategies during joint reading with young children. The authors, representing four different research labs, report what they have learned from their separate investigations of technology supports for adults and young children engaging in shared reading experiences. Developing digital tools that support and encourage parents and children to ask and answer questions in dialogue about a story shows promise as one way to support literacy development for children who may not receive optimal linguistic input in the home. If successful, technology scaffolds may provide an efficient, non-intrusive intervention to help adults contribute to children's literacy development. In addition, this line of research may serve to inform the design of socially contingent, intelligent agents that could engage in shared reading experiences with children to help build their literacy skills.

Keywords Joint reading · Shared reading · Dialogic reading · Adult-child reading · e-Books · Young children · Technology supports · Scaffolding · Intelligent agents · Adult-child interaction

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1 Introduction

Research has revealed a number of benefits of parent-child joint reading for children's literacy development. One way in which adults can facilitate young children's literacy learning is with "dialogic reading," a style of reading picture books in which adults engage children in conversation about what is happening in a book while reading together (Whitehurst et al. 1988; see also a discussion of dialog in e-book reading in Tønnessen and Hoel [this volume](#)). This dialogue can take the form of asking and answering questions, commenting about book content, and making connections between book events and the child's real-life experiences. Across a large number of studies, there is evidence that dialogic reading facilitates children's language and vocabulary development (Bus 2001; Mol et al. 2008; Morgan and Meier 2008; What Works Clearinghouse 2007; Whitehurst et al. 1988).

In addition, early reading success is dependent upon preschoolers' code-related skills, including print awareness and knowledge (Hammill 2004; Storch and Whitehurst 2002). Shared reading of storybooks with adults gives young children the opportunity to acquire this knowledge. Storybook reading is a context in which children receive rich and complex language input in proximity to congruent print content (Weizman and Snow 2001). Therefore, it might be expected that children would acquire print knowledge in the context of joint storybook reading with an adult. However, children do not look at the print in picture books unless they have been explicitly taught letter names and sound correspondences beforehand (Evans and Saint-Aubin 2005, 2009). Therefore, explicit print referencing by the adult reader is an essential component of shared reading, if children are to gain print knowledge in this context.

1.1 *Book-Reading Language*

Both affluent and working-class families use relatively more talk with richer language while reading than they do during their other daily activities (Hoff-Ginsberg 1991). Book reading seems to elicit parents' highest-quality talk, possibly because the themes of books are more varied and unusual than day-to-day family routines are (Cunningham and Stanovich 1998). However, mothers with more education and resources talk more in general to their children using longer utterances with more varied vocabulary than mothers with fewer resources do (Hart and Risley 1995; Hoff 2003a, b; Rowe 2012), resulting in a "30 million word gap" in cumulative exposure by age three (Hart and Risley 1995) that contributes to an overall achievement gap during the school years (Farkas and Beron 2004; Hoff 2006, 2013; Huttenlocher et al. 2010; Rowe 2008). Although critics of Hart and Risley's early study point out methodological flaws (e.g., Dudley-Marling and Lucas 2009), a substantial language input gap has also emerged in recent research (e.g., Fernald et al. 2013; Gilkerson et al. 2017; Schady et al. 2015). In observational studies, parents with less education and fewer resources are less likely to define new words

for children while reading (Evans et al. 2011) or to engage in reciprocal conversations that allow children to practice using vocabulary (Dickinson and Tabors 2001) compared with parents of higher socioeconomic status.

Significant *within*-SES variation in language input has also been documented in recent studies, for both higher and lower SES families. Some parents with relatively few resources engage in more conversation with their children than other parents of the same SES do (Gilkerson et al. 2017; Sperry et al. 2018; Weisleder and Fernald 2013), including richer, more varied language during reciprocal conversations about objects of shared attention—which relates to children’s improved language development (Hirsh-Pasek et al. 2015). There is also substantial variability in the number of words and amount of reciprocal conversation that highly educated parents provide their children, with some economically advantaged children subsisting in a relatively impoverished language environment (Gilkerson et al. 2017). Technology supports that encourage and train *all* parents to converse with their children more during book reading might help to bridge existing gaps in language input across SES.

1.2 Parent Training

Training can be effective for helping adults to adopt the practices of both dialogic reading and print referencing. When parents are trained to use dialogic reading strategies in a lab setting, children show improvement in acquisition of story vocabulary and general expressive language growth (Arnold et al. 1994; Strouse et al. 2013; Whitehurst et al. 1988; Zevenbergen and Whitehurst 2003). Teachers also can be trained to incorporate dialogic questioning interactions into preschool classroom activities, leading to significant advances in children’s expressive and receptive vocabulary (Hargrave & Sénéchal 2000). Likewise, when adult co-readers are taught to use print referencing strategies, there are beneficial impacts on children’s attention to and learning from print (Justice et al. 2008b, 2010; Zucker et al. 2009). There are not many (if any) studies that incorporate training parents in both dialogic reading and print referencing. These strategies are often used with children of somewhat different ages, with dialogic reading strategies used with younger children. Also, in the context of brief parent training programs, it may be ineffective to ask parents to focus on too many new skills simultaneously (Pile et al. 2010.)

Training adults in techniques that support children’s early literacy learning, while effective, can be time consuming and expensive (Blom-Hoffman et al. 2007; Briesch et al. 2008; Flowers et al. 2007; Justice et al. 2008a). According to Hindman et al. (2016), the few effective interventions for families and educators to “bridge the word gap” in vocabulary exposure and build children’s language rely on fidelity of training facilitated by intensive, ongoing, on-site support. However, scaling up this level of training is expensive, especially for communities with few resources. A potential solution is offering adults training in dialogic techniques and print awareness using interactive digital media.

1.3 *Technology Support for Parents*

Incorporating technology support for adult-child reading interactions into e-books may hold promise for children's literacy development. Digital devices that can display e-books have been adopted by families from all socioeconomic groups in the U.S. (Etta [this volume](#); Smith 2013), with most families of all income levels now having a touch screen device. For instance, according to a 2015 study, 90% of toddlers in a low-income, traditionally underrepresented population in the U.S. had used a touch screen by age 2, and 83% of children under 5 had a tablet computer in their home (Kabali et al. 2015). Adoption of smart phones and tablets capable of displaying e-books is increasing rapidly in Canada, with 73% of adults over 18 owning a smart phone in 2015 and 52% a tablet computer (Canadian Radio-Television and Telecommunications Commission 2016).

e-Books typically include an option for audio narration, which could be a boon for parents with poorer reading skills or those not fluent in the language their children must use in school. In addition, the capacity of e-books to highlight the meaning of words with audio-visual effects (e.g., animation and/or sound effects) has been shown to promote literacy skills (Bus et al. [this volume](#); Takacs et al. 2015). Children also like e-books, a promising fact for increasing their exposure to books (Picton and Clark 2015). However, there are indications that, although children may be more engaged with e-books than with traditional paper books, parents talk to their preschoolers less about the story while reading books with digital elements compared with print books (Krcmar and Cingel 2014; Parish-Morris et al. 2013; Richter and Courage 2017). Furthermore, shared reading with e-books increases parent talk that might *distract* attention from the story, such as directives to manage behavior or regulate sharing of the device (Krcmar and Cingel 2014). To alleviate this disadvantage, prompts for parents could be built into e-books to inspire dialogic conversation about the story and encourage print referencing.

