Exploring Young Children's Patterns of Image Use in a Picturebook

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Abstract

Using analysis of oral reading and eye movements, this study examined how third grade children used visual information as they orally read either the original or the adapted version of a picturebook. Eye tracking was examined to identify when and why students focused on images as well as what they looked at in the images. Results document children's deliberate use of images and point to the important role of images in text processing. The content of images, availability and placement of text and images on a page, and children's personal strategies affected the use of images.

Although many researchers have studied the process of reading, we still have much to learn. In the past research has focused on how readers process the written words, attempting to describe the cognitive processes that translate print into oral text and meaning (Adams, 1990, 1994; LaBerge & Samuels, 1974; Rumelhart, 1994). More recently greater attention has been paid to how readers use a variety of information available in texts, both verbal (words) and visual (non-verbal), to construct meaning (Duckett, 2001; Macken-Horiak, 2004; Unsworth, 2004).

These visual aspects of texts are highly important in electronic sources (Frey & Fisher, 2008) and in the various offline paper sources read by adults (newspapers, magazines, informational texts) and children (content textbooks, graphic novels, picturebooks). Lemke (2002) refers to reading material that includes both verbal and visual texts as "multimodal." He argues that all understanding is multimodal; that is, we cannot construct meaning by using only the verbal or visual system (p. 302). To effectively prepare children for this visual/verbal world, we need to expand our current understanding of the reading process to include how young readers use visual information during reading.

Because illustrations are prominent in picturebooks and other material children encounter in school, picturebooks provide a realistic environment for studying young children's use of visual information. Additionally, basal reader anthologies, material frequently used for reading instruction, often consist of adaptations of picturebooks that involve deletion of illustrations and re-arrangement of verbal text (Feathers & Bocheneck, 2006; Reutzel & Larson, 1995). These adaptations provide opportunities to examine the role of images in picturebooks by comparing children's reading of adapted and original versions. This is the approach we used to examine how young readers used visual information, that is, the images, as they orally read either an original picturebook

or an adaptation of the picturebook in a reading anthology designed for second grade students.

Theoretical Framework

This study is based on the premise that reading is a meaning construction process which involves the use a variety of strategies to build comprehension, including monitoring understanding and taking deliberate action when meaning is not maintained (Clay, 1991; Goodman, 1984, 1994). Thus in contrast to viewing reading as a verbal-centric endeavor that relies on automatic word decoding as a pathway to meaning, a constructivist approach assumes that everything that readers do, including looking at images as well as words, is deliberate and centered on the formation of meaning. Additionally, meaning construction is accomplished through readers' transactions with visual and verbal signs guided by context, the reader, and the interpretative practices of the community (Goodman, 1996; Kress & van Leeuwen, 2006; Rosenblatt, 1978; Smith, 2004; Vygotsky, 1978).

This theoretical view is supported by studies that have demonstrated that eye movements are not automatic but are instead affected by syntax (Frazier & Rayner, 1982; Holmes & O'Regan, 1981), contextual constraints (Ehrlich & Rayner, 1981; Rayner & Carroll, 1984), and global processing (Hyönä, Lorch, & Rinck, 2003). Additionally research indicates that reading paths-the progression of what is looked at in a multimodal text- are not predominately governed by perceptual salience (features such as color, size and placement on a page), but are also influenced by semiotic factors, namely, the extent to which the semiotic content of image and verbal text are related (Hiippala, 2012) and the particular interests of readers (Holssanova, Rahm & Holmqvist, 2006).

This theory leads to a view of picturebooks as "semiotic space," that is, texts in which meaning is created through the conjunction of both images and words (Kress & van Leeuwen, 2006). Theorists in children's literature echo this view, arguing that the visual and verbal aspects of picturebooks are interrelated. For example, Bader (1976) called the visual and verbal "interdependent components" stressing that both contribute to story development. Moss (1990) referred to the "interweaving" and Lunn (2003) to a "marriage" of pictures and words. Instead of viewing images as visual depictions of what the verbal text says, these theorists posit that the visual text carries its own meaning, a meaning that is related to and inter-twined with the meaning expressed by the verbal text (Kress, 1997; Kress & van Leeuwen, 2006). Sipe (1998) referred to this visual/verbal relationship in picturebooks as a "synergy" because the two together produce an effect that is greater than what either could produce alone. This effect is produced as readers oscillate between the sign system of the visual text and that of the verbal text (p.102).

In addition to working together to create a story, Nodelman (1988) suggested that pictures and print also change each other so that what is in the images influences how we read the words and what is in the verbal text affects how we view the images. Reiterating this view, Nickolajeva and Scott (2006) suggested that the visual and verbal texts create "expectations for the other which in turn provides experiences and expectations-----in an ever-expanding concatenation of understanding" (p.2). Thus, readers do not simply use images as support for understanding the words; instead the images themselves are an integral part of the overall text.

