

# Content not form predicts oral language comprehension: the influence of the medium on preschoolers' story understanding

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**Abstract** The purpose of this study was to investigate the influence of digital and non-digital storybooks on low-income preschoolers' oral language comprehension. Employing a within-subject design on 38 four-year-olds from a Head Start program, we compared the effect of medium on preschoolers' target words and comprehension of stories. Four digital storybooks were adapted and printed for read-alouds. Children were randomly read two stories on the digital platform, and two by the assessors. Following the story, children completed vocabulary and comprehension tasks, and a brief motivation checklist. We found no significant differences across medium; children comprehended equally well regardless of whether the story was read digitally or in person. However, using repeated ANOVA measures, we found a significant main effect of the story read. This research indicates that the content of the book rather than its form predicts story comprehension. Implications for using digital media in the preschool years are discussed.

**Keywords** Digital media · Early literacy · Within-subject design · Preschoolers · Oral language comprehension

## Introduction

Young children with limited oral language comprehension are at risk for encountering difficulties in early literacy and throughout their schooling (Cunningham & Stanovich, 1997). Even before entering kindergarten, the average cognitive score of children in the highest socioeconomic group is 60% above the score of the

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lowest socio-economic status group (SES) (Lee & Burkam, 2002). These problems are further compounded by the *word gap* (Hart & Risley, 1995) the stark differences in the accumulated number of words children are likely to be exposed to from these differing SES groups. Prior to kindergarten, Hart and Risley (2003) describe the gap as a 30-million-word catastrophe, which grows exponentially over the early years so that by first grade the high-performing student will know about twice as many words as that of the low-performing student.

Such differences have often led to a discourse that have focused the linguistic deficits of low-income children, a view that they lack the fundamental discourse and reasoning skills that other middle-class children bring to school (Michaels, 2013; Miller & Sperry, 2012). To the contrary; these children bring rich discursive repertoires, styles, vocabulary and narrative strategies to school (Gumperz, 1982; Hoff, 2006). Significant advances in our understanding of sociolinguists, for example, has allowed for a shift from a deficit to a difference view of dialectal differences in social discourse (see de Villiers & Johnson, 2007; Stockman, 2010). However, while these children have no fundamental deficits in their language and language learning abilities, they may have less exposure to and fewer opportunities to learn the academic language and experiences that are valued in school. Therefore, it is the school-based language and the precursors related to literacy skills that these low-income children will need, building on their linguistic skills to develop robust reading performance and achievement.

Consequently, supporting word and world knowledge, especially for children most at risk, is critical if we are to change the trajectory of their long-term achievement (Hirsch, 2006). Given the rich language in books, interactive storybook read-aloud activities have been considered one of the potent strategies to accelerate their development (Bus & Van Ijzendoorn, 1995). However, recent research suggests that digitized stories may also provide a context for engaging children in vocabulary and comprehension learning activities (Verhallen, Bus, & deJong, 2006). Video representations bring stories to life through sound, action, words, and zooming among other formal features. For example, there is now an emerging body of literature demonstrating that e-books, with supports designed to provide additional information about the characters and the definitions of words, can enhance low-income children's word reading and concepts of print (DeJong & Bus, 2004; Korat & Shamir, 2007). In short, they may offer multimedia supports for vocabulary and content learning essential for comprehension, especially for children with limited opportunities to engage with books or other language-rich experiences.

Nevertheless, a common finding in the literature is that children learn better through real-life events than video presentations (Kirkorian et al., 2015). This learning difference, demonstrated in numerous studies with infants and toddlers has been coined the *video deficit effect*. Based on research by Anderson and Pempek (2005), the video deficit represents the discrepancy between learning from a live person and learning from an equivalent media source such as video. Barr and Wyss (2008), for example, found that toddlers required twice as much exposure to learn from video than for a real-life event. Further, the deficit might persist beyond the toddler years. In a controlled experiment, Roseberry and her colleagues (Roseberry, Hirsh-Pasek, Parish-Morris, & Golinkoff, 2009) found that 30 month olds learned a

set of verbs significantly better when an experimenter was live than when she appeared in a video condition. Even though children older than 3 gained some information from video alone, this learning was still not as robust as learning from live social events.

In the face of overwhelming evidence that young children do not learn as much from video as from live interactions (Krcmar, Grela, & Lin, 2007), numerous position statements have either discouraged all screen time for infants and toddlers, or at the very least seriously recommended to limit media experiences for young children even through the preschool years (American Academy of Pediatrics and Media, 2011; National Association for the Education of Young Children, & Fred Rogers Center for Early Learning and Children's Media, 2011). Nevertheless, children are engaged in media use. In a typical day, 83% of children ages 6 months to 6 years use some form of screen media (Rideout, 2013). In fact, the average screen use for young children is about twice the amount of time (1 h, 36 min) compared to reading or being read to by an adult (40 min).

