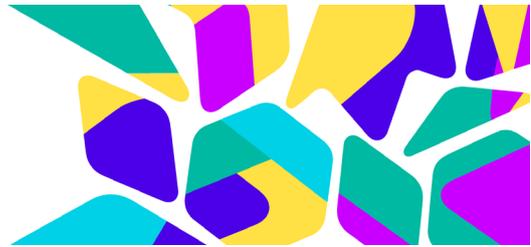


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Enhancing Interactivity: How has design exploration of physically and intellectually interactive picturebooks enhanced shared reading?

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Abstract: Children’s book design can have a significant impact on shared reading practices, interaction, and engagement. We hypothesise that books designed with the intention to specifically enhance the author’s story through interactivity will provide opportunities for new experience design outcomes that are both human-object and human-human centred. The multi-faceted problem of children’s books has been explored by linguistics, history, and education researchers, yet seldom using a design lens. In previous work we developed a traditional and highly interactive picturebook which we observe here being used by families. The study explored how physical and intellectual enhancements change the level and types of interaction within a shared reading environment. The inclusion of physical and intellectual enhancements within the book promote a greater level of interaction and engagement from the parent and child. However, this is only the case if the enhancements provide meaningful interaction, and have relevance to the story. Our results provide design solutions for designing effective children’s books in the future.

Keywords: picturebooks; interactive books; children’s books; paper engineering

1. Introduction

Shared reading between a parent and child is an important opportunity for learning, development, and growth for young minds. Children’s books, including picturebooks, whether used by individuals, or in shared reading situations, enable a wide range of learning opportunities. Children’s books also afford the opportunity to engage readers in interactive learning and reading experiences that could further enhance the shared reading experiences as well as the learning opportunities. However, the level of interaction and engagement that occurs within these shared reading sessions has the potential to vary greatly depending on the parent, child, and the design features within the book itself. Given the many variables



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that lead to interaction and engagement in shared reading sessions we believe that further investigation into the design of books that encourage reader participation is required.

In this paper we focus our work on children's picturebooks. An expansive definition of a picturebook was provided by Bader (1976):

A picturebook is text, illustrations, total design; an item of manufacture and a commercial product; a social, cultural, historical document; and foremost an experience for a child (p. 01).

Put simply, Kiefer states that a picturebook can be described as "an artefact of culture that contain[s] visual images and often words" (Kiefer, 2010, p. 01). In our work we posit a definition whereby a picturebook can be understood to be a book in its many forms (physical or electronic as well as the many sub classifications therein) that may combine text and image in some form. Specifically, in this paper we are concerned with physical picturebooks.

Previous work has investigated design features of successful children's picturebooks, and recommendations for appropriate language and story content (e.g. Hall, 1990; Bloom, 2002) and imagery (e.g. Piro, 2002; Gibbons, 1999) have been presented in the literature. In turn, there has been a broad range of home and school education techniques developed to encourage successful shared reading practices. Missing from the literature is evidence to support the design of highly interactive picturebooks that enhance shared reading. Interactivity provided by picturebooks and the experience of shared reading is hypothesised to support learning (e.g. Cheng and Tsai, 2014). Piehl (1987) explains that interactive features should be included to enhance the narrative of the book or, in the case of non-fiction interactive books, help the reader to better understand the textual content.

Examples of interactivity in printed books discussed in the literature have included physical interactions that draw upon the basic learning principle of 'touch', as discussed by Silverman (2006) or as Goodwin (2008) suggests, "invite involvement" (p. 29) or exploration of the content and more recently augmented reality exploration (e.g. our related work; Vanderschantz et al. 2018 & 2019).

Considerations relating to children's digital books have also featured throughout the literature including for example interaction design (e.g. Vanderschantz and Timpany, 2012; Wasik and Bond, 2001) and typographic design of electronic texts (e.g. Vanderschantz, 2009; Vanderschantz et. al. 2010; Walker and Reynolds, 2000). We posit that specific consideration of the interactive properties of books provide opportunities for enhanced reading experiences and could further enhance the shared reading experience. We therefore propose investigation into features of interactivity that would create numerous opportunities for interaction with the book and could therefore be considered a *highly interactive picturebook*. This potential for synergising the literature and providing guidance for designers is central to the research presented in this paper.

We present a user observation study that compares a traditional children's picturebook with an interactive children's book designed specifically to provide meaningful human-object and

human-human interactions. Seven families with children aged between four and six years old participated in a series of user observation studies and from these we identified increased interaction amongst parent and child when presented with the highly interactive version of the picturebook. The results provide design solutions and frameworks for the successful design of children's interactive books in the future.

2. Related Work

The value of children's books has long been advocated, with researchers showing that children's books are important not only for learning literacy, but also aspects of problem solving, socialisation, hand-eye coordination, creativity and understanding the world (Freedman-DeVito, 2004). It is important for children to be able to emotionally engage with picturebooks and identify with the story quickly (Goodwin, 2008), allowing them to become involved in the narrative and have an active desire to discover the outcome (Norton, 2011). We focus the related work on discussion of interactivity, particularly with reference to physical objects including books, and how interactivity can enhance shared reading situations.

2.1 Interactive Books

'Interactive' is a broad term that encompasses a wide range of variables. "Interactivity is a theoretical construct that grapples with the origins of captivation, fascination, and allure" (Rafaeli and Sudweeks, 1997, para. 1). Rafaeli and Sudweeks (1997) state that interactivity is not tied to a medium, but is a communication process. When defining interactivity types of affordances can be identified based on the role they play in supporting interactivity, physical affordance and cognitive affordance based on the work of Norman (1999), as well as sensory affordance and functional affordance (Harston, 2003).

