"This book is magical!": exploring emergent readers' preferences and wishes for storytelling tools

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ABSTRACT

Emergent readers are young children who are beginning their journey towards literacy; they enjoy shared reading both at school and at home, and maybe they are already able to read and write their own names. We involved emergent readers aged 4 to 6 years old and recruited through a local library, in a two-month long exploratory study, with weekly sessions in which they interacted with both traditional books and digital storytelling tools, engaging them in a series of activities to elicit their preferences, needs and wishes, following the formative evaluation approach. Basing our findings on direct observations, field notes and analysis of the recorded sessions, we found that tools explicitly designed for interaction trigger a higher level of engagement. Besides, we gained a deeper insight on how to conduct collaborative design sessions with small groups of emergent readers.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**; **Interaction techniques**.

KEYWORDS

children, preschool, collaborative design, codesign, emergent readers, storytelling, literacy

1 INTRODUCTION

Younger children, aged 4 to 6 years old, are becoming users of technology in their own right, both for educational and entertaining purposes. While parents often have a good attitude towards the use of technology for learning purposes [6, 31], digital play is not as popular and it was in fact shown to be the least preferred option among different type of play [21]. Therefore, technology designed for children should be not only entertaining but also educational,

to respect parents' wishes and preferences for their children and so favour the dissemination of and growth of innovative solutions.

However, the role of children in the design of new technology should not be limited to being a user, but children can and should be involved as equal stakeholders throughout the whole design process, as design partners [12]. More recently, another perspective has been suggested: giving children the role of protagonists in the design, empowering them to shape the design of new technology and giving them the opportunity to assume a critical stance toward technology [22].

While children involved in this role as usually older, many collaborative design techniques originally designed for adults and older children have successfully been adapted to be used with younger children [2, 19, 49], while other techniques have been specifically designed for this age group [16] [3].

Our exploratory study is part of a larger project focusing on the design of storytelling technology to support the development of children's literacy skills as they learn how to read independently. The aim of the exploratory study is to gain a sense of how children interact with different kinds of books and storytelling tools, while the ultimate goal - further down the line - consists of extracting user requirements and designing a prototype based on their wishes.

After recruiting a small group of children aged 4 to 6 years old, we met with them weekly for two months, engaging them in specific activities, both with and without technology, such as reading traditional books, reading game-books, and playing with various toys designed to tell them stories or help them create stories. As we built a relationship with the children, we relied on direct observations and on the analysis of the drawings produced by the children during the activities. The analysis of our data allowed us not only to extract requirements for the future design of prototypes, but also to gain a deeper insight on how to conduct co-design sessions with children in this age range, and to answer the following research questions:

- **RQ1.** What kind of storytelling activities work better in engaging emergent readers and meeting their needs and wishes?
- **RQ2.** What insight, in the design of new technology, can we gain by exposing emergent readers to different kinds of storytelling activities?

2 RELATED WORK

2.1 Storytelling, shared reading and literacy

Shared book reading between parent and child is not only a learning opportunity, correlated with better reading achievements and

language growth [5, 40], but also a social practice that supports parent-child bonding and foster intimacy [49].

Current research also shows that dialogic reading, which consists in reading *with* children, asking questions and interacting with them, is effective in promoting emergent literacy [10, 23, 29, 50].

While some research suggests that shared parent-child reading using an electronic format negatively affect children's story comprehension [24, 32] and dialogic verbalisation [30], multimedia stories are more beneficial in terms of story comprehension and vocabulary than traditional story-books when children read them on their own, and they are on par with shared parent-child reading of traditional books [47].

Moreover, the downsides of using technology for shared parent-child can by mitigated and even negated by explicitly designing for shared participation [18]. One example of such design is TinkR-Books [7], a flexible table-based storybook in which both parent and children can alter the text of the story by manipulating the characters on the screen, that was shown to elicit more dialog and dialogic questioning compared to print books.

In this context, multimedia tools for storytelling should not be seen as an improvement over parent-child shared reading, but as an enhancement or a substitute, in cases when a parent is not available or needs help performing the role of orchestrator and narrator during shared reading activities, which is a real point of tension identified by research [49].

Examples of such technology are, for example, a web app scaffolded with audio prompts [38], or using a robot that collaborates with children to create shared stories [44].

Some tools are instead designed for the use in the classroom, such as an iPad application allowing emergent readers to combine word tiles and hear the resulting sentences and stories spoken aloud [26].

There are also forms of narrative that, while not necessarily digital, are interactive in their own right: game-books, made popular in the '80s and '90s by the Choose Your Own Adventure children's book series [8], are a form of fiction that allows the reader to change the course of the story by making choices that lead the narrative to different paths. While game-books lost popularity with the advent of video games, research shows that they can be effective in helping students learn a second language [33, 34, 39].