Acknowledging this reality of media exposure for young children, therefore, is critically important to better understand how different media might support children's vocabulary and comprehension. Evidence for the video deficit, for example, largely comes from studies of infant and toddlers' comprehension of video and their ability to demonstrate learning post viewing, not children beyond 30-months. Whether such deficits are still evident for children who have an emerging understanding of representational thinking such as preschoolers remains an open question. Furthermore, studies of video deficits have been largely agnostic regarding the quality and age appropriateness of the video itself. Using eye-tracking technology, for example, we reported stark differences in children's comprehension of video when comparing a more crowded and faster-paced clip (e.g., Baby Einstein) to a slower-paced clip (e.g., Baby bugs; Neuman & Pinkham, 2015). However, when designed with clearly articulated instructional and developmental principles in mind, numerous studies (Fisch, Shulman, Akerman, & Levin, 2002; Linebarger, Kosanic, Greenwood, & Doku, 2004) have shown that video can be an effective conveyer of content that promotes vocabulary and comprehension skills.

Alternatively, there are scholars who argue that the medium of instruction may have little to do with learning. In one of the most widely noted quotes, Clark (1983) contends that "...media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition" (p. 445). In contrast, Kozma (1994) has argued that certain media attributes could possess particular characteristics that make it more or less suitable for different kinds of learning tasks. Therefore, the question becomes: Are certain activities such as storybook reading more effective in one medium or another? Clark (1994) asks researchers to apply a replaceability test: Whenever there is a medium that is thought to cause learning, one must ask if another set of media would lead to the same result.

Given the increasingly prominent role of video in the lives of young children, this study was designed to examine children's learning through different media, listening to stories and video. Although nothing can replace the interactivity that comes from a live read aloud experience between an adult and child, there are

certain features in video that might enhance word learning especially for children with limited vocabulary. Our previous research found that video with its many audio and visual affordances was able to enhance children's developing conceptualizations of words better than viewing static pictures in books (Neuman, 1995). More recently Mayer (2001) reported that multimedia supports combining visual and auditory supports enabled children to have a deeper understanding of word meanings than through one medium alone.

Further support may come from Paivio's dual coding theory (Paivio, 2008), which posits that visual and verbal information are processed differently, creating separate representations for information processed in each channel. Silverman and Hines (2009), for example, found a positive effect for English learners in prekindergarten through second grade as a result of media-enhanced vocabulary instruction. Chambers and her colleagues (Chambers, Cheung, Madden, Slavin, & Gifford, 2006), as well, have shown that the use of embedded multimedia can enhance vocabulary and comprehension, reporting a moderate effect size when compared with instruction without media.

However, there is little consensus in the research on how the medium itself affects low-income preschoolers' word learning and comprehension. Although some studies have shown an advantage of digitized stories over print presentations (Korat, 2010; Segal-Drori, Korat, & Shamir, 2010), others have shown that live presentations more effectively enhance children's comprehension (Terrill & Daniloff, 1996). Two studies illustrate these contrasting findings. Korat, for example, examined the effects of e-book reading in comparison with print storybook reading on Israeli kindergartners' and first grade children's story comprehension. Randomly assigning 90 children into treatment and control groups, posttest measures indicated that children who read the e-book version exhibited significantly greater progress in word meaning and word reading compared to the control group. On the other hand, Terrell and Daniloff (1996) compared the effectiveness of computer, video and live adult reading for 78 preschoolers. Embedding novel words (e.g., nouns, verbs and adjectives) to be learned within the story, these researchers found a small, but significant effect for live reading over the other two modes. Still others, however, suggest that learning is equivalent across medium (e.g., Neuman, 1992).

Furthermore, some research argues that proficiency in vocabulary and comprehension may be tied to motivation to learn (Csikszentmihalyi, 1991), and that different media may potentially motivate children to read more than others (Crum, 2015). For example, Guthrie and his colleagues (Guthrie & Klauda, 2014) found that practices which encourage motivation systematically nourished children's engagement, and ultimately influenced children's retention of information and understanding of text. Children who turned to reading on their own for intrinsic motivation, the sheer enjoyment of the activity, were more likely to develop proficiency in reading.

