Research Reports

The Effect of Tactile Illustrations on Comprehension of Storybooks by Three Children with Visual Impairments: An Exploratory Study

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In tactile illustrated books, the reader has to explore the tactile picture in order to interpret its meaning and to associate it with the text content. As is the case with sighted children (Carney & Levin, 2002), tactile illustrations could be beneficial for language and literacy development of visually impaired children (that is, those with blindness or low vision) (Hatwell, 2001; Heller & Gentaz, 2014; Miller, 1985) and should help them in understanding and remembering the story (Stratton & Wright, 1991). However, the identification of tactile illustrations is not simple, and it varies according to the characteristics of the tactile pictures, the level of visual experience of the participants (Heller, 1989; Lebaz, Jouffrais, & Picard, 2012; Lederman, Klatzky, Chataway, & Summers, 1990; Thompson, Chronicle, & Collins, 2003, 2006), prior experience with tactile pictures (Theurel, Witt, Claudet, Hatwell, & Gentaz, 2013; Valente & Darras, 2013), and the task's demands (Picard & Lebaz, 2012).

Several studies showed that outlined 2-D representations of objects can be hard to understand by children and adults with visual impairments (Heller & Gentaz, 2014; Heller, McCarthy, & Clark, 2005; Lederman et al., 1990; Picard & Lebaz, 2012). Indeed, the haptic system is very efficient in the processing of material properties of objects but is less so in the processing of spatial properties that characterize 2-D illustrations (Klatzky, Loomis, Lederman, Wake, & Fujita, 1993; Lederman & Klatzky, 1987). Moreover, studies showed that blind children identify the object more easily through textured 2-D illustrations than through outlined and thermoformed illustrations (Theurel et al., 2013; Thompson et al., 2006). Texture is a material property that helps the haptic identification of both 3-D objects (Klatzky, Lederman, & Metzger, 1985; Klatzky et al., 1993; Morrongiello, Humphrey, Timney, Choi, & Rocca, 1994) and their representation.

The use of 3-D manipulable objects might be another encouraging way to illustrate storybooks. In a study analyzing a book-reading activity using 2-D and 3-D illustrations, Bara (2014) showed that visually impaired children used a wider variety of exploratory procedures with 3-D illustrations than with 2-D illustrations, which suggested that these children were able to collect more information with the former kind of illustration technique.

The aim of this study was to examine the effect of the presence or absence of illustration as well as the effect of the type of illustration on the processing of information in a short story. In this exploratory study, three 6-year-old children with different levels of visual impairment participated in a joint book-reading task. During the task, the children needed to listen to the story and to explore the illustration. How the child interacted with the adult and with the book during reading, and what he was able to recall about the story, were examined as clues to the process of understanding the story.

Methods

Individuals with visual impairments

Three 6-year-old children, recruited from a local center for visually impaired individuals,

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participated in this study. All of them were included in a general education school and were supported by specialist teachers and educators who intervene in the class or at the center. They were enrolled in the school grade expected for their chronological age (first grade). The teacher's regular assessments at the school did not show any differences between the three children in language, verbal comprehension, or reasoning. None of them presented any known cognitive or psychiatric disabilities. They had infrequent use of illustrated books at school, and never at home (more details about the participants are available in Table 1).

Written consent was obtained from the parents of each child participating in the study and from the educator. This research respects ethical principles for research involving human subjects (World Medical Association Declaration of Helsinki), and was approved by the center for blindness and visual impairment as well as by the University.

Materials

The three books used contained 10 pages. They were distinguished from one another by the types of illustrations (see Table 2). Three stories were made up, based on the original story by Claude Boujon, La chaise bleue (The Blue Chair). In the original story, two characters (a wolf and a dog) find a simple object (a chair) that is transformed into a world of fantasy and becomes a house, a boat, a castle, and a playground. The game is stopped by a third character at the end of the story. Table 2 presents the characters and the transformations of the object for each book tested.

In a preliminary control study, the vocabulary used in each story was evaluated by the teachers as easily understandable based on their knowledge of the children's language level.

Procedure

The books were read by the same educator in charge of the three children, to avoid variabil-

Table 1
Profiles of the participants.

Participant	Gender	Age	Category of visual impairment	Cause of deficit	Literacy	Specificities of visual impairment
Bastien	Male	6 years, 3 months	Low vision	Albinism	Just starting to learn braille and print simultaneously	High hypermetropia, astigmatism, strabismus, photophobia, and nystagmus
Mathias	Male	6 years, 3 months	Low vision	Optic nerve glioma	Just starting to learn braille	Globally reduced residual visual capacity; perception of motion with the left eye
Edouard	Male	6 years, 3 months	Congenital blindness	Retinal malformation	Just starting to learn braille	Globally reduced residual visual capacity; no perception of shapes

Table 2
Materials.