Interactivity occurs in message-based, and participant-based, dimensions and on continua from low to high on each of these dimensions (Downes and McMillan, 2000). The attempt by Downes and McMillan (2000) to define interactivity reveals that there are many variables when describing interactivity and the motivation of the individual in the interactive environment plays a part in determining how interactive an environment is.

Interactivity during reading occurs in a range of ways. Interaction can be naturally afforded by the physicality of a traditional book, while designers, authors, and publishers also incorporate intentionally interactive features into books by way of illustrations, text presentation, textual instruction, or physical enhancements. Selznick (2008) suggests that at its most basic level interactivity with a book comes with the turning of the page. Silverman (2006) discusses the importance of physical engagement by stating that, "learning comes through touching and physical sensation. Thinking is anchored by movement, and touch..." (p. 71). This physical interaction is one of the earliest forms of learning, and consequently is why 'touch and feel' interactive books are so effective and engaging for young readers. The *Smithsonian Institution Library* discusses how "movable and pop-up books teach in clever

ways, making the learning experience more effective, interactive, and memorable” (National Museum of American History, 2010, p. 7). By promoting a hands-on approach to learning – both figuratively and literally – interactive books allow the depiction of a written concept in visual form. While there are potentially many benefits of using pop-up books in educational contexts, Taylor and Bluemel (2003) also highlight the benefits of using interactive books in shared reading situations.

Timpany and Vanderschantz (2012) investigated interactivity in printed books and identified two types of interaction, *Physical Interactions* and *Content Sequencing Interactions*. Timpany and Vanderschantz suggested that in a book interaction can be identified as occurring through both the physical enhancements of the page itself (physical interaction), as well as the intellectual enhancements that promote interaction in the form of questions, answers, and sequencing of content (content sequencing). That is to say, a reader can interact with both the physicality of the book as well as with the content of the book. Timpany and Vanderschantz suggest that interactive features of books encourage further interaction as well as providing learning tools that can assist the child to understand a new concept either physically or intellectually.

Timpany and Vanderschantz’s (2012; 2013) research provided the first categorisation system to aid researchers and publishers to describe interactive properties of children’s books and can be used when analysing, selecting and designing children’s books. Their classifications (see Table 1) provide a way to discuss, analyse and understand the interactivity levels within children’s printed books and how this leads to reader interaction.

Timpany and Vanderschantz concluded that interactivity can be viewed as a continuum, where the medium of the book demands different types of interaction from its readers in order for the content to be consumed. They suggest that with a more complex enhancement, children will be prompted to interact and engage with the book at a deeper level. That is to say, depending on the level of interactivity, interactive children’s books allow young readers to become more engaged in the literary experience and gain more from the book. Timpany and Vanderschantz recommend that children’s books be designed with these frameworks in mind in order to ensure that children gain the greatest enjoyment and educational possibilities from reading sessions. To date the literature does not describe works that have been developed specifically to engage high levels of interactivity nor have these works been tested with users.

Table 1 Timpany and Vanderschantz (2012) Dual Categorisation System for Describing Children’s Interactive Printed Books. Physical Enhancement (L) and Content Sequencing (R).

<i>Physical Enhancement</i>	<i>Content Sequencing</i>
Level 0 - Reader is required to open book and turn pages	Level 0 - Reader’s attention is guided in a linear course through page content
Level 1 - Reader is required to open book and turn pages with some additional interaction within the book	Level 1 - Reader’s attention is intentionally guided in a non-linear course around page content
Level 2 - Reader is required to open additional inner pages to reveal further content	Level 2 - Reader’s attention is intentionally guided in a non-linear course around page/book content and drawn back and forth between set areas of contrasting content
Level 3 - Reader is required to lift flaps, turn wheels, pull tabs, push buttons etc	Level 3 - Reader is required to solve puzzles/challenges to/or determine the order in which the pages are read
Level 4 - Reader is required to interact with multiple layers of interactive elements or create/arrange content themselves	Level 4 - Reader is required to progress through the book by making decisions that will affect the ultimate story line
	Level 5 - Reader is required to carry out activities or actions guided by content of the book externally

2.2 Shared Reading

Shared reading is the act of a child and adult reading together, and is widely considered to be beneficial for helping with early literacy and language development (Ezell and Justice, 2005). Shared reading is suggested to promote both a child’s understanding as well as their engagement with texts and stories (Worthy et al. 2012). The practice of shared reading enables one-on-one learning, where the child can progress from not being able to read, to being able to read independently. Goodwin states that adults within shared reading situations “act as mediator between the text and the book” (2008, p. 30), therefore helping the child in this transition from non-reader to independent reader. Shared reading is important for children’s literacy development not simply because of the act of a child listening to a parent or caregiver read, but through observing, participating in, and interacting with the reading experience (Justice and Kaderavek, 2002).

The quality of shared reading experiences impacts the facilitation of language development, particularly that of expressive language development (Fletcher, 2005). Girolametto and Weitzman (2002) discuss three key behaviours and their associated techniques designed to gain responses from young readers and promote further learning and engagement; Child-oriented responses, Interaction-promoting responses and Language-modelling responses. These three “responsiveness” behaviours, explored further by Ezell and Justice (2005), rely on parents reacting to situations and acting accordingly. Han and Neuharth-Pritchett (2013)

investigated strategies that can help to maximise the benefits of at home shared reading with pre-schoolers. They classified the shared reading practices between a parent and child into meaning-related or print-related. These dialogic reading practices were identified when the child and parent become active partners in the reading experience through meaningful interactions, including providing feedback and asking questions which Han and Neuharth-Pritchett refer to as “wh- questions”, or “who”, “what”, “where”, “when”, and “why” questions. These features of shared reading identified in the literature all highlight the role of interaction in shared reading. Interaction between adult and child, interaction between adult and book, and interaction between child and book.