Given the lack of consensus in the extant research base on how print and digitized stories might compare as contexts for vocabulary and comprehension for preschoolers, more research is clearly needed. This research, therefore, addresses the issue of comparability in learning vocabulary and comprehension skills in stories that are read aloud compared to stories presented in digital form to low-income preschoolers. For this study, we used *Speakaboos*, a program available

through iTunes that includes over 100 interactive stories targeted to preschoolers and kindergartners. Rather than explicit skill development, the *Speakaboos* series is designed to delight young children in learning about language through listening to tightly-woven stories that will motivate them to read in any medium. The following questions guided our research:

1. What is the effect of a real life storybook reading compared to a digital book reading on children's learning of target words? On their comprehension of stories?
2. To what extent is children's motivation to read related to medium?
3. Are the differences in children's comprehension related to the story content, and not the medium?

## Method

### Participants

The study was conducted in a Head Start program, serving 3- and 4-year old children. Four classrooms, including all 4-year-old children from the centers, were invited to participate in the study. Parent consent was 100%. From these classrooms, 38 children were randomly selected; 19 boys, 19 girls. Average age of the children was 4.15 ( $SD = .22$ ) years old. Ninety percent of the children were African American; 8% were Hispanic; 2% were of European descent. All children were English proficient according to their teacher and parent application forms, and all received free and reduced lunch. Children's Peabody Picture Vocabulary Test (PPVT-4; Dunn & Dunn, 2007) indicated an average standard score of 87.32 ( $SD = 15.33$ ), one standard deviation below the norm. Using a power calculator (Faul, Erdfelder, Lang & Buchner, 2007), we determined that for a moderate effect, the sample size would yield a two-tailed power of .85.

### Design

To examine the effects of the medium on vocabulary and comprehension, we used a within-subject design. In a within-subject design, each student receives both instructional conditions in a counterbalanced approach and serves as his/her own control. In our case, the within-subject factor was medium (real life storybook reading; digital story). Therefore, in this study each participant received both treatments, two in person storybook readings and two digital stories, each of which was conducted in a randomized order. For example, each child was randomly assigned to an in-person/digital story rotation, counterbalanced so that the child received both medium formats twice. Rotations were also counterbalanced so that each story had an equal number of in-person and digital storybook experiences. For each story, vocabulary, comprehension, and motivation measures (described below) were assessed.

There were a number of benefits in using this design. First, because each student received both treatments, we were able to control for between-subject variability, reducing error and increasing our power to detect potential differences. Second, within-subject designs may control for threats to internal validity, since individuals essentially act as their own controls. Third, within-subject designs typically do not require a large pool of subjects; a similar experiment in a between-subjects design would require twice as many participants as a within-subjects design. Furthermore, the threat of a carry-over effect was minimal since four different stories were examined. In other words, children never heard the same story in both digital and in-person formats.

### Instructional content

The videos included four approximately 7-min stories from the *Speakaboos* series. As shown in Table 1, stories were roughly comparable in length, and adhered to the basic elements of story grammar, with a clearly identified setting, characters, events

**Table 1** Description of digital books included in study

Title	Synopsis	Duration	Vocabulary words
Ish (Flesch 90.5) <sup>a</sup>	Ramon loved to draw all the time. One day his older brother laughed at a drawing of his vase. After that, Ramon felt like he couldn't draw well. He tried over and over until his little sister helped him see that his drawings didn't need to look like a vase, but to look vase-ISH	6:04	Vase Silent Crumpled Gallery Haunted
Sid the Science Kid: hello doggie(Flesch 102)	Sid hears a dog barking outside his window and wonders whether animals can talk. At school, he learns about how different animals communicate using sounds and body language. In the end, Sid is able to guess what some animals are trying to say	7:53	Bark Chest Communicate Attention Popcorn
Superkids: A sticky situation(Flesch 80.7)	Noodle Boy goes to Superhero School to become a superhero. However, he thinks the other SuperKids have better superpowers than he does. When Dr. Goo goes up their playground, Noodle Boy and the other SuperKids go to stop him. In the end, Noodle Boy saves the day	7:30	Bounce Zoom Goo Whirlwind Villain
The Valentine Contest(Flesch 79.5)	At this year's Valentine's Day party, Princess Ana wants someone to dance with. King Carlos holds a contest to see who can create the perfect valentine for Princess Ana. From the three contestants, Princess Ana chooses Morris the Monster's yucky valentine	7:50	Contest Bakery Yucky Glittery Valentine

Vocabulary words were given in order, arranged according to level of difficulty

<sup>a</sup> Flesch Reading Formula indicates that all stories are within the *easy to read* category

and resolution. These stories varied in theme, and were designed to cater to different student interests to children at the preschool and kindergarten level. Each story had animated pages that turned, characters that moved with the action of the story, and text that lit up during the narration. As a measure of text difficulty, we calculated the readability of the text using the Flesch readability formula (<http://www.readabilityformulas.com/free-readability-formula-tests.php>). Although we recognize that these levels were designed to represent a measure of the difficulty for a child who might read the text, not listen to the story in one medium or another, it provided a method to ensure relative comparability across text. According to the formula, each text was identified as *easy to read*. Furthermore, since all children listened to each story (in one format or the other), these slight variations in difficulty were likely to represent the kinds of differences one might see in day-to-day storybook reading.

