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Elana Herbst April 7, 2020

The Role of Illustrations in Shared Book Reading: Book Design, Illustration References, and Preschoolers' Memory for Facts

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Abstract

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Prior research demonstrates that illustrations contribute to children's understanding and memory of book content during shared book reading, particularly when they reflect the text and do not contain any additional information (alignment), and are noticeable to the readers (salience). Very young children further benefit from an adult's guidance to the relevant illustration, but factors influencing why readers choose to reference certain illustrations are unknown. The current research aimed: a) to examine the effect of illustration alignment and salience on illustration use during shared book reading of an expository picture book, and b) analyze relations between illustration references and children's memory for book facts. Study 1A generated alignment and salience scores to use in analysis for Study 1B. Ten adult participants viewed a picture book with the words removed and recorded what she or he thought the illustrations on the page represented. This data was used to generate salience scores, and book coding was using to generate alignment scores. In Study 1B, twenty-nine adult-child dyads were videotaped reading the same expository picture book. At the end of the session, children participated in a memory task. Videos were coded for illustration references. Results demonstrate that both adults and children are more likely to reference aligned compared to unaligned illustrations, and that children in particular are sensitive to illustration salience even with alignment held constant. Furthermore, adults' aligned object references both overall and during reading support children's memory for book facts. This study suggests that design of expository books affects illustration references, which in turn influence children's memory for book facts.

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Table of Contents

Table of Contents

The Role of Illustrations in Shared Book Reading: Book Design, Illustration References During Shared Book Reading, and Preschoolers' Memory for Facts

Shared picture book reading is an activity in which parents frequently engage with their children. There is a growing body of research investigating shared book reading, the activity during which an adult reads to a child. The question of how adult-child dyads interact with picture books is of central significance to educational science. Of particular interest is the value of shared book reading as a tool to promote children's learning prior to their entry into formal education (Bus, van IJzendoorn, & Pellegrini, 1995; Flack & Horst, 2016). Studies suggest that it is not only the presence of shared book reading, but also the quality of the reading experience that plays a role in children's learning. Practices that reinforce information from book texts and engage and guide the child's focus by asking questions, describing illustrations and concepts, and labeling of book features can support learning (Blewitt, Rump, Shealy, & Cook, 2009; Reese & Cox, 1999).

Book design, namely the relations between illustrations and text, has also received attention for its potential to influence learning. Cognitive theories propose a *picture facilitation effect*, referring to the increased understanding or learning that takes place when information is represented in both text and illustration formats compared to in text only or picture only formats (Carney & Levin, 2002; Flack & Horst, 2016; Greenhoot, Beyer, & Curtis, 2014; Mayer, 2005; Mayer & Moreno, 1998; Schnotz, 2005; Sweller, 2005). Yet despite much research on both shared-book reading and on illustrations, open questions remain as to how young children learn factual information from picture books during shared-book reading interactions. Research investigating fact learning with illustrations has examined school-aged or adult samples. Additionally, research on preschool-aged children has focused primarily on comprehension and

word learning from narrative, or storytelling, texts and not on fact learning. Therefore, the potential for illustrations to enhance preschoolers' fact learning from expository, or factual, texts during shared book reading is largely unexplored. We addressed this void in the present research. The work was organized around two goals. The first goal was to test whether features of illustrations, specifically (a) the overlap in meaning between the book text and illustrations and (b) illustration salience, influence how adult-preschooler dyads interacted with illustrations. The second goal was to assess whether these features of illustrations and adult-child interactions with illustrations related to children's fact learning.

Features of Illustrations

Much research has shown that presenting information in multimedia formats improves learning outcomes among adults, older children, and preschool-aged children (Carney & Levin, 2002; Danielson, Schwartz, & Lippmann, 2015; Greehoot et al., 2014; Takacs & Bus, 2018). However, presenting two modes of information is only beneficial if the multimedia design follows cognitive science principles of learning. Otherwise, adding information in an additional mode may do more harm than good (Mayer, 2005; Schnotz, 2005). The dominant theories of multimedia learning, Mayer's Cognitive Theory of Multimedia Learning (CTML), and Schnotz's Integrated Model of Text and Picture Comprehension (IMTPC) both describe circumstances when the format of information presentation may be helpful and when it may be harmful. Both theorize that the human information processing system includes separate channels for processing different kinds of sensory information, namely visual/pictorial and auditory/verbal, and that each channel is limited by working memory constraints (Mayer, 2005; Schnotz, 2005). They suggest that multimedia learning occurs by integrating different external representations of a concept to construct a single mental representation (Mayer, 2005; Schnotz, 2005). When reading a picture

book, a person can view the same concept represented in both the book text and in the illustration. When a learner receives information about a single concept both verbally and visually, the information transmits to working memory through two different channels and is combined to create one representation. Each channel on its own has a limited working memory capacity. Through this combination, the learner will have a stronger representation of this concept based on more information than each channel could process individually (Mayer, 2005; Schnotz, 2005). This is particularly beneficial when learners have low prior knowledge, as creating a mental model from only verbal information is difficult and adding pictorial information as another source offers an additional route to mental model construction and retrieval (Schnotz 2014).

Both Mayer (2005) and Schnotz (2005) propose that information presented in multiple modes benefits learners when the separate pieces integrate into a single, strengthened, representation. In this way, multimedia design which successfully represents a single idea across multiple modes should enhance learning. Multimedia design straying from these guidelines may not benefit learners. In fact, incoherent multimedia representations may have deleterious effects on learning. The coherence principle of IMTPC suggests that too much pictorial information can result in cognitive overload and hinder learning, particularly if this information is irrelevant to or contradicts the verbal information (Schnotz, 2005). Schnotz (2005) suggests that multimedia designers should avoid extraneous words or pictures that detract from the learning goal. These cognitive theories outline a careful balance for multimedia design, the outcome determining whether the overall effects are helpful or harmful. Presentation of consistent information across modes positively impacts learning, but too much or contradictory information interferes with it.

Experimental evidence supports the theories proposed by Mayer (2005) and Schnotz (2005). Carney and Levin (2002) reviewed effects of pictorial illustrations on adult students' text processing. In a meta-analysis, the researchers found that purely decorational illustrations, which bear little to no relation to the text content, exhibited no beneficial learning effects. On the other hand, learners benefited from representational illustrations containing the ideas mentioned in the text content (Carney & Levin, 2002). Similarly, Danielson, Schwartz, and Lippmann (2015) found that in an online learning environment, adult learners who viewed illustrations designed to correspond to the text (Carney and Levin's representational classification) out-performed learners who viewed purely decorational illustrations. Therefore, research suggests that illustrations can be beneficial to learning when they contain information in the text and do not contain any additional information, a principle I will refer to as *alignment*. The construct of alignment has been introduced in the literature, where it goes by a variety of names including "representational," and "congruent" (Carney & Levin, 2002; Danielson et al., 2015; Takacs & Bus, 2018). Yet I argue that these definitions do not take into account both directions in which a concept and illustration can align. That is, the principle I present here is that alignment uses one measure to classify *ideas* (concepts or objects) contained in the book overall, not only in illustrations: concepts and objects are either aligned, thus represented in both the text and the illustration, or unaligned, either represented in the text but not the illustration or, in the illustration but not the text. The other definitions in prior studies do not take both directions of alignment into account.