1.4 *Technology Support for Children*

Another possibility is that interactive digital media might provide direct support to children, lessening the need for parent and teacher involvement. With the development of artificial intelligence, the suggestion has been raised that interactive intelligent agents might be able to supply the kinds of input and contingent feedback that adults provide for children in social learning interactions (Brunick et al. 2016; Troseth et al. 2016). One way that intelligent agents may support children is through the development of "parasocial relationships," defined by Hoffner (2008) as emotionally-tinged relationships between people and media characters, which are in some ways similar to the affective bonds that are formed in real social relationships. Children tend to develop parasocial relationships with familiar on-screen characters, which has been shown to promote learning from them (Lauricella et al. 2011). However, some aspects of parent-child interactions cannot be replaced, such as

shared prior experience. Thus, even if socially interactive intelligent agents become a reality, it is not likely that they could fully replace adults engaging in shared reading with young children, at least not any time soon. Instead, socially interactive intelligent agents might serve as reading assistants for the child when adult co-readers are not available. In addition, on-screen characters who appear when parents and children are reading together may model interactions that support learning, helping parents develop their repertoire of interaction strategies to use when reading books with their children.

One recent study indicates that simply building questions into storybook pages (without an on-screen character) does not support low-vocabulary children's learning as well as when an adult co-reader asks the questions at the same places in the book (Strouse and Ganea 2016). However, there is reason to believe that software-provided questions may help children learn if they are delivered by an on-screen character with whom children can interact. Using a video storybook with some animation, Smeets and Bus (2012) examined the effect of having an on-screen "computer pal" (similar to a cartoonish Muppet face) who introduces the book and then asks vocabulary-related questions either during storybook reading or afterwards. The computer assistant also provides feedback based on the child's answers. In the condition with the computer pal asking questions (during *or* after the story), kindergarten children made significantly greater expressive and receptive vocabulary gains than those of children who watched the storybook video with no questions. In a follow-up study, the same researchers determined that having an on-screen character who asked vocabulary-related questions was a more effective learning aid than simply providing labels and definitions when children clicked on target objects in the illustrations. Since there was not a condition with an on-screen character providing definitions in this study, though, it is not clear whether *the simple presence of an on-screen character* engaging with the child helped build children's vocabulary or whether the effect was caused by *the character asking questions and providing feedback*.

1.5 Summary

In this chapter, we examine the possibility of building technology supports to scaffold effective adult interaction strategies during joint reading with young children. If successful, technology scaffolds could potentially provide a more efficient, less intrusive intervention (compared with in-person training) to help adults contribute to children's literacy development. In addition, this line of research may serve to inform the design of socially contingent, intelligent agents that could engage in shared reading experiences with children to help build their literacy skills.

The authors, representing four different research labs, have all been investigating the creation of technology supports for adults and young children engaging in shared reading experiences. Rather than describing each of the different projects separately, we have organized this chapter by integrating the design work of all four labs, then the research methods of all labs, and finally the research results of all labs.

The intention of this organization strategy is to integrate and synthesize the four bodies of work, pointing out similarities and differences at every step of the research process. The goal is to suggest general principles that emerge from this comparison to inform future technology projects to support early literacy.

2 Designing Technology Support for Adult-Child Joint Reading

All of the projects reported here include on-screen characters with a goal of supporting language and literacy. However, differences in the implementation of these characters and the learning goals provide informative comparisons. In this section, we address similarities and differences in the features of the characters, design of the books, and training or instructions given to parents.

2.1 *Family Story Play and StoryVisit*

Revelle and colleagues have created several different versions of a system to support adult co-readers in dialogic reading with young children (Revelle et al. (2013). Two of these reading systems, *Family Story Play* (Raffle et al. 2010) and *StoryVisit* (Raffle et al. 2011), allow children to experience a sense of togetherness with adults separated from them by long distance, by enabling them to read children's story-books together over video chat. Both systems were research prototypes that led to the development of the commercial product *Storytime* on kindoma.com. Although there are some technology differences between the two systems, both *Story Play* and *StoryVisit* enable the remote grownup and child reader to see and hear each other, and to see and control the same book.

In both of these systems, modeling of dialogic reading strategies is provided on each page of the book by an on-screen, interactive social agent, *Sesame Street's Elmo* character. When selected, Elmo asks questions or makes comments about the story, designed both to model dialogic reading techniques for adults and to increase child engagement. Elmo's actions, like the rest of the book content, are synchronized for both the adult reader and the child on their separate screens. Character dialogue was produced for every page of every book, so Elmo can ask children contextually relevant questions and draw a child's attention to specific aspects of the story. Elmo never reads the book, but instead asks questions or makes dialogic-reading-style comments, designed to invite children and adults to engage in conversation with him and with each other.

Additional supports for dialogic reading were built into both *Story Play* and *StoryVisit*. Before engaging in the remote reading interaction, adult readers were shown a dialogic reading training video, hosted by *Sesame Street's Maria*. In addi-

tion, printed reading tips appeared on every page of the book on the adult's screen, suggesting questions the adult reader might ask or comments to make on that page.

Two additional features were included in *StoryVisit* that were not in *Story Play*. First, in *Story Play*, either the adult or the child could click on Elmo to initiate his comment or question. In *StoryVisit*, the adult was given exclusive control over Elmo and was given choices regarding Elmo's responses, so that Elmo became part of the family's ongoing conversation about the book, rather than being perceived as interacting directly with the child. For instance, the adult could say, "Elmo, what's happening on this page?" and then click on "Talk" to initiate his commenting on the story. The adult also had the option to click on "Yes" or "No," to make Elmo answer yes and no questions or to click on "Ha Ha" to make Elmo laugh. In addition, *StoryVisit* included a "shared pointing" feature, in which either the adult or child could click on something on the page, and the other user would see a pointing hand icon appear on that section of the page. This allows children or adults to point to pictured characters or objects in the book about which they are asking questions or commenting.