We created print storybooks for each of the videos. Screenshots from the videos chosen to be optimally representative of the theme were used as illustrations. Dialogue from the script was incorporated verbatim in the books. Similar to a strategy used by Silverman (2013), we incorporated phrases such as “Sid says” to ensure that the story flowed appropriately when necessary. In this respect, the video and print storybooks contained similar content, and assured us that the treatments were as comparable as possible. Four independent reviewers examined the print and digital versions and agreed that the stories were equivalent.

## Measures

We administered five brief assessments for each story to examine children’s vocabulary, comprehension, and motivation and interest in reading:

*Free Recall* Following the reading/video, the child was asked to retell the story. Based on his/her initial response, we prompted the child one time with a “can you tell me more?” All free recalls were recorded and transcribed verbatim. Two trained assistants coded transcriptions. Based on Morrow’s typology (Morrow, 1988), a point was given for each story element described (e.g., setting (1), characters (1), events (3), plot or theme (1), resolution (1). Inter-rater reliability was 87.1%. A total of seven points for each recall was possible (see “Appendix” for examples of coded recalls).

*Story sequencing* Less reliant on expressive language, we constructed a sequencing task to measure children’s comprehension for each story. We created five pictures with event scenes from each story. Cards were mixed, and children were asked to sequence the story. The child received a total score (0–5 possible) based on the number of events in the correct order. Inter-rater reliability was 100%.

*Vocabulary* Five words from each story were chosen as target words. These words were all identified *Tier 2* words in Beck, McKeown, and Kucan’s heuristic (2002), considered to be sophisticated words that may be useful for children to know for comprehension. Prior to the start of the study, these words were screened by 10 children from this age group at a neighboring Head Start to determine their

familiarity; although several words such as “yucky” were correctly identified, the total number of known words did not reach above chance.

In the administration of the task, children were first given a word, such as “gigantic” then given a sentence with the word in context. Children were asked to identify the meaning of the word. Responses were recorded and transcribed verbatim. All responses were coded on a three-point scale (1 = correct; .5 partially correct; 0 = incorrect). A total score for each assessment was calculated. Inter-rater reliability was 90.9%.

*Reading interest* To determine if reading a particular story might motivate the student to read something related to it, we constructed a three-card assessment. The assessor asked the student, “What would you like to read about next?” Children were asked to point to one of three pictures that had: (1) a similar character as the story just read; (2) a similar theme (such as a party) as the story; (3) a random event or character. Cronbach’s alpha was .90.

*Motivation to read* To gauge children’s general interest in reading and compare across media formats, we developed a three-item assessment with six picture options: reading on tablet; reading with parents; playing with friends; watching television; painting; and playing with toys. The assessor asked the student, “What would you like to do afterschool today? What would you like to do over the weekend?” And, “What would you like to do over the summer?” Following each question, the student was asked to point to the activity they wished to do in each context. Cronbach’s alpha was .90. For both reading interest and motivation to read, we then calculated the proportion of children that indicated each response.

## Procedure

Four graduate assistants with masters’ degrees in education or educational psychology were trained to conduct the research. A scripted protocol was developed for each treatment. In the in-person read-aloud, the research assistant was trained to briefly introduce the story to the child, then read it aloud with minimal interruptions. Following the reading, the assistant administered the five assessments in set order. Similarly, a protocol was developed for the digital storybook. Once again, the research assistant briefly introduced the story, adjusted the headphones for the student, and turned on the digital story, and followed by the assessments.

Children were randomly selected in classrooms to participate in the study.

Each child was escorted to a quiet corner of the library, and then randomly assigned to either a real-life storybook reading, or a digital story on an iPad with headphones. Over the course of two weeks, children were read/or listened to four stories.

Following each story, the child was administered the five tasks. Together the story reading and assessment tasks took approximately 20-min. Each day the child received a new story in one of the formats. Three children were consistently absent from school and did not complete all four stories. The final sample, therefore, included 36 students, representing a 3% attrition rate.