Viewing reading as a process of meaning construction and understanding picturebooks as a semiotic space in which the verbal and visual work together to support the construction of meaning, it becomes important to understand whether and to what extent readers make use of these aspects of picturebooks. Assuming that readers are engaged in a process of meaning construction, studying what readers look at during reading and when they look at those things could help inform our understanding of how readers use images when constructing meaning. Additionally, from a semiotic perspective, the aesthetic whole created by the interrelationship of images and words is disrupted if images are changed or eliminated (Galda, 1991; Kucan, 1994; Nodelman, 1988). Thus, comparing the reading of two different versions of the same text that differ only in visual features could promote understanding of the role of these features.

Children's Use of Images During Reading

Given the theoretical framework it is important to consider whether 1) children are aware of and use the relationship between images and words to construct meaning, and 2) what we already know about children's use of images in picturebooks.

Researchers investigating the responses of children during storybook read-alouds have determined that young children use the relationship between images and print to construct meaning (Hubbard, 1989; Sipe, 2008; Sipe & Brightman, 2005; Yaden, Smolkin & Conlon; 1989). Yaden, et al. (1989) saw this in the comments and questions of pre-school children during parent read alouds, and Sipe and Brightman (2005) in the statements related to images made by primary grade children during classroom read alouds. These studies suggest that children are not only viewing the images but that they integrate what they observe in the images with the verbal text.

Additionally research has used eye tracking to document the extent to which young children look at images and print during story read-alouds. As might be expected, these studies found that young children focused mostly on the pictures when a story was read to them (Evans, Saint-Aubin, & Landry, 2009; Justice, Skibbe, Canning & Lankford, 2005), although children who were beginning readers focused more on the print (Roy-Charland, Saint-Aubin & Evans, 2007).

Two studies looked more closely at the relationship between the words and the images by studying what was looked at in the images and mentioned in the verbal text. Evans and Saint-Aubin (2005) varied the details mentioned in the verbal text and found that this altered what young children (age 48-61 months) looked at in the images as they listened to a story. If an item was mentioned in the verbal text children were more likely to look at that item in the illustration.

In the second study, Verhallen and Bus (2011) also used eye tracking to examine the visual/verbal relationship. They confirmed that the children (age 61-72 months) fixated more often and for longer times on items highlighted in the verbal texts read to them. They also noted that children were more likely to fixate on human or anthropomorphic (human-like) figures. Additionally, as the stories were read to the children multiple times over several days, their fixations on images changed. After three encounters with the text, there were fewer fixations lasting for longer periods of time as children looked at fewer items but in more depth. The results of these two studies

suggest that during read-alouds children use the synergy between the visual and verbal texts to deliberately choose what to examine in the images.

Although these studies provide information about children's use of images while listening to a story, it is important to examine what young readers look at as well. Duckett (2002) studied the eye movements of six first grade children as they orally read a picture storybook. Unlike the younger children, these first graders focused more on print than on images, although the images still constituted 20% of fixations. Similar to the previous studies, Duckett also noted that children looked at characters and what he called "major components" of images, that is, important objects mentioned in the verbal text. In addition, he examined the saccades (movements from one point to another) between print and image and found that some were related to word identification while others occurred after the reading of a word or before or after reading a page. However, the fixations before and after reading a page were problematic. Because Duckett controlled when children were presented with the next page, he could not clearly identify whether each fixation focused on the page just completed or the page about to be read. His total data set led him to argue that rather than being a distraction from the verbal text, the images supported meaning construction.

The use of images during reading was also examined by Arya and Feathers (2012), who used oral reading analysis, eye tracking, and oral retellings to examine the strategies used by two second grade students as they orally read a narrative text. Unlike the children studied by Duckett, in this study the readers controlled page turning and could spend as much time on a page as they chose. These readers showed clear patterns of looking at illustrations before and after reading the verbal text on a page as well as during the reading of the verbal text both to support word recognition and to construct meaning. Their retellings of the story confirmed the impact on their understanding. These patterns of use suggest that young readers use images in a variety of ways.