2.2 *Read with Me, Talk with Me*

Troseth, Strouse, and colleagues (2017; Troseth et al. [in press](#)) also created supports for dialogic reading in a system called *Read with Me, Talk with Me*, which was designed as an effortless training tool to help parents engage in conversation with their children while reading e-books together. The books are customized versions of *The Big Dog Problem* (Oxley and Aaronson 2016), an e-book based on the PBS KIDS show *Peg + Cat*. The e-book includes a voiceover narration by the main child character (Peg) that plays automatically when each page is flipped. The customized versions include an overlay in which Ramone (a young adult character) appears in the corner of the page after the story narration finishes on each page to model dialogic questioning techniques for parents. Ramone, a character in the television show, was not in the story line of this particular book.

Two versions of the book were created with the Ramone overlay, with two goals in mind: challenging children to express themselves and encouraging parents to take over questioning. In the spirit of dialogic reading (Zevenbergen and Whitehurst 2003), the topics of conversation presented by Ramone during the second reading of the book call for more complex linguistic responses from children than during the first reading. At first, Ramone asks simple questions that can be answered with a tap on the touch screen (e.g., "Who is taller, Peg or Cat?") to engage children and build their confidence in responding. Across the two reads, his questions and topics become increasingly more open-ended and complex, requiring memory, inference, and verbal responses, (e.g., "Why is Peg excited?"). Ramone also incorporates many text-to-life topics (distancing prompts), such as "Who is the tallest in your family?" See Fig. 1 for one page of the experimental e-book.



Fig. 1 A page from the *Read with Me, Talk with Me* experimental e-book. (Peg + Cat © 2013, Feline Features, LLC. All Rights Reserved. Used with permission)

To promote the second goal, Ramone's support is gradually withdrawn across the two book readings, with the intention of handing control of the questioning over to parents. Ramone pops up automatically in the corner of each page during the first reading, and models dialogic questioning by asking the questions himself. Gradually, Ramone's questions are replaced by suggestions for parents and children to discuss, such that parents have to generate the questions on their own. Finally, near the end of the second book, Ramone stops appearing automatically but is available to be triggered if the parent-child pair want to hear his suggestion for a topic of conversation. The goal is for parents to learn to generate their own questions by the end of the second reading, and for them to feel inspired to generate questions when reading other books with their children (i.e., to generalize what they have learned about dialogic reading).

When Ramone appears on screen and begins to talk, he is accompanied by a text box displaying his verbal prompt. Clicking or tapping the text box repeats the prompt. A "coffee cup" icon also appears, which parents can tap to repeat Ramone's questions. On pages in the second book where Ramone does not appear automatically, parents can tap the coffee cup if they want a hint about questions to ask. Other than the text box and coffee cup, there are no hotspots, and animation throughout is light. On the title page for both books, Ramone offers encouragement about the importance of parent-child talk during reading, but adult co-readers were given no prior training in reading strategies.

2.3 *iRead With*

Rvachew and colleagues (Rees et al. 2017; Rvachew et al. 2017) have been conducting qualitative and quantitative studies to explore the impact of a series of specially designed e-books, called *iRead With*.¹ These books were designed specifically for shared reading by an adult and child; therefore, although a narration feature is available, the design effort was placed on the “read and talk” mode with the intention that the adult read the text and interact with the child. Each page is clearly divided into two regions: the top two-thirds of the page contains illustrations with embedded hotspots and animations and the bottom third contains the corresponding text, including “living words,” which provide animations to reinforce word meaning. Sound effects are associated with certain hotspots and animations. An adult avatar appears on the lower left and a child avatar on the lower right side of each page. These avatars can be personalized by replacing them with photos of the adult and child readers.

Print referencing is encouraged with features to attract attention to certain words that occur frequently throughout each book. For example, in the story “*What’s That Funny Noise?*” featuring the media character Caillou, the words *Mommy*, *Daddy*, *noise*, *monster*, and *shadows* appear in a slightly larger bolded font and in a color that is unique to each word. When touched, these words animate to reveal a characteristic feature; for example, a shadow appears under the word *shadows* and horns grow on the word *monster* (See Fig. 2). Touching these words in the text also launches a story- and meaning-relevant animation in the story illustration in the top portion of the page. For example, on one page, touching the word *shadows* toggles window blinds up and down to reveal and conceal shadows on the bed.



Fig. 2 Bottom portion of page from an *iRead With* book. When the Living Word “shadows” is touched, shadows are shown under the word, the mother avatar releases a prompt to the reader to ask a question about the shadows on the bed and an animation in the illustration (not shown) demonstrates how a light source creates the shadows. (Image taken with permission from Tribal Nova Inc. (2015b). *Caillou: What’s that funny noise?* (Version 1.3.3) [Mobile application software])

¹*iRead With* books were created by Tribal Nova Inc. (currently Houghton Mifflin Harcourt Montreal) with consulting support from the Child Phonology laboratory at McGill University. The books are no longer available for purchase. The special features of these books are described here in relation to their potential benefit as components of digital storybooks in general.

Simultaneously, a prompt bar appears in association with the adult avatar to suggest a dialogic reading-style comment or question that could be posed to the child to support vocabulary learning, story comprehension or emergent literacy skills. With repeated readings, new prompts are added to the book. In research with the books, adult readers were given no training in reading strategies besides familiarization with the e-books and their features.

2.4 *Dialogic Actress*

A few years ago, Strouse et al. (2013) created a video version of a built-in dialogic questioner in a set of five very lightly animated, narrated children's video storybooks. The character, Miss Sue, appears in a picture-in-picture window in the bottom corner of the page. Miss Sue is a video recording of an adult sitting in an armchair with a TV remote, which she lifts to "pause" the story before asking a question. The video storybook is frozen while she asks her question and for a short pause afterward, giving children time to respond.

Children watched one of five storybook videos at the lab with a researcher who encouraged them to respond to Miss Sue, and took the four additional video storybooks home on DVD to view. As in the case of the *Peg + Cat* books discussed above, easier and more challenging versions of Miss Sue's questions were embedded in two separate copies of each of the storybooks. In the videos, Miss Sue spoke directly to children, not to parents. Strouse and colleagues point out that although children who interacted with the dialogic actress did not get the same kinds of social contingency (responsiveness) or social feedback as those who interacted with a parent, they could potentially experience some learning gains with the dialogic actress due to their enhanced engagement with and elaboration on the story content while answering questions.

2.5 *Summary: Designs*

Thus, across all of our labs, the design of digital storybooks (in the form of either e-books or videos) with embedded dialogic questioning help was occurring independently. All of the experimental products included modeling of dialogic reading by an on-screen character, but there were a number of differences in their design as well, including the type of character used for the modeling, whether the storybooks included a narrator reading the story, the number and type of features that were offered to support adult co-readers' interaction techniques and children's learning, and other factors (see Table 1).