2.2 Co-designing with young children

Collaborative design has many benefits, such as improving processes of idea generations, promoting cooperation and creativity, and improving users' satisfaction in the long term [43] [25]. While in the past co-designing was mainly performed with adult users, in the last decades children have also started being involved in the design of new technology, first as testers, then as informants and finally, design partners in their own right [12]. According to Read et al., the ideal age for collaborative design is between 7 and 10 years old, as children of that age have a good capacity of abstraction and reflection, but they are still very imaginative, and they lack prejudices and preconceptions [36]. In this age range, both brainstorming and prototyping work well as design methods: while children uncover a higher number of design ideas when prototyping, they provide more detailed criteria when brainstorming [41].

Many methods to evaluate technology with children, such as the Fun Toolkit, have also been developed for older children, at least 7 years old [37].

However, as in recent years children have been starting to use technology earlier and earlier, there is a new need for technology to be designed for younger children, who are at a different stage of development than older ones. According to Piaget's theory of child development, in fact, children aged 2 to 7 years old are in the pre-operational stage of development, while children aged 7 to 12 years old are in the operational stage, and these two stages are characterised by different abilities and needs [35]. Therefore, methods and activities that work with older children are not guaranteed to work with preschool children.

Some techniques developed for older children, such as Cooperative Inquiry [11], have been successfully adapted for younger children with some changes, such as allowing the children to draw their ideas instead of writing them down and working in smaller groups [13]. Both [45] and [13] emphasize that children work better in smaller groups. This is also supported by [4], who goes beyond that to present evidence that younger children, aged 4 to 5 years old, have the most difficulty in working collaboratively, and work better in pairs.

Other techniques have been proven to be useful with older preschoolers, but still present challenges with children on the younger side of this age range: for example, Barendregt and Bekker [2] used the drawing intervention method to elicit design ideas with children aged 4 to 7 years old, and found that the younger children found it hard to collaborate, and had difficulty using drawings to communicate design ideas. This was also true for Hiniker et al. [19], who used *Fictional Inquiry* and *Comicboarding*, techniques developed to elicit insights from adults users, with children aged 4 to 6 years old; while 5 and 6 years old were able to successfully generate design ideas, 4 years old children had more difficulties in doing so. However, younger children still participated enthusiastically, suggesting that with more adult facilitation, they could participate fully in the design process. This is also confirmed by Farber et al. [13], who note "More adult facilitation" as one of the changes to design methods needed to involve younger children. However, Marco et al. [28] report that less structured sessions, that required a small amount of instructions to be given to children, tended to elicit more reliable and valuable data for researchers.

There are also many design methods developed specifically for younger children. With an approach centred on constructive play practice, consisting of three steps aimed at creating a story-line and establish a cooperative process, children can become protagonists in the design process [42], as also envisioned by [22]. Another example is *Mixing Ideas* [17] has been used to foster collaboration among young children. This technique includes three stages: in the first one, each child generates their own ideas by drawing them; in the second stage, small groups of children mix their ideas together, with each small group combining their ideas into one idea; in the third and final stage, adults take a larger role, giving more structure to the groups. A technique called *Play-based design* has also been developed for younger children: it has three basic steps involving make-believe play activities with an adult facilitator [45]. Finally, *Embedded Figures in Stories* [3] is a method designed to inform

child-tangible interaction for children aged 2 to 4 years old and to elicit age-specific knowledge about young children's spatial skills.

3 METHODOLOGY

3.1 Recruitment

Figure 1: Tellie

A local children's library supplied us with a space to conduct our sessions and circulated an announcement to recruit children using their own mailing list, composed of all the parents that had previously registered at the library. The announcement consisted in a brief presentation of our project, and a consent form, approved by the ethics committee of our university, to be signed by parents, asking for the child's age and the school they attended, and to consent to the audio-video registration of the sessions. We did not operate any sort of selection among the participants; the first 12 children who registered were the ones involved in the project. While we were originally planning for a smaller group, around 6-8 children, we decided to accept a higher number of requests to account for unplanned absences (due to illness or other reasons). We also included two slightly younger children (around 3y 6m old) to accommodate sibling groups attending together. There were also two children who joined our project after the first session, upping the total number of participants to 14. As we had imagined, not all children participated to all sessions; however, we managed to establish a core of children who attended regularly. Table 1 shows the ages and gender of the children, and the sessions in which they participated. Some of the children only participated in one session, and one did not come to any session, so we did not include them in our analysis.

