ABSTRACT

Dialogic reading, in which the reader prompts the child to speak while listening to the story being read, represents a promising way to boost children’s linguistic development but it is unclear how content interactivity and agency affect the technique. We used video interaction analysis to investigate the effect of interactive elements on speech production of 12 children between the ages of 16 and 33 months when engaged in individual dialogic reading sessions with a tablet-based e-book. Interaction with interactive elements did not reduce the children’s responses to dialogic reading prompts. Spontaneous utterances were longer than prompted ones and the children’s engagement with interactive elements or sounds coming from the application most often triggered these spontaneous utterances.

Categories and Subject Descriptors
H.5.2 [Information Interfaces and Presentation] User Interfaces

Keywords
Dialogic reading; interactive e-book; tablet; speech production

1. INTRODUCTION

Early language development provides the basis for a child’s competence in language and literacy. Late talkers not only perform worse in behavioral tests of spoken and written language but also show decreased neurological activity suggesting longer term effects on linguistic performance during their school years [6]. Studies on dialogic reading, in which the reader takes an interactive approach and prompts the child to engage in speech production in relation to the book, have shown promising results both for expressive and receptive language skill acquisition [5]. Tablet computers now constitute a platform ready to be taken to the bedside for nighttime reading - a common venue for child-parent reading activities - and they are becoming part of the inventory in daycare centers, another venue in which many children are exposed to and experience reading. A number of interactive or e-books specifically aimed at pre-school children have become available but whether reading activities aimed at increasing language acquisition are enhanced or disturbed by interactive elements remains unclear. According to a survey, parents find interactive elements potentially detrimental in shared reading situations [8]. How does the child’s agency in manipulating the interactive elements in the book affect their responses in a dialogic reading situation?

To this end, we observed 12 children in one-on-one dialogic reading sessions of an interactive book on a tablet. The application contained interactive elements that allowed for pointing or dragging, which resulted in animations or visual state changes; were muted or had sound; and worked once or repeatedly. The paper focusses on how the interactive elements impacted dialogic reading in terms of the adults prompting behavior and the children’s response frequencies and lengths.

2. BACKGROUND

A range of studies has shown positive correlations between the frequency of shared book reading and children’s acquisition of language skills [2]. Dialogic reading is one example of a more concise approach to shared reading - see for example Whitehurst’s seminal work on picture book reading [9] in which the adult encourages the child to talk about and discuss the contents of the book. Mol et al.’s meta-analysis on dialogic reading showed significant gains in vocabulary and language development [5]. For 2-3-year olds Zevenbergen & Whitehurst included the following activities in dialogic reading: asking open-ended and what questions with follow-ups to child’s responses, confirming and praising the child’s utterance, repeating what the child says and expanding on this, helping the child as needed, following the child’s interest and creating an enjoyable experience for the child [10]. In Whitehurst’s original description [9] of the technique the ideal facilitation follows a PEER-sequence: The facilitator...
prompts the child to say something (“What is the lion doing?”), evaluates the child’s response (“Yes, the lion is eating...”), expands it through rephrasing and/or adding information (“...a big sausage.”), and repeats the prompt (“Can you say sausage?”).

To the best of our knowledge, no studies have investigated how using a digital interactive book on tablets or computers instead of paper impacts dialogic reading in general and our target age group in particular. The only available account we found about how interactive elements impact shared reading was Valaa & Takeuchi’s large-scale survey of parents of 3 to 5 year olds. Parents found the following features or parts of interactive books to be the most distracting: videos (66%), games (63%), and hotspots/animations 48%. The latter refers to (potentially) highlighted interactive elements that can be triggered to: emit sound, move, or cause changes in state of the interactive book [8]. However, it remains unclear whether the results apply to dialogic reading facilitated within the interface. For the c application, for example, when showing the child how to interact.

Moreover, we logged application errors that occurred, e.g. in out- of-sync renditions of audio, which occurred in 72 cases with more than two seconds delay due to poor wireless internet connectivity.

The coding from the 65 minutes of recorded footage contained a total of 1408 logged events, including 108 prompted and 96 spontaneous word utterances and 77 verbal non-word utterances. We coded utterances as spontaneous if they had no obvious causal relationship with the caregiver’s dialogic reading prompts.

For the subsequent analysis we used the following dependent variables on an overall and per-scene basis. We took the number of prompted word responses and divided them by the number of prompts that the adult had issued for each child (response/prompt ratio). For both spontaneous and prompted utterances we

3.3 Procedure
Caregivers facilitated the sessions in a dedicated room over the course of one day. The caregiver sat on a beanbag with the child seated on his/her lap and held the tablet (c in Figure 1). An experimenter assisted in case of technical errors - situated out of sight behind the child between two high-definition camcorders (a) (c.f. Figure 1). A high quality audio recorder (b) recorded the audio. We conducted debrief interviews with two caregivers after they had facilitated all sessions.

3.4 Analysis
For the analysis of the recorded footage we relied on Jordan & Henderson’s Video Interaction Analysis [4]. We initially took a grounded approach to establish categories of events from which to analyze the material. After having watched one full session and generating a first set of codes independently two researchers created a merged set of codes. Three researchers then applied this coding scheme to the entire corpus. For a child’s utterance we logged its length in words, discernibility (yes/no), spontaneity (whether the utterance related to the most recent prompt), and its reason, for example whether it related to a prompt or an interaction in the interface. For the children’s interactions with the app we logged how they interacted and whether these interactions were successful. For the adults we logged: the type of prompt according to the PEER model, prompt details, for example whether it prompted for a location or label and encouragements of the child to interact. We logged all adult interactions with the application, for example, when showing the child how to interact. Moreover, we logged application errors that occurred, e.g. in out-of-sync renditions of audio, which occurred in 72 cases with more than two seconds delay due to poor wireless internet connectivity.
computed *length of utterance* in words. Spontaneous utterances (words and non-words) were computed on a per minute basis since the caregivers spent between 26 and 60 seconds in the scenes. Furthermore, we looked into the *prompts per minute* the facilitator had used.

We computed for each child and scene the number of touch screen *interactions* they had *per minute* (*ipm*) and the ratio to the interactions the adult had (*child/adult agency ratio, caar*). This provided us with an estimate of the child’s agency vis-à-vis the application and allowed for controlling for the difference in styles the caregivers had in using the application during the dialogic reading. The male caregiver who read to six children controlled the application himself most (*ipm* average of his children was 2) whereas the other two caregivers encouraged and had the children interact with the application more (*ipm* averages of 3 and 5.5).

4. RESULTS

We found a strong positive correlation (*r*(*10*)=0.74, *p*<0.01) between the children’s age and their response/prompt ratio. Older children responded more often to dialogic reading prompts. There was a nonsignificant correlation 0.1 between age and the utterance length of the children’s responses. The response/prompt ratio (ranging from zero to 1.1) and utterance length (from 0 to 3.4 words) across all scenes are summarized in Figure 2. The children’s spontaneous utterances were significantly longer (2.5 words) than the ones responding to a prompt (1.8 words) - according to a paired t-test for the children that had replied to prompts and talked spontaneously *t*(5)=3.11, *p*=.026. The large difference was due to a number of closed question prompts from the caregivers, which resulted in yes/no replies from the children. When we excluded simple yes/no responses for both prompted and spontaneous utterances the difference was smaller (prompted 2.4, spontaneous 2.7 words) but still significant. We found no significant correlations between the children’s age and the length of their spontaneous and prompted responses but there was a positive trend between age and the length of spontaneous utterances but no such trend with the length of prompted responses (see the trend lines in Figure 4). Older children produced longer spontaneous utterances than younger ones. But when prompted the older children’s utterance were of similar average length.

The children interacted with the application on average 2.4 times per minute. Younger children interacted as much with the application as the older ones did. To check whether the children would respond less often or more mono-syllabic when interacting more with the application we included age in a multiple regression analysis along with *imp* as predictors of the children’s *average utterance length* and their response/prompt ratio. We found no significant effects and Figure 3 plots the child’s *imp* against their average utterance length and their response/prompt ratio. In other words, there was no evidence that increased interaction with interactive elements reduced the children’s responses to prompts nor the length of their responses.

To test the independent variables from our factorial design we ran multiple regressions on children’s (both spontaneous and prompted) utterance lengths and their response/prompt ratio. We found no significant contribution of gesture, sound or repetition as predictors with age, *ipm* and *caar* included in the regression as controls. Of the control variables only age was a significant predictor for the response/prompt ratio. However, the multiple regression, which included the same set of predictors and controls on spontaneous utterances (per minute), showed that both age (*β*=.16, *t*(90)=4.57, *p*<.001.) and *caar* (*β*=.28, *t*(90)=2, *p*<.049) were significant predictors. Older children and those that interacted more with the application than their caregivers spoke more often spontaneously. The scenes in which the children could repeat actions did not yield significantly more interactions than the scenes not allowing for repetition.

The children derived most fun from the animations and sounds. Of the 39 times the children laughed or giggled, most were triggered by animations (12) and sounds (11). Of the 96 spontaneous utterances the largest number happened because of or in relation to interactions with the application (22) and sound (12). A follow-up regression comparing utterance lengths of these
two with all other triggers of spontaneous utterances showed that these two triggers resulted in significantly longer utterances. The longest spontaneous sentences were evoked by sound (3.5 words) and when commenting “it wants to be down here” or asking about pointing or dragging interactions “can you put it there?” (2.9).

Most of the spontaneous utterances around interactions occurred in the last scene, which had no sound but various animals could be repeatedly dragged and re-positioned anywhere on the screen. The prompted utterances that fared better than average (1.8 words) were the ones in which the children described an action (2.4), labeled an object or character (2.3) or talked about a sound that was made (2).

The adults prompted the children on average 2.3 times per minute and between zero to 12 times in the different scenes. We tested gesture, sound and repetition impacted on the adult’s prompting frequency by entering them along with ipm, caar, and age as predictors in a stepwise regression in which factors with the smallest p-value (<.05) were entered first. Only age and sound significantly predicted prompts per minute. The adults prompted more frequently when the children were older (β =.14, t(90)=2.77, p<.01) and in scenes that did not contain sound (β =.56, t(90)=2.02, p<.05.). This was mirrored during the debrief interviews with the caregivers. The caregiver who had prompted least suggested including music and narration while the most prompting caregiver feared that narration would weaken the contact with the child. Both disliked interactive elements not supported by text, as they did not know what to tell about them.

5. DISCUSSION

The initial concern that children might talk less often or with shorter responses when engaged with interactive elements was not warranted in our sessions. The children who interacted with the application more than the caregivers (larger caar) made more spontaneous utterances, too. However, since caar represents a covariate this finding would need more controlled follow-up research to provide causal conclusions.

The engaging effect of sound does not come as a surprise with the number of books available that supplement the visual reading experience with sounds. While sound in the scenes resulted in fewer prompts from the caregivers, it stimulated longer spontaneous utterances from the children. We used only sounds shorter than six seconds and further studies need to include the limits at which sound might begin to have detrimental effects, which the survey results from Vaala & Takeuch suggest.

The sizes of targets and difficulties with dragging might pose a usability problem but we found that these problems fostered verbal exchanges in line with the goal of dialogic reading.

We decided against using one facilitator unfamiliar to the children and relied instead on caregivers they knew. However, we found that facilitation by different adults varied a lot both in terms of dialogic reading and how much they allowed or encouraged the children to interact with the application. While dialogic reading represents an interactive, child-driven situation with large differences between children, we would still advocate for using one trained facilitator to keep this condition more controlled. The fact that the children’s spontaneous utterances were longer than the prompted ones was partially due to some caregivers’ prompts. This raises an important concern for training, which Zevenbergen and Whitehurst originally addressed with two workshops. Although our caregivers were all familiar with and had received a refresher before the session, they might have facilitated the sessions differently with more training. When engaged in dialogic reading with e-books facilitators might benefit from having access to example prompts as some of the closed questions we observed resulted in short yes/no answers and the caregivers disliked interactive elements not supported by the storyline. Similarly, initial work on teaching facilitators dialogic reading involved example and training sequences.

6. CONCLUSION

The children’s agency in manipulating interactive elements did not adversely affect their responses to dialogic reading prompts. Interactive elements did provide triggers for children to speak in addition to dialogic reading prompts in shared e-book readings sessions. Sounds and being able to move objects and characters around produced longer spontaneous utterances in comparison to responses to dialogic reading prompts. Open-ended interactions worked particularly well and future research should explore concepts for spontaneity more in the context of dialogic reading.

7. ACKNOWLEDGMENTS

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8. REFERENCES