Table 1 Factors in digital storybook design, research methods, and results across studies

	Family story play	Story Visit	Read/talk with me	iRead with	Dialogic access
Design of technology support					
On-screen character?	Muppet Elmo	Muppet Elmo	Cartoon young adult, Ramone	Cartoon avatar for adult	Adult female actress
Role of character	Model dialogic reading strategies	Model dialogic reading strategies	Model dialogic reading strategies	Prompt dialogic reading strategies	Engage in dialogic reading strategies
Narrator text?	No	No	Yes	No	Yes
Text tips?	Yes	Yes	Yes	Yes	No
Added features		Shared pointing		Print referencing	
Research methods					
Child ages	2-4	1-6	3-4	5-6	3
Participants	8 families	61 families	94 families	64 children	81 children
Adult partner	Grandparent	Grandparent	Parent	Volunteers	None required
Dialogic Training?	Yes	Yes	No	No	No
Reading location	Remote	Remote	Co-located	Co-located	Co-located
Reading context	Lab	Home	Lab	School	Home & Lab
Research results: technology-scaffolded e-book versus unscaffolded book					
Talk during reading	(1) More adult and child story-related talk		(1) More adult and child story-related talk (2) More overall utterances, words, unique words	(1) More adult and child story-related talk (2) More print referencing	Parents provided little content-related talk, but children regularly responded to actress's questions
Duration of reading	Reading sessions lasted longer	Reading sessions lasted longer	Reading sessions lasted longer		
Child engagement	Child engagement significantly higher		Similar attention and affect as in other conditions		Children regularly responded to actress

3 Research on Technology Supports for Adult-Child Reading Behaviors

In this section we discuss research that each of our teams has conducted using our respective forms of dialogic reading storybooks. We describe similarities and differences across the projects with regard to research methods used, implementation of the research studies, and the context surrounding usage and testing.

3.1 *Family Story Play*

In Raffle et al.'s (2010) *Story Play* research, eight families with children between the ages of two and four (5F, 3 M), their parents (6F, 2 M), and their grandparents (6F, 2 M) used both *Story Play* and traditional video conferencing technology to enable them to read books together from different locations. Participants were selected for diversity of income level and ethnicity. To simulate reading together from a distance, family members were taken into separate rooms in a research lab (grandparent in one, child and parent in the other). Each family participated in two reading sessions with a brief break in between: one using *Story Play* to read an interactive version of *The Monster at the End of this Book* (Stone and Smollin 1971), which included modeling of dialogic reading strategies by the Elmo character and provision of text-based dialogic reading tips for the grandparent, and one using Skype with a traditional paper copy of the same book. The order of reading sessions (*Story Play* vs. *Skype*) was counterbalanced. In the *Story Play* sessions, grandparents were shown a dialogic reading training video before the call. All reading sessions were recorded on video, and after the sessions, grandparents and parents were interviewed about their experiences.

Videos were coded using a qualitative verbal and social interaction coding scheme developed for this project. Coding focused on behaviors of the child, parent and grandparent while reading each page of the book. The coding scheme included five broad categories, with verbal and non-verbal components in each category: behaviors related to *Book Content* (including dialogic reading-style questions or comments), behaviors reflecting positive or negative *Affect*, indicators of child *Attention/Engagement*, coordination of *Page Turns*, and *Interaction with Elmo*, the on-screen character (see Raffle et al. 2010, for more detail).

3.2 *StoryVisit*

Research on *StoryVisit* (Raffle et al. 2011) took the form of a field test of a prototype web-based e-book system, available for a period of 4 weeks. A parent/child pair and their long-distance adult relative could simultaneously log into the system from

their respective homes. Families could log on as many times as they wanted during the 4-week period. Sixty-one families used the system for at least one reading session with a long-distance reader, and the maximum number of reading sessions engaged in by any of the families was five. Children of these families ranged in age from 1 to 6 years.

Four versions of the *StoryVisit* prototype were created, varying (1) whether the e-book co-reading experience included the Elmo character modeling dialogic reading strategies, (2) provision of text-based dialogic reading tips for the adult reader, (3) both or (4) neither. Each family was randomly assigned to one of these four conditions when they signed up for the study. All versions included video conferencing with five e-books adapted from the Sesame Street library, and the shared pointing feature.

For all 61 families, basic usage data (amount of time spent per session, number of books read per session, etc.) was logged by the system. In addition, all participants completed pre- and post-surveys, and 19 of the families completed a post-test telephone interview. Four of the families received home visits by the research team, which included observation and recording of video during book-reading sessions and in-depth semi-structured interviews.

3.3 *Read with Me, Talk with Me*

The effectiveness of *Read with Me, Talk with Me* is currently being examined with two samples of 3- and 4-year-olds and their caregivers (Troseth et al. [in press](#); Strouse et al. [2017](#)). In one sample, 32 families were recruited through childcare centers serving families of low socioeconomic status. Caregivers and children were videotaped while they read either the two versions of the book with the Ramone character offering dialogic questioning support, or the original version of the *Peg + Cat Big Dog Problem* e-book (as released on the *PBS KIDS* website, without the dialogic questioning) twice. In the other study sample, 67 families have been recruited thus far from a database developed from state birth records, word of mouth, daycare centers, and families who volunteered during events at the zoo. This sample includes families from a variety of income levels.

In this study, caregivers and children are assigned to read the two versions of the book with the Ramone character, or to read one of three different versions of the original *Peg + Cat* book: (1) the e-book with the sound (narration) *on*, (2) the e-book with the sound *off*, or (3) a printed paper version of the book, created by taking screenshots of the e-book. In all of the comparison conditions, parent-child dyads read the original *Peg + Cat* book (without Ramone's questioning support) twice. Analyses for both samples include *Amount of Parent-child Talk*, *Content of Talk*, *Child Affect* and *Child Attention*, all coded from videotapes. Parents were also interviewed and provided written feedback about their experience with the books.

3.4 *iRead With*

To assess the impact of the *iRead With* features on adult scaffolding behaviors, Rvachew et al. (2017) conducted a study using a randomized control crossover trial design. Twenty-eight children in an English-speaking school situated in a low-income, urban community participated in a 2-week one-on-one shared reading experience with volunteer adult readers who shared one book with the child three times each week. Of the eight volunteer readers, three were parents from the school community, two were school staff and three were undergraduate students.