While it is clear that the role of the adult in a shared reading situation is critical it is fair to assume that not all adult reading partners will be well versed in structuring a reading situation that is optimal for a child’s development. Mol et al. (2008) discuss that interactive reading techniques were not spontaneously applied in observational studies, suggesting that parents need training on how to practice these techniques to assist with teaching language. Bus et al. (1997) go so far as to suggest that helping participants to improve their reading habits is required to fully support and facilitate effective learning for young people in shared reading situations. Certain features and criteria enable shared reading to be more productive, depending on the choice of book and the participation of both parent and child. A book chosen for shared reading should “invite involvement” (Goodwin, 2008, p. 29) from both the child and the parent. The interaction between the parent, child, and book can become a “process-related communication” as discussed by Rafaeli and Sudweeks (1997). In this regard, any reading experience when properly facilitated by the parent can become a shared reading experience. By utilising books with engaging content that challenge the young reader, children will be encouraged to push themselves and strive to understand at a higher level (Goodwin, 2008). Given the need to further support adults, caregivers and parents to facilitate meaningful learning opportunities and interactions with picturebooks for their children we hypothesise that books that are designed with interaction as a central premise will assist with improving shared reading situations.

3. Method

We undertook a user observation study to investigate how interactive features in children’s picturebooks change the interactions, engagement, and book use between a parent and child in a shared reading situation.

This research sets out to determine;

- How do children and parents interact with books during shared reading sessions?
- Do interactive features of books affect how parents and children use books?

3.1 Procedure

Seven families were invited to participate in two 20-minute shared reading observation sessions. These sessions were video recorded and manual field notes were taken. Each session included an observation of shared reading and a post-observation semi-structured interview. An initial interview was conducted before the first observation session to capture demographic information and an understanding of the child and parents' reading habits. Interviews and observations were conducted with all seven families in their homes, and at times that were selected by the families.

Table 2 Coding and categorisation of interactions.

Observations	Theme Code	Classification	Code	Physical	Intellectual	Non-Book
Emphasis	1	Voices -parent	1.1	1.1.1	1.1.2	1.1.3
		Exaggeration – parent	1.2	1.2.1	1.2.2	1.2.3
		Exaggeration – child	1.3	1.3.1	1.3.2	1.3.3
		Pointing out feature – parent	1.4	1.4.1	1.4.2	1.4.3
		Pointing out feature - child	1.5	1.5.1	1.5.2	1.5.3
		Singing – parent	1.6	1.6.1	1.6.2	1.6.3
		Singing – child	1.7	1.7.1	1.7.2	1.7.3
Physical	2	Touching book – parent	2.1	2.1.1	2.1.2	2.1.3
		Touching book – child	2.2	2.2.1	2.2.2	2.2.3
		Actions – child	2.3	2.3.1	2.3.2	2.3.3
		Actions – parent	2.4	2.4.1	2.4.2	2.4.3
		Noises – parent	2.5	2.5.1	2.5.2	2.5.3
		Noises – child	2.6	2.6.1	2.6.2	2.6.3
		Looking closer – parent	2.7	2.7.1	2.7.2	2.7.3
		Looking closer – child	2.8	2.8.1	2.8.2	2.8.3
Questions	3	Reader – Child	3.1	3.1.1	3.1.2	3.1.3
		Child – Reader	3.2	3.2.1	3.2.2	3.2.3
		Book – Child	3.3	3.3.1	3.3.2	3.3.3
Answers	4	Reader – Child	4.1	4.1.1	4.1.2	4.1.3
		Child – Reader	4.2	4.2.1	4.2.2	4.2.3
		Child – Book	4.3	4.3.1	4.3.2	4.3.3
Comments	5	Reader	5.1	5.1.1	5.1.2	5.1.3
		Child	5.2	5.2.1	5.2.2	5.2.3

Following the initial interview, the child and parent took part in the first observation, a shared reading of the traditional (control) version of '*Hannah's Favourite Place*'. The second session took place no earlier than one week after the first reading observation and involved observing the parent and child participating in shared reading with the interactive version of '*Hannah's Favourite Place*'. After each of the shared reading sessions, a short semi-structured interview was conducted that asked the parent and child questions about how they interacted with and used the features of the book, and what they enjoyed about the book that they read.

Parents and children were interviewed, interactions with the books were video recorded with audio, and photographs as well as researcher notes were taken. Observations of the observed interactions by the parents and children and how these were guided by the book features, were coded according to the categorisations presented in Table 2. The codes used were developed to encode whether the observations noted were based on; emphasis, physical interactions, asking questions, answering questions or commenting. Emphasis interactions were encoded when a participant made voices, exaggerated a word, or sang. Physical interactions that were coded included touching the book, making actions or acting out the story (some of which included noises). Question and answer interactions were those between child and adult and may have been prompted by the book, or by the readers themselves. Finally, comment interactions were used to code general discussion throughout the reading session.

3.2 Materials – Hannah's Favourite Place

For this study we use the book '*Hannah's Favourite Place*' by Fiona Mason. *Hannah's Favourite Place* was developed as a research tool specifically to allow comparison between a book that includes no specifically designed interactive content (referred to throughout as the *traditional picturebook*), and one that encourages interaction through the inclusion of purposefully designed and developed interactive elements that enhance the story and the reading experience (referred to as the *highly interactive picturebook*). The two books have the same narrative and base illustrations in order to facilitate direct comparisons of the opportunities created by the different book formats.



Figure 1 Front Cover (L) and Spread 2 (R) of the traditional picturebook version of Hannah's Favourite Place.