As reviewed above, much of the multimedia learning literature focuses on factual learning in older children and adults. It also provides motivation for the investigation of multimedia learning in the context of shared book reading with young children. Few studies have

examined the role of illustrations in fact learning from shared book reading, but based on cognitive learning theory, we may expect that illustrations will be most beneficial to those with low prior knowledge, suggesting that preschool-aged children would find them particularly useful (Schnotz, 2014). Furthermore, presenting verbal information auditorily instead of in a written form further reduces cognitive load and improves performance on retention and transfer tests, suggesting potential positive implications for a shared book reading activity (Mayer & Moreno, 1998; Sweller, 2005). Schnotz (2005) also proposed the temporal contiguity principle, that spoken text present in close temporal proximity to the illustration is most effective. This is highly relevant to shared book reading, as often the spoken text and the illustration are presented at the same time. Evidence from eye-tracking studies shows that 4- to 5-year-old children spend the majority of the shared book reading experience focused on the pictures, and that children focus more on details that they hear highlighted by the book text (Evans & Saint-Aubin, 2005; Takacs & Bus, 2018). These findings indicate that illustrations capture children's attention and provide evidence that children use both pictorial and verbal information to make sense of book content. Ultimately, there is reason to believe that illustrations have the potential to affect the book reading experience and children's ability to recall information from shared book reading.

Shared Book Reading

Early childhood research suggests that listening to an illustrated book can improve children's memories for story content compared to a non-illustrated version of the same storybook. In a study by Greenhoot et al. (2014), parents read either an illustrated or non-illustrated book to their 3.5- to 4.5-year-old children. Children were later asked to retell the story, and the authors found that illustrations enhanced story recall (Greenhoot et al. 2014). Similarly, Takacs and Bus (2018) played a recording of a book and showed kindergarteners written text

with either illustrations that matched the narration, illustrations that did not match the narration, no illustrations, or no text. The authors found that the children who viewed the illustrations that matched the narration performed significantly better in a story retelling task than any of the other groups (Takacs & Bus, 2018). These findings provide evidence that illustrations positively affect young children's memories for story content from a narrative picture book, particularly when the illustrations align with the book text as suggested by Mayer's (2005) and Schnotz's (2005) theories.

The existing literature suggests that young children benefit from multimedia storybooks. Other evidence indicates a potential need for parental support for children to gain optimal benefit from the illustrations. Greenhoot and Semb (2008) found no difference in story recall between 51-month-old children who heard a computer-read narration and viewed illustrations and 51-month-old children who only heard the narration. The authors speculated that illustrations in the computer-read format may not have been effective for very young children because they did not understand the relevance of the illustration, or they lacked the working memory resources to encode the two pieces of information and connect them (Greenhoot & Semb, 2008; Mayer & Moreno, 1998). These results differ from the Greenhoot et al. (2014) findings that illustrations aide children in this same age group in a shared book reading setting. This contrast suggests that parental interaction is a key factor in very young children's ability to benefit from illustrations.

Shared book reading and the parental guidance that accompanies it may be crucial for very young children to reap the benefits of illustrated stories. However, the general act of shared book reading alone may not be sufficient. It appears that specific types of interactions which guide children's attention and reinforce the relevant information are most supportive of learning. Reese and Cox (1999) compared parental book-reading styles and found that a "describer" style

of book reading, in which parents focus on describing and labeling pictures, was more effective at promoting vocabulary learning in preschoolers than other reading styles. This style may be most effective because it guides the child's attention to the supporting illustration and elucidates connections between verbal and pictorial information that the child may struggle to make on her or his own. A study by Flack and Horst (2016) further supports this idea. The researchers compared preschool-aged children's word learning from two versions of the same story: with one illustration per page spread or two illustrations per page spread (a page spread is two pages). The children learned fewer words in the two illustrations per page spread condition, likely due to increased cognitive load from the extraneous images (Flack & Horst, 2016; Sweller, 2005). In a second study, the experimenter read children a book with two illustrations per page spread but gestured toward the relevant page in one of the conditions. The children in the gesture condition learned words significantly better than the children whose attention was not guided (Flack & Horst 2016). Children's picture books typically have illustrations on both pages of a page spread, so the authors' second finding is particularly important. Taken together, these studies suggest that nonverbal and verbal adult interaction with book illustrations support children's word learning during shared book reading and provide motivation for examining illustration references.

Present Study

In summary, cognitive theories of multimedia learning propose that learners benefit from the presentation of a concept both verbally and pictorially, as in both the text and illustration of a book. Furthermore, book illustrations are most beneficial when they represent the text and do not contain extraneous details (Mayer, 2005; Schnotz, 2005). In line with these theories, findings from shared book reading studies show that children's performance on word learning and story

recall tasks improves after hearing a story with illustrations compared to without illustrations. Illustrations increase performance on these tasks particularly if they align with the book content and if an adult guides the child's attention (Flack & Horst, 2016; Greenhoot et al., 2014; Greenhoot & Semb, 2008; Reese & Cox, 1999; Takacs & Bus, 2018).

There are a number of gaps in the literature relating to how children learn information from illustrations in shared book reading contexts, which we address in the current study. First, nearly all of the previous research on shared book reading focused on how the context of shared book reading influences children's word learning or story recall from narrative storybooks. Although no studies have examined fact learning from shared book reading, evidence suggests that fact learning and word learning share similarities which make it reasonable to extend the word learning literature to fact learning (Waxman & Booth, 2000). Additionally, investigating shared book reading with expository texts is particularly important because children may be less likely to independently make connections between the illustrations and text in factual compared to narrative books due to their higher frequency of unknown concepts. In fact, expository books have been found to prompt more interaction with the book and contain more unique and specialized vocabulary (Gardner, 2004; Price, van Kleeck, & Huberty, 2009). Thus, adult interaction with the illustrations may play a particularly important role in facilitating learning from these texts.

Second, there is strong motivation to investigate interactions with book illustrations and their role in learning from factual books. Despite this, no studies have examined factors contributing to why parents and children would reference certain illustrations and not others. Authors of cognitive learning theories emphasize the importance of illustration alignment and the absence of extraneous illustrations for facilitating learning (Mayer, 2005; Schnotz, 2005).

However, there is currently no research on how these features of illustrations affect illustration references within a book, and whether these references are related to children's learning.

Third, much of the present literature focuses on parental interaction with the book and its effects on children's learning, leaving the role of children's interactions with the books largely unexplored. Children can easily become confused or distracted by extraneous illustrations (Flack & Horst, 2016; Schnotz, 2005). Thus, it is critical to examine what children notice and reference during shared book along with parent's references.

The present research filled these gaps in the literature by: a) examining how features of illustrations (textual alignment and salience) within a children's expository book affect how the illustrations are used by caregiver-child dyads during shared book reading; and b) examining the relation between how an illustration is used and children's memory of the book's facts. Before addressing these aims, in Study 1A, we identified the salience level and alignment of individual illustrations to be used in analysis of Study 1B. Adult participants digitally viewed an edited version of the factual children's book *What Lives in a Shell* with the words removed. The participants viewed one page spread at a time and recorded what they thought the illustrations on each page spread represented. The adults' responses were used to create a salience score for each object such that more frequent mention of an object by participants resulted in a higher salience score. This score aimed to capture what a pre-literate child may notice on a page before the text is read to them. I also created an alignment measure independent of the adults' responses for each object or concept that identified whether each object or concept represented in the illustrations was also mentioned in the book text. In Study 1B, we examined the quantity and type of adults' and children's unique illustration references during shared book reading. Dyads

comprised of adults and their preschool-aged children read factual picture books, followed by a testing phase during which the experimenter asked the child memory questions about the book.