In a separate study (previously unpublished), the research team replicated Rvachew et al.'s (2017) study procedure with 36 children in a French-language school in a middle-class suburban community. Of seven volunteer adult readers, four were retired school personnel (three teachers, one principal), one was a parent and two were undergraduate students.

In both studies, adult-child pairs read two stories: *Caillou: What's That Funny Noise?* (Johnson 2009; Tribal Nova Inc 2015b) and *Caillou: My First Play* (Pleau-Murissi 2010; Tribal Nova Inc 2015a). Over the 2-week experience, the reading pairs shared one story in print book form and the other story in e-book form. The adult readers were given no training regarding reading strategies besides some initial familiarization with the books and the e-book features.

The readers were instructed to share the print book and the e-book as they normally would with a kindergarten-aged child and were also told to use their own discretion regarding use of the e-book features. The children were randomly assigned to a counterbalanced reading order as well as to a volunteer reader. Shared reading exchanges were audio recorded.

The recordings of the reading sessions were transcribed and scored for adult scaffolding behaviors during shared reading. All adult utterances that were not verbatim readings of text from the book were coded according to five categories: (1) *Rapport and Behavior*; (2) *Book Mechanics*; (3) *Story Related*; (4) *Word Meanings*; and (5) *Print or Word Structure*. Details of the coding system with examples are provided in Rvachew et al. (2017).

3.5 *Dialogic Actress*

The dialogic actress ("Miss Sue") embedded in storybook videos was used in one condition of a larger study. Strouse et al.'s (2013) research involved a comparison of learning outcomes (acquiring story vocabulary, story comprehension) for 81 children who watched four storybook videos over a period of 4 weeks at home, with either: (1) parents who were trained in dialogic questioning strategies (20 children); (2) parents who were asked to direct children's attention to story events, but not to ask questions (21 children); (3) parents who were told to act "as usual" while

children watched (typically with very limited parent-child conversation, and children often watched on their own) (20 children); or (4) the on-screen actress in a picture-in-picture window who used dialogic questioning strategies in similar ways to parental dialogic questioning (20 children).

Parents in all conditions were instructed to have their children watch the first two stories 3–5 times per week for the first 2 weeks; they then had their children watch two new stories 3–5 times per week for the following 2 weeks. In the case of the dialogic actress condition, parents received two versions of each story, one with easier and one with more challenging questions. They were instructed to have their child view the video containing two stories with easier questions for 1 week and the video of the same two stories with challenging questions for the next week. Then they repeated this procedure with the other stories over the next 2 weeks. Parents of children in the dialogic actress condition were instructed not to repeat the actress's questions because the researchers were interested in what children would learn from the videos "on their own."

Parents and children visited the lab for vocabulary pre-testing prior to the study. After watching the first two video stories at home for 2 weeks, they returned for post-testing (*Story Vocabulary* and *Story Comprehension*). After another 2 weeks, they returned for vocabulary and story comprehension post-testing for the final two stories. At the final visit parents and children were also video-recorded while they watched one of the stories in the lab; they were instructed to watch in the same way they had done at home during the study.

3.6 Summary: Methods

As with the design of dialogic storybooks across the authors' four research labs, there were some basic similarities across research methods for all of the studies, including ages of children (6 and under) and observation of adult-child interactions during usage. There were also some differences in research methodology, such as the relationship of the adult reader to the child, whether the adult reader received training in dialogic reading or not, whether the two readers were co-located or at a distance, and whether the reading was done at home or in the lab. There were also differences in the type of comparison conditions used. See Table 1 for a comparison of research methods employed.

4 Research Findings

In this section we report and compare the results of research conducted in each of the four research labs.

4.1 *Family Story Play*

Raffle et al. (2010) found a number of benefits of *Story Play* reading sessions (interactive book with technology support for adults' dialogic reading) over *Skype* reading sessions (adult reads traditional paper book to child over video chat). Both methods of incorporating shared reading into grandparent-grandchild remote interactions significantly increased the length of such interactions compared with *Skype* conversational sessions with young children, previously reported as lasting 2–3 min (Ames et al. 2010). The *Story Play* sessions, however, lasted significantly longer ($M = 11:48$ min) than the *Skype* reading sessions ($M = 8:23$ min) in Raffle et al.'s (2010) study. Child engagement levels were high throughout both kinds of reading session, but higher for *Story Play* (child engaged, on average, 97% of the time) than for *Skype* (child engaged, on average, 84% of the time).

Participants seemed to enjoy both *Skype* and *Story Play* reading experiences. Grandparents expressed approximately equal levels of positive affect with *Story Play* and *Skype*, but both parents and children expressed more positive affect with *Story Play* than with *Skype*. It is possible, of course, that parents' enjoyment increased for *Story Play* as a reflection of children's increased enjoyment due to the interaction with the Elmo character. Although inclusion of the Elmo character was successful at increasing children's engagement and enjoyment, some of the adults perceived that Elmo was there solely to entertain the child and did not perceive him to be a welcome part of the reading interaction. Some grandparents were frustrated by Elmo's distraction from their interaction with the child, with one commenting, "I think he likes Elmo better than me."

Regarding dialogic reading, grandparents in both conditions asked children questions related to the content of the book (e.g. "What is Grover doing?" or "Are you afraid of monsters?"), but grandparents in the *Story Play* condition did so more often (averaging two per page) than those in the *Skype* condition (one per page, on average). Children answered their grandparents' questions on average once per page in both reading conditions. Grandparents gave children positive reinforcement (e.g., "Good job!" or "That's right!") for answering questions or talking about the story slightly more often in the *Story Play* condition (11% of *Story Play* pages, 4% of *Skype* pages).

4.2 *Story Visit*

In this study, Raffle et al. (2011) were not able to examine the effects of supports for dialogic reading on adult reading partners' behaviors directly, since it was a field study and there was no record of participant verbalizations, only computer interactions. Instead, analyses focused on comparing various aspects of the participants' e-book interactions for the various book feature conditions (Elmo modeling dialogic reading, text-based dialogic reading tips, both or neither). Families whose

reading experience included Elmo modeling had significantly longer reading sessions than those who had neither Elmo modeling nor text-based reading tips. In addition, families experiencing Elmo modeling engaged in more total reading time across all sessions than families in any of the other conditions.

Adult readers' use of the text-based dialogic reading tips was also examined. In both of the conditions that had text-based reading tips available, the reading tips were clicked quite infrequently (on less than 5% of the pages read). Comparing families who had reading experiences featuring Elmo modeling *and* text-based reading tips to those who only had the text-based tips, adult readers who had text-based tips alone clicked on the reading tips more often (tips clicked on 7% of the pages read) than those who also had Elmo modeling dialogic reading strategies (tips clicked on 2% of the pages). Comparing whether tips were ever clicked at all across the two conditions, a full 75% of the families with text-based tips alone clicked on the tips at least once, whereas only 20% of those who also had Elmo modeling ever clicked on the text-based tips at all.