The highly interactive picturebook (Figure 2) that was developed incorporated a range of physically and intellectually interactive enhancements throughout the book. Design decisions were taken to develop a highly interactive book that rates high on both of Timpany and Vanderschantz (2012) physical and content sequencing scales (see Table 1). We took cues from Timpany and Vanderschantz as well as the wider literature in order to develop this interactive printed picturebook. While we set out to design and implement a highly interactive picturebook when developing Hannah's Favourite Place, we were guided by the assumption that there is a fine line between being an effective reading tool and simply a game or an interactive feature that exists with little purpose. Itzkovitch (2012) argues that interactivity must be considered to ensure the reader is engaged in learning experiences that are enhanced by the interactive reading experience and are not distracted from the reading or learning intention. Timpany et al. (2014) expand on this based on their shared reading study stating that activities or games that are inconsequential or included 'for the sake of it' have the potential to add nothing to the storyline, and may in fact hinder the overall learning experience.



Figure 2 Front Cover of the traditional picturebook version of *Hannah's Favourite Place* (L) and Spread 2 of the of the highly interactive picturebook version of *Hannah's Favourite Place* (R).

When developing the highly interactive picturebook we implemented physical (see Table 3) and intellectual enhancements (see Table 4) aimed at promoting both physical as well as intellectual interactions. Our goal was to develop enhancements that would promote multi-faceted learning opportunities and afford human-object as well as human-human interactions.

Table 3 *Hannah's Favourite Place* physical enhancements

Spinning Wheel
Simple and complex pop up structures
Tactile Letters
Lift the Flaps
Envelopes containing objects
Pull tabs
Windows
Moving elements – swinging jack
Accordion mechanisms
Sliders
Dry-Erase page

An example of the physical enhancements includes the addition of a tactile alphabet letter on each page to promote letter recognition through physical interactions. Another example is that each spread’s illustration was enhanced with a tactile or illustrated ‘hidden’ cupcake for search and find activities that afforded both physical and intellectual interaction. Table 3 presents the physical enhancements included in the book. Further intellectual features were included in the form of goals that are listed in the front of the book, along with instructions to guide the parents in the shared reading activities provided. The goals were designed to encourage parents to focus on different aspects of the book and to assist parents to adjust the reading experience according to a level appropriate for their children. Table 4 presents the intellectual interactions included in the book.

Table 4 Hannah’s Favourite Place intellectual enhancements - goals

G1	Find the cake or cupcake on each page
G2	Point out the letters and talk about the alphabet
G3	Talk about words, meaning and spelling
G4	Find something to count on every page
G5	Find different shapes, talk about them and draw them
G6	Identify the colours
G7	Ask questions about the book and the real world
G8	Talk about your favourite places and draw them
G9	Imagine what your favourite place could be

3.3 Participants

We used the snowball recruitment technique to find participants through personal contacts, within the community, and through referrals. The participant sample included seven families, each with children between the ages of four and seven. Table 5 provides a detailed overview of the participant sample.

Table 5 Participant Sample - interactive children’s books

Family ID	Family 1	Family 2	Family 3	Family 4	Family 5	Family 6	Family 7
Age	5	4	4	6	6	4	4
Child	M	M	M	F	M	M	F
Parent	F	F	F	F	F	F	F

4. Results

Here we discuss the results of the two observation and interview sessions. To help illustrate the results of our observation study we will describe some of the individual family observations (paper limits mean we cannot describe all interactions made by each family).

4.1 Observation Session 1 — non-interactive picturebook

Session 1 was the first time that the families had seen and read *Hannah's Favourite Place*. During Session 1, all children stated that their favourite part of the book was the pictures with five of the seven parents also stating that they enjoyed the pictures. Four parents commented on their enjoyment of the text with Parent 4 describing the rhythm of the story as “Dr Seuss-y”. Alternatively, Parent 2 commented that they did not like the story due to the “made up word” (Glubmumpkin).

During Session 1 we noted a wide range of behaviour and interactions by the parents ranging from pointing out features of the book to asking questions and making comments. We noted the total number of interactions varied per family. Family 2 made the highest number of total interactions during Session 1 (149 total interactions) compared to Family 6 who made only four interactions (see Figure 3). The fact that the total interactions varied so greatly provides evidence for the need for educating parents about effective shared reading practices, and demonstrates that books themselves must give parents the tools for participating in such a way. We further detail the interaction types undertaken by the families in Figure 4. Figure 4 shows that each parent appears to approach interactions when shared reading in a different manner. No parent we observed used a high number of all interaction types, instead, typically favouring one or two interaction types. In the case of families 4 and 6 we see that they undertook very few of any interaction types, but still favoured one or two interaction types in the small number of interactions they had.