We hypothesized that overall, dyads would reference more of the high salience and aligned illustrations than the low salience and unaligned illustrations. We also predicted differences in illustration references between adults and children. We predicted that both adults and children would reference more aligned compared to unaligned illustrations. Additionally, children, but not adults, would reference more high salience than low salience illustrations. Little is known about why parents and children choose to reference the illustrations that they do, but it is likely that adults will stay on topic and reference illustrations that they believe are important to the gist of the book, and that children are more likely to reference illustrations that they notice and are interesting to them regardless of their relation to the book text. Furthermore, because prior studies have shown alignment to be important for promoting learning, we predicted that the number of adults' aligned references would positively predict children's memory (Carney & Levin, 2002; Danielson et. al., 2015; Takacs & Bus, 2018). We also hypothesized that number of aligned references occurring during reading and text-relevant speech combined would positively predict children's memory above and beyond general aligned references, in line with Schnotz's (2005) temporal contiguity principle, and the idea that a stronger connection between the illustration and book text will result in children's increased memory performance.

Study 1A

The main purpose of this study was to inform illustration salience and alignment measures to use in analysis for Study 1B.

Methods

Selection of Materials

For this study, we selected the children's picture book *What Lives in a Shell (WLS)* by Kathleen Weidner Zoehfeld, illustrated by Helen K. Davie. This book is a factual children's book about different kinds of animals that live in shells. With the cover and title pages, the book contains 23 pages, 20 of which feature content. Participants viewed these 20 pages (10 page spreads) during this study. Each page contained vibrant, colorful, and detailed watercolor illustrations depicting objects and concepts relating to shells and the animals who live in them. WLS is optimal for this study because it is an exemplar of an engaging factual book designed for preschool-aged children.

Determining Alignment

Alignment was defined as whether the illustrations and text of WLS overlap and represent each other. For each page spread, I recorded every object and concept that was either mentioned in the book text or represented by the illustrations. Objects are nouns such as "shell," "cat," and "turtle." Concepts describe the objects and are qualities or actions, including "growing," and "smooth." For each object or concept mentioned in the illustration, an independent coder and I noted whether the book mentioned each object or concept in the illustration, the book text, or both. We matched 85% of the time, and when we did not match, I revisited those items and used my coding. As a result, each object or concept mentioned in the illustrations received a score indicating presence or absence of alignment. An object or concept referenced in both the text and illustrations aligned, whereas an object or concept referenced in the illustrations but not the book text or the book text but not the illustrations did not align.

Objects and concepts found both in the book text and the illustrations were coded as aligned, whereas objects and concepts not found in both the book text and the illustrations were

coded as unaligned. I found that 72% of the objects and 52% of the concepts were aligned, and 28% of the objects and 48% of the concepts were unaligned.

Determining Salience

Salience was determined by adult raters.

Participants. The sample for the study was 10 adult participants (7 females, 3 males). Prior to participation, participants gave informed consent for the study and then competed a brief demographics form evaluating gender and race/ethnicity, in accordance with the National Institute of Health. The participants' ages ranged from 20.1 to 22.4 (M = 21.7 SD = 0.87). Based on self-report, the sample was 78% White or Caucasian, 10% Asian, and 10% Black or African American. Participants were recruited through word of mouth. Participation in the study was voluntary and participants did not receive compensation. The study was conducted in accordance with the University IRB.

Materials and Procedure. This study quantifies illustration salience. The illustration salience score measured which objects and concepts represented in the illustrations participants most frequently referenced, regardless of the text on the page.

I removed the text from a digital copy of WLS using the image manipulation program GIMP so that the participants viewed only the illustrations. Participants viewed this edited version of WLS one page spread (two pages) at a time presented on a computer using Microsoft Powerpoint (See Figure 1). The participants viewed the book by page spread instead of by individual page to model an organic picture-book reading experience. Before completing the task, the experimenter told participants the purpose of the study, "The purpose of this study is to identify how well the text of a children's book represents the illustrations. This is a picture book designed to teach science facts to children, not to tell a fictional story." Then participants were

informed that they would be viewing pictures from the book with the text removed and were asked to write "what you think the illustrations on that page spread represent." They were informed that there were no right or wrong answers. The participants went through each page spread at their own pace, one page spread at a time. They were told not to go back to previous page spread. Because the goal was to discover what the participants noticed initially about an illustration on the page spread, it was important that their responses corresponded to information from illustrations on that page spread and that page spread only. If participants were allowed to go back, they may have altered their responses based on what they viewed in later pages or thoughts that occurred after moving on to other pages, and the response would no longer measure the participants' immediate observations of the illustrations on that page spread.

Measures and Data Processing. The salience score represented how noticeable each object or concept was to a reader without the book text directing his or her attention. This score aimed to capture what a pre-literate child may notice on a page before the text is read to them. Two independent coders and I each noted whether participants mentioned the objects and concepts from the alignment scheme. Coders one and two matched 89% of the time, coders two and three matched 92% of the time, and coders three and one matched 90% of the time. I then calculated the total number of mentions of each object or concept across all the participants' responses.

A higher salience score indicated a more frequent mention of the object or concept, whereas a lower salience score denoted a less frequent mention. For example, if all 10 participants mentioned the concept "growing," in their responses, it would earn a salience score of 10. Each object or concept in WLS received a salience score based on the adult participants' responses. Overall, few participants mentioned each object (M = 3.84, SD = 3.23) or concept (M = 1.47, SD

= 2.36). As show in Figure 2, object and concept salience scores followed a similar right skewed distribution. Over half (55%) of the concepts received a score of zero, most likely due to the inherent nature of a concept: abstract adjectives and verbs are difficult to identify without accompanying text.

After calculating the salience scores, I assigned each object and concept a salience value of high or low. Objects and concepts that earned a salience score of 0-3 were classified as low salience, and objects and concepts that earned a salience score of 4-10 were classified as high salience.

I made the cutoff for low salience a score of three instead of the halfway point of five based on the distribution and design of the study. The participants' open-ended responses varied greatly in the length and number of object and concepts mentioned, so the likelihood of all ten participants mentioning any one object or concept was very low. Therefore, expecting half the participants to mention an object or concept to classify it as high salience might have artificially inflated the count of low salience objects and concepts. Instead, classifying a score of three and below as low salience means that over 1/3 of the participants needed to mention the item for it to be high salience. This is a much more realistic cutoff given the task and distribution of the results. 52% of objects and 83% of concepts earned a score of 0-3 and were classified as low salience. 48% of objects and 17% of concepts earned a score of 4-10 and were classified as high salience.

Results and Discussion

Using the scales described above, each object or concept in WLS received an alignment score and a salience score. This categorized each illustration into one of four groups, shown in Table 1. Due to the low number of illustrations classified as unaligned high salience, this

category of illustrations was excluded from the analyses. The remaining categories are aligned high salience, aligned low salience, and unaligned low salience.

This study operationalized salience and alignment, allowing for use of WLS for investigation of my primary questions in Study 1B.

Study 1B

The purpose of this study was to determine relations between illustrations and adults' and children's references as a function of salience and alignment, and how that relates to children's memory for book facts.

Methods

Participants

The sample was comprised of adult-child dyads and included 29 adult participants (28 females, 1 male) and 29 child participants (14 females, 15 males). The child participants' ages ranged from 3.58 to 5.57 (M = 4.78 SD = 0.48). Prior to participation, participants gave informed consent for the study and then competed a brief demographics form evaluating gender and race/ethnicity, in accordance with the National Institute of Health. Adults also provided information about their level of education and occupation. Based on self-report, the adult sample was 79% White or Caucasian, 3% Asian, 10% Black or African American, and 7% did not answer. Based on parent report, the child sample was 66% White or Caucasian, 3% Asian, 14% Black or African American, 10% White or Caucasian and Asian, and 7% White or Caucasian and Black or African American. Families were recruited in the metro Atlanta area from the university's Child Study Center database. Each family received a $5 gift certificate to a local vendor and children received a small prize in recognition of their participation. Children also received stickers and a bookmark throughout the study. There were two sessions and families

received this compensation after each session, twice in total. The study was conducted in accordance with the University IRB.