4.3 *Read with Me, Talk with Me*

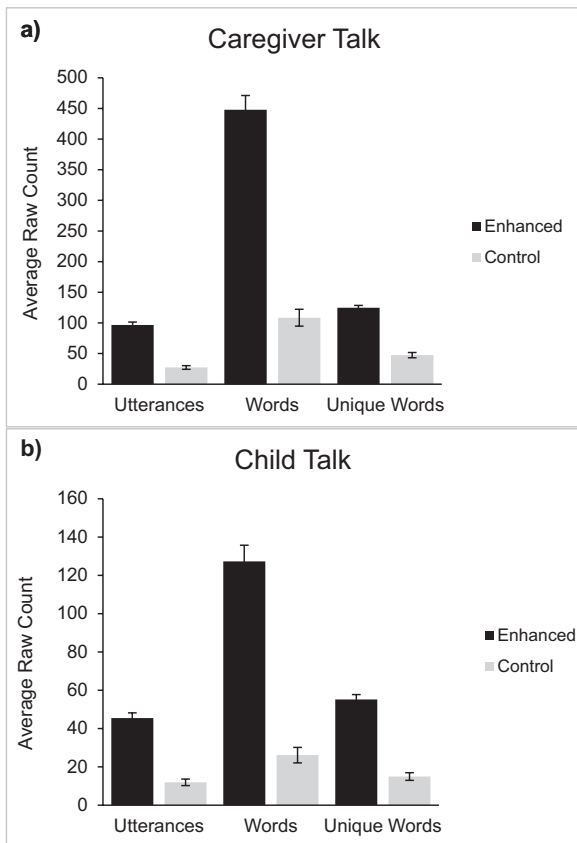
Results for *Read with Me, Talk with Me* are consistent across the two samples (Troseth et al. [in press](#); Strouse et al. 2017). The number of parent and child utterances and words said during reading is 3–4 times greater for pairs reading the e-book with Ramone's dialogic questioning example than those reading the book without Ramone (see Fig. 3 for data from Troseth et al. [in press](#)). The number of parent and child unique words (an indication of language quality) is 2–3 times greater in the Ramone condition. During feedback interviews, some parents claim that they talk more often with print books, or that they would talk more if the e-book narration and Ramone did not automatically play. However, in the second study (Strouse et al. 2017) parent and child utterances, words, and unique words are all significantly higher in the condition with Ramone than in any of the comparison conditions (e-book with narration, e-book without narration, and the print book version).

The number of parent and child utterances focused on story content (as opposed to directing children's attention, talking about the device, or being off-topic) show a similar pattern: 3–5 times higher for the Ramone condition. Content-related talk in the condition with Ramone is 75–90% of talk for parents and children in the two samples.

Parent-child pairs spend about twice as long with the Ramone book as they do with the books in any of the comparison conditions. Despite the significantly longer time, children appear to have equivalently high attention and positive affect throughout the sessions.

Finally, there is some evidence that parents are adopting the dialogic questioning strategies modeled by Ramone in the books. Across the five pages at the end of the second book on which Ramone does not automatically appear with suggestions for questions, most parents very infrequently tapped the coffee cup to trigger Ramone,

Fig. 3 Parent (a) and child (b) utterances, words, and unique words spoken while reading the enhanced e-book with the embedded dialogic questioner, or the control book, twice. Data from the sample of families of lower socioeconomic status. All condition differences were significant at the $p < .001$ level



asking their own questions instead. Parents of lower SES asked nearly ten original questions on average across the five pages (Troseth et al. [in press](#)). During the feedback sessions, parents commented that Ramone was helpful and gave them ideas about new types of questions they could ask, especially those that connected the book with their child's life.

4.4 *iRead With*

The results of research on the *iRead With* e-books are shown in Table 2. Specifically, Table 2 displays the mean (with standard deviation) number of adult comments per shared reading session as coded in each category, averaged across stories within book format. The results for the English language study (Rvachew et al. 2017) are shown on the left in Table 2 and the results for the French language study on the

Table 2 Mean adult comments during shared reading in the English and French schools

Number of adult comments	English language school					French language school				
	Paper book		iRead With		d_z	Paper book		iRead With		d_z
	M	(sd)	M	(sd)		M	(sd)	M	(sd)	
Rapport/behavior	14.01	13.33	18.02	11.78	0.35	26.92	17.82	28.21	15.16	0.06
Book mechanics	1.53	2.65	5.02	4.97	0.65	0.04	0.11	4.38	2.56	1.58
Story related	20.77	16.67	22.98	14.3	0.11	30.12	11.33	39.7	21.77	0.41
Word meanings	3.54	4.38	6.53	6.86	0.34	13.14	8.56	15.65	10.17	0.16
Print referencing	0.64	1.69	3.63	4.28	0.61	0.49	0.57	6.82	6.5	0.91

right. The effect size for paired values (d_z) is reported for each category of comments, indicating that the e-book had a large effect on the number of comments related to book mechanics and print referencing in both schools. Overall, the adult readers in the French-language school produced more comments in general in both book contexts compared to the adult readers in the English-language school: the greater number of story- and vocabulary-related comments and questions suggests a more sophisticated dialogic reading style by the adult readers in this school that was located in a middle-class community.

Although these overall results apply to both the English language study and the French language study, the effects are more pronounced in the latter study. The transcripts revealed that the French-speaking adult readers produced more complex questions about the stories and displayed a more sophisticated interactive reading style overall. For example, it was common for adult readers to ask “What did she do?” on the first page of *Caillou: What’s That Funny Noise?* prompted by the animation of Mommy kissing Caillou. One English-speaking reader acknowledged the child’s correct answer with, “Yeah, she just kissed Caillou,” whereas a French-speaking reader followed up with a second question, “Elle l’a bisou, pourquoi?” [*Why did she kiss him?*], leading to a more extended conversation. This result is in line with the more elaborative style of highly educated parents that has been found in prior research (e.g., Hoff 2003a, b, 2006; Huttenlocher et al. 2010).

Given the obvious differences between the French and English-speaking readers with respect to the use of dialogic reading strategies, the similarity between these readers when it comes to print referencing is striking. There was less than one instance of print referencing per print book reading session for both the English speakers ($M = .67$) and the French speakers ($M = .52$). Both groups of readers significantly increased print referencing in the e-book condition and, once again, the effect was more striking for French speakers. A five-fold increase was observed for those reading in English ($M = 3.41$) and an 11-fold increase was seen for French readers ($M = 6.23$).

