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An empirical investigation of parent-child shared reading of digital personalized books

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ABSTRACT

Numerous studies have documented the benefits of parent-child shared reading of print books, but few studies have examined parent-child reading behaviours with digital personalized books. This lab-based study examined the child language outcomes following shared reading of a personalized digital book by twenty-six British mothers and their 3- to 4-year-old children. The digital book included pages that were individualized to each participating child, with each child's name, photograph, favourite toy and food, as well as generic pages with no personalized content. The findings indicate the significance of personalization features in parent-child shared reading on screen and indicate the importance of parents' role in expanding beyond children's focus on self during shared reading.

1. State of the art

The benefits of parent-child book reading of print books for children's language growth, emergent literacy and reading achievement have been documented since the early 1980s (e.g., Snow & Goldfield, 1983). The potential benefits of parent-child shared reading of digital books have also begun to be recognized (e.g., Morgan, 2013) but to date have not been systematically examined. In this study, we investigated parents' and children's reading behaviours when sharing a digital book which contained some pages with personalized features for individual children and some pages that were not personalized. We examined the impact of parent-child shared reading of the digital book on parental and child talk to determine whether there is a difference for children's vocabulary learning between the reading of personalized and non-personalized pages of digital books. We also considered the quality of mothers' talk and children's spontaneous speech during the shared reading interaction. We ground our study in literature concerned with three main areas: parent-child shared book reading, personalized books, and digital personalized books.

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2. Study background

2.1. Parent-child shared book reading

As summarised in a meta-analysis by Bus, Van Ijzendoorn and Pellegrini (1995), a strong body of research evidence has documented the positive outcomes and mechanisms of parent-child shared reading of print books. Parent-child shared reading of print books is known to have positive effects on children's vocabulary development (Senechal & Cornell, 1993), acquisition of written language (Bus, Van Ijzendoorn, & Pellegrini, 1995) and emergent literacy more widely (Reese & Cox, 1999). The linguistic content of young children's books plays a role in parent-child engagement during book reading (Cameron-Faulkner & Noble, 2013) and diverse book features, including words, images and story grammar, influence the extent to which parents engage children during a story reading session, as argued by Breit-Smith, van Kleeck, Prendeville, and Pan (2017). Children's vocabulary learning is the most well-documented benefit of parent-child shared reading of print books (Hargrave & Sénéchal, 2000). Research with print books shows that parents and children typically engage in family-related reminiscing, book-related talk and/or intertextual talk connecting the book text to other texts (Saracho, 2017). It is well-established that parent-child conversations about past events (reminiscing) support children's language development (Snow, 1983), autobiographical memory and narrative skills (Reese & Newcombe, 2007). Four-year-olds often relate their knowledge of other texts to the texts that they read (Torr, 2007) and such intertextual comments are actively supported by teachers in schools during book reading (Harris & Trezise, 1997).

For adult speech during book reading, a body of research shows that the use of abstract language (as part of a dialogic reading style) is linked to children's increased vocabulary learning (e.g., Reese & Cox, 1999). Studies in the field of cognitive psychology have established that for adult and child readers, relating new information to oneself supports the retention of the new information (the so-called self-referential memory effect, see Klein, Rozendal, & Cosmides, 2002; Turk et al., 2015). The use of personal pronouns matters in children's reading with adults (see e.g., Kross & Ayduk, 2017). For example, "synthetic personalization," that is, using the second person in storytelling to refer to the reader (*you, your, yours*), builds rapport with anonymous audiences (see Matwick & Matwick, 2014), while using first- and third-person pronouns has been found to positively affect young readers' immersion in a story and their overall appreciation of the reading experience (Hartung, Burke, Hagoort, & Willems, 2016).

In our previous work (Kucirkova & Tompkins, 2014), we examined the relationship between the context of mother-child shared book reading and the extent of mothers' and their 3–5-year-old children's talk about emotions directly relevant to the child, the mother or to a third person. We compared the occurrence of personalized emotion talk with 40 American mother-child dyads in three conversational contexts: reminiscing, book reading and play, and found that in the reminiscing context, the dyad talked mostly about their own emotions and in the book reading context talked mostly about the emotions of a third person. Building on this evidence, in Kucirkova, Messer, and Sheehy (2014a), we analysed children's use of personal pronouns in relation to personalized print books, compared with matched non-personalized books. The personalized books contained children's names as well as names of their friends and were read in kindergarten by a researcher one-to-one with each of thirty-five British children (mean age 36.94 months). The findings indicated children's increased use of first-person pronouns such as *me, myself* and *I* in relation to the personalised books, as compared to the matched non-personalized books. In the study reported in this paper, we further explored how parents and children used personal pronouns during their shared reading of digital personalized books.