Book type	Characters	Object found	Tranformations of the object	Final character
No illustrations	A turtle and a rabbit	A wooden box	A wooden hut, a racing car, a trampoline, a tom-tom, a sailing boat, and a picnic table	A fox
2-D illustrations	A ship and a little girl	A fishing net	A jump rope, a hammock, a parachute, something to climb trees, a magic carpet, and a backpacking tent	A hen
3-D illustrations	A dog and a monkey	A tractor tire	A secret hiding place, a trampoline, a swing, a buoy, a spaceship, and a rolling game	A camel

ity in how the books were read. Before each page of the book was read, the child was encouraged to explore the illustration once to give him an idea of what it contained. The child was free to explore the illustration as long as he wanted and to ask questions or make comments during the reading. After the reading phase, the child was invited to freely recall the story with as many details as possible. Each child participated in three individual reading sessions, one for each book, with an interval of one week between each session. The order of books was different for each child. The reading sessions were videotaped and analyzed.

Two research assistants, unaware of the purpose of the experiment, coded the videos. They transcribed the verbal exchanges between the child and the educator during the reading and the recall of the story. For each story, they rated the match between the text and the manual exploration. The text was split up into 29 propositions that could be matched with a tactile exploration. For example, when the text mentioned "the girl" it was expected that the child touched or held the girl illustration. One point was awarded each time the child touched the correct part of the illustration (2-D illustration; see Figure 1) or when he held the correct character or made the appropriate action (3-D illustration; see Figure 2). The number of verbal comments during reading, the number of matches between the text and the manual exploration, and the number of story elements recalled by the children were collected. Each child received a matching text-exploration score based on the concordance between what was read and what part of the illustration he explored. Each child also received a score for his

Figure 1. A participant exploring a 2-D illustration.

Figure 2. A participant exploring a 3-D illustration.

Table 3
Number of verbal interactions, the percentage of correct text-exploration matches, and the number of correct details recalled.

Participant	No illustrations	2-D illustrations	3-D illustrations
	Number of verbal interactions during reading		
Bastien	3	23	17
Mathias	0	9	6
Edouard	0	11	2
	Percentage of correct text-exploration matches during reading		
Characters			
Bastien	0	40.9%	83.3%
Mathias	0	68.2%	66.7%
Edouard	0	81.8%	77.8%
Transformations			
Bastien	0	100%	100%
Mathias	0	100%	100%
Edouard	0	100%	100%
Total			
Bastien	0	55.2%	90%
Mathias	0	75.9%	80%
Edouard	0	86.2%	83.3%
	Number of correct details recalled after reading		
Characters			
Bastien	5	4.5	4
Mathias	5	5	6
Edouard	6.5	5	5
Transformations			
Bastien	6	7	7
Mathias	5	4	7
Edouard	3	4	8
Other information			
Bastien	2	5	3
Mathias	3	5	6
Edouard	3	3	2
Total			
Bastien	13	16.5	14
Mathias	13	14	19
Edouard	12.5	12	15

recall of the story based on the number of details he spontaneously gave about the characters (for instance, their name or the color of the object), the object transformations, and other details present in the story. The percentage of agreement between the two coders was 100% for the verbal interactions, 88% for the text-exploration match, and 96% for the recall scores. For the propositions the two coders disagreed with, the video was watched again and discussion between the two coders and the researcher led to agreement.

Results

Table 3 presents the number of verbal interactions, the percentage of correct text-exploration matches, and the number of correct details recalled for the three children.

Taking into account their specificity (same age, but different visual impairment level), we analyzed each case independently. This descriptive analysis allowed us to have an accurate view of what happened during the reading sessions and of what the children remembered about the story.

Case 1: Bastien

Bastien (a pseudonym) made more verbal comments with the presence of illustrations. With 2-D illustrations, verbal comments allowed him to anticipate the transformations and to suggest a possible use for the object. With the 3-D illustrations, the verbal comments allowed him to explain how to transform the object. The match between text and manual exploration was higher with 3-D illustrations than with 2-D illustrations for the characters. Concerning his recall of the story, there was no noticeable difference between the three illustration conditions. The 2-D illustrations led to recall of additional details about the story.