4.5 *Dialogic Actress*

Strouse et al. (2013) found that children whose parents were trained to ask dialogic questions during video storybooks had significantly better story comprehension and vocabulary learning than those whose parents directed their attention to story elements or were in the “watch as usual” control group. Children who saw the videos with the dialogic actress had scores on both comprehension and vocabulary outcomes that fell between these groups, not differing significantly from the results in any of the other conditions. (The sample size only had reasonable power to detect quite large effects.) It is possible that the dialogic actress better supported learning compared to the plain video storybooks, but was not equivalent to in-person parent questioning.

At the final lab visit (after 4 weeks of home viewing), parents and children watched one of the video stories in the lab and were told to act as they had done at home during the study. Recall that parents in the dialogic actress condition were instructed not to repeat back the actress’s questions, but otherwise were not restricted in their behavior. Parents in the dialogic actress group made on average only 1.35 story-related comments during this viewing, the lowest of all conditions. However, children were quite interactive with the video, responding verbally to Miss Sue 63% of the time when she asked a question. All parents reported that their children responded to Miss Sue aloud at least some of the time when watching the videos at home. Strouse and colleagues hypothesized that some support for children’s learning would occur through the cognitive aspects of thinking about and answering questions about the story, even when these questions were asked by an on-screen character. Based on children’s responsiveness to the character, it seems promising to include a dialogic questioner in digital storybooks, even if this agent is not capable of providing feedback to children the way that parents can.

4.6 *Summary: Results*

Table 1 summarizes the common results across research studies from the four labs. In studies in which adults were asked to participate with the child and verbalizations were measured, there was more talk about book content with the e-books that incorporated scaffolds than those without. Across studies, reading sessions were also longer for the e-books that included these supports, and child attention and affect, when measured, was equivalent or higher with scaffolded than non-scaffolded books. The two studies that measured parents’ tendency to trigger text tips found that parents did this rarely, and the one study that examined print referencing revealed that technology support for such behaviors was effective in increasing adult print referencing.

5 Discussion

5.1 *Parent Training in Dialogic Strategies*

Two of the studies provided explicit training in dialogic reading strategies and three did not. Summarizing across studies, the provision of explicit training did not seem to be necessary, as results were equally strong for those research conditions that simply provided modeling of dialogic reading in the e-book as for those that provided training videos. Studies of dialogic training have not worked as well with low-income groups as with higher SES groups, possibly because training and implementation are complicated and costly (Mol et al. 2008). Thus, having a way to introduce dialogic reading that is simpler than memorizing a complex scheme may be better. According to Hindman et al. (2016), “The success of interventions that aim to close the language stimulation gap rests largely on the degree to which they ultimately help families and educators talk more, using words that children will encounter in texts, in ways likely to help children learn” (p. 2). In the studies reported here, having a dialogic reading agent did this – it got parents and children talking much more about book content.

5.2 *Print Referencing*

One of the most striking results reported here was in Rvachew et al.’s (2017) study using the *iRead With* e-books that incorporated animations to draw attention to individual target words in the text, such as *noise*, *monster*, and *shadow*. Adult and child English speaking co-readers from a school in a low-income urban neighborhood exhibited a *five-fold* increase in print referencing compared with those who read a paper book. The results were even more striking in French-speaking readers from a school in a suburban middle-class neighborhood, with an *11-fold* increase in text referencing. Print referencing is an important pre-literacy skill for young readers to master. This result is in line with the general finding from Takacs et al.’ (2015) meta-analysis that audio-visual supports (such as relevant animations) in e-books can support young children’s literacy development.

5.3 *Parasocial Relationships*

Most of this work has been focused on existing media characters, to capitalize on the possibility that children’s pre-existing parasocial relationships with the characters (e.g., Brunick et al. 2016) would make the on-screen character more effective in engaging children’s attention and helping them learn. The authors had the advantage of working with highly developed and familiar media properties (Caillou, Peg

+ Cat, Sesame Street) and with experienced, professional children's media producers and writers to create character dialogue that was both authoritative and informative, yet entertaining and engaging. In the projects described here, children were highly engaged with popular media characters (e.g., Elmo), but children also engaged with and responded to a previously unfamiliar on-screen female adult seated in an armchair (Strouse et al. 2013). Some prior work has indicated that children are more likely to learn from familiar than unfamiliar characters (Lauricella et al. 2011), and also that children can become familiarized and learn from a previously unfamiliar character over a few months of exposure (Howard Gola et al. 2013). Thus, children's response to the female adult in Strouse and colleagues' study may have been supported by repeated exposure during the month-long study. It is also possible that children would have learned even more if the on-screen character had been a familiar favorite.

The likelihood of a character being effective in developing parasocial relationships with both children and adults may also rest on the attributes of character. Elmo is clearly a children's character, and some of the adults who used *Story Play* expressed a feeling of being in competition with Elmo for the child's attention. There may have been a perception that Elmo was there to interact with the child, causing him to be less effective as a model for adults to emulate. Ramone, on the other hand (a character in the Peg + Cat television series), is a young adult person of color, chosen to be accessible to an ethnically diverse audience. The fact that he is not a child character may help adults understand that the prompts he offers are 'for them' and not just between the character and the child.

5.4 *Control of Character Scaffolding*

Two of our research efforts investigated how the character's modeling of dialogic reading is triggered, whether it is automatically provided or can be requested by either the adult or the child when needed. Parents who read with Ramone reported they wanted more control over *when* and *if* the on-screen character provides prompts. Raffle et al. (2010) received similar feedback, which resulted in a modification to the software used in Raffle et al. (2011). In the first study, Elmo's comments or questions could be initiated by either the child or the adult. Based on user feedback, in the second study Elmo's comments/questions were only made when initiated by the adult co-reader. Although Raffle et al. (2011) did not report formal data regarding adult initiation of prompts, they informally observed that adults did initiate Elmo's prompts because the children enjoyed them so much, and the adults generated their own questions/comments as well. Similarly, when Ramone no longer appeared automatically (on the last five pages of the second version of the Peg + Cat book), parents either triggered Ramone or, more frequently, asked their own questions.

One concern is that, without substantial exposure to dialogic questioning, parents may not adopt the method. Most parents in all conditions of the *Read with Me, Talk with Me* research reported that they “sometimes” or “always” pause to ask questions/talk with children when reading, yet we observed low levels of parent-child talk in the conditions without Ramone’s example. It will be important in future research to determine whether giving parents more control over the dialogic questioning model actually results in sufficient parent exposure to dialogic reading techniques.