## Analyses

We first examined the data using descriptive statistics, focusing on the differences in vocabulary and story comprehension by medium. This allowed us to address our first question, namely, whether the medium influenced child outcomes. We then followed this analysis by looking at these dependent variables by story to determine whether the content might matter more than the form. We conducted paired-samples *t*-tests to examine differences in form and used repeated measures analysis of variation to determine whether there were story effects. Finally, we conducted Chi squares to examine whether there were differences in motivation to read by book. Together, these analyses were designed to address our essential questions: To what extent might children's understanding be influenced by the medium or the message (content) and how might the context affect their motivation to read?

## Results

### Effects of the story medium on children's vocabulary and comprehension

To address our first question, we examined children's vocabulary and comprehension outcomes for each medium. Scores for the in-person read-alouds (2) and the digital read-alouds (2) were collapsed to reflect average scores in each format. Means and standard deviations of children's vocabulary and comprehension scores for each medium are shown in Table 2. These results indicated that on average, children were able to identify slightly less than two words per story. Comprehension scores showed that on average, children were able to freely recall slightly more than two elements or events in story formats. However, scores on the measure that depended less on expressive language were higher, indicating that children were able to sequence more than half of the events in stories. Both formats seemed to support talk about the story; average number of words used in the free recalls appeared relatively similar.

We conducted paired-sample *t*-tests on each of the vocabulary and comprehension assessments. As expected, based on the descriptives shown in Table 2, there were no significant differences between trials by medium for free recall

**Table 2** Means (and standard deviations) of comprehension and vocabulary by medium

Variable	Live Storybook reading (N = 36)	Digital storybook (N = 36)
Comprehension—Free Recall	2.53 (1.22)	2.57 (1.28)
Comprehension—Story Sequencing	4.33 (1.45)	4.06 (1.41)
Vocabulary	1.94 (1.26)	1.93 (1.29)
Words used in Free Recall	48.47 (37.70)	49.76 (42.30)

( $t(35) = .22, p = .827$ ); story sequencing ( $t(35) = 1.13, p = .265$ ), vocabulary ( $t(35) = .04, p = .971$ ), and the number of words used in the recall ( $t(35) = .34, p = .731$ ). Therefore, to address our first question, it appears that neither vocabulary nor comprehension outcomes were influenced by the medium of instruction.

### Effects of the medium on children's motivation to read

Our next question addressed children's motivation to read, and whether a book's format might enhance interest in reading about a similar character or theme. Table 3 describes the proportion of children indicating each response. These scores indicated that children were inclined to be motivated to read about a similar character or topic in the story. In the case of in-person reading, almost three quarters of the children indicated that they would like to hear an additional story with similar character or topic, whereas over two-thirds were interested with the digital story. Nevertheless, when provided with more alternative leisure options, only slightly more than one quarter of the sample indicated interest in reading in either format.

Because these motivation measures were categorical, we conducted a McNemar-Bowker  $\chi^2$  Chi square test. We found no significant differences between trials based on medium for character or topic,  $\chi^2(3) = 1.39, p = .707$ . Similarly, there were no differences when children were asked if they would like to read after school,  $\chi^2(3) = .619, p = .892$  during the weekend,  $\chi^2(3) = .236, p = .501$ ; or during the summer,  $\chi^2(3) = .133, p = .721$ . Taken together, these results suggest that motivation to read also did not differ by medium. Rather, it appeared that children were motivated by the story and its characters and themes instead of the medium itself.

### Effects of content on vocabulary and comprehension

In these next series of results, we address the perennial question raised by Marshall McLuhan in his controversial book, *Understanding media* (McLuhan, 1964) and subsequently challenged by Richard Clark and others. Rather than the medium (e.g., whether it is read or viewed), comprehensibility could be related to the content of the story itself (e.g., its message) and not to the medium.

**Table 3** Proportion (and standard deviation) of children motivated to engage in further reading activities by medium

Motivated to	Live storybook reading (N = 36)	Digital storybook (N = 36)
Watch program with same character/topic	.72 (.35)	.65 (.33)
Continue reading after school	.32 (.34)	.31 (.36)
Continue reading over the weekend	.28 (.35)	.29 (.40)
Continue reading over summer	.24 (.30)	.24 (.33)