Case 2: Mathias

When the story was not illustrated, Mathias (a pseudonym) made no verbal comments. With 2-D illustrations, the verbal comments were used to show that he understood the transformations or to verify that he correctly understood the illustrations. With 3-D illustrations, his comments showed that he understood the transformations, and he explained what to do with the objects ("Yes, he has to jump"). There were no noticeable differences between the two kinds of illustrated books concerning the text-exploration match. The number of story details recalled was slightly higher with the 3-D illustration condition in comparison to the two other conditions.

Case 3: Edouard

When the story was not illustrated, Edouard (a pseudonym) made no verbal comment. With 2-D illustrations, he asked some vocabulary questions to better understand some words ("hammock," "parachute") or to better understand the illustrations. With 3-D illustrations, few verbal comments were made. He manipulated the objects but did not speak at the same time. The text-exploration match was high in both conditions, which means that the child understood what happened in the story and what the illustrations represented. The number of details recalled was higher with the 3-D illustrations, especially for the object transformations. There were no noticeable differences between the condition with no illustration and the condition with 2-D illustrations. Note that one of the two transformations that were not understood during reading was recalled.

Discussion

Overall results showed that the absence or presence of illustrations influenced the number of verbal interactions between the child and the reader. When no illustration was provided, the three children listened to the story quietly and most of the time asked no questions of the adult. When exploring illustrations of both kinds (2-D or 3-D), children were more active, adding verbal comments while exploring the illustration or making the actions with the miniaturized objects.

Concerning the free recall of the story, the number of items recalled was slightly lower when no illustration was provided, especially for recall of the object transformations. On the one hand, as is the case for sighted children, we can expect that the redundancy of the verbal and the pictorial information strengthen memory traces and facilitate recall. On the other hand, processing of the tactile and verbal information at the same time might increase the memory load and, in turn, lower the performance. The illustrations may have helped memorization, but the effect was not as large as could have been expected.

As shown in other studies, different illustration techniques make the identification

more or less easy (Theurel et al., 2013; Thompson et al., 2006). Our results suggest that the children were able to identify accurately the 2-D and the 3-D illustrations. Bastien was able to anticipate the text content by exploring the 2-D illustrations' pictures. For the other two boys, some tactile illustrations were not perfectly understood, and they asked the reader about the link between the text content and the illustration. Overall, the 3-D illustrations were well understood and the three children were able to reproduce all the transformations with the objects.

Individuals with low vision are often at an advantage in the perception and interpretation of tactile displays because of their familiarity with pictures and increased haptic skills (Heller, McCarthy, & Clark, 2005). This difference might explain why the 3-D illustration technique was effective for the child who was congenitally blind, who exhibited a high level of recall with this technique.

Some limitations of the research need to be pointed out. First, what we observed with only three children is not generalizable to the general population. However, an original methodology has been validated that could be used in a future study with a larger sample in order to help designers improve tactile books. Second, the stories were repetitive. The same structure was chosen in order to control the kind of story in the three reading conditions. The children might have been familiar with this text structure and might have anticipated the text. Even if the order of the books was not the same for the three children, it might have affected the results. Third, the kind of story and the assessment lean towards memory processes more than understanding. The children were asked to recall the story, not to make links between the parts of the text.

Conclusions

There is no doubt that illustrations in storybooks are beneficial in allowing children to understand and remember the stories. However, it is important to think about how to illustrate tactile books and to precisely assess the effects of the illustration techniques on reading and understanding. Few tactile illustrated books exist, and they are often inadequate, since they are mainly based on a visual approach (converting a visual picture into bidimensional tactile representation). We advise teachers of students with visual impairments and other practitioners to add 3-D elements with which children with visual impairments can interact (for example, miniaturized objects or pop-up illustrations). In our point of view, these 3-D illustrations that are based on real environmental objects, available both to children who are sighted and to those who are visually impaired, could create communication bridges between these two communities during shared book-reading activities in class.

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The Behavior Problems Inventory–Short Form: Utility for Children and Adolescents with Visual Impairments

Markus Lang and Klaus Sarimski

Several studies reported a higher prevalence of maladaptive behaviors in children and adolescents with visual impairments (that is, those who are blind or have low vision) compared with typically developing youths. Early studies reported that up to 57% of youths with visual impairments also have mental health problems (Jan, Freeman, & Scott, 1977; Tirosh, Shnitzer, Davidovitch, & Cohen, 1998). More recent studies found that approximately 25% of these children and adolescents have persistent problems with mental health (Maes & Grietens, 2004; Pinquart & Pfeiffer, 2014; Sharma, Sigafoos, & Carroll, 2002). These include problems with attention, anxiety, decreased initiative and communication, aggression, and low self-esteem. Some of the children and adolescents with visual impairments