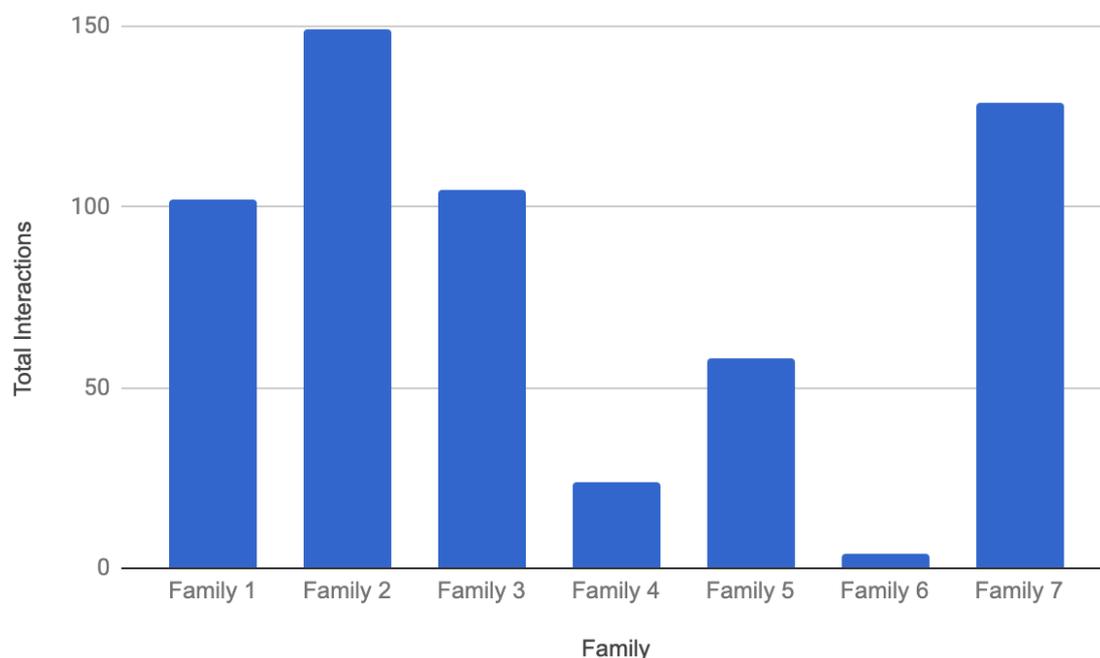


Figure 3 Total number of interactions by all 7 families – Session 1

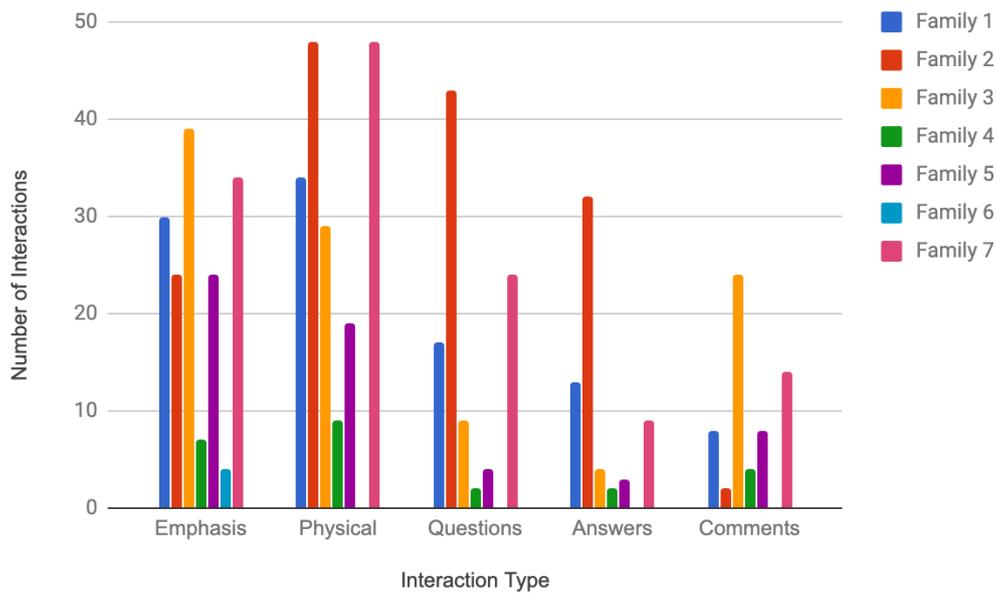


Figure 4 Total interactions by all families according to interaction type – Session 1

When asked about their reading session all parents stated that their actions were intended to keep their child interested in the shared reading experience. This shows an understanding of the importance of keeping children engaged in the shared reading practice, whilst demonstrating that the understanding and undertaking of effective shared reading practices varies greatly from family to family. Six parents believed engagement was accomplished by involving the child in the reading activity, and one parent (Parent 6) believed that, to keep the child attentive she had to read the book as fast as possible.

During the interview process, it was found that Family 1 participates in shared reading on a daily basis, with the parent actively seeking out aspects within books to “keep him listening... keep him engaged”. This shared reading practice was demonstrated in Session 1, with 102 interactions noted in total – 45 of these driven by the parent, and 57 by the child (see Figure 3). Parent 3 encouraged her son to touch and turn pages during the first observation session. When asked about this they stated that the practice “stimulates the brain and encourages him to explore”. This demonstrates Parent 3’s understanding of the importance of touch in the learning process, even in a non-interactive book. Family 4 included one of the oldest children in the study – 6 years old – during the initial interview, the mother stated that shared reading only occurs between the pair twice a week, however the child undertakes independent reading on a daily basis. Throughout both reading sessions, both mother and daughter took turns to read through the text.

4.2 Observation Session 2 – highly interactive picturebook

During Session 2 we again noted a wide range of behaviour and interactions by the parents and children. Family 2 again made the highest number of total interactions during Session

2 (400 total interactions) compared to Family 6 who still made the fewest interactions with only 100 interactions (see Figure 5). We further detail the interaction types undertaken by the families during Session 2 in Figure 6. The results in Figure 6 show that even though the number of interactions increased overall for all families each parent still seemed to engage more in one or two interaction types. Families 4 and 6 increased their numbers of interactions, but with a strong preference for physical interactions, as encouraged by the book. For all families the greatest number of interactions were physical, but the second most common interaction was either emphasis, questions, or comments.

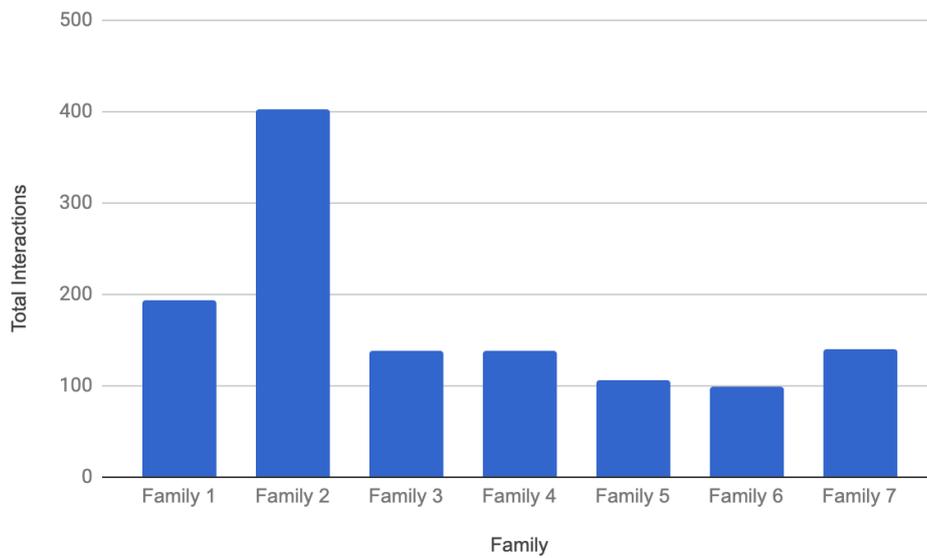


Figure 5 Total number of interactions by all 7 families – Session 2

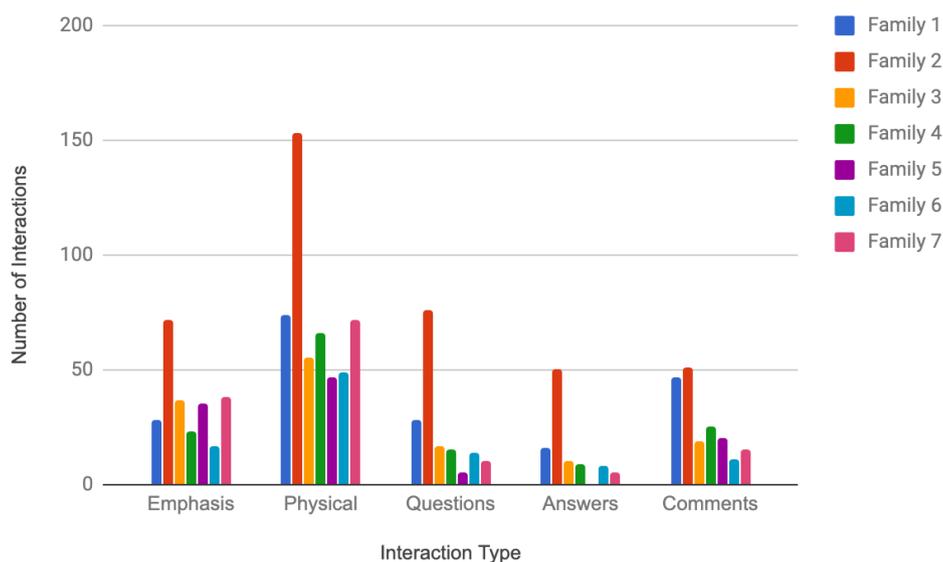


Figure 6 Total interactions by all families according to interaction type – Session 2

The total number of interactions more than doubled from Session 1 to Session 2 (571 to 1217, see Figure 7). The increase between Session 1 and 2 can directly be attributed to the physical and intellectual enhancements of the highly interactive version of *Hannah's Favourite Place*. Examples of these increases from session to session include Family 4 made only 24 interactions in total (see Figure 3) in Session 1, with 15 of these undertaken by the parent, and nine by the child. Yet, Session 2 saw a large increase in interaction from both parent and child (101 total interactions, see Figure 5). This is significant due to the fact that the pair rarely participates in shared reading in the home setting. This demonstrates that effective shared reading practices continue to be beneficial for children through their higher levels of reading and development. Equally, Family 6, a family who reads once a month together and who made only four interactions in the first session, made 99 in the second session. Out of the 138 total interactions noted in Session 2 by Family 3, 99 of these were driven by design features of the book (44 interactions were conducted by the parent, and 55 by the child).

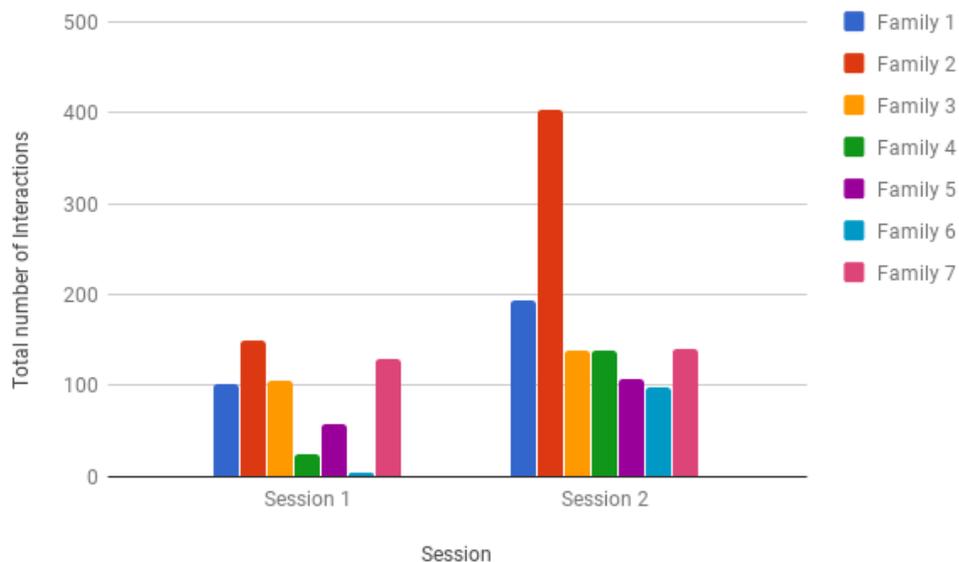


Figure 7 Comparison of total number of interactions per family over Session 1 & Session 2

Whilst there was an overall increase in total number of interactions between the two sessions, it is interesting to note where these increases were most significant, and which interactions were lacking. The physical interactions increased the most from Session 1 to Session 2, (187 in Session 1 to 516 Session 2, see Figure 8). Family 7 showed the most significant increase in physical interactions, which jumped from 42 physical interactions in Session 1 to 72 physical interactions in Session 2. 51 of these 72 interactions were undertaken by the four-year-old child, demonstrating how the addition of physical interactive features promotes tactile, 'hands on' learning especially for these younger participants.