To conduct this analysis, means and standard deviations by story are described in Table 4. Although all four stories were similar in length and clarity of storyline, this analysis suggests that *Ish* and *Valentine* were more difficult to comprehend than others. To examine whether these differences were significant, we conducted a repeated measures analysis of variance (ANOVA) on each of the vocabulary and comprehension measures. As shown in the table, we found a significant main effect of story on free recall ( $F(3,33) = 8.19, p < .001$ , story sequencing,  $F(3, 33) = 4.91, p = .006$ , and vocabulary,  $F(3,33) = 9.09, p < .001$ ), but no significant main effect of book for the number of words used,  $F(3, 33) = 1.38, p = .267$ . Pairwise comparisons indicated that *Ish* was significantly more challenging than the other three stories for free recall ( $p < .001$ ;  $p = .027$ ;  $p = .024$ ) and story sequencing ( $p < .003$ ;  $p < .002$ ;  $p = .010$ ). Similarly, children had greater difficulty with vocabulary from *Ish* compared to the other three stories ( $p < .001$ ;  $p < .001$ ;  $p = .002$ ). Children also showed less learning from *Valentine*, with free recall marginally significantly more difficult than *Superkids* ( $p = .052$ ) as well as vocabulary ( $p = .020$ ) or *Sid* ( $p = .018$ ). Taken together, these results suggest that there were significant differences in vocabulary and comprehension across stories, with some stories more clearly understood better than others.

Children were also less motivated to learn more about the character or the theme for *Ish* compared to the other stories (see Table 5), indicating a connection between comprehension and motivation. Stories that were more comprehensible, therefore, were more motivating, leading children to want to read more.

### Effects of content on vocabulary and comprehension by medium

In our final analysis, we examine whether differences in children's vocabulary and comprehension in these stories might differ by medium. Table 6 displays the means and standard deviations for each story across the two formats.

Clearly, we noted some slight variations across media; however, in conducting a series of independent samples *t*-tests, we found no significant effects on any of the dependent variables. In order to account for family-wise error rate, we conducted a Bonferroni correction for each of these dependent measures, making .013 the cut off

**Table 4** Means (and standard deviations) of comprehension and vocabulary by story

Story	Superkids (N = 36)	Sid (N = 36)	Ish (N = 36)	Valentine (N = 36)
Comprehension—Free Recall	3.17 (1.63)	2.67 (1.6)	2.03 (1.21)*	2.56 (1.38)†
Comprehension—Story Sequencing	4.47 (1.71)	4.61 (1.81)	3.47 (1.32)*	4.22 (1.90)
Vocabulary	2.38 (1.44)	2.32 (1.27)	1.25 (1.42)*	1.79 (1.42)**
Words used in Free Recall	50.36 (44.24)	53.81 (45.33)	45.06 (36.77)	47.25 (42.03)

\*Mean is significantly lower than all other means in row

\*\*Mean is significantly lower than Superkids and Sid, but significantly higher than Ish

† Mean is marginally significantly lower than mean for Superkids

**Table 5** Proportion (and standard deviation) of children motivated to engage in further reading activities by story

Motivated to	Superkids (N = 36)	Sid (N = 36)	Ish (N = 36)	Valentine (N = 36)
Watch program with same character/topic	.72 (.45)	.83 (.38)	.50 (.51)*	.69 (.47)
Continue reading after school	.31 (.47)	.31 (.47)	.37 (.49)	.29 (.46)
Continue reading over the weekend	.33 (.48)	.33 (.48)	.25 (.44)	.22 (.42)
Continue reading over summer	.23 (.43)	.29 (.46)	.26 (.44)	.17 (.38)

\*Mean is significantly lower than Sid

for significance. By this commonly-held standard, there were no significant differences by format for any of the stories ( $ps > .109$ ).

Finally, we examined children's motivation to read by story and format, once again conducting a series of Chi square tests with a Bonferroni correction. There was a trend toward significance for viewing over reading the Sid story as to whether children were more likely to want to read next week,  $\chi^2(1) = 3.74$ ,  $p = .053$ , but no other significant differences ( $ps > .221$ ) (Table 7).

Taken together, these results suggest that differences between stories were unlikely to be related to the medium in which they were conveyed. Furthermore, the medium did not seem to be a major determinant on whether children would be likely to read more or not. In contrast, these results suggest that it was the story content that appeared to influence children's vocabulary and comprehension, and not the medium itself.

## Conclusion

Young children's ability to learn from digital media continues to be a hotly debated topic. Recent statistics indicate that children are spending as much as 2 h a day on mobile devices, listening to stories, playing games and other activities (Common Sense Media, 2013). With on-screen activities becoming an everyday occurrence in the lives of young children, educators and parents are questioning its efficacy as a tool for learning.