Additionally, eye tracking has identified how illustrations are used in informational texts. For example, Hannus and Hyönä (1999) examined the use of illustrations in science textbook material. Their results showed that both high and low ability students (age 10) used the illustrations but in limited ways. They also noted that the high ability students seemed to benefit more from the inclusion of illustrations. These students also spent more time reading what they identified as the more relevant portions of the verbal text. This suggests that while high ability students spent more time on the verbal text, neither they nor the low ability students viewed the images in this material as an important source of information. Mason, Tornatora and Pluchino (2013) and Mason, Pluchino and Tornatora (2013) also studied children's use of illustrations in science material and identified three patterns of visual behavior that were related to reading comprehension. They examined readers' integration of verbal and graphical information and both studies found that students (grades 4 and 6) who had high patterns of "integrative processing", as shown by a high number of saccades from the text to the image, had higher comprehension than low integrators. Although these studies are limited in that the text was short and included only a single illustration, they do suggest that a key factor is the integrative processing of both visual and verbal text.

These studies of children's reading of narrative and informational texts indicate that children do make use of images as shown by their fixations on both images and

words. Additionally, the studies suggest that movement between the verbal and visual features are indicators of integrative processing, the interrelation of verbal and visual information. Verhallen and Bus (2011) and Arya and Feathers (2012) begin to link integrative processing to semiotic connections between the verbal and visual texts and to strategies that support meaning construction. All of these studies looked at either young children who are not yet reading or who are just beginning to read or they looked at older children reading informational material. This suggested to us a need to examine students who were more proficient readers of narratives to determine whether they use images in the same ways as those previously identified. Additionally, several of the studies indicate that transitions between the verbal and visual text are important to meaning construction as well as what is looked at in the images (Duckett, 2001; Mason, Tornatora & Pluchino, 2013; Verhallen & Bus, 2011). Therefore, in this study we examined both these things. Specifically, in order to understand third grade students' use of images during the reading of a picture storybook we focused on two major questions:

1. What are the patterns in children's use of images during reading of a picturebook?
2. What factors affect children's use of images during reading?

Methodology

Think alouds, retellings and analysis of oral reading are often used as ways to infer reading processes. However, think alouds and retellings do not show ongoing processing, and oral reading analysis provides no information about the use of images. For a number of years eye movements have been used to gain some understanding of what individuals do as they read. Just and Carpenter (1984) and Rayner and Sereno (1994) argue that eye movements occur naturally during reading, and thus the study of eye movements is not intrusive or artificial in the way that think alouds are. They also contend that eye movement analysis provides an online view of the comprehension process. Many of the studies discussed here used eye tracking in just this way to explore what children do while they read. For these reasons, we used eye tracking in this study to examine how children use images while reading a picturebook. Additionally, previous research has tended to examine the textual features, oral reading, and eye movement in isolation but by combining these in this study, we were able to more clearly identify not only when children used images, but also, possible factors that influenced that use.

Setting and Participants

Because we are located within a large city, we were especially interested in the reading of children who live in this area and attend local schools. Some of the local children attend a University Literacy Program that provides free tutoring for 90 minutes per week from October through April. In this program college students enrolled in a graduate level class provide instruction to the children. This program accepts any children who enroll and is not restricted only to children with specific reading problems. Parents of third grade children in this program were informed about the study and all of the parents with children at this grade level agreed to allow their children to participate.

The six children (four males and two females) attended the local public schools in this large urban community. In their school, language arts instruction is imparted during the daily 90-minute literacy block using the Open Court Reading (SRA/McGraw-HIll, 2002) program. The children in the study are all African-American and are representative of the population of the urban area in which they reside. They are all native English speakers and did not receive any special education services. Their oral reading accuracy on the story read in this study averaged 97.4% (range 91.6-99.7).

We direct the tutoring program and are familiar to the children as we often join them as they work with tutors to observe the instruction or to participate in the instruction. Thus the children are comfortable with us. Because the eye tracking occurred during the tutoring session in a room that is part of the tutoring program, the children were also in a familiar location. The task, orally reading a text and retelling it, was also familiar to the children as they often do this in their local schools and in the tutoring program.

Material

In order to identify patterns of image use and the factors that might affect that use, we selected two versions of a 370 word story, *The Wolf's Chicken Stew* (Kasza, 1987). Because we wanted to study the reading that children would engage in on their own, we chose two versions of a story already in existence that children might encounter in or out of school. However, we wanted a text that was unfamiliar to the children; so we selected one not currently being used in the local schools. Finally, to insure that the text was not too difficult for the children to read, we chose a text one year below the children's reported independent reading level. The original version is assessed at Level K (second grade) by Fountas & Pinnell (1996) and the adapted version of the story is found in the Houghton Mifflin second grade basal reader, *Silly Things Happen* (Kasza, 1991).

There were 9 double page spreads and 10 single page illustrations in the original version and 3 double page spreads, 3 single page illustrations, and one page that contained 3 separate illustrations spread over the page in the adapted version of the text. Additionally each version contained an image on the title page. Images on the left hand page and that on the right hand page of double page spreads were numbered separately [for example 2A (left) and 2B (right)]; thus there were a total of 29 images in the original text and 13 in the adaptation.