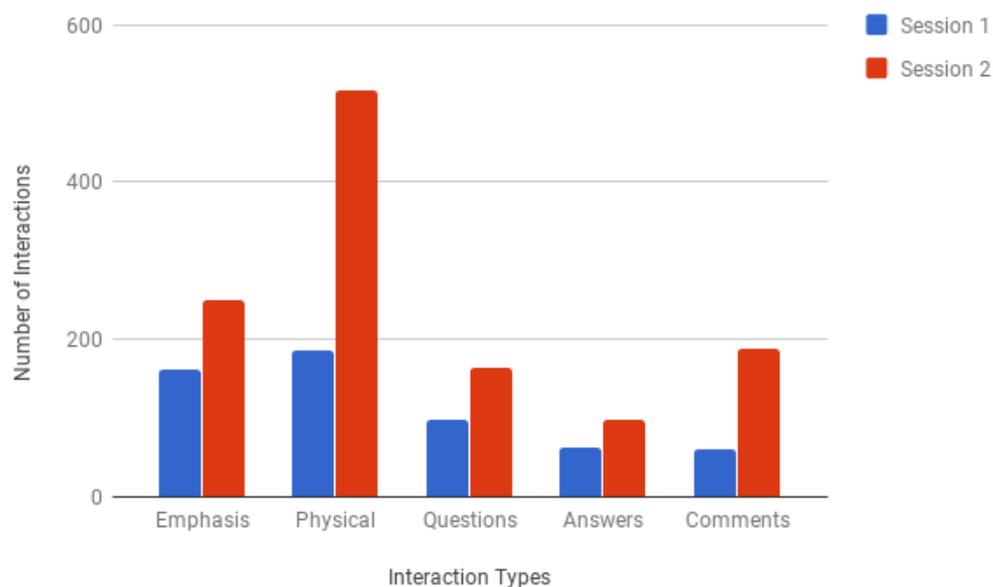


Figure 8 Total Interactions that occurred over the two observation Sessions

Emphasis interactions increased from 162 in the first session to 250 in the second session (see Figure 8). The physical and intellectual enhancements within the interactive version of *Hannah's Favourite Place* encouraged both parents and children to point out features, ask questions, and to make further connections between the storyline, illustrations and enhancements on the page. An example of a coded Emphasis Interaction for Family 1 was when the child pointed to the paper enhancements and stated “these are the flowers that reach to the sky” making the connection between the storyline and the physical enhancement of the book.

Questions and Answers were the interaction types that occurred least often (see Figure 8). In Session 2 it was noted that there was a tendency for parents to either repeat questions or reword a question previously asked. This was seen to happen both within a single spread and across multiple spreads. For example, Parent 1 was noted to ask her son “can you see some things?” when pointing to the spinning wheel on Spread 1, and also “can you see what’s in there?” when pointing to the flower paper-engineering-enhancement on Spread 3. Another example was when Parent 2 pointed to the boat on Spread 14 and reworded her question “what are they on?” to “what are they sitting on?” in order to further prompt the child for an answer and redirect his attention.

Whilst the occurrence of comments was not particularly high when compared to physical interactions, the increase in comments between sessions is noteworthy. There was an increase of 128 interactions between the first and second observations – from 60 comments to 188 (see Figure 8). This increase in comments demonstrates how the inclusion of physical and intellectual enhancements can allow the book to become more relevant to the child and the ‘real world’. This was seen with all families when discussing the ‘hidden cupcake’.

The families used this feature to discuss food, taste, nutrition and appropriate times to eat cupcakes. Consequently, the inclusion of such interactive features encouraged the reading partners to make connections between the book and the real world, in turn enriching the learning experience.

During the final semi-structured interview after the second session, all parents noted that they enjoyed the highly interactive version of *Hannah's Favourite Place* due to the fact that their children were having fun. Parent 4 stated "I enjoyed that she enjoyed it. She was obviously having fun." This indicates that the parents' level of enthusiasm and consequent engagement can be directly linked to that of the child. Conversely, four parents discussed the fact that the interactive elements may be somewhat distracting, and stated that they had the potential to take away from the story content itself. Parent 1 addressed this concern, and the consequent solution, by stating that her child was "more engaged in the book, but [I] don't know if he followed the story... but maybe he learnt more by doing [because] on the drawing page he wanted to draw a unicorn [alluded to in the text] and toast". This idea was observed by the other three parents who were concerned about the distracting nature of the interactive elements. Consequently, it could be said that parents understand interactive books differently to children - where children seamlessly jump between the elements and the story, parents seem to separate the two. All seven children stated that their favourite part of the interactive version of *Hannah's Favourite Place* were the interactive elements themselves.

5. Discussion

This study has provided insights into the success of implementing physical and intellectual interactivity into picturebooks. We take this opportunity to discuss how the designed interactions developed in *Hannah's Favourite Place* have facilitated the recommendations for shared reading and picturebooks that we presented in the related work section of this paper.

5.1 Shared Reading

The non-interactive picturebook version of *Hannah's Favourite Place* saw great variation in total interactions over the seven families. Whilst all parents stated that their actions were intended to keep their child interested in the shared reading session, their total number of interactions and attempts at engaging the children were drastically different, varying from 4 – 149 total interactions. Six parents believed engagement was accomplished by involving the child in the reading activity and shows some understanding of the benefits described by Justice and Kaderavek (2002) of children participating in the reading experience. However, not all parents engaged in the full array of interactive reading practices (Ezell and Justice, 2005; Han and Neuharth-Pritchett, 2013) with the traditional picturebook suggesting that even effective shared readers would benefit from guidance in order to further the learning experience which supports the recommendation made by Mol et al. (2008).