There is a substantial body of research that children learn oral language comprehension better from a live person than from an equivalent video source (Kirkorian et al., 2015). Kuhl and her colleagues (Kuhl, Tsao, & Liu, 2003), for example, found that infants who heard a speaker in a live demonstration learned to discriminate between sounds in a foreign language, whereas the video display failed to confer this advantage. Similarly, for older-aged children, experimenters (Roseberry, Hirsh-Pasek, Parish-Morris, & Golinkoff, 2009) found that those 30 month olds and older children in their sample learned verbs (e.g., more difficult to master than nouns) better when given live demonstrations than in the screen condition.

**Table 6** Mean (and standard deviation) of children's comprehension and vocabulary by story and medium

Story	Superkids		Sid		Ish		Valentine	
	Live (N = 18)	Digital (N = 18)	Live (N = 18)	Digital (N = 18)	Live (N = 18)	Digital (N = 18)	Live (N = 18)	Digital (N = 18)
<i>Variable</i>								
Comprehension—Free Recall	3.07 (1.65)	3.40 (1.65)	2.37 (1.78)	2.82 (1.53)	2.00 (1.25)	2.04 (1.30)	2.59 (1.28)	2.53 (1.50)
Comprehension—Story Sequencing	4.73 (1.87)	3.8 (1.03)	4.13 (1.67)	4.77 (1.93)	3.60 (1.50)	3.43 (1.20)	4.35 (2.03)	4.11 (1.82)
Vocabulary	2.33 (1.50)	2.5 (1.33)	1.88 (1.09)	2.60 (1.39)	1.43 (1.58)	1.28 (1.06)	1.82 (1.55)	1.76 (1.34)
Words used in Free Recall	43.96 (33.70)	67.00 (63.48)	60.71 (63.45)	49.41 (29.67)	52.93 (48.39)	39.43 (48.39)	41.35 (20.94)	52.53 (54.62)

**Table 7** Proportions (and standard deviations) of children's motivation to engage in further reading activities by story and medium

Story	Superkids (N = 18)		Sid (N = 18)		Ish (N = 18)		Valentine (N = 18)	
	Live	Digital	Live	Digital	Live	Digital	Live	Digital
	(N = 18)	(N = 18)	(N = 18)	(N = 18)	(N = 18)	(N = 18)	(N = 18)	(N = 18)
Motivated to								
Watch program with same character/topic	.69 (.47)	.80 (.42)	.93 (.27)	.78 (.43)	.53 (.52)	.48 (.51)	.76 (.44)	.63 (.50)
Continue reading after school	.34 (.49)	.20 (.42)	.21 (.43)	.38 (.50)	.27 (.46)	.43 (.51)	.41 (.51)	.16 (.37)
Continue reading over the weekend	.38 (.50)	.20 (.42)	.14 (.36)	.45 (.51)	.27 (.46)	.24 (.44)	.24 (.44)	.21 (.42)
Continue reading over summer	.19 (.40)	.30 (.48)	.36 (.50)	.23 (.43)	.27 (.46)	.29 (.46)	.18 (.39)	.17 (.38)

Such discrepancies in learning, described as the video deficit, have given rise to concerns that young children, even at the preschool age, do not learn as much from video as from live interactions. The claim is not that children are not learning; rather, it is that they are not learning as much as they would, given the opportunity for interactions with a live person. This is an important distinction, since there are numerous studies (Fisch et al., 2002; Linebarger et al., 2004) showing positive effects for learning from media.

Our study, therefore, was to examine children's vocabulary (e.g., both nouns and verbs) compared to a live event, in this case an adult reading one-on-one with a child. We used a within-subject design to rigorously assess a child's performance against him or herself, reducing error variance that is often found in many small-scale quasi-experimental assessments. Furthermore, we used multiple measures of comprehension, and motivation to read for each of our stories, providing a more thorough assessment than previous studies that have compared media treatments.

We found no evidence of a video deficit for preschoolers. Children's free recall was relatively modest across both video and live presentations of stories. However, their ability to sequence using picture supports indicated comprehension of the basic elements of the stories in both medium. In addition, their ability to talk about the stories in either format suggests that the stories generated much to talk about. They also appeared to enjoy stories and were motivated to watch/read another story with a similar character or theme. In fact, what was most striking in these data were the similarities not the contrasts in children's responses to the medium of instruction.

Rather, our data suggests that the medium may have less to do with learning than the message itself. For example, our analysis of children's vocabulary and comprehension of the individual stories suggested that some were harder to understand than others. Even though these stories were presumably on the same level (e.g., easy to read according to the Flesch readability formula), there were significant differences in all three measured outcomes. Children had more limited understanding of *Ish*, and *Valentine* compared to the other two stories, and importantly, were less likely to be motivated to read or view a story with a similar character or theme.