Although there were no differences in the number of words in the two versions, there were differences in the arrangement of words due to the reduction from 29 narrative pages in the original text to 10 in the adaptation. These occurred when images from the original story were eliminated and sentences related to those images were added to other pages. These differences in the images and arrangement of words and image provided opportunities to explore children's use of images by comparing the patterns across the two versions.

Data Collection

We worked with children one on one in a session lasting 35-40 minutes. Each child orally read one of the versions of the story on a computer with 3 reading the adapted version and 3 reading the original version. The same child did not read both the versions

of the story because that would have resulted in a practice effect, that is, reading the first version would affect student performance on the second version of the story. The story was displayed on the computer screen exactly as it would appear if the children had read from the book, that is, each screen-shot displayed two facing pages (spread) of the original text. Students controlled movement from one screen-shot to another and were instructed to take as much time as they wanted on each spread. Additionally, to insure that we could separate fixations made after reading a spread from those made before beginning to read the next spread of the story, a plain white page was inserted between story spreads and shown for one second before automatically moving to the story spread. While students read, eye movements were tracked using an Applied Science Laboratories Model 504-Eye Tracker and Gaze Tracker with measurement accurate within half a degree of visual angle. A head tracker was also used to maintain focus on the eye. After orally reading the text, children retold the story. The session was audio taped and the eye tracking and oral reading were digitally recorded.

Data Analysis

This study is part of a larger study that also analyzes the oral reading and retellings, but, in this paper we focus on children's eye movements during reading. We began our exploration of the use of images by studying the eye movement data for each complete reading, including the total number of fixations and the average duration of fixations involving text and those involving images as well as the movement from the verbal text to the images (transitions). This allowed us to identify broad patterns of difference across the two versions of the texts and also similarities and differences across readers.

Additionally, to more closely examine the patterns and identify the factors that affected those patterns, we compared the patterns with the text features. First we determined the transitions for each student for each page of the text and the fixations involved in those transitions. Then we identified the origination and destination of each transition. For example a transition may begin in Sentence 2 and the destination may be Image 1. Then the eye tracking was viewed while listening to the audio of the reading to identify what students were saying at the point of the transition. That allowed us to identify the potential reasons for the transition such as difficulty recognizing a word. Finally, we studied the image fixations to determine exactly what children were focusing on in each image. In order to allow the patterns to emerge from the data, we used the constant comparison method (Strauss & Corbin, 1998) to identify patterns in the eye movement data and factors that appear to be related to those patterns. All data were coded and analyzed independently by two researchers with differences resolved by re-examining the data and discussion.

Results

The data reveal differences in children's use of images in the two versions of the story as well as variations in image use across the children. Additionally, certain factors were identified that had an impact on children's patterns of image use (e.g. placement and content of images).

Variations in Image Use

Overall the children focused more on the verbal text than on the images. More of the fixations were focused on the print (85.2%) with an average of 1097 fixations on the text and 169 focused on the images. Fixations on the text were also of longer duration (113.737 ms and 134.583) than those on images (107.588 ms and 124.336 ms) (Table 1). While these patterns generally held true across the two versions of the story, there were also some differences in the fixations for the adapted and original versions.

Table 1

Fixation Duration across the Two Versions of The Wolf's Chicken Stew

	Total Story		Images			Text		
Versions	Total*	Average Length*	Total*	Average Length*	Percent of Total Duration	Total*	Average Length*	Percent of Total Duration
Original								
Dave	116436.000	105.979	19809.000	97.581	17.02	96627.000	107.602	82.98
Eli	103989.000	89.937	15624.000	95.268	15.02	88365.500	83.918	84.98
Sarah	263925.704	145.948	41183.391	129.916	15.60	222742.313	149.692	84.40
Sum	484350.704		76616.391	322.765		407734.813		
Average	161450.235	113.955	25538.797	107.588	15.88	135911.604	113.737	84.12
Adaptation								
Tony	129518.000	129.644	9253.500	121.757	7.14	120264.500	131.007	92.86
Cory	206673.477	146.692	36083.883	129.796	17.46	170589.594	139.257	82.54
Freddie	255872.496	132.749	12388.433	121.455	47.93	133484.063	133.484	52.17
Sum	592063.973		57725.816			424338.157		
Average	197354.658	136.362	19241.939	124.336	23.18	141446.052	134.583	75.85

Note. Data displayed in milliseconds (ms)

Children who read the adaptation took longer to read the text as shown in the total fixation duration (Table 1), had more variation in the percent of image fixation duration (Table 1), and a higher average number of transitions per image (9.50 vs. 6.61) (Table 2). Even though there are fewer total transitions for the adaptation, there are also fewer images in this version; so the average per image is higher.