Materials and Procedure

This study examines a subset of data from a larger study, during which the participants read four factual picture books: *Biggest, Strongest, Fastest* by Steve Jenkins, illustrated by Steve Jenkins, *Bugs are Insects* by Anne Rockwell, illustrated by Steve Jenkins, *Whose Food is This?* by Nancy Kelly Allen, illustrated by Derrick Alderman and Denise Shea, and *What Lives in a Shell* by Kathleen Weidner Zoehfeld, illustrated by Helen K. Davie. The present study only examined one of these books, WLS, to control for differences between book styles. I chose WLS in particular because the book does not ask as many direct questions as the other books, which leaves room for more unique adult and child interactions with the text and pictures during the shared book-reading activity.

Adults and children came into the lab and sat next to each other on a couch. The experimenter gave families two books per session and instructed the adults to read to their children however they would naturally at home. Each family read four books total, two per session, and book order was counterbalanced. All parts of the session were audio recorded and videotaped from two different angles. After the book reading phase, children participated in a test phase. There were three memory tasks: free, open-ended, and forced-choice. Per memory task, children were always presented with the first book read to them followed by the second. Once the memory task was completed for each book, the child participated in the next memory task. In the free recall task, the experimenter showed the cover of the book read and asked the child to tell a stuffed panda "who did not hear the book" what she or he learned in the book. The child was prompted up to two times to provide explanations and then the experimenter moved on

to the next book/recall task. In the open-ended task, the experimenter asked the child 6 recall questions relating to the book. Half of the questions assessed global knowledge that related to the theme of the book such as "why do animals need a new shell?" and half of the questions assessed local knowledge, or more specific facts such as "how many legs does a crab have?" For the forced-choice task, children were re-asked the questions that they got incorrect in the open-ended testing in a forced choice format. After the memory tasks, the experimenter administered the Woodcock-Johnson Test 1A-D, which assesses vocabulary. This test was important to control for a possible relation between children's WCJ scores and their performance on the memory task. Children received stickers between tasks to help them stay engaged. Session two followed the same procedure but with two different books, with the exception that children did not participate in a Woodcock-Johnson test. About half of the participants read WLS in session 1, and about half read it in session 2.

Data Reduction

Dyad videos were coded for individual picture references. Because the goal of the study was to examine how the alignment between text and illustrations and illustration salience affect how the dyad uses and interacts with the illustrations, only references to illustrations were recorded. For example, a participant's general mention of a shell that she or he saw at the beach last week would not count as an illustration reference even if there were shells depicted on that page. A reference must directly address the specific illustration. Definitions and examples of the coding scheme are presented in Table 2. For each illustration reference, I first recorded which object or concept the participant referenced. Next, I recorded who referenced the illustration, either the adult or the child. This is important to capture because illustration references may serve different purposes for adults and children and the two members of the dyad may interact with the book in

different ways. I also recorded when the illustration reference occurred, either during reading or during extra-textual talk. This identifies whether the illustration reference simply accompanied the reading of the text itself or occurred in an interaction outside of the reading. If the illustration reference occurred during extra-textual talk, I recorded whether the speech was new information or text-relevant information. New speech indicated that the participant used the illustration to convey information that went beyond the meaning of the book text itself. Text-relevant information denotes that the reference reinforced ideas from the book text but did not introduce any new ideas not contained in the text.

I also recorded gesture use, either a point or an action. A point refers to the participant simply pointing with no other motions, and captures a single, specific illustration reference. Action refers to the use of a moving gesture other than a single finger point. This distinction is important because the participant's choice of whether to use a point or an action contributes to the meaning the illustration reference conveys. For example, dyads may use points to label objects or nouns such as "cat," and actions to represent more complex concepts including adjectives such as "smooth" or verbs such as "grow." These different codes were designed to capture all significant types of interactions that caregivers and children could have with illustrations in the book that may affect children's learning from the book.

Data Analyses

The data from the alignment and salience scores, video coding, and children's recall were used for analysis. Analyses were conducted to determine presence of a relation between the salience and alignment of individual illustrations and how they are used by dyads during book reading (i.e., if they are mentioned, who mentions, and type of reference based on coding scheme). Further analyses were conducted to examine the relations between the frequency and

type of the dyad's illustration references and the children's performance on the recall task. I compared unique references, meaning that per participant only the first reference to a particular illustration is counted. Each result is standardized for comparison such that it reflects the number of illustrations referenced out of the total number of illustrations in that category, determined by Study 1A. In this paper, "unique references" refers to this proportion of illustrations referenced out of the possible illustrations. For example, if a participant mentioned 10 aligned high salient objects out of a possible 25 high salient objects, she or he would get a score of 0.40.

I examined whether overall, more of the high salience and aligned objects and concepts were referenced than the low salience and unaligned objects and concepts. Additionally, I examined if adults and children referenced more of the high salience and aligned objects and concepts during extratextual talk than low salience and unaligned objects and concepts. Further analyses were conducted to determine differences in the illustration references between parents and children, testing whether parents are more likely to reference images that align and whether children are more likely to reference images high in salience. Using scores from the memory task as a measure of learning, analyses were also conducted to investigate how illustration references influence children's fact memory. We tested whether the quantity of adults' unique illustrations references predicted their children's memory. Further analyses were conducted to determine if the number of aligned references positively predicted children's memory. We also examined if the combined number of references during reading and text-relevant speech predicted predict children's memory, even above and beyond aligned references. Lastly, we examined if the number of children's illustration references predicts their memory for book facts.

Results

The goal of this study was to test whether illustration elements, namely alignment and salience, impact adult-child interactions during shared book reading and 4- to 5- year-old children's memory of book facts. I aimed to answer two overall questions: First, do illustration elements influence the number of unique references that participants make to each illustration category? Second, does the nature of participants' illustration referencing predict children's memory of book facts?

Both the adults and children engaged with the illustrations in the book text. 100% of the adults and 100% of the children referenced at least one object, and 100% of the adults and 93.1% of the children referenced at least one concept during the session. As shown in Table 3, adults referenced more unique objects than concepts $t(28) = 6.88$, $p < .001$. Children showed the same pattern $t(28) = 7.22$, $p < .001$.

Book Variables and Illustration References

I predicted that overall, the dyads would reference more aligned than unaligned objects and concepts, as well as more high than low salience objects and concepts. A unique dyad reference refers to the first reference to a particular object or concept by either member of the dyad; a reference by either the adult or the child, or both the adult and the child, would count as one dyad reference. I used paired-samples *t*-tests to examine these predictions because there were not enough unaligned high salient objects and concepts to include this category so I could not perform a two-by-two analysis. Instead, I compared groups at the level of aligned vs. unaligned and high vs. low salience, which requires comparisons between two within-subjects groups. Therefore, a *t*-test is most appropriate. As expected, for objects, dyads referenced more aligned ($M = 0.43$, $SD = 0.11$) than unaligned ($M = 0.07$, $SD = 0.08$) objects, $t(28) = 17.11$, $p < .001$, as

well as more high salience (M = 0.43, SD = 0.11) than low salience (M = 0.28, SD = 0.09) objects, $t(28) = 7.91$, $p < .001$. For concepts, dyads also referenced more aligned (M = 0.25, SD = 0.14) than unaligned (M = 0.16, SD = 0.09) concepts, $t(28) = 4.3$, $p < .001$, as well as more high salience (M = 0.28, SD = 0.17) than low salience (M = 0.19, SD = 0.10) concepts, $t(28) = 3.13$, $p = .004$. This indicates the importance of both alignment and salience in influencing the dyad's interaction with the illustrations.

Adults and children differed in their interactions with the illustrations. Unsurprisingly, as seen in Table 3, compared to children, adults made significantly more object; $t(28) = 9.07$, $p < .001$ and concept references $t(28) = 8.14$, $p < .001$. In spite of this difference, I expected the same patterns for adults and children. That is, I predicted similarities and differences between adults' and children's referencing of different illustration categories. I expected both adults and children to reference more aligned than unaligned illustrations, but that only children would reference more high salience than low salience illustrations.

The results partially supported these hypotheses. As seen in Table 4, adults referenced more aligned objects than unaligned objects, $t(28) = 15.96$, $p = <.001$, and referenced more aligned concepts than unaligned concepts $t(28)=4.55$, $p = <.001$. Similarly, children referenced more aligned objects than unaligned objects, $t(28) = 9.44$, $p = <.001$. Contrary to my hypothesis, there was no significant difference in children's references to aligned and unaligned concepts, $t(28) = 1.10$, $p = .280$. However, the incidence of children's concept references is so low that this result should be interpreted with caution.

Comparing high salience and low salience illustrations as seen in Table 4, adults referenced more high salience objects than low salience objects, $t(28) = 8.72$, $p = <.001$ and referenced more high salience concepts than low salience concepts, $t(28) = 2.26$, $p = <.001$.

Children displayed the same pattern, referencing more high salience objects than low salience objects, $t(28) = 5.88$, $p = <.001$ and more high salience concepts than low salience concepts, $t(28) = 4.16$, $p<.001$. These results support my hypothesis.

I then investigated references to high compared to low salience objects and concepts while controlling for alignment, as shown in Table 5. Among aligned objects and concepts, adults referenced more of the high salience objects than low salience objects $t(28) = 2.64$, $p = .013$. However, there was no significant differences in the adults' references to high salience compared to low salience concepts which supports the hypothesis, $t(28)=0.79$, $p = .439$ As expected, children referenced more high salience objects than low salience objects $t(28) = 4.86$, $p < .001$, and referenced more high salience concepts than low salience concepts $t(28) = 5.26$, $p < .001$.

Reference Type

There were a variety of different ways in which the dyads could interact with an illustration. Overall, most dyads engaged in diverse types of references. As shown in Table 6, adults used speech and gesture to reference significantly more unique objects $t(28) = 14.32$, $p < .001$, and concepts $t(28) = 9.00$, $p < .001$, than they referenced using speech-only. Results showed the same pattern for children; Speech and gesture accounted for significantly more unique object references $t(28) = 2.81$, $p < .001$, and concept references $t(28) = p < .001$, than speech-only in children as well. Furthermore, 100% of the adults made at least one object and one concept reference using both speech and gesture, along with 94% of the children. Interestingly, whereas 76% percent of adults and 100% of children referenced an object using only speech, only 31% of adults and children did the same for concepts. This means that very few participants reference concepts using only speech.

Adults could make a speech reference either reading from the book, or during extra-textual talk. Extra-textual talk is any speech that occurs beyond simply reading the book text. Because the children are not the readers, all of their speech references are extra-textual talk by definition. 93% of adults referenced at least one object and 93% percent referenced at least one concept while reading from the book. 100% of the adults referenced at least one object and at least one concept during extra-textual talk, with 90% of children referencing an object and 83% percent referencing a concept during extra-textual talk. This illustrates the variety in types of references, and shows that most parents and children engaged with the illustrations using each of the possible reference types.

Book Variables and Reference Type

I examined the relation between book elements and type of speech to see if the same patterns emerged. Adults made almost no references to unaligned objects ($M = 0.00$, $SD = 0.01$) and concepts ($M = 0.06$, $SD = 0.05$) while reading, so I chose to only examine references to aligned illustrations while reading the book text and isolate the effect of salience. Among these references, adults referenced more high salience objects ($M = 0.30$, $SD = 0.13$) than low salience objects ($M = 0.25$, $SD = 0.09$), $t(28) = 3.11$, $p = .040$. There was no difference in adults' unique references of aligned high salience concepts ($M = 0.15$, $SD = 0.15$) and aligned low salience concepts ($M = 0.17$, $SD = 0.15$) while reading $t(28) = -0.55$, $p = .600$.

I also investigated the relation between illustration elements and extra-textual talk references. This is particularly important because references made during reading are made almost exclusively to aligned objects and concepts and account for over half of aligned references. Extra-textual talk excludes references that occur while reading the book text, so it is a better measure of what illustrations dyads choose to spend further time on. I conducted paired-

sample *t*-tests to examine if extra-textual talk references are influenced by alignment and salience in the same way that overall references are. As seen in Table 7, The results showed more unique references to aligned compared to unaligned illustrations for adults' object references, $t(28) = 8.46$, $p = < .001$, and children's object references, $t(28) = 8.72$, $p = < .001$, but not for adults' concept references, $t(28) = 1.94$, $p = .060$ or children's concept references, $t(28) = 0.44$, $p = .663$. Furthermore, the results showed more references to high salient compared to low salient illustrations for adult's object references, $t(28) = 3.92$, $p < .001$, adults' concept references, $t(28) = 3.94$, $p < .001$, children's object references, $t(28) = 5.7$, $p < .001$, and children's concept references, $t(28) = 4.23$, $p < .001$.

Extra-textual talk covaries between members of the dyad. I found a strong positive correlation between the adults' and children's unique extra-textual talk overall object references, $r(27) = 0.76$, $p < .001$, as well as between adults' and children's unique extra-textual talk references to aligned objects, $r(27) = 0.75$, $p < .001$. This shows that adults and children are interacting with the book as an adult-child dyad, and their referencing patterns are not independent from each other.

Relation Between Illustration References and Open-Ended Recall Score

The reported children's memory scores are the proportion of six questions answered correctly. Children answered both global and local questions (3 of each). Global questions assessed general knowledge about the book, while local questions assessed specific knowledge. Children's total open-ended memory scores ranged from 0.17 to 1.0 ($M = 0.53$, $SD = 0.25$). Their open-ended scores for global questions ranged from 0 to 1.0 ($M = 0.57$, $SD = 0.29$), and scores for local questions ranged from 0 to 1.0 ($M = 0.49$, $SD = 0.33$). This shows wide variability in children's memory scores.

I examined the relation between illustration references and children's performance on the memory task. Some of the planned analyses were inappropriate to perform due to the low variance of certain illustration references, therefore I do not discuss all possible relations. The excluded reference types are children's references to aligned concepts, and adults' and children's references to both aligned objects and concepts using text-relevant extra-textual talk.

Overall, I expected a positive relation between the dyad's number of unique aligned illustrations referenced and children's performance on the memory task. Results of a Pearson correlation showed a non-significant relation between total open-ended memory questions and dyad's aligned object references, $r(27) = 0.19$, $p = .340$, as well as the dyad's aligned concept references, $r(27) = 0.29$, $p = .141$.

I also investigated this question for each of global and local separately. Because of the low number of each of the global and local memory questions, these analyses must be interpreted with caution. There was not a significant relation between children's global open-ended memory scores and dyad's aligned object references, $r(27) = -0.07$, $p = .706$, or aligned concept references, $r(27) = 0.11$, $p = .568$. In contrast, there was an association between children's open-ended scores on local memory questions and the dyad's aligned object references, $r(27) = 0.41$, $p = .027$, but not aligned concept references, $r(27) = 0.31$, $p = .101$.

I expected adults' unique references to aligned illustrations to predict children's open-ended recall scores. I did not find significant correlations between adults' unique references and children's total recall scores for aligned objects, $r(27) = 0.32$, $p = .093$, or aligned concepts, $r(27) = 0.28$, $p = .151$. Children's unique references to illustrations also did not predict their total open-ended memory scores for aligned objects, $r(27) = -0.23$, $p = .234$.

I did not find a correlation between adults' references and children's global open-ended memory scores for aligned objects, $r(27) = 0.08$, $p = .677$, or aligned concepts, $r(27) = 0.12$, $p = .531$. Unexpectedly, children's references to aligned objects were inversely related to their global open-ended memory scores, $r(27) = -0.37$, $p = .048$.

I found a significant positive correlation between adults' references to illustrations and children's local open-ended memory scores, for aligned objects, $r(27) = 0.44$, $p = .016$, but not for aligned concepts, $r(27) = 0.28$, $p = .144$. Children's references to aligned objects did not predict their local open-ended memory scores, $r(27) = 0.09$, $p = .656$.

I also expected the combination of references made while reading and made using text-relevant speech to positively predict children's open-ended recall scores. This captures the number of illustrations referenced in a way that directly relates to the book text, Table 8 shows descriptive statistics. However, children's total open-ended memory scores were not related to adults' references made while reading or using text-relevant speech for aligned objects, $r(26) = 0.26$, $p = .183$, or concepts, $r(26) = 0.26$, $p = .190$. Additionally, children's global open-ended memory scores were not related to adults' references made while reading or using text-relevant speech for aligned objects, $r(27) = 0.08$, $p = .674$, or aligned concepts, $r(27) = 0.09$, $p = .629$. Lastly, children's local open-ended memory scores were not related to adults' references made while reading or using text-relevant speech for aligned objects, $r = 0.33$, $p = .085$, or aligned concepts, $r = 0.27$, $p = .158$.

I additionally investigated the relation between adults' aligned references made only during reading and children's memory scores. Adults' aligned object references during reading positively predicted children's total open-ended memory scores, $r(26) = 0.38$, $p = .046$, but adults' aligned concept references during reading did not, $r(26) = .37$, $p = .052$. There was no

relation between children's open-ended global memory scores and adults' aligned object references during reading, $r(27) = 0.19$, $p = .325$, nor adults' aligned concept references during reading, $r(27) = 0.21$, $p = .275$. There was a relation between children's local open-ended memory scores and adults' aligned object references during reading, $r(27) = 0.38$, $p = .044$, but not adults' concept references during reading, $r(27) = 0.35$, $p = .064$.

Woodcock-Johnson Vocabulary Scores

Children's Woodcock-Johnson vocabulary scores (WCJ) ranged from 77 to 140 ($M = 111.7$, $SD = 16.7$). I examined how WCJ relates to children's and adult's references scores and children's vocabulary scores as an additional contributing variable. WCJ scores were positively correlated with children's total open-ended memory scores, $r(26) = 0.40$, $p = .041$, and children's global open-ended memory scores, $r(26) = 0.48$, $p = .009$, but not children's local open-ended memory scores, $r(26) = 0.19$, $p = .34$. Children's WCJ scores were not related to the dyad's unique aligned object references, $r(26) = 0.05$, $p = .783$, or aligned concept references, $r(26) = 0.06$, $p = .778$. Neither were WCJ scores related to adults' aligned object references, $r(26) = 0.13$, $p = .508$, or concept references, $r(26) = 0.08$, $p = .684$. They were also not related to adults' references made during reading and text-relevant speech combined to objects, $r(26) = .12$, $p = .537$ or concepts, $r(26) = 0.07$, $p = .734$. Likewise, there was no relation between WCJ scores and adults' object, $r(26) = .26$, $p = .188$ or concept, $r(26) = 0.13$, $p = .48$, references made only during reading. Similarly, children's references to aligned objects, $r(26) = -0.29$, $p = .135$, were not correlated with their WCJ scores.

Discussion

This study explored the effect of illustration elements on the shared book-reading experience and children's learning from picture books. We aimed to address two primary

questions. First, how do the features of illustrations influence whether or not they are used by adults and children in a naturalistic shared book reading context? Second, do adults' illustration references predict children's performance on a book fact memory task?

In terms of question one, we found that overall, both adults and children referenced more aligned than unaligned objects. Adults, but not children, referenced more aligned than unaligned concepts. The effects of alignment on illustration references during extratextual talk mirrored those of general referencing, with the exception of adults' extra-textual talk references to concepts. We found no difference between quantity of adults' extra-textual talk references to aligned and unaligned concepts. Both in general and during extra-textual talk, adults and children reference more high salience objects and concepts than low salience objects and concepts. Holding alignment constant revealed differences between adults and children. With alignment held constant, adults referenced more high salience objects than low salience objects, but there was no difference in number of references to high salience concepts compared to low salience concepts. This result was the same overall and while reading from the book text. Children, on the other hand, referenced more unique high salience illustrations than low salience illustrations for both objects and concepts even when controlling for alignment. We also found relations between adults' and children's referencing behavior: the two members of the dyad's overall illustration references as well as aligned extratextual talk references were correlated.

For our second question, we found that both dyads' and adults' aligned object references positively predicted children's local open-ended memory scores, and adults' references during reading positively predicted children's total and local open-ended memory scores. We also found that children's references to aligned objects negatively predicted their global open-ended

memory scores. Neither adults' nor children's concept references were significantly related to children's memory scores.

The present study explores the question of why adults and children may reference certain illustrations and not others in a naturalistic shared book reading setting. We are the first to demonstrate that features of picture book illustrations, namely alignment and salience, actually influence whether or not readers will reference them. It also is the first study to assess the unique benefits multimedia book design that follows cognitive learning theory may have in terms of preschooler's fact learning from expository picture books.

Overall, adults referenced more aligned than unaligned illustrations. No previous studies have directly examined adults' intentions regarding illustration references, but research on book reading style provides some insight into these findings. Variety in book reading styles are evident in our results: the relatively high standard deviations indicate variation in the number of illustrations referenced overall as well as differences in use of gesture and extra-textual talk. It is well-established that adults vary in their approach to shared book reading for both narrative and expository books (Audet, Evans, Williamson, & Reynolds, 2008; Price et al., 2009; Reese & Cox, 1999). Audet et al. (2008) propose that differing shared book reading styles may be driven by different goals, including general cognitive stimulation, fostering a positive experience and fostering reading. Based on personal goals, a parent may use illustration references to simply keep children engaged and entertained, or as a deliberate tool to facilitate learning by scaffolding children's integration of the illustrations and book text (Greenhoot et al., 2014). One would expect parents with the goal of cognitive stimulation to employ the latter illustration use, which would likely result in more aligned illustration references than would a general engagement strategy. Price et al. (2009) found that compared to narrative picture books, expository picture

books promote a higher frequency of extra-textual talk that labels or draws attention to an illustration, draws inferences, and provides factual knowledge, definitions, or explanations. As these are all features of a "cognitive simulation" type goal, it seems likely that adults in the present study deliberately used more of the aligned illustrations in an effort to support their children's acquisition of factual knowledge.

Our finding that adults reference more aligned than unaligned objects suggests that adults primarily use illustrations to engage with ideas that are mentioned in the book text. That we found no difference in adults' references to aligned compared to unaligned concepts during extratextual talk may be accounted for by a difference in referencing strategy. An unaligned reference is not inherently negative, it just does not directly overlap with the book text. Concepts that are not aligned may be interesting to children and help adults keep them engaged with the activity. For example, a parent may point out an interesting attribute of an illustration during extratextual talk which may entertain the child and help keep focus on the book. Another possible explanation is that to be aligned, the concept must be clearly mentioned in both the book text and the illustrations. Some of the references to unaligned concept illustrations likely reflect a parental attempt to apply a concept mentioned in the book text to an illustration that does not clearly reflect that concept. A parent may reference a crab and say, "he outgrows his shell," an action mentioned in the book text but not depicted in the illustration. The object "crab," on the other hand, is aligned and this reference is counted as such in the object analyses. In sum, the lack of difference in adults' references to aligned and unaligned concepts was unexpected but does not detract from the overall finding of influence of alignment.

Children also referenced more aligned than unaligned objects overall. As only the parents read from the book, all of children's references are extra-textual talk. Children rarely mentioned

concepts at all, which is unsurprising. Concepts represent verbs and adjectives and are more abstract ideas than nouns. Preschoolers have been found to make more basic compared to abstract utterances in both narrative and expository shared book reading (Danis, Bernard, & Leproux, 2000; Price et al., 2009). Our finding that children reference more aligned compared to unaligned objects may be indicative of increased attention to ideas reflected in both the book text and the illustrations. Previous eye-tracking studies have shown that children spend more time attending to illustrations that are congruent with the book text, and that children's attention to features of illustrations can be experimentally manipulated by changing the book text (Takacs & Bus, 2018; Evans & Saint-Aubin, 2005). Our evidence suggests that children not only attend more to illustrations highlighted by the book text but go so far as to engage with more of them compared to illustrations unrelated to the book text.

Additionally, children referenced more high salience illustrations than low salience illustrations for both objects and concepts even when controlling for alignment. Children spend the majority of the book-reading experience focused on illustrations, so although their attention may be guided by the book text and adults' references, they are still drawn primarily to interesting and highly salient illustrations (Evans & Saint-Aubin, 2005). This finding is crucial because it suggests that for children to attend to and engage with an illustration, it must be high in salience in addition to aligned with the book text.

Although we found that adults reference more high salience than low salience illustrations in general, when alignment was held constant we did not find this difference in references to high salience compared to low salience concepts. Adults do not need the illustration to be highly salient in order to reference a concept they deem important. This is consistent with the idea of adults' goals for shared book reading discussed earlier. Concepts contain more

information and are more difficult to understand, so this may point to a more effortful and creative referencing strategy for concepts than objects in an attempt to facilitate children's understanding, regardless of whether the idea is most salient on the page.

Book features are not the only factor influencing children's illustration references. Illustration references do not occur in isolation, but instead in a dyadic relationship. Adults and children appear to influence one another in their referencing behavior. Although we cannot conclude directionality from this correlational data, due to the nature of shared book reading parents generally take a guiding role in the experience. Danis et al. (2000) propose reciprocal communication in shared book reading guided by the adult, creating a 'zone of proximal development.' Further research on the interaction between adults' and children's references could elucidate the true nature of this relation to help gain a better understanding of how alignment and salience influence each individual member of the dyad as well as how adults and children influence each other.

In sum, results for our first question demonstrate that alignment and salience influence adults' and children's illustration references, and indicate that children in particular are sensitive to salience. Alignment, salience, and the other member of the dyad's behavior all appear to influence the nature of adults' and children's shared book reading experience.

For our second question, we found that both dyads' and adults' aligned object references positively predicted children's local open-ended memory scores, and adults' aligned object references during reading positively predicted children's total and local open-ended memory scores. Cognitive theories suggest that learning information with dual representations aides encoding of that information as well as recall, and multiple experimental studies support this particularly if an adult guides the child's attention (Mayer 2005; (Flack & Horst, 2016;

Greenhoot et al., 2014; Greenhoot & Semb, 2008; Reese & Cox, 1999; Takacs & Bus, 2018). Our findings demonstrate that adults' aligned object references, particularly those made during reading, provide the necessary support to allow their children to integrate the verbal and pictorial object representations and facilitate memory for book facts.

Not all aligned references appear to facilitate learning. Unexpectedly, children's references to aligned objects negatively predicted their open-ended global memory scores; children who referenced fewer aligned illustrations performed better on the memory task. This was surprising because references to aligned objects represent use of illustrations for support or additional discussion of objects and concepts mentioned in the book text, and this should strengthen children's representations of an idea. However, a reference to an aligned object may introduce new information or include discussion that is not directly related to the book text. It is possible that when discussing the book text further children became distracted by their own thoughts and ideas about the topic, leading to lower scores on the memory task. An alternative explanation incorporates children's vocabulary ability. We found that children's WCJ scores were positively correlated with children's total and global open-ended memory scores. Perhaps some children with a weaker vocabulary need to make references and ask questions to attempt to comprehend the book more than is necessary for children with a stronger vocabulary, but that this compensation is not enough to overcome vocabulary ability. This unexpected finding warrants further research to determine the exact nature of this relation and explore whether children's aligned extratextual references could be beneficial.

In sum, the results for our second question demonstrate a positive relation between children's memory scores and adults' aligned object referencing both overall and while reading

the book. It also shows that children's aligned object references are negatively related to their memory scores.

Limitations and Future Directions

A major limitation in this study is that we did not manipulate the book. Therefore, it is not possible to rule out alternative explanations for the effects, such as whether the most frequently referenced illustrations also simply happen to be the most engaging or interesting. We also used only one book, so the results could be book specific. Additionally, only three of the four illustration categories naturally had enough illustrations to include in the analyses. A future study could use multiple books to address the question of how alignment and salience affect the dyad's interactions with the illustrations while controlling for these factors. To do this, one could experimentally manipulate alignment (by adjusting whether or not the book text refers to a particular illustration while keeping the illustrations constant) and salience (adjusting the prominence of a particular illustration on the page), and assess whether these manipulations affected the prevalence of interactions with that illustration. Books can be designed to include an equal number of illustrations in each category to investigate the effects of all four categories. This would add strong causal experimental support for influence of illustration type on number of references and strengthen the findings and generalizability of the current study.

The memory task used to assess children's memory for book facts poses an additional limitation. Children answered 6 questions about the book, but the questions were not designed for this study, so they did not include an equal number of topics from each alignment and salience category. Additionally, there were only 3 each of global and local questions, so there may have been too little variance in memory scores to find an effect in some cases. A future direction could be to include more questions, and match each question to an illustration and

ensure that questions about objects and topics in each category are included to more directly investigate how book alignment and salience affects children's learning.

An additional limitation is the small and homogenous sample. The participants were mostly white and middle-class so the results may not generalize to all populations. Furthermore, all of the adults in the study were female. Research has shown that reading behavior can vary with socioeconomic status, as well as with the gender of the parent and child (Bus et al., 1995; Vandermaas-Peeler, Sassine, Price, & Brilhart, 2011). A future study could include a more diverse sample to increase its generalizability to the population.

An interesting extension of this study could be use of eye tracking to better measure how alignment, salience, and adults' references affect attention to illustrations. In the current study, my measure of children's attention was their references and the adults' references. Whereas this is a good measure of each individual's active engagement with the illustrations, it is not a complete measure of children's attention. When a parent references an illustration, the goal most likely is to redirect the child's attention and engage them with the book content. The effectiveness of this strategy for redirecting attention is not clear from the current study. A child may ignore the adult's reference, or, conversely, children could attend to an illustration without referencing it. Incorporating this technology would provide details including exactly which illustrations children attend to and how long they attend to them. Future research could explore what children actually attend to during book reading and during adults' illustration references, assess whether this varies by alignment and salience, and test the relation to children's fact learning from the book.

Conclusions

The present study shows that both adults and children are more likely to reference aligned compared to unaligned illustrations, and that children in particular are sensitive to illustration salience even with alignment held constant. Additionally, this study shows that adults' aligned object references both overall and during reading supports children's memory for book facts. Although shared book reading is widely studied, there is little to no evidence examining why adults and children choose to reference the illustrations that they do. This study provides novel insight into how illustration elements affect how children and adults reference illustrations in expository texts, and explores a relation to children's learning. These results have particularly important implications for picture book design, as these factors influence the shared book reading experience and thereby the potential benefits the dyad gains from reading and interacting with the illustrations in the book. In particular, design of expository books has the potential to enhance children's fact learning. Books should represent important concepts in both the text and illustrations, and illustrators should ensure that aligned images are salient enough for children to attend to them. With these principles in mind, a well-designed picture book will encourage illustration references that engage preschool-aged children with novel concepts in an informal and enjoyable context.

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Tables

Table 1

Alignment and Salience Scores for Objects and Concepts

	Object (N)			Concepts (N)		
	Aligned	Unaligned	Total	Aligned	Unaligned	Total
High Salience	25	4	29	10	1	11
Low Salience	22	11	33	26	28	54
Total	47	15	62	36	29	65

Table 2

Explanation of Study 1B Coding Scheme

Coding Category	Code	Definition	Example
Image		Record the image or idea that the participant references. This could be either a) the actual illustration, or b) an attribute that the participant expresses using the illustration.	a) Reference to a shell coded as "shell" (object) b) Reference to the smoothness of a shell coded as "smooth" (concept)
Who references?			
	Adult = 1	Adult references illustration, using speech, gesture, or both	Adult (A) reads "birds like to eat snails" and points at snail
	Child = 2	Child references illustration, using speech, gesture, or both	C points at illustration of turtle and says "turtle"
Reference When Reading vs. Extra-Textual Talk			
	Referenced while reading book = 1	Participant references illustration while reading the book text. Also includes **a** paraphrase that is similar to and replaces the original book text	A reads "birds like to eat snails" and points at snail A paraphrases "this bird might like to eat this snail"
	Referenced during extra-textual talk = 2	Participant references illustration outside of reading the text	A says "see how it went back inside the shell so the bird can't eat it?"
New Speech vs. Book or Repeated Speech (only if Reference When Reading vs. Extra-Textual Talk = 2)			
	New information = 1	Speech that adds extraneous information not included in the book text	A says "its eyes look different than yours"
	Text-relevant speech = 2	Speech that does not add any additional information beyond what is included in the book text	A reads "most are rounded on top and flat on the belly" then says "look they're round on the top"
Gesture			
	Point = 1	Refers to image using a single finger point	A points to image of bird in nest while reading "birds build nests"
	Action = 2	Refers to image using moving gesture other than single finger point. Most often used to illustrate adjectives and verbs or draw connections between multiple illustrations.	A traces turtle's belly as reads "most are rounded on top and flat on the belly"

Table 3

Unique Illustration References by Dyad Member

	Adults		Children	
	M	*SD*	*M*	*SD*
Objects	0.31	0.08	0.13	0.1
Concepts	0.19	0.1	0.04	0.03

Table 4

Alignment, Salience and Unique Illustration References

	Alignment				Salience			
	Aligned		Unaligned		High Salience		Low Salience	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Adult Objects	0.39	0.1	0.06	0.07	0.38	0.01	0.24	0.08
Adult Concepts	0.24	0.14	0.14	0.09	0.24	0.16	0.18	0.10
Child Objects	0.16	0.09	0.04	0.07	0.19	0.10	0.08	0.09
Child Concepts	0.04	0.03	0.03	0.04	0.08	0.06	0.03	0.03

Table 5

Unique References to Aligned Illustrations, by Salience

	Aligned and High Salience		Aligned and Low Salience	
	M	*SD*	*M*	*SD*
Adult Objects	0.43	0.14	0.33	0.11
Adult Concepts	0.26	0.17	0.24	0.16
Child Objects	0.22	0.11	0.10	0.11
Child Concepts	0.09	0.07	0.02	0.03

Table 6

Reference Type

	Object		Concept	
	M	*SD*	*M*	*SD*
Adult Speech and Gesture	0.29	0.08	0.19	0.10
Adult Speech Only	0.03	0.03	0.01	0.01
Child Speech and Gesture	0.08	0.07	0.03	0.03
Child Speech Only	0.04	0.03	0.01	0.01

Table 7

Extra-Textual Talk References by Alignment and Salience

	Aligned		Unaligned		High Salience		Low Salience	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Adult Objects	0.17	0.08	0.05	0.06	0.11	0.08	0.05	0.04
Adult Concepts	0.10	0.06	0.07	0.07	0.12	0.09	0.06	0.04
Child Objects	0.14	0.09	0.04	0.06	0.09	0.06	0.02	0.02
Child Concepts	0.03	0.03	0.03	0.04	0.05	0.07	0.00	0.00

Table 8

Aligned References by Type of Speech

	Adults				Children			
	Objects		Concepts		Objects		Concepts	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Aligned Combined Reading and Text-Relevant Extra-Textual Talk	0.34	0.11	0.22	0.14	N/A	N/A	N/A	N/A
Aligned Reading	0.27	0.10	0.16	0.14	N/A	N/A	N/A	N/A
Aligned Text-Relevant Extra-Textual Talk	0.11	0.07	0.08	0.09	0.07	0.03	0.03	0.03

Figures

Figure 1. One image-only page spread of *What Lives in a Shell*. Adapted from Zoehfeld, K.W. (1994). *What Lives in a Shell?* New York, NY: HarperCollins

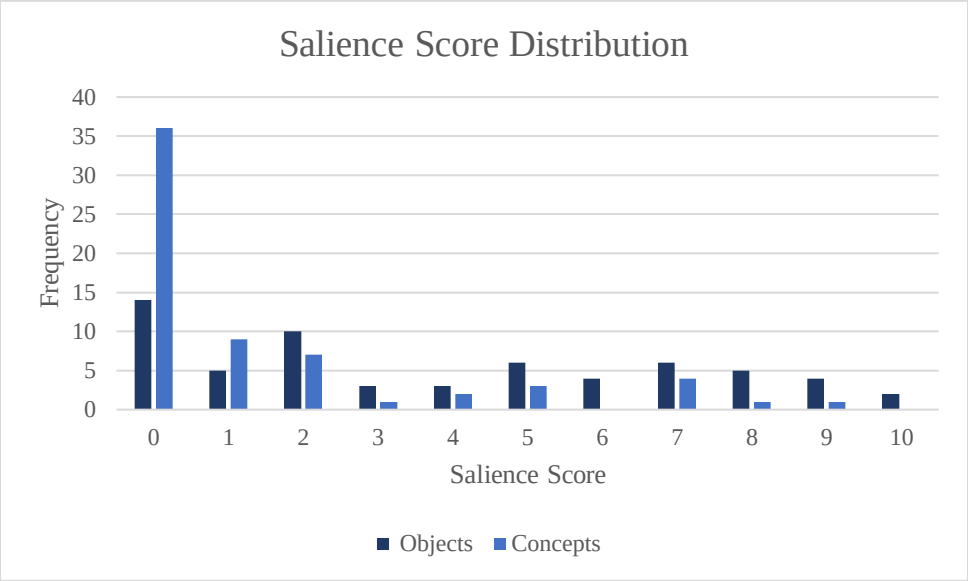

Figure 2. Adult ratings of salience score for objects and concepts