2.2. Personalized books

We chose to focus on personalized books given their rising popularity on the children's book market and in light of emerging evidence of personalization being used in children's books for commercial or political purposes (Hobbs, 2020), as well as for therapeutic, aesthetic and educational purposes (Kruse, Faller, & Read, 2020). Commercially produced personalized books are available in both print (e.g., Wonderbly Ltd.) and digital formats (e.g., Mr Glue stories) and are dubbed the success story of children's publishing, with start-ups reporting 400 % growth by switching to personalized titles (PR Distribution, 2019). Personally relevant information is more familiar to children than the fictional imagined worlds of traditional children's storybooks, and a number of studies have found personal relevance increases engagement with complex narratives and facilitates the reading process (see Kuzmičová & Bálint, 2019 for a review). Related to this point are the observations that parents and children enjoy reading personalized books together (Kucirkova, 2017; Kucirkova, Messer, & Sheehy, 2017), and that when both parents and children enjoy a book, the reading session tends to be more engaging for both reading partners and more instructive for the child (Robertson & Reese, 2017).

We therefore hypothesized that personalized books may enhance parent-child shared book reading by influencing parent talk and increasing children's engagement with reading. The inclusion of personal information and family photographs might increase caregivers' reminiscing during shared book reading relative to their talk when sharing traditional, non-personalized books with their children. Furthermore, reminiscing stimulated by personalization may in turn increase child responsiveness. Haden, Haine, and Fivush (1997) reported that reminiscing with print books led to better narrative structure in children's utterances. This might help children to locate themselves in relation to the past and to their personal memories (Fivush & Nelson, 2006). Building on this body of literature, we were interested in exploring the differences in child responsiveness when their mothers talked about personal memories while reading *digital* personalized books, and whether the inclusion of personally relevant information might be beneficial for children's reading and language use during parent-child shared reading of digital books.

2.3. Digital books

Alongside print books and oral storytelling, today's children encounter stories in an unprecedented array of digital forms and formats, including e-books, interactive story apps, story-driven video games and augmented-reality iBooks. These digital books, to use an umbrella term, dramatically increase the range of book features, such as expressing meaning via multimedia features in highly interactive digital books (Zipke, 2017). Comparatively recent studies suggest that diverse digital book features may influence reading outcomes, either positively or negatively (Al-Yaqout & Nikolajva, 2015), and that the reading medium might influence the degree to which children comprehend texts (Mangen, Walgermo & Brønnick, 2013). Many digital books also create new opportunities for personalisation because their digital programming enables personal information to be incorporated into stories, such as users' own photos, audio-recordings or information collected automatically through embedded algorithms (Kucirkova, 2019). To date, digital personalized books have not been studied for their effects on young children's language use during parent-child shared reading. Our study aimed to address this gap, with attention paid to children's language learning. Our focus on vocabulary learning was directly informed by a previous study in which we examined the effects of reading a personalized and non-personalized *print* book on child's vocabulary learning (Kucirkova et al., 2014a; Kucirkova, Messer & Sheehy, 2014b).

In Kucirkova et al. (2014a, 2014b), the personalized book contained the child's photograph, the child's name and the child's favourite activities or places for play, as reported by the child's parent. In the 2017 study, the non-personalized book was the same as the personalized book, but all personal information was replaced with non-personalized information. This non-personalized information was purposefully matched with the personalized information for greater contrast. For example, typical gender preferences were taken into account so that if a child's favourite activity was playing with cars, the non-personalized book would state the main story character enjoyed playing with another object, such as dolls. The favourite book was a standard book chosen by the child from their home library. Our findings in Kucirkova et al. (2014a, 2014b) suggest that children scored higher in tests of word acquisition if the words were embedded in personalized, as opposed to non-personalized print books. In the more recent study reported in this paper, we followed a similar design but with personalized and non-personalized pages in *digital* books, focussing on parent-child verbal interaction and children's use of vocabulary when reading personalized and non-personalized pages in a digital book.

3. Theoretical framework

The study was framed around the concept of socio-material assemblage (Johri, 2011), which offers an apt theoretical lens to explore the mutual influences of social and material factors in situated learning. This theoretical framing, Johri (2011) argues, can help overcome the 'inherent dualism in the learning technologies literature between the social implications of technology use and the material aspects of technology design' (p.210). It is also compatible with socio-cultural theory, which foregrounds the role of social relationships (such as the parent-child relationship in this study) and cultural artefacts (such as books) in mediating children's learning (Vygotsky, 1978). From a socio-material perspective, technologies in and of themselves are not enough for learning. Rather, technologies and their use are inextricably connected with socially and culturally-situated beliefs and practices in sociomaterial assemblages.

Adopting a socio-cultural theoretical framing, Lauricella, Barr, and Calvert (2014) studied thirty-nine US parents' talk with traditional and digital books and found that parents were more engaged with the digital books, but children's story comprehension scores were almost equal for both book formats. The authors concluded that children's dispositions (the child's attention and language skills) together with parent engagement during book reading predict children's story comprehension skills, rather than the book format *per se*. Reflecting on this evidence, Courage (2019) concluded that the question of digital books versus print books (or vice versa) is the wrong question for researchers to pose. Instead, Courage (2019) pointed to the inter-relationships between individual child characteristics, e-book material content, and the context in which joint reading occurs, and encouraged researchers to study in detail the particularities of each medium to provide evidence-informed guidance for the optimal design of children's digital books.

We built on this thinking in our study by focusing on a detailed analysis of parent-child talk (speech that was not reading of the story text) when reading *digital* books with *personalization features*. Instead of comparing the digital book versus other book formats, we examined in fine detail the socio-material intersections of parents' and children's reading behaviours in relation to a digital book that contained both personalized and non-personalized pages. Our focus was on the social and the material, honing in on the single marker of personalization by designing a study that included observations of parent-child verbal exchanges during their shared reading of digital books with personalized and non-personalized pages.

3.1. Study aims

This study focused on static personalization features related to the child's life that included textual personalization (names of things the child likes) and visual personalization (photo of the child). To our knowledge, this is the first study that analyses in detail the patterns of language use in parent and child talk during shared digital book reading when the book is personalised to a specific child. The research questions were:

- 1 Is there a difference between children's vocabulary learning from personalized versus non-personalized pages of a digital book?
- 2 How do personalized and non-personalized pages within the same digital book influence mother-child talk? More specifically, how do they influence themes in their talk, quality of mothers' talk and the mother's and child's use of personal pronouns?

4. Methods

4.1. Study participants

Twenty-six British mothers and their three-to-four-year-old children (eight girls and eighteen boys) were recruited from the Wales in the United Kingdom. The mothers were recruited via a database of families interested in participating in research at the Cardiff University Centre for Human Developmental Science. Child eligibility criteria included 1) being native speakers of English and 2) having no pre-existing developmental diagnosis, including global developmental delay or autism spectrum disorder, as determined through parent report. These exclusion criteria were set up to ensure homogeneity in the sample. Children's language was measured at the beginning of the study using the British Picture Vocabulary Score Test (Dunn & Dunn, 2009), which is a British version of the Peabody Picture Vocabulary Test measuring children's receptive vocabulary. Child participants' average score on the test was 5.19, with $SD = 1.44$, which indicates that children's general language skills were high and equivalent to five-year-old children's skills using this measure.

To find out more about our participants, mothers were asked to fill out a short demographic questionnaire at the first visit to the study lab, with questions containing a range of options concerning mothers' highest qualification, age, family income and number of siblings, as well as a request for adult respondents, who were all mothers, to rank their own and their child's confidence in using digital media as high, medium or low. All mothers rated their confidence with digital media as either high or medium, while for their children, ten mothers selected the medium category, ten selected the high category and six mothers indicated that their children's confidence with digital media was low.

Five children in the sample were the only child in their family, and ten of the participating children were the oldest child in their family. The majority of mothers were highly educated ($n = 21$) with only five without a university degree. With the exception of three children, all children were from families that earned above £20k per year, which is considered average or above average family income according to UK Office for National Statistics (2019).

4.2. Study procedure

The study was approved by the University College London University Ethics Committee and followed the British Educational Research Association's Ethical Guidelines (BERA, 2018). All mothers were provided with an information letter that explained the purpose of the study and procedure. If the children agreed to participate, mothers were asked to sign a consent form and were sent further details about the study process. Children's ongoing assent to participate in the study was checked verbally by the researcher during the lab visit. Given the focus on personalization features, we asked mothers to provide us with details about their children which we subsequently used to personalize their child's version of the digital book. More specifically, we asked mothers to tell us: their child's preferred name (how they refer to their child); their child's favourite breakfast food (using the wording the child would use, such as Cheerios™ if the child liked eating a specific brand of cereals) and their child's favourite toy (we asked mothers to be very specific so that for example, if the child liked Little Kitty™ dolls, parents would write Little Kitty dolls rather than just dolls). In addition, we asked mothers to supply us with a photograph showing them and their child hugging each other and looking happy. If mothers did not have such a photograph, the researcher took a photo of the mother and child during their visit to the lab. This personal information was inserted into the story template used for each child, using the freely available Our Story app (http://wels.open.ac.uk/our_story). All personal information in the app was stored offline and deleted at the end of the data collection phase.

We used a simple digital book that we created for this study and that contained both personalized and non-personalized features. The book did not contain any interactive features apart from the possibility to swipe pages from left to right, increase the image size (zoom in) or make the written story text appear or disappear on a page. Following the study procedures deployed in Kucirkova et al. (2014a), we selected eight words that were purposefully chosen for their complexity from the British Picture Vocabulary Test, which the children were unlikely to be familiar with. Four words of these eight words were embedded in the personalized pages (culinary, copious, foundation, carpenter) and four words in the non-personalized, generic pages (escorting, ascending, departing, embracing). With the exception of these eight complex words, the story was written in simple, age-appropriate language. We anticipated that the children might learn the eight complex words after repeated readings, and we measured each child's acquisition of the words using a pictorial recognition test adapted from the British Picture Vocabulary Scale. The book was twelve pages long, with four filler pages that had no target words. One page was personalized with the child's name, one with the child's photograph, one with the child's favourite toy and one with the child's favourite food. The generic pages were about story characters previously unknown to the mothers or children with pictures downloaded from the Shutterstock© photo website. All children were therefore presented with the same digital story, tailored to each child's personal details, that is, with non-personalized sections of the book that were the same for all children, and with some personalized sections, including individual children's photographs and text related to their personal lives. We constructed the books in this way to examine possible differences between personalized and non-personalized pages in relation to children's vocabulary learning and parent-child talk around the book.

Mothers were invited to the Cardiff University Centre for Human Developmental Science for two visits during which they took part in various activities, including reading the digital book which was adapted with personalized features for each participating child. Prior to the first reading session, mothers were shown by the research assistant how the digital book worked (e.g. that they had to swipe from right to left, and that there were no sounds or interactive features). The book was read three times by each participating mother-child dyad, with the first reading scheduled for the first visit and the two subsequent readings for the second visit. There was a one-week gap between the two reading sessions. In this paper, we focus on the third reading during the participants' second (and final) visit

Table 1

Four-level abstraction coding of adult non-immediate talk during book reading (A greater abstraction score equals greater levels of inference in adults' speech).

Levels	Definition	Explanation	Examples
L1	Perceptual identification: The utterance refers solely to one object pictured in the book. This level includes object labelling either at the basic, subordinate, or superordinate levels. It also includes stating an intrinsic property of the object (e.g., colour) or drawing attention to the object or one of its properties.	The adult draws the child's attention to the perceptual qualities of an object/human being/wider environment but these need to be immediately noticeable on the page in the book.	<ul style="list-style-type: none"> • Look at the man! • Show me the pancakes! • Where is Bernie? • Is there a carpenter in this picture? • Where is the bottom of the house? • The colour of the woman's jacket is pretty. • Where are you in the picture? • Look, who is there [in the picture]?
L2	Perceptual relationship: The utterance links two objects or events that are both represented in the picture. The link may involve an intrinsic property (same colour), spatial relation (left of, above), a common action (X and Y produce something, or X acts on Y), or a common feeling.	The adult makes a comparison to something that is inside the book, the two compared objects/entities need to be both inside the book.	<ul style="list-style-type: none"> • The man is as tall as the mountains. • The pancakes are bigger than the plate! • The croissants are bigger than the muffins. • The carpenter and the hammer are here on the page. • These vegetables are so colourful! • See, the man and woman are going together! • Who is hugging you in the picture? • Daddy's T-shirt is blue.
L3	Displaced reference: The utterance links a pictured object or event with an object or event that is absent either in space (spatially displaced reference) or time (past talk), typically including subjective experiences with the object.	The adult needs to make a comparison or a reference to the child's life, prompting the child's thinking and memory.	<ul style="list-style-type: none"> • Do you remember when we were in the mountains? • We made pancakes recently, did you like them? • Your dad likes to have a big breakfast at the weekends too. • Just like the [child's favourite food] you had this morning! • Do you like eating vegetables? • Look, there is a puzzle in this room too! • We embrace every evening before bed, don't we? • We do this at the airport sometimes don't we!
L4	Inference: The utterance conveys one or several inferences, including logical reasoning and imaginary description, or states some social knowledge.	The adult needs to connect the book's content to the world outside, making a reference to "possible worlds", inferences and justifications. These can draw both on the child's life and the story characters but need to take the child's thinking outside his/her current frame of mind.	<ul style="list-style-type: none"> • I think the man likes to play with your doll! • Do you think mummy/daddy are good cooks? • I think this might be too much for Bernie to eat alone! Bernie's tummy is full with pancakes. • Do you think the [child's favourite food] gives him lots of energy to do his job? • Do you think our house has foundations? • What/who do you think the puzzle might be for? • Why is [person in photo] happy? • I think the daddy would be sad to be leaving his family here, don't you?

to the lab. While for the first two readings, mothers were instructed to read only the text and minimize extra-textual comments, for this third reading, mothers were encouraged to deviate from the text as much as they liked and comment on the book as much as they wished. This procedure mirrors that followed in our previous parent-child reading studies with personalized books, where three reading sessions were sufficient to establish a difference in outcomes between personalized and non-personalized conditions (Kucirkova et al., 2014a, 2014b).

These procedures ensured the study followed a within-subjects design with counterbalancing, which allowed us to compare possible differences between the personalized and generic pages within each digital book, so we could record the impact of social and material factors influencing the mothers' and children's language use during their shared digital book-reading.

4.3. Language outcomes

Commensurate with previous studies on parent-child book reading our analyses focused on non-immediate talk, that is, talk that 'goes beyond the information contained in text or illustrations to make predictions; to make connections to the child's past experiences, other books, or the real world; to draw inferences, analyse information or discuss the meaning of words and offer explanations' (De Temple & Snow, 2003, p.19). We aimed to achieve a detailed and holistic profile of parents' and children's reading strategies during the reading sessions. Inspired by Elster's (1994) comprehensive approach to pattern-analysis of pre-schoolers' emergent readings, we characterised parent-child verbal language exchanges in three phases: 1) themes in talk (pattern analysis) 2) quality of mothers' talk (based on pre-established categories) 3) use of personal pronouns (micro-level analysis). We provide details for each phase.

4.3.1. Vocabulary learning

Children's acquisition of the unknown words was measured using a pictorial recognition test adapted from the British Picture Vocabulary Scale. The test had ten sets of four drawings, similar to those in the BPVS. In addition to the eight unknown target words, there were two low-level additional words to give children a sense of achievement. The testing procedure was similar to that of BPVS, in that the researcher said the target word aloud, and asked the child to select it from the set of four. Children's correct answers were scored as one point per answer, yielding an overall maximum score of four per personalized or non-personalized condition.

4.3.2. Themes in talk

With personalized books read on paper and created by parents with photos and text of their choice, children's talk has been found to resemble reminiscing (Kucirkova et al., 2013; Kucirkova, Messer, Sheehy & Flewitt, 2013). In this study, we were keen to characterize both parents' and children's talk during the reading of digital books with personalized features. To this end, we were not interested in quantifying but in selecting salient examples that characterize the conversations, following a typical discourse analysis procedure, where examples are selected based on the extent to which they reflect repetition, disfluency or misunderstanding in the conversation, the so-called 'cruces points' (Fairclough, 1992, p.230).

Table 2
Categories for children's talk during parent-child book reading.

The Analytical	The Intertextual	The Personal	The Transparent	The Performative
Sipe's (2008) original definitions of the five categories of talk				
'All responses that seem to be dealing with the text as an opportunity to construct narrative meaning.'	'This category reflected the children's abilities to relate the text being read aloud to other cultural texts and products.'	'Children connect the text to their own personal lives'	'Includes responses suggesting that the children had entered the narrative world of the story and had become one with it.'	'Children's responses indicate that they are entering the world of the text in order to manipulate or steer it toward their own purposes.'
Aliagas and Margallo's (2017) definitions of the five categories in their study				
When the reader draws on textual and visual information to interpret the story	When the reader connects the text with other texts	When the reader connects the story with his/her own life	When the reader is absorbed by the text and less distanced from the story,	When the text is manipulated by a reader with personal goals, typically humorous or ludic.
Examples from our participants				
M What's that?	Mother: Cats enjoy jumping high to catch things. [reads story text]	Mother: oh look ... blueberries, strawberries and cream.	'Where's the man going?'	The child gives mother a hug and asks: 'Do you like honey?' [in response to a picture showing mother and child embracing].
CH Wood.	Child: And eat them.	Child: I eat blueberries and cream.	'What's that cat doing?'	'Is that for me?' [in response to a picture of biscuits]
M Wood, M and what's that? CH A tape measure. M Tape measure. CH And that's a hammer.	Mother: And eat them sometimes. But I don't think he would like to eat that.	Mother: Yeah you do.		

4.3.3. Quality of mothers' talk

In addition to the documentation of what parents and children talk about, we aimed to assess the occurrence of parents' and children's verbal engagement identified in established research as most beneficial for children's vocabulary learning: abstract talk and abstract language. To assess the level of abstract language in parents' speech, we adopted the coding scheme developed by Hoicka, Jutsum, and Gattis (2008) that was used with British pre-schoolers in lab-based reading studies. We distinguished four *levels of abstraction in parents' talk* during book reading: 1) perceptual identification; 2) perceptual relationship; 3) displaced reference; and 4) inference. Table 1 provides definitions, explanations and examples from our data for these four levels.

To understand the patterns in children's reading behaviours, we adapted the coding criteria originally developed by Sipe (2008) for print books and applied by Aliagas and Margallo (2017) for children's digital book reading on iPads in an ethnographic study with Spanish children aged between 18 months and 5 years. While in Aliagas and Margallo's (2017) study children engaged with the digital books at home and on variously repeated occasions, in our study children engaged with the digital books on three occasions in the research lab. Given the child participants' young age and the relative brevity of their talk, we used Sipe's (2008) five over-arching categories to code children's talk, without the sub-categories. Table 2 specifies the five categories and our adaptation of the categories in light of our data.

4.3.4. The use of personal pronouns

To assess parents' and children's use of first- and second-person personal pronouns, we coded mother and child use of first personal pronouns (I, me, myself, my), second-person pronouns (you, your), third-person pronouns (he, his; she, her; it, its), plural first pronouns (we, our), plural second-person pronouns (you, your) and plural third-person pronouns (they, their).

4.4. Analysis procedure

The analysis of mother-child talk only occurred for speech during the third reading, where extra-textual comments were encouraged. All verbal engagement between mothers and children reading the digital book was professionally transcribed. Talk that did not relate to the reading session (e.g., the child asked to use the toilet) was removed from the analyses. Talk that was verbatim reading of the book's text was also removed. The transcript was divided into utterances by children and utterances by mothers. Following Halliday (1975), we refer to utterance as the smallest unit of speech (which could be a single word or continuous piece of speech) that begins and ends with a clear break (such as a pause), has paralinguistic and prosodic features, and can serve as an ellipsis or space/gap fillers (such as 'er', 'um'). We were interested only in the extra-textual utterances that mothers made around the book text. We did not code participants' non-verbal engagement. A research assistant (RA), who was not present at the parent-child lab visits and was blind to the hypotheses, coded all transcripts, according to the coding guidebook developed by the authors. A sample was also coded by the Co-I and discussed with the RA to check for reliability in coding procedures. The coding for mothers' level of abstractness in speech was second-coded by a researcher independent of the project and trained in the coding via a coding manual co-written by the researcher who completed the initial coding to ensure coding reliability. Any utterance made by the mother was coded according to the four levels of abstraction adopted from Hoicka et al. (2008) (see Table 2 for details); a mother's repetition of or minimal reply to a child's comment was still accepted within the abstraction coding. The inter-rater reliability score was calculated using an equally-weighted Cohen's kappa, which indicates a moderate level of agreement above chance when it is between .41 and .60 (Altman, 1999). The Cohen's κ between our two coders was .48 (95%CI = .42, .54; $p < .001$). Disagreements were resolved through discussion between coders and the second author of the study.

5. Findings

The data violated tests of normality in some of our comparisons, with high skewness and kurtosis and Shapiro-Wilk's test $p < 0.05$ for mothers' talk at L3 and L4 of the abstraction coding. In light of this, and our small sample size, we decided to use non-parametric measures.

5.1. Vocabulary learning

Children's vocabulary learning did not differ across the personalized and non-personalized pages as assessed by the word recognition test (Wilcoxon test $Z = 6.00$, $p = .777$). The children's learning rate was very low in both conditions: for personalized pages Mean = 1.11 (SD = .863) and for non-personalized pages Mean = 0.76 (SD = .587). Furthermore, there was no difference in the amount of mothers' talk and children's engagement between personalized and non-personalized (generic) pages. This was tested by analysis of differences in the mother's number of utterances, at each of the four levels of abstraction (see table 1), and in children's number of utterances between personalised and non-personalised pages.. These comparisons were non-significant for all coding sub-categories of the parents' talk (Wilcoxon test for L1: $Z = .153$, $p = .878$; L2: $Z = -1.723$, $p = .085$; L3: $Z = .261$, $p = .794$; L4: $Z = .917$, $p = .359$) and the child's engagement (Wilcoxon test $Z = -1.443$, $N = 25$, $p = .149$). Reanalysis using parametric methods, in this cases using repeated-measures t-tests, did not alter the significance of our findings. Because there was no difference between personalized and non-personalized pages, all remaining analyses were collapsed across page type.

5.2. Themes in talk

Extracts1-3 illustrate exchanges where Child1 used personal talk with generic, non-personalized pages. In Extract1, the child pointed out the letters of his name where he could find them when these were part of another word.

Extract1

M1: A copious breakfast with so many things. [book text]

C1: Mummy that's me.

M1: Is that you?

C1: That's my name.

M1: Oh there's a 'M' there for [child's name]

C1: Yeah. I've got 'A' on my name.

M1: You've got 'A' on your name, you have.

C1: And that, and that ... everything on my name.

M1: Wow, wow.

Extract2 shows the conversation around another generic, non-personalized page with a picture of a woman drinking tea. Despite the absence of personalization features, the child reacted to the image and to the text with references to her personal life and teas that her parents drank at home.

Extract2

M2: It is time for drinking tea.

CH2: I eat waffles.

M2: You do.

M2: The woman enjoys drinking tea. It is relaxing. [book text] Look, what's she drinking?

CH2: Tea.

M2: Tea.

CH2: No, that's not tea.

M2: It is, it's just got no milk in it.

M2: A cup of tea at the end of the day is relaxing. [book text]

CH2: No it's strawberry tea.

M2: It's strawberry tea is it?

CH2: Yeah.

M2: Okay. Oh ...

Extract3 illustrates how the personalization features of the book contributed to enjoyable memories and experiences during the book reading sessions.

Extract3

M3: Discovery days are so much fun – what did you discover? [book text]

M3: What did we discover?

CH3: I liked the snuggle bit.

M3: You liked the snuggle bit,

M3: You liked discovering that there was a picture of us snuggling, did you?

CH3: Yes.

The frequency of occurrence of the five categories of children's comments is summarized in Table 3. The high occurrence of analytical comments (35.8 %) indicates that children were mostly drawing on the text and visual representation of meaning in making their comments. The second most frequent category were comments related to the child's personal knowledge (29.3 %), followed by comments in which children drew on other texts or their knowledge unrelated to the book or direct personal experience (19.7 %). Only a tenth of children's comments indicated they were fully immersed in the story and less than 5 % of comments were linked to children's performance of specific story elements.

5.3. Quality of mothers' talk

Table 4 summarizes the occurrence of individual abstract talk categories in mothers' talk. As can be seen from the percentage figures, the most frequently used category by mothers was perceptual identification, which is the lowest level of abstraction. However, the highest level of abstraction (inference), was almost as frequent as that of the lowest level at 20.7 %.

Table 3
Proportions of children's reading strategies.

1=Analytical	2=Intertextual	3=Personal	4=Transparent	5=Performative
35.8 %	19.7 %	29.3 %	10.8 %	4.23 %

Table 4
Occurrence of mothers' use of abstract talk.

L1: Perceptual identification	L2: Perceptual relationship	L3: Displaced reference	L4: Inference
22.9 %	18.6 %	16.4 %	20.7 %

5.4. The use of personal pronouns

Table 5 summarizes the proportion of all personal pronouns used by mothers and children, coded in relation to *me*, *you*, *he/she*, *we*, *they* and their possessive equivalents. The descriptive statistics show that mothers used mostly second- and third-person in their talk, while children used mostly first-person talk. More than half of all pronouns used by children were self-referential.

There was a considerable degree of correspondence between mothers' talk and children's utterances, as shown with correlations in Table 6. Kendall's Tau correlations were performed with all types of talk categorised. For brevity, here we report the significant correlations between mothers' highest (L4: inference) and lowest degree (L1: perceptual identification) of abstract talk with the three most frequent types of children's talk (analytical, intertextual and perceptual), as well as these three types of children's talk and mothers' use of personal pronouns. Mothers' inferring was significantly correlated with children's personal talk, but children's personal talk was not correlated with perceptual identification. The correlations also showed a significant relationship between mothers' use of 'you' pronoun and children's response in analytical and personal style, and between children's intertextual style and mothers' use of third-person pronouns (both in plural and singular).

6. Discussion

This article is the first detailed attempt to document the language use that accompanies mother-child shared reading of digital books with personalization features. New technologies, including digital personalized books, bring new challenges to the reading process, which Crook (2005) conceptualized in terms of the technologies' non-linearity, authorship and personal construction. This study looked closely at a particular type of digital book: we aimed to establish whether there is a difference to children's vocabulary learning and parent-child language use with digital books that contain personalization features. Unlike previous studies, which found effects of shared reading on children's vocabulary (e.g., Kucirkova et al., 2014a, 2014b; Opel, Ameer, & Aboud, 2009), we found no difference between personalized and non-personalized pages in relation to children's vocabulary learning or amount of parent-child talk. When we looked at the parent-child language use across both personalized and non-personalized pages, we found strong correspondence between mothers' and children's language use. Notably, we found that the highest level of abstraction in mothers' inference-building talk related to children's analytical and personal verbal responses. We also found that inference building appeared to be related to mothers' use of second and third-person pronouns. These two findings suggest that mothers engage in higher levels of abstraction talk in proportionate response to their children's utterances during shared reading. This in turn relates to the nature in which mothers refer to the child or other protagonists, such as story characters or personal family members.

Conversely, children's most frequent reading strategy with personalized digital books was to draw on their personal experience and to refer to themselves. This reading strategy was evident in the content of the children's talk as well as their use of personal pronouns. In other words, while mothers tended to draw their children's attention to other characters and new objects in the book, children's attention was mostly on their own experiences, reminiscing and their reference to themselves in the book. These findings led us to conclude that parent-child spontaneous talk whilst reading a digital personalized book is characterized by a high level of self-referencing. To summarise, while we did not find a marked difference between mother-child language use when reading personalized and non-personalized pages, we cannot be sure whether the finding is related to the personalized nature of the digital book, or whether it was linked to the digital format of the book, or to the lab-based context in which the shared readings took place or to the combination of all these factors. Further research is needed to build knowledge about the mutual influences of adults' and children's talk during shared book reading, and about children's responses to books that are relevant to their personal experiences.

In our previous studies, we used separate personalized and non-personalized books and only in a print format. In Kucirkova, Messer and Whitelock (2013), for example, we analyzed the reading engagement of seven English parents and their children aged 12–33 months when sharing a paper-based personalized book, a non-personalized book and a child's favourite book. Kucirkova et al. (2013) showed more positive engagement between parents and children (measured as frequency of smiles, laughter, shared eye contact) and more verbal engagement with personalized books as opposed to the non-personalized and favourite books. Reflecting on the findings of the study reported here, it could be that a digital book that contains both personalization and non-personalization features interfered with meaning-making through cognitive overload. These effects could be explained with the dual processing theory of working memory (Mayer & Moreno, 1998), according to which an overload in visual working memory (e.g., children paying simultaneous attention to the book's pictures, text and interactive elements) leads to cognitive overload that reduces individuals' learning. This

Table 5
Personal pronouns with percentage of total occurrence in mothers' and children's non-immediate talk.

	1st person singular	2nd person singular	3rd person singular	1st pers. plural	3rd person plural
Mother	8.7 %	36 %	37 %	9.2 %	10.6 %
Child	51.06 %	10.2 %	30.6 %	2.9 %	5.1 %

Table 6
Correlations between mothers' utterances and children's type of talk.

Child's talk	Correlation with		Correlation with		
	L4 inference	L1 perceptual identification	Mother_2nd singular (you)	Mother_3rd singular (he or she)	Mother_3rd plural (they)
Analytical	.364*	.580**	.381**	.270	.200
Intertextual	.252	.562**	.272	.402**	.386*
Personal	.462**	0.181	.534**	.120	.275

P < 0.05; ** P < 0.01.

hypothesis is in line with Bus and colleagues' findings (e.g. Bus, Takacs, & Kegel, 2015) that digital books with interactive features that were incongruent with the storyline disrupted a child's story comprehension and vocabulary learning.

Overall, our findings make a small, but we would argue significant, contribution to extant literature that examines parent-child engagement with digital books. Previous studies that compared digital versus print books found that digital books disrupt parent-child dynamics during book reading (Chiong, Ree, Takeuchi, & Erickson, 2012) but little is known about the mechanisms underlying these responses. In our study, children's attention was on their personal experience and not on the storyline, even when personalization was congruent with the fictional storyline.

The study outlined how the social aspects of shared reading (e.g. the value of reminiscing about past shared experiences) intertwined with the material aspects (the personalisation). Given our study findings and the previously established link between reminiscing and self-referential language, we recommend that future digital book design is optimised for reminiscing prompts relevant for both the parent and child. With regards to the concept of socio-material assemblage, another study implication is the need for guidance for parents, particularly on the kinds of reminiscing exchanges they might endeavour to prompt during shared reading.

6.1. Study limitations

We found no difference between the personalized and generic pages in the testing book and could not establish any clear differences in vocabulary learning. This could be because there was no difference, because the two conditions were not sufficiently distinct from each other, or because of low levels of vocabulary learning in the laboratory-based study conditions. Possible reasons are that: 1, the personalized and non-personalized sections appeared in the same book rather than in two separate books; 2, the personalized photo and information about the child was not matched with contrasting non-personalized information; 3, the book was in a digital format that is associated with personalized content more than print books or other materials used by parents and children during shared reading.

We recommend that future experimental studies interested in examining personalization/ non-personalization difference use two separate books (personalized and non-personalized books) and/or more clearly differentiate the personalization contrast inside the books. Mothers' high use of inference-related talk could be attributable to the specific sample of mothers participating in the study. Similarly, children's focus on self in their talk could be attributed to general developmental characteristics or to the personalized features of the book they read, or both. Moreover, the medium in which the digital book appeared in this study - an iPad - may have influenced children's responses, given that iPads are often used with children in this age group to view photos of themselves and/or family photographs, so the personalized pages would have been congruent with children's previous experiences of viewing texts on iPads. Given the study design, we cannot be sure whether the patterns we observed were unique to our sample, to the book that was used or to the interaction of these two factors. Therefore, any causal influences or generalizations would not be warranted; our study details the patterns in parents' and children's reading behaviour within a unique and little studied reading context. Our socio-material orientation allowed us to highlight the inter-relationship between the materiality of the medium, the situated nature of the social context and the personal relationships between each mother and child.

Personalized features are not bound to a specific book genre, which is an important aspect for research, as most knowledge about children's digital book reading comes from studies focused on fictional stories (see Strouse & Ganea, 2017). Future studies could examine how non-fiction texts relate to personalization. This study was short-term and did not investigate parent-child reading patterns over time. It also focused on comparatively affluent majority population participants from a specific geographical location, with a pre-established profile. Future longitudinal studies could expand our findings to a heterogeneous sample of diverse families' patterns of talk during shared reading with diverse genres of digital texts. Such studies could be conducted in labs but also at home, with participatory research methods where families film their reading interactions and follow a reading protocol similar to that in our study.

6.2. Study implications

Personalized books explicitly encourage focus on self and this encourages self-referencing in young children. Self-referential and self-focused reading behaviour, coupled with children's enjoyment of the book, might be useful book features to motivate children to read, particularly those who are typically disengaged or not interested in reading (see Picton, 2017). Personalized books directly call for readers' attention with familiar content, which is likely to be a factor in why young children respond to them with a high level of self-reference. When Kucirkova et al. (2014) compared children's self-referential speech between a personalized book and a non-personalized book, the occurrence of 'me, myself, my' was significantly higher in the personalized book condition, and less common in more generic reading contexts. While the direct relationship between self-referencing in generic reading and children's

learning outcomes has not been studied, two experiments with 7–9-year olds show that self-referencing enhances children’s vocabulary learning with both real words and no-sense words (Turk et al., 2015). It follows that there is a strong potential for using children’s focus on self in reading digital personalized books for teaching children new vocabulary and this potential should be supported in the future design and educational use of digital personalized books.

We could describe children’s self-referential/personal reading behaviour as extratextual talk, a term used by Hartman (1995) to characterise the reading patterns applied by a reader to ‘situate her understandings exclusively in terms of her own personal experience or knowledge, never once situating the text in relation to other passages in the study’ (p.545). Hartman describes the profile of one of the students in his study, Diane, who drew on her own personal preferences when interpreting the text. As he put it: ‘Diane seemed to have definite ideas about what she liked and was interested in, as well as her dislikes and things she was not interested in. If a text meant something to her personally, then she liked it and was interested; otherwise, she found fault with it and became uninterested.’ (p.545). Diane was, in Hartman’s interpretation, judging the text on her own terms and she asserted her own meaning over the author’s meaning. Hartman studied proficient readers engaging with multiple texts whereas in our study the children were non-readers and engaged with one text. Nevertheless, we could make similar claims about children’s reading strategies with the personalized books in our study. The children were highly engaged with the books but by and large, they constructed their own meanings and interpretations of the text. Their mothers tried to highlight the features of the text that were non-personalized, frequently using third-person pronouns and questions/prompts to take the child reader beyond the text. These compensating reading strategies were relatively frequent with our mother participants but since this study was the first to examine these patterns with digital books with personalized features, we cannot compare this finding with other reports. We recommend that future research further explores parents’ and children’s specific reading behaviours in relation to personalization and expands our focus on static personalization to dynamically personalized children’s digital books.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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