The point of transition to each image was examined to determine when the transition occurred (Table 3). Of the total number of transitions for children who read the original version, 5.05% occurred when the children struggled with word identification. This contrasts with 58.7% that occurred either before children began reading a page or after they completed the reading. An additional 14.7% of transitions for these children occurred after children had correctly read a word and then looked at the specific item in the image. Children reading the adapted version used the images slightly more to support

word recognition, 13.5%, and they transitioned more often to images after correctly reading a word, 23.4%. They also had fewer transitions to images before and after reading the words on a page, 39.6%, but this is not surprising given that their version contained fewer pages and fewer images.

Table 2

Fixations and Transitions Involving Images in the Story and On the Title Page

Version of Story	Child	Number of Fixations				Number of Transitions			
		Title Page	Story	Total	Story Average per Image	Title Page	Story	Total	Story Average per Image
Original	Dave	10	178	188	6.36	5	34	39	1.21
	Eli	36	121	157	4.32	7	68	75	2.43
	Sarah	24	288	312	10.29	6	83	89	2.96
	Total	70	587	657	20.96	18	185	203	6.61
Adaptation	Tony	28	60	88	5.00	10	27	37	2.25
	Cory	139	129	268	10.75	15	59	74	4.92
	Freddie	20	81	101	6.75	5	28	33	2.33
	Total	187	270	457	22.50	30	114	144	9.50

Overall the children used images before reading 27.5% of the time and to confirm meaning after reading a page or shorter portions of the text, 64.4% of the time. Images were used to support word recognition only 8.1% of the time. Thus, the percentage of transitions to images to support word recognition is small as compared with meaning related transitions, 91.9% (e.g. before reading to set context and after reading to confirm). This suggests that children use images to support understanding to a much greater extent than they use them to support word recognition.

Table 3

Time of Transition to an Image Across the Two Versions: Percent of Transitions

Version of Story	Child's Name	After Reading Page	Before Reading Page	Confirm After Reading	After Word /Phrase	After Sentence	Support Word Recognition
Original	Dave	60.47	30.23	6.98	0.00	0.00	2.33
	Eli	8.70	20.29	8.70	55.07	0.00	7.25
	Sarah	19.77	46.51	23.26	5.81	0.00	4.65
	Group	24.75	33.84	14.65	21.72	0.00	5.05
Adaptation	Tony	19.23	34.62	11.54	11.54	7.69	15.38
	Cory	26.79	5.36	32.14	17.86	3.57	14.29
	Freddie	20.69	20.69	17.24	17.24	13.79	10.34
	Group	23.42	16.22	23.42	16.22	7.21	13.51
	Total	24.27	27.51	17.80	19.74	2.59	8.09

Patterns and Factors that Affect Children's Use of Images

Patterns of fixations and transitions were examined to explore children's use of the images and several factors that appear to affect that use were identified.

Placement of images and text on a page. One factor, placement of images and text on a page is demonstrated most clearly on one page of the adapted version. In this instance images that occur on three different pages in the original story were deleted (Images 7, 9, 11) and the images from the facing pages (Images 6, 8, 10) were shrunk and placed onto one page in the adapted version (Figure 1).