5.5 Research Conducted in Lab Versus Home

In most of our studies, parents and children were observed in the context of a research laboratory. It is possible that in these contexts, parents talked more during reading than they would have at home, since they knew that they were being observed. We expect that parents may have been on their “best behavior.” However, parents’ best behavior differed across conditions. For example, parents who had Ramone’s example (in *Read with Me, Talk with Me*) talked three or more times as much as those without Ramone. An important future direction for this research is investigating how parents use the product in a more naturalistic environment. In *StoryVisit* testing, parent language was not tracked, but parents and children spent more time with the books when Elmo provided scaffolds, offering indirect evidence that more discussion likely was taking place in this condition even without direct observation by researchers. In addition, parents in the *Dialogic Actress* study reported on a questionnaire how much they talked while their children watched the videos at home, and how much their children responded directly to Miss Sue. During videotaped observations in the lab, parent and child behavior seemed to match what parents had reported at home. Thus, there is some evidence that these products are effective when used in ecologically valid contexts.

6 Next Steps: Generalization of Strategies Learned

Among the important current and future directions for this line of research is determining whether the kinds of effects demonstrated here would be maintained over a longer time period and in different reading contexts. One of the most critical questions is whether adults will generalize the reading behaviors and strategies they learn with the kinds of technology supports used in these studies to their shared reading with traditional paper books or e-books without the technology supports.

Some initial evidence regarding generalization of strategies learned in e-books with technology support to reading contexts without the support comes from Rvachew et al.’ (2017) comparison of adult-child pairs who read an e-book with technology support for dialogic reading strategies in Week 1 of their study and then

read a traditional paper book in Week 2. There was no evidence of carry-over of reading styles demonstrated with the e-book in the first week to reading behaviors with the paper book in the second week.

Revelle et al. (2017) examined the effects of children's and parents' shared reading of e-books with dialogic reading support. Lower- and middle-class families with 3-year-old children read e-books together on a mobile phone at a local library or preschool once a week for a period of 8 weeks. A randomized controlled trial design was used, in which half of the parent-child pairs read e-books featuring the Elmo character modeling dialogic reading, as previously described for the *Family Story Play* (Raffle et al. 2010) and *StoryVisit* (Raffle et al. 2011) projects. The other half of the families read the same e-books, but without the Elmo character modeling strategies. Parents received no training in dialogic reading strategies before engaging in the reading sessions. Before and after the 8-week e-book reading period, all parent-child pairs read print books together, enabling a pre-test versus post-test comparison of parents' and children's verbal interactions while reading together. All reading sessions were coded for parents' and children's dialogue, using the same coding categories described for the *Family Story Play* project (Raffle et al. 2010).

Preliminary results indicate that there were no significant differences in post-test (print book) levels of parent-child conversation about book content for the condition in which the Elmo character modeled dialogic reading strategies versus the no modeling condition. For both conditions, neither parent nor child verbalizations showed any significant pre-post change. A consideration of the differences between the conditions in this study versus previous studies reporting increased parent-child talk about book content with modeling reveals a number of potential factors that could have contributed. First, in contrast to the previous research of Revelle and colleagues, there was no dialogic reading training of parents involved. The research of the other co-authors here, however, involved no explicit training and still found significant effects. Second, this was the first study of those reviewed in this chapter that used a mobile phone (rather than a larger device) for shared reading. Perhaps it is more difficult for parent and child to engage in joint reading effectively on a small device. Finally, the fact that this was a "lab study" that required parents and children to come into a research space once a week for 8 weeks could have resulted in "fatigue" and/or boredom on the part of parents and children, which might inhibit their carrying on extended conversation in the post-test session. In the future, a home-based study using a larger device might look for clear evidence of generalization of learning from technology supported e-books.

7 Technology Support for Adult-Child Reading: Questions Raised

There are quite a few open questions about how to best design digital tools to support adult-child co-reading. The studies described here do not provide conclusive answers about whether a familiar character supports learning and engagement more

than a novel character, and whether the child-directed nature of a character like Elmo supports or distracts from parent-child talk. It is possible that a child-directed character is more engaging, but it may make parents feel as though they are interrupting communication between their child and the on-screen character. Similarly, we do not know whether story narration provided by the e-book is better than parent reading under some circumstances, such as when parents are first being exposed to dialogic questioning. Parents might like to control the pace of reading or pause in the middle of a page to talk, and thus feel interrupted by the narration. On the other hand, narration could support parents who are less confident about reading. Narration may be a feature that should be adaptable over repeated readings and for different readers. Finally, we do not know the optimal amount of scaffolding to provide to families, and at what point to give families control to turn off the questioner. Initial research suggests that parents do not often tap to trigger tips, so it may be important to ensure the questioner is on screen long enough to provide sufficient modeling for parents before the questioner becomes optional. In addition to optimal design, there are still questions about how tools such as these would work when deployed in real-world environments. We do not know whether parents who are not directed by researchers would opt to use products containing dialogic reading supports and for how long. We do not know if parents would talk as much without the knowledge that they were being observed by researchers. Additionally, the way these products work when used by parents who volunteer for research studies may not reflect how well they would work with parents who are not the type to volunteer for research. Troseth and Strouse plan a follow-up study using the e-book with Ramone that will address some of these concerns by giving families the opportunity to take the books home to read for 2 weeks, and recording them in this authentic environment, but participants will still be volunteers who will know they are part of a study.

Studies of long-term child outcomes are also needed. We have assumed that by increasing the amount and quality of children's language exposure, these experiences will also increase their vocabularies, as research has shown a strong link between these variables (Hart and Risley 1995; Hirsh-Pasek et al. 2015; Hoff 2003a, b, 2006; Rowe 2012; Weisleder and Fernald 2013). We do not yet know, however, whether the amount and type of language that these products promote is effective in changing child literacy outcomes.

Across these studies, there also are a few lessons learned. First, explicit training in dialogic reading strategies does not seem to be necessary to promote increased talk between parents and children, since simple modeling of these strategies by an on-screen character results in increased parent-child talk about the story. It also appears that parents and children enjoy these experiences – they opt to spend more time with books incorporating characters that question, and engagement and affect are equivalent or higher than for books without the characters. Thus, screen media incorporating characters who model questioning appear to be a good avenue for promoting children's language development.

The “word gap” in children's exposure to language, related to having fewer family resources and less parent education, has been described as a *disparity in oppor-*

tunities to learn language (Carter and Welner 2013). Recent research documents variability in language environment even for children with socioeconomic advantages, some of whom are offered much less opportunity than their peers to learn language (Gilkerson et al. 2017). Developing digital tools that support and encourage parents and children to ask and answer questions in dialogue about a story shows promise as one way to bridge these gaps.

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