3.2 Setting

We conducted 6 sessions, all taking place in a separate room that was offered to us by the library. The room was comfortable, large and quiet, offering the possibility to project content on a spacious white wall, however it had very big glass windows that proved to be a distraction, as people – both adults and children – were often passing by the windows, capturing the attention of the children. The sessions took place in the afternoon, around an hour after the end of the school day, to allow time for children to have a snack and relax after school. This was suggested by the library volunteers, as it was near the usual time when children usually came to the library with their parents. We started the first session by introducing ourselves and then asking each child to introduce themselves; each of the following sessions started with a recap of the previous sessions, in which we asked the children what they remembered from the previous week. After that, we usually performed two activities per

Id	Gender	Age	S1	S2	S3	S4	S5	S6
C1	F	4y 6m	Yes	Yes	No	Yes	No	No
C2	M	5y 8m	Yes	Yes	No	No	No	No
C3	M	4y 3m	Yes	Yes	No	No	No	No
C4	M	4y 8m	Yes	Yes	Yes	Yes	No	Yes
C5	M	6y	Yes	Yes	Yes	Yes	No	No
C6	F	3y 7m	No	No	Yes	Yes	Yes	Yes
C7	F	5y 4m	No	No	Yes	Yes	Yes	Yes
C8	F	4y 7m	Yes	Yes	Yes	Yes	No	Yes
C9	F	5y 11m	Yes	Yes	Yes	Yes	No	No
C10	F	4y 9m	No	No	No	No	No	No
C11	F	3y 6m	No	No	Yes	No	Yes	Yes
C12	F	5y 4m	No	No	No	Yes	No	No
C13	F	4y 9m	No	Yes	No	Yes	Yes	Yes
C14	F	5y 7m	No	No	No	No	No	Yes

Table 1: Id, gender and age of the children at the beginning of the study, and participation in each of the sessions

session, alternating different types of reading, and options with and without screens. At any given time, one researcher participated in the activity with the children, acting as the facilitator/adult reader, while at least one other researcher observed the activity and took notes. We kept to the established routine along the full length of the study. While most of the activities were performed by the whole group at the same time, for some of them we divided the children into smaller groups. When dividing the children in smaller groups, we tried to respect children's preferences - some of the children were already friends or classmates before the study - while at the same time creating groups with a certain degree of diversity in terms of ages and gender, as compatible with the distribution of participating children. So, for example, a group might be composed by two couples of friends - one composed of two older children and one of two younger children - or when we had two boys participating in a session, we assigned each boy to a different group. All the sessions were recorded, with the consent of the children's parents or guardians.

3.3 Activities

A range of different activities was devised to engage children and help us better understand their needs when designing for enjoyable and educational reading experiences. From existing literature and interviews we conducted with experts in education and literature for children as well as storytellers, we extracted few heuristic rules for having engaging reading aloud sessions. These being: making sure the room is quiet, each child has a comfortable seat, possibly at the same level of the reader, that the story being read was suitable for their age. We also took inspiration from some techniques that were relayed to us by these professionals, such as using puppets, impersonating characters, acting out the scenes, asking questions and adding fun moments.

We offered the following activities:

Traditional books: we proposed two traditional books, chosen among the most popular for this age group.

Traditional Game-books: game-books are a form of interactive fiction in which the reader can choose different alternatives during the narration. These particular game-books were specifically marketed for the 4-6 age range.

Digital Game-Book (Prototype): This is a prototype mobile version of one of the game-books used during the session; it has hyperlinks that allowed to follow the chosen path just by touching the screen.

Lunii: Lunii [27] (Figure 1) is a radio-like toy that allows the children to choose some elements in a story (for example the protagonist, the setting and an item in the story) and then tells the story while children listen.

Figure 2: Lunii

Silent Book: silent, or wordless books, are books with just pictures, without any text. Children and adults read them together to create narratives, by describing what happens in the pictures.

Storycubes: Storycubes [1] are a set of 9 dice representing various items and characters, that are rolled and then used to create a story.

Digital Storycubes: a digital version of the Storycubes.

Tellie: Tellie[9] (Figure 2) is a small robot with a white, soft body and different lights, that allows children to choose among different stories and songs. Tellie has two storytelling modes: one without questions, and another that asks children two questions for each story. After each story, Tellie plays a short song related to the story.

Augmented Book: A paper book that has QR codes in the pages, that led to videos and songs, with the different chapters being recited in the videos.

3.3.1   Session 1. During the first session, 7 children were present; the first activity involved a traditional book, which was read aloud by one adult reader to the children. The children sat on pillows on the ground, in a circle, with the adult also sat on the ground at the same level of the children. The reader frequently stopped to ask questