

Children Learn Words Better From One Storybook Page at a Time

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Abstract

Two experiments tested how the number of illustrations in storybooks influences 3.5-year-old children's word learning from shared reading. In Experiment 1, children encountered stories with either two illustrations, one illustration or one large illustration (in the control group) per spread. Children learned significantly fewer words when they had to find the referent within two illustrations presented at the same time. In Experiment 2 a gesture was added to guide children's attention to the correct page in the two illustrations condition. Children who saw two illustrations with a guiding gesture learned words as well as children who had seen only one illustration per spread. Results are discussed in terms of the cognitive load of word learning from storybooks.

Keywords: word learning; cognitive load; extraneous information; storybooks; illustrations.

Sharing illustrated storybooks is a common activity for parents and young children (e.g., Rideout, Vanderwater, & Wartella, 2003) and provides a richer source of vocabulary than everyday conversation (Montag, Jones, & Smith, 2015). Several studies demonstrate that the styles of illustrations influence how well children learn from books (e.g., Tare, Chion, Ganea, & DeLoache, 2010). However, little is known about how the *number* of illustrations influences learning. The current experiments investigate how well children learn new words from storybooks when they view one or two illustrated scenes at a time.

Pre-literate children rely on illustrations to help them make sense of the story content (for a review see, Wagner, 2013). Specifically, in an eye-tracking study, Justice, Skibbe, Canning, and Lankford (2005) found 4-year-old kindergarten children looked longer at the illustrations than the print that accompanied texts, indicating that even with some emerging print awareness, children look primarily at illustrations. In another eye-tracking study, Evans and Saint-Aubin (2005) found that even with a range of illustration styles, preschool children spent the majority of their time looking at illustrations and only 6% of their time looking at the printed text (see e.g., Roy-Charland, Perron, Boulard, Chamberland, & Hoffman, 2015; Roy-Charland, Saint-Aubin, & Evans, 2007).

Pre-literate children have a growing awareness of reading conventions, such as, print conveys meaning and is read from left-to-right and top-to-bottom (for a review see International Reading Association & The National

Association for the Education of Young Children, 1998; Snow, Burns, & Griffin, 1998). However, because they cannot yet read, young children are unlikely to know when the reader has moved from the left-hand page to the right-hand page. That is, children may be unable to determine which illustrated scene represents which part of the story. Thus, multiple illustrated scenes displayed simultaneously may make it more challenging to associate new words with their illustrated representations.

Evidence suggests that word learning is even more challenging for children when increasing amounts of perceptual information are presented simultaneously. For example, children struggle to learn object names when target objects are presented in less predictable locations (Benitez & Smith, 2012), with many extraneous objects (Horst, Scott, & Pollard, 2010) and with multiple combinations of extraneous objects, rather than the same combinations repeatedly (Axelsson & Horst, 2014). Such findings are consistent with cognitive load theory (Sweller, 1998, 1989 or see, Paas, Renkl, & Sweller, 2003 for a review), which explains how working memory capacity is inherently limited and is especially problematic in situations with extraneous information. Thus, reducing extraneous perceptual information helps children focus on the target information, which then improves learning. For example, Son, Smith, and Goldstone (2008), reduced cognitive load by providing simplified depictions of novel objects and found that this promoted better generalization of novel objects than more complex examples. Whether decreasing the number of illustrated scenes presented simultaneously in a storybook also decreases the cognitive load of word learning from shared storybook reading remains unknown.

In the current experiments we investigate whether decreasing the number of storybook illustrations presented simultaneously increases preschool children's ability to learn words incidentally from shared storybook reading. All children were presented with three storybooks that included illustrated scenes of a family's activities. The same two novel objects were included across the scenes and were named on the pages on which they were depicted (four pages for each object). Critically, all children heard the same three stories and saw the same 10 illustrations per story, however, the number of illustrations presented simultaneously and guidance varied across conditions. In Experiment 1, children saw either two illustrations (one

scene on each page of the open book) or one illustration (only on the right-hand page with the other side blank). Children in a control condition saw a large storybook (cf. Big Book Reading, Tse & Nicholson, 2014) with one illustrated scene the same size as the two illustrations combined because we were concerned that another difference between the other conditions was the length of time needed to visually scan the two illustrations rather than one illustration. If decreasing the number of illustrations also decreases the cognitive load of word learning from storybooks then children should learn more words when they see only one illustration at a time. In contrast, if the number of illustrations does not affect cognitive load, then children should learn words equally from one- or two-illustration books. In Experiment 2, we investigate whether guiding children’s attention to the correct page with a simple gesture helps children focus on the correct page and improves word learning—even with two illustrations.

Experiment 1

Method

Participants Thirty-six 3.5-year-old children ($M = 41.99$ months, $SD = 1.76$ months, range = 38.87-45.14 months) participated. Children were monolingual, British-English speakers from predominantly middle-class families. All children were typically developing with no reported speech or language difficulties. Twelve children each were randomly assigned to one of the three conditions: one illustration ($M = 41.87$, $SD = 0.65$, 6 girls), two illustrations ($M = 42.85$, $SD = 0.43$, 6 girls), or control condition (one large illustration, $M = 41.92$, $SD = 0.45$, 6 girls). There was no difference in maternal education levels between conditions, Fisher’s Exact Test = 3.71, $p = .98$. Two mothers each in the one and two illustrations conditions and three mothers in the control condition had completed high school (GCSEs and/or A-levels) and/or completed a vocational diploma or access course. Eight mothers each in the one and two illustrations conditions, and six in the control condition had an undergraduate degree and/or an undergraduate degree with a postgraduate certificate (e.g., Postgraduate Certificate in Education (PGCE), an additional teaching qualification). One mother each in the one illustration and control conditions had a Master’s degree and one mother in each condition had a doctoral degree. One mother in the two illustrations condition and one mother in the control condition declined to answer this question. Parents were reimbursed for travel costs and children chose a small gift as a thank you for participating (e.g., a colouring book).

Storybooks. Stimuli included three 10-page storybooks slightly modified from Horst, Parsons, and Bryan (2011) *The Very Naughty Puppy*, *Nosy Rosie at the Restaurant*, and *Rosie’s Bad Baking Day*. Each storybook depicted and named the same two novel objects four times. Each object had a function: the orange inverted slingshot functioned like

a hand mixer (*tannin*) and the metal kinetic wheel was used like a rolling pin (*sprock*). Throughout each story, objects were named incidentally and were not the focus of the story. The objects appeared twice on their own pages and twice together. We used real photographs edited with the poster edges feature in Photoshop to make them look like drawings typical of a commercially available children’s book. Across storybooks there was no difference in the number of words per page, $M = 45$, $SD = 9.34$, $F(2,24) = 0.98$, $p = .39$.

All children heard the same stories and saw all the illustrations for each story. The only difference between conditions was the way storybooks were printed (see Figure 1): children either heard stories with two A4 illustrated scenes per open spread, one A4 illustrated scene per spread (i.e., the left-hand page was always blank), or one A3 illustrated scene per spread. In the ISO A-series paper system (i.e., European standard), A3 pages (29.70 x 42.00 cm) are twice the size of A4 pages (21.00 x 29.70 cm), thus the A3 condition served as a control condition where the storybooks included only one illustration per spread (as in the one A4 illustration condition) but included the same overall illustrated area as the two A4 illustrations condition). Because the one illustrations condition differed from the two illustrations condition in both surface area and amount of items/details, we wanted to include a control condition to disentangle which of these was driving any potential effects. Equating the number of items/details would have precluded presenting all children with the same illustrations; therefore, we tested surface area as the control condition. Data from all three conditions were collected at the same time.

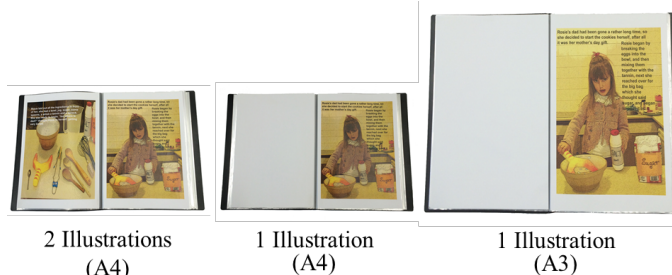


Figure 1. Page 5 in *Rosie’s Bad Baking Day* as seen by children in the 2 illustrations, 1 illustration and 1 large illustration conditions, respectively. Note, in the 2 illustrations condition page 4 is viewed at the same time as page 5.

Test stimuli. An A4 test booklet with images of four novel objects per right-hand page was used on the test trials (the left-hand pages were blank). On each page, four objects were presented on a plain white background without any other contextual information. Across test trials the targets (*tannin* and *sprock*) were presented with four additional novel objects that the children had not previously seen, so that each trial would present children with a different combination and it would not appear that a question was being repeated. Finally, a practice trial page included images of four known objects: a dog, a plane, a duck and a chair.

Procedure. Each child was tested individually in a children’s lab at the university. During the reading phase, the experimenter sat opposite the child and held the storybook upright, to her side, with the pages facing the child, like a preschool teacher would when reading to a group of children during “circle time.” The parent sat on a seat in a different corner of the room. All children were read each of the three stories. For each child all three stories were presented in the same format (e.g., two illustrations per spread). No dialogic techniques, such as giving definitions for novel words or pointing, were used during the readings. Story-order was counterbalanced across children.

After reading the final story, the experimenter proceeded to the test phase, which began with four warm-up trials to get the child used to pointing to pictures in the test booklet and to ensure the child understood the task. The experimenter opened the test booklet to one of the warm-up trial pages and asked the child to point to one of the familiar objects (e.g., “can you point to the plane?”). Across the four counterbalanced warm-up trials, children were asked to point to an object in each quadrant of the page. Next, the experimenter tested word learning. On each trial the experimenter turned to a different test page and asked the child to point to one of the novel objects. In total children were asked to point to each target novel object twice (see also Werchan & Gómez, 2014). On half of the trials one target was present (e.g., *sprock* with three other novel objects) and on half of the trials both targets were present (e.g., *sprock* and *tannin* with two other novel objects). These latter trials ensured that children were not simply choosing the correct object because it had been the only one they had previously seen (for a review of this issue see (Axelsson & Horst, 2013). Trial order, page and quadrant were counterbalanced across participants.

To confirm that children do not dislike books with only one illustration per page, we also asked children to rate their enjoyment of the individual stories and found no differences in enjoyment across stories or conditions, therefore for brevity these data are not included here but are available from the authors upon request.

Results

Children in the one illustrations condition ($M = 0.75$, $SD = 0.34$, $t(11) = 5.14$, $p < .001$, $d = 1.48$) and in the control (one large) condition ($M = 0.75$, $SD = 0.30$, $t(11) = 5.75$, $p < .001$, $d = 1.66$), chose the target object more than expected by chance (.25) see Figure 2, Left Panel. However, with Bonferroni’s correction ($p = .017$), children in the two illustrations condition did not chose the target object more than expected by chance ($M = 0.44$, $SD = 0.28$, $t(11) = 2.28$, $p = .04$, $d = .66$). To test for differences between illustration formats, children’s proportions of correct choices were entered into an ANOVA with illustration format (two, one, one large) as between-subjects factor. The ANOVA yielded a main effect of illustration format, $F(2, 33) = 4.10$, $p = .03$, partial $\eta^2 = 0.20$. Planned contrasts showed that children who saw two illustrations learned fewer words than children

who saw one illustration per spread, $t(33) = 2.87$, $p = .007$, partial $\eta^2 = 0.20$. There was no difference in word learning between one illustration in A4 or one illustration in A3 $t(33) = 0.00$, ns . Thus, illustration size did not affect word learning, but the number of illustrations did.

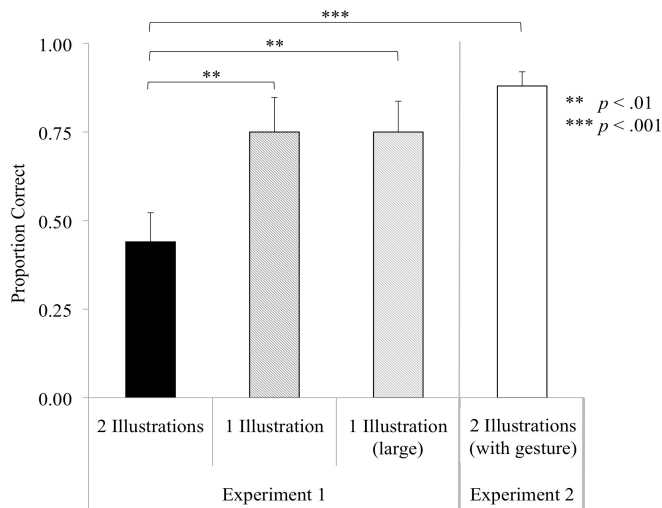


Figure 2. Proportion of correct word learning trials for Experiment 1 (left) and Experiment 2 (right). Error bars represent +1 SEM.