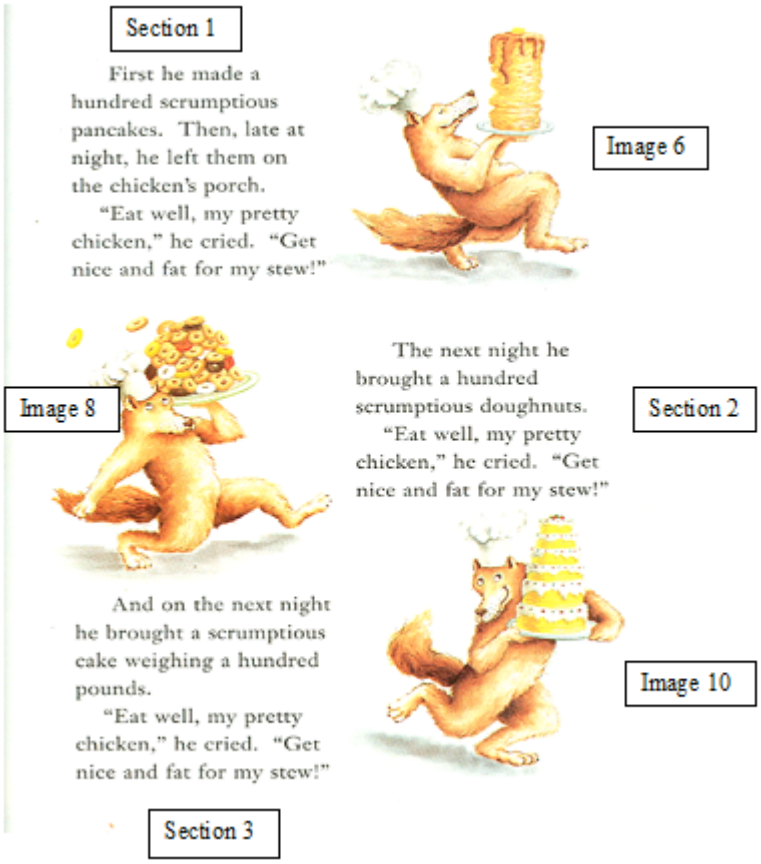

Figure 1. Images 6, 8, and 10 in the Adapted Version of *The Wolf's Chicken* Stew

There were more transitions to Image 6 for children reading the original version (12 vs. 8), and more on Image 8 (9 vs. 18) and Image 10 (8 vs. 13) for those reading the adapted version. While reading the adaptation, Section 1, which is related to Image 6, Tony made one transition to Image 6 and four to Image 8. For Section 2, Tony transitioned to Image 10, and then several times between Images 10 and 8. For section 3 he transitioned to Image 8 two times and to Image 10 once. Similarly, Cory transitioned to all three images (6, 8, 10) while reading Section 3, and Freddie consistently transitioned to the image below the text section she was reading. These transitions between different portions of the text and images suggest that students were having difficulty determining the relationship between sections of the text and the images. The lack of such transitions in the authentic version in the same portion of text suggests that the children's confusion on this page in the adapted version is related to the display of images and text.

Content of images. Another factor that appeared to affect image fixations is the content of the images. Fixations varied when similar content was repeated across multiple images. This is most clearly seen in the original version that contains similar images depicting the chicken's house at night. Three images (Images 7, 9, 11) show an almost identical view of the chicken's house that is a smaller version of Image 12B

(Figure 2). The only difference across these images is the shape of the moon which changes to show the passage of time. Images 7, 9, and 11 appear on the right of three consecutive spreads with Images 6, 8, or 10 (Figure 1) on the left.

Image 12A Image 12B

Figure 2. Images 12A and 12B in Both Versions of *The Wolf's Chicken Stew*

Children who read the original version gradually decreased both the number of transitions and the number of fixations on the house (Images 7 through 12B). There were 16 fixations on Image 7, nine fixations on Image 9, eleven on Image 11, and six on Image 12B . One child, Eli, accounted for all of the fixations on Image 11, most of which occurred as he struggled with the word "scrumptious". Additionally, the total fixation duration decreased from 1813.058 ms on Image 7 to 626.299 ms on Image 12B.

This clearly demonstrates the children's deliberate use of images. All the students who read the original version had gaze points on these images that provided sufficient information to determine that Images 9, 11, and 12B were already familiar and therefore did not merit additional study. In this instance, redundancy in the images affected both the number of fixations on subsequent images and the fixation duration.

This contrasts with the three children who read the adapted version of the story that includes Images 12A and 12B but not Images 7, 9, and 11. All of these children fixated on Image 12B (19 fixations) for a total duration of 1904.764 ms, triple that of children who read the original story. This was the first time that the chicken's house was depicted in the adaptation, and children fixated on the door, windows, chimney and the path to the house, the same things that children who read the original version focused on in Images 7 and 9. The comparison of these images documents that while children make

use of images in texts, the extent to which they use those images and the things they look at vary depending on the images themselves.

Availability of images. Availability of images was another factor related to children's use of images. When content was not available because images were deleted, the use of related images was affected. This was seen with the use of Image 12B previously discussed, and it also occurred with Images 15A, 15B, and 16B. In the original version of the story, the double page spread (Images 15A and 15B) provides the first view of the baby chicks which are shown in the top 2/3 of Image 15A (Figure 3). Image 15B shows the chicken facing the chicks with her beak open as if talking to the chicks, and the wolf with a sheepish look on his face.

Figure 3. Images 15A and 15B in the Original Version of *The Wolf's Chicken Stew*

Children reading the original version had 29 fixations on the chicks in Image 15A. They had fewer fixations (14) on the chicks in Image 16B (Figure 4) on the following page as compared to students who read the adapted version (30) which did not contain Images 15A and 15B. Additionally, students who read the original version that shows the wolf with a sheepish look on his face looked at the wolf's face in Image 15B (10 fixations), and had fewer fixations on the wolf in Image 16B (11 vs. 26) than the students who read the adaptation. Since all of the students accurately read the verbal text accompanying Image 16B, the fixations on the image are not related to word recognition. The data reveal that although all the children looked at both the wolf and the chicks in Image 16B, the extent to which they looked at the image was influenced by the inclusion or exclusion of Image 15A/B.

Figure 4. Image 16B in Both Versions of *The Wolf's Chicken Stew*

Importance of items in images. The data further show that not all items in an image were equally important. What children looked at in images was not random, but focused on specific things. About half of the image fixations within the narrative (47.8% and 55.2%) focused on the anthropomorphic characters in the story (the wolf, the chicken, the chicks). Thus in Image 1, which depicts the wolf sitting at a table eating, 63% of the fixations are on the wolf, and, in Image 3A/B, depicting the wolf creeping up on the chicken, 87.1% of the fixations are on the wolf and the chicken.

The children, however, also focus on important objects mentioned in the verbal text such as the chicken's house, the pancakes, the doughnuts, and the cake. Thus in Image 1, in addition to fixating on the wolf, children also focused on the dishes that contained his meal (37%). Given the verbal text—*There once lived a wolf who loved to eat more than anything else in the world. As soon as he finished one meal, he began to think of the next.*----it is not surprising that the children look at the food. Similarly, in the double page spread depicting the wolf standing behind a tree in a grove of trees (Image 2A) and the chicken walking (Image 2B), 62.3% of the image fixations are on the wolf and the chicken and 37.7% on the trees. The text that accompanies these images indicates that the wolf *walked across the forest in search of a delicious chicken.* Children are choosing to focus not only on the characters in the story but also important items in the story such as the forest. Thus the items fixated in the visual content were those that were often mentioned in the verbal content.

However, this does not completely account for fixations on the items. Certain items in the images seem to have attracted the children's attention. On the title page, the wolf is shown wearing a chef's hat. Most of the children (5/6) looked at that hat on the title page with 9 total fixations. They continued to look at the hat in Image 5B (10 fixations), Image 6 (1 fixation), Image 8 (4 fixations) and Image 10 (13 fixations). The hat is not mentioned in the verbal text, and one might consider that the hat symbolizes the wolf as a "chef"; however, the children looked at the hat before "cooking" was mentioned in relation to Image 5B, in fact, before the children even began reading the story. Our current data do not suggest a definitive reason for this interest in certain items, but it does raise questions for future exploration.

Children's personal strategies. Mention of an item in the verbal text also does not completely explain fixations on items because many of the fixations occur before the children begin reading the page. For example, Eli looks at the chicken in Image 14A and the chicks in Image 15A before reading the text on those pages. Personal strategies that readers develop to use images to construct meaning, such as looking at images before reading the verbal text, constitute the final factor that affected the children's use of images. Because this factor can be influenced by many things already discussed such as availability, content, and placement of images, personal strategies are most clearly identified by the use of images before and after reading the complete text on a spread.

In the adapted version there were 6 opportunities for children to look at images prior to or after reading the text on a spread. The children who read this version looked at images before reading the text on an average of 72.1% of the spreads (50%-83.3%) and after reading on 61.1% of the spreads (50%-83.3%). Children who read the original version with 14 spreads looked at images before reading on 83.3% of the spreads (64.3%-100%) and after reading on 69.1% of the spreads (28.6%-85.7%). These averages however do not present the entire picture. While children who read the original version fairly consistently looked at images before reading, Eli looked at images much less after reading (4/14) than either Dave (14/14) or Sarah (11/14) who were more consistent in looking at images after reading. Eli also focused on images more during reading than Dave or Sarah; therefore he may not have felt a need to look at images again after reading the page.

Children also looked at images after reading a portion of the text (Table 3). For example, Tony and Freddie looked at the images after reading Sections 1 and 2 of the page shown in Figure 1, and Cory looked at the wolf's hand holding a bowl, the sugar, the flour, and the chef hat on the wolf's head in Image 5B after reading the sentence: *The wolf ran home to his kitchen, and he began to cook.* Children in both groups also consistently transitioned to images after correctly reading a word or phrase, as if to confirm what had been read or to see what a character or object looked like (Table 3). For example, Corry read, "There once lived a wolf who loved to eat," looked at the wolf, and then continued the sentence "more than anything else in the world." Freddie read, "First he made a hundred scrumptious pancakes," then looked at the pancakes, and Eli, after reading "If there were just some way to fatten this bird," looked at the chicken walking up the path toward her house in Image 4B before continuing to read the sentence. In these instances, the children were not having difficulty with word identification, but

seemed to be engaged in the oscillation between words and images (Sipe, 1998) that leads to integrative processing (Mason, Tornatora, & Pluchino, 2013).

In summary, many factors including the placement and content of images affected how children used the images during reading, including children's own personal strategies such as looking at images before and after reading a page or section of text. Because this study included only six third grade children reading two different versions of a single story, additional research should be done to explore the reading of children of a variety of ages across different texts. Such research might shed additional light on children's personal strategies and might explore children's development over time of strategies for image use, the effects of strategy instruction, and the impact of different verbal/visual arrangements.

Discussion

Proponents of children's literature have long argued that images are a crucial part of the text (Genette, 1997; Golden & Gerber, 1990; Higgonet, 1990), and research has suggested that children use verbal and visual information to construct meaning (Duckett, 2001; Hannus & Hyönä, 1999; Mason, Tornatora & Pluchino, 2013). This study, through the use of both oral reading and eye tracking, not only documents that children make use of the relationship between the verbal and visual texts, but also helps to clarify factors that influence children's use of images.

Children in this study all used images in a variety of ways. Although there was variation in the percentage of total reading time attributed to images, all the children focused to a greater extent on print than on images. These results are different from Evans, Saint-Aubin and Landry (2009) who found that young children paid more attention to images than to print when stories were read to them. Our results, however, are in agreement with Roy-Charland, Saint-Aubin and Evans (2007) who found that more attention was paid to print when the print was within the children's reading ability. Since our subjects were reading independently, they paid more attention to print than to images, but images were an important focus during reading.

Use of images seemed to occur smoothly when placement of images and print were clear but one arrangement appeared to be problematic. Children who read the adapted version seemed to have difficulty determining which pictures of the verbal text were related to the various images on one page of the story as shown by their transitions between images and print. It appears that, in this instance, the placement of multiple images and sections of texts required an increased number of transitions to integrate the processing of words and images.

Additionally, these children demonstrated the use of personal strategies for making the most of images and of the relationship between images and print. While children sometimes looked at images to support word recognition, they used images to a greater extent to construct meaning. This builds on previous research on first grade students that showed a similar deliberate use of images by readers, not just when they had difficulty with the text, but also to prepare for reading a page and to confirm meaning (Arya & Feathers, 2012).

Finally, the patterns of eye movements, what Kress and van Leeuwen (2006) refer to as reading paths, suggest that the construction of meaning was an important factor in

reader choices of what images to examine and what to focus on in those images. They focused on images that provided important information and paid less attention to those that did not provide new information, and they focused on specific items in the images that were vital to text understanding. This was seen in the decrease in fixations across images of the chicken's house in the authentic version and in the higher number of fixations on Image 12B in the adapted version. Children also focused more frequently on characters and objects discussed in the verbal text, findings consistent with research by Evans and Saint-Aubin (2005) and Verhallen and Bus (2011). However, this study extends our understanding to children reading a story independently, and reveals that these children engage in practices that are different from children listening to a story. These independent readers looked at images before they began to read. Additionally, although these readers focused on items in images that were mentioned in the verbal text, their decisions about what to examine in images was also influenced by other factors such as layout, redundancy of information, and personal strategies. This deliberate use of images suggests that the children viewed the text as semiotic space.

Implications

Building on the results of this study which has helped identify when and how children use images during reading, it seems logical that reading instruction should expand beyond a focus on the verbal text and provide extended opportunities for children to engage in discussion of visual aspects of a variety of texts. Children should be taught how to read illustrations, understand the grammar of visual images and visual design in picture books, and given time to think and talk about the art in picture books (Arizpe & Styles, 2003; Lewis, 2001; Sipe, 2000). As suggested by Frey and Fisher (2008), these discussions should not be considered extension activities that occur after the verbal text is understood but an integral part of text processing. This is important for all children, but especially for those young at-risk or struggling readers whose instruction often predominately addresses word identification. These children may be better served by teaching them how to effectively use the visual aspects of texts in support of and in conjunction with the verbal aspects.

These results also have implications for the commercial reading programs that are used for reading instruction as they often involve adaptations that delete images and re-arrange both images and text (Feathers & Bochenek, 2006; Hoffman, Sailors & Patterson, 2002; Reutzel & Larson, 1995). Given the important role that images play in texts as well as the importance of arrangement of text and image on a page, more thought should be given to adaptations made to texts used in these programs so that they will better support developing readers.

Additionally, given the increased use of multi-modal texts, that is, those that involve both images (visual) and words (verbal), especially on internet sites, it is vital that we understand the impact of both visual and verbal features of texts. This study provides avenues of research, involving complex examination of oral reading, eye movements, and text design that can help educators better understand the complexities of the reading process, especially the processes that readers use in these multi-modal texts. Such studies could lead to practical applications such as selection of reading material by schools and school districts, the development of more effective reading material, and the

development of specific instructional strategies to encourage the use of visual features and also to assist readers in engaging with particular visual features.

Acknowledgements

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