Our thesis was confirmed following the examination of the interaction of story and treatment effects. Regardless of the medium of presentation, children appeared to have more limited understanding of certain stories than others. This suggests that neither medium was able to bolster children's comprehension when the story was perceived to be difficult or not motivating. At the same time, however, it suggests that neither medium was superior to the other.

These results could further buttress Clark's thesis (1983), suggesting that we have overestimated the means of delivery and have underestimated the importance of the content conveyed in the media. This thesis offers exciting possibilities, especially for low-income children. It suggests that different forms of content delivery, specifically a live presentation and a digital presentation may provide rich opportunities for developing vocabulary, background knowledge, and comprehension. These results further confirm findings from a study by Korat and Shamir (2007) who found similar effects for vocabulary learning between a real-life reader compared to a video presentation. Similarly, Silverman (2013), in a more recent

study, found no differences in vocabulary learning between video viewing and book reading conditions.

Although certainly not a substitute for parent–child interactive reading, digital stories from quality media sources such as *Speakaboos* may represent an important source of learning for young children. Recognizing that the skills of vocabulary and comprehension start early on and develop over time, digital stories may provide engaging and multidimensional supports for enhancing opportunities to learn (Verhallen, Bus, deJong, 2006). This might be especially important for those children from low-income communities who have had fewer experiences in listening to read alouds, and fewer experiences with words in a variety of contexts (Verhallen & Bus, 2010). Note also, that children’s comprehension of these stories occurred without instruction or prompting support.

These results provide further confirmation that the interpretative processes in both print and video may be similar across media presentations. For example, in a previous study, we asked fifth graders to think aloud as they read and viewed episodes from two mystery stories. We found that the actual strategies such as predicting, questioning, and inferencing which children used, were similar across different media presentations but the source for their strategies were somewhat different (e.g., using action rather than character descriptions; Neuman, 1992). These findings led us to propose a *theory of synergy* (Neuman, 1995, 2009), which suggests that multimedia presentations, specifically repeated presentations through reading and video can be used to complement learning, engaging children in using multiple cues for comprehension. Building on this study and previous studies in the literature, future research should continue to consider the important role of digital stories and live read aloud presentation used in concert on word learning and comprehension.

There are, of course, limitations in our study. For one, our sample size was small, and relatively homogeneous. All children came from an economically distressed community and all were eligible for free and reduced lunch. Therefore, we cannot generalize to a larger, and more heterogeneous population. Furthermore, given the sample size, our study may have not been able to detect small, but educationally important differences over time. Second, our findings are confined to examining children’s comprehension of stories, not their learning gains from digital stories or live storybook readings. To do so would have required pre- as well as posttests measures, which might have created pretest sensitivity, a critical internal validity problem. It might also have seriously extended the assessment period, trying the patience and attention of young preschoolers. In addition, our measures make have lacked the sensitivity necessary to detect subtle differences in how well children understood or could articulate their understanding of these stories. Although we used two measures of comprehension (e.g., retelling; and story sequencing) to address this problem, we still may have underestimated their ability to demonstrate their understanding. We also recognize that the context of our analysis may not represent the ideal circumstances under which children are read to or listen to a story in a digital format. In both contexts (Strouse, O’Doherty, & Troseth, 2013), supportive adults may potentially scaffold children’s experience with stories which would have implications on their learning. And finally, given the sample size and



design, we could not explore the potential mechanisms that might account for differences across stories and children's comprehension.

With these considerations in mind, the results of our study suggest that both digital stories and in-person storybook reading are both fertile ground for learning vocabulary and comprehension. Consequently, rather than either/or, we should probably promote both-and, recognizing that both approaches to storybook reading provide children with rich opportunities to learn in ways that are highly engaging and motivating. It also suggests that content, not medium, matters and that stories in either form are most engaging when they are best understood.

## Appendix: Examples of coded student recalls

*From Sid the Science Kid* (Digital storybook)

The story was about a dog. That's it.  
And then he's gonna tell the teacher about the animals.  
And she saw bumble bees  
(Score: 3 (introduction, and two events))

*From Sid the Science Kid* (In-person reading)

The boy saw two dogs.  
He saw his new grandma dog.  
Then he saw another dog  
(Score: 3 (three events))

*From Superkids* (Digital storybook)

It was about being the superheros  
And the slide in the park.  
That's it.  
(Score: 2 (introduction, one event))

*From Superkids* (In-person reading)

The boy was a superhero.  
When the superheros stopped the sticky stuff.  
When he messed up the playground.  
(Score: 3 (character and two events))

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