Discussion

Many illustrated storybooks are printed with two illustrations per spread (e.g., *In the Night Kitchen* by Maurice Sendak or *Dinosaur Roar!* By Paul and Henrietta Stickland)—if not more (e.g., *The Incredible Book Eating Boy* by Oliver Jeffers contains 6 illustrations on pages 7-8). Further, some books include a combination of one or more illustrations per spread (e.g., *The Smartest Giant in Town* by Julia Donaldson). Our goal is not to suggest that all of these books be reprinted. Therefore, we conducted a supplementary experiment to provide children with additional support so that they can learn from storybooks with multiple illustrations.

Because young children do not necessarily know when the text is referring to the left- or right-hand page, they may benefit from a non-verbal gesture to look to the correct page. Specifically, a non-verbal signal may help children to focus on the correct illustration at the correct time, thus improving their chances of learning new words from the storybook (cf. Booth, McGregor, & Rohlfing, 2008).

Thus, in Experiment 2 we again read children storybooks with two illustrations per spread, but included a quick sweeping hand gesture to indicate which page we were reading from. We chose a sweeping gesture over other possible techniques to keep the manipulation visual without additional auditory information. We did not use a pointing gesture because we wanted to perform the same gesture on every page and some pages did not include a novel object, while others included both novel objects. Thus, this

sweeping gesture allowed us to maintain an incidental word learning task, rather than providing ostensive reference. If storybooks with one illustrated scene per spread are more helpful than storybooks with two illustrated scenes because children do not know which page to look at, then guiding them towards the correct page should improve word learning to similar levels as those from single illustration displays.

Experiment 2

Method

Participants An additional twelve 3.5-year-old children ($M = 40.45$ months, $SD = 1.30$ months, range = 38.45 to 45.03 months, 6 girls) participated. Children were monolingual, British-English speakers with no reported speech or language difficulties. Two mothers had completed high school (GCSE's and/or A-levels), seven had an undergraduate degree or an undergraduate degree with a postgraduate certificate. One mother had completed a Master's degree, one a doctoral degree and one declined to provide this information. Parents were reimbursed for travel costs and children chose a small gift as a thank you for participating (e.g., a colouring book).

Stimuli. The same stimuli were used as in the two illustrations condition in Experiment 1.

Procedure

All children were read the three storybooks with two illustrations per spread. The procedure was the same as in Experiment 1 except that before reading each page, the experimenter smoothly swept her open hand from the top of the page to the bottom, thereby drawing children's attention to the correct page.

Results

Children learned the words from the story (see Figure 2, Right Panel). Specifically, children chose the target object more than expected by chance ($M = 0.88$, $SD = 0.17$, $t(11) = 12.84$, $p < .001$, $d = 3.71$). Our goal was to determine whether adding a simple gesture would be sufficient to improve children's word learning from storybooks with two illustrations per spread. Thus, we compared the word learning performance of children in the current study to children in the two illustrations condition of Experiment 1. Children who had the additional support to guide their attention to the correct page learned words significantly better than children who did not have that support, $t(22) = 4.58$, $p < .001$, $d = 8.78$.

Discussion

In Experiment 2 we investigated whether orienting children's attention to the correct storybook page with a simple gesture while reading could diminish the effects of cognitive load from multiple illustrated scenes found in Experiment 1. Adding the gesture did not significantly

increase the amount of time needed to read the story, but did significantly improve children's word learning compared to reading without a guiding gesture.

The rates of word learning observed in Experiment 2 are similar to other studies using dialogic reading techniques, such as pointing or asking questions (Walsh & Blewitt, 2006). For example, Ard and Beverly (2004) read storybooks to 3- and 4-year-old children either verbatim or with one of three dialogic techniques; added questions, added comments, or both questions and comments. Children learned approximately 75% of the new vocabulary with the dialogic reading techniques included but only 53% with verbatim readings. Although the efficacy of the use of dialogic techniques to improve children's word learning from storybooks is not in doubt, multiple dialogic techniques are often employed in combination, making it harder to compare effects across the literature for individual techniques (see Wasik, Hindman, & Snell, 2016 for a recent review). It is therefore particularly exciting to see that such a simple gesture could have such powerful effects on children's learning.

General Discussion

Across two experiments we investigated whether decreasing the number of storybook illustrations presented simultaneously increases preschool children's ability to learn words from shared storybook reading. In Experiment 1 we read children 10-page stories with either one, two, or one large illustration per spread. Children learned the new words better when presented with only one illustration per spread, regardless of the image size, even though all children saw the same number of illustrations overall. In Experiment 2 we read children the same stories with two illustrations per spread, but added a small sweeping gesture to indicate which page we were reading. Although children in this condition were presented with multiple illustrations at once, they were able to learn more words than expected by chance and more words than children presented with the same number of illustrations but no guidance on which page to attend to. Taken together these findings suggest that children's word learning is improved by helping children focus on the relevant information by either reducing the number of illustrations presented (Experiment 1) or directing their attention to the correct illustration (Experiment 2).

These findings are consistent with cognitive load theory (Paas et al., 2003; Sweller, 1988, 1989), which suggests that extraneous information can prevent optimal learning. The more information children need to think about, the more challenging the task. Consequently, removing extraneous perceptual information may improve learning (see, e.g., Son et al., 2008). For example, kindergarten children are better able to learn information from science lessons when the extraneous information of a highly-decorated classroom is removed (Fisher, Godwin, & Seltman, 2014). Similarly, reducing the amount of extraneous information in graphs improves children's mathematics skills (Kaminski &

Sloutsky, 2013) and removing extraneous information in ABC books improves alphabet learning (Chiong & DeLoache, 2012). In the current study, in the two illustrations format, children are faced with processing additional materials—which in some cases may even provide conflicting information—slowing down the process of word learning. Children do not know when the story moves from one illustration to the other. In contrast, in the one illustration format, the child is provided with only the relevant scene, which corresponds with the text they are currently hearing, thereby reducing the cognitive load associated with understanding the story and the new words. Similarly in Experiment 2, children are directed towards the relevant scene, thereby reducing cognitive load.

Although children in the current studies learned target words better when presented with single illustrations, there may be benefits for other types of learning from multiple illustrations. For example, story comprehension may be better supported by having more to look at, particularly as visual attention to illustrations during storybook reading predicts story comprehension (Kaefer, Pinkham, & Neuman, 2016).

The current findings may also be informative for research comparing e-books (i.e., storybooks presented on screens) with traditional two-illustration paper storybooks. Some studies report a deficit in learning from e-books (e.g., Segers, Takke, & Verhoeven, 2004) while others do not (e.g., Korat & Shamir, 2007). One explanation for this discrepancy is that e-books often contain added manipulative features, which may hinder learning. For example, e-books often contain additional games (e.g., de Jong & Bus, 2002) or interactive dictionary features (e.g., Korat, 2009). Previous research indicates that added manipulative features such as pull-tabs hinder learning from paper books (Tare et al., 2010), however some features of e-books may be helpful in the same way as dialogic techniques by highlighting key information at the right time. Another explanation is that e-books are often presented only one illustration at a time (e.g., Verhallen & Bus, 2011), which could be an additional confounding factor when comparing between storybook media types. The current findings suggest that such single illustrations help children focus their attention on relevant information and may aid learning especially when children are exploring books without an adult.

The current experiments demonstrate that reducing the number of simultaneous illustrations to just one at a time improves children's word learning from shared storybook reading. This has important implications for educational research and suggests that even seemingly minor differences in illustration format can result in significant differences in how well children learn. These findings should help shape future storybook research design, and provide useful practical solutions, which could be used by teachers and parents alike and may inform our understanding of how to create eBooks and other media that children may encounter without an adult. Furthermore, in an age of seemingly

endless possibilities, they provide a stark reminder that less is sometimes more.

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