All seven families increased their total number of interactions between the two sessions.

This shows that the physical and intellectual enhancements of the book promoted more interaction from both parent and child, and allowed young readers to become more engaged in the literary experience and gain more from the book (Timpany and Vanderschantz, 2013). As features are touched and pointed out, questions are asked, and comments are made, the parent and child actively engage with each other and the book. These observations are therefore evidence of development of literacy, as well as communication (Timpany and Vanderschantz, 2012), social skills (Zeece, 2009) and further emotional development (Norton, 2011). Equally these increased interactions have provided an in-book tool to train and support shared reading practices for parents as recommended by Mol et al. (2008) and Bus et al. (1997).

5.2 Physical Interaction

Silverman (2006) notes that children learn through play and it is important that designers take this into account when creating children's books. The fact that all parents stated that they enjoyed the interactive, version of *Hannah's Favourite Place* due to the fact that their children were having fun indicates that this 'fun factor' is imperative when designing effective children's books. Silverman (2006) also notes that children have a tendency to 'learn through doing' and therefore physical interaction and 'touch' is important within the shared reading and learning environment. Our study has shown that an interactive book that encourages this practice leads to further engagement from the child and a significant increase in interaction compared to a traditional picturebook. Our study also indicates that the design of meaningful physical enhancements act as a bridging device to promote a range of interaction types for both children and adults. As children are encouraged to explore, discover, and understand cause and effect, they are also prompted to participate in responsive interactive reading behaviours (Girolametto and Weitzman, 2002; Ezell and Justice, 2005). These behaviours were observed as shared readers pointed out features, asked questions and made connections between the book and the real world.

Whilst a number of parents voiced their concern over the distracting nature of the physical enhancements, it is important to understand that children and adults view the world differently. Children seamlessly jump between the physical enhancements and the story, whilst parents seem to separate the two. We suggest that because "movable and pop-up books teach in clever ways, making the learning experience more effective, interactive, and memorable," (National Museum of American History, 2010, p. 7) it is important that parents embrace the learning possibilities of interactive books in the shared reading environment. As Goodwin (2008) discusses, the parent acts as a mediator within the shared reading session, therefore we would argue that the parent can help to guide the session if they believe that the child is getting too distracted by the design enhancements. An effective interactive children's book can provide the tools for successful shared reading, so parents need to embrace such books and be open to broader learning opportunities within the shared reading environment.

5.3 Intellectual Interaction

The increase in comments from the traditional book to the interactive book demonstrates the increased successes of the children in our study relating the story to the 'real world' and potential evidence of emotional growth and attachment (Goodwin, 2008; Norton, 2011). Comments such as "I have my favourite place now", from the child of Family 1, demonstrate how physically and intellectually interactive books can provide further engagement in the story, and hence the possibility for emotional understanding and growth (Zeece, 2009).

As children develop their reading skills, it is important to encourage further learning opportunities. Family 4 demonstrated how shared reading with older children can promote language-modelling behaviours (Ezell and Justice, 2005), and encourage continued learning of reading and literacy in the home environment. Whilst this family stated that they did not often participate in shared reading in the home environment, the interactions noted, as well as the increase of interactions during the second session, proves that shared reading is a practice that can evolve with the age and stage of the child. Consequently, it is important that independent readers continue to be supported through books such as the highly interactive version of Hannah's Favourite Place.

6. Conclusion

We undertook a user observation study of seven families engaging in shared reading sessions with non-interactive as well as interactive picturebooks. This study showed how physical and intellectual enhancements to picturebooks can change the level of interactivity and types of interaction within a shared reading environment. The findings of the study demonstrated the importance of designing effective children's books which include, an appropriate story, illustration, theme and the creation of an emotional relevance or connection with the child. In addition, the physical and intellectual enhancements prompted children and parents to interact and engage with the book at a much higher level than the traditional version of the book. The study demonstrated the broad learning possibilities of a highly interactive picturebook while also presenting design innovations and solutions for future printed interactive picturebooks.

Our study showed that meaningful physical and intellectual enhancements that promote a range of interaction behaviours can be observed when shared readers point out features of the book, ask questions, and make connections between the book and the real world. We posit that it is important that effective interactive children's picturebooks include enhancements that add to the story and engage children on a number of emotional and intellectual levels. We further conclude that these design choices should ensure enhancements add value rather than cause distraction during individual or shared reading sessions.

All shared readers would benefit from further support, which we have found can be offered through the design features of an effective children's picturebook. We recommend development of tools that encourage and teach adults, including teachers and parents, how

to facilitate engaged and interactive reading. In order to ensure that varying interactions and shared reading practices take place, addition of goals, such as used in our interactive book, provide tools for adults that can be used when they share this, or any other book, with their child. Equally, a well written and illustrated book should lend itself to questions from the parent and consequently will promote interaction. Questions that include *who, what, when, where, why, and how*, and engage children in the imagery, storyline and relevance of the theme of the story and relate this to the real world will create strong learning opportunities for children.

To design an effective interactive children's picturebook, three basic steps must be taken. The book needs to include the fundamental principles of a successful children's picturebook, including appropriate story, illustration, theme and the creation of an emotional relevance or connection with the child. In turn, the book must provide support to shared readers through instruction or guidance in order to ensure that both parties benefit from shared reading situations. The book must include physical and intellectual enhancements that provide meaningful interactions, and have a relevance to the story outcome or storyline itself. These aspects combined will enable both the shared reader and the child to gain more from the shared reading session, and promote fun, enjoyment and education in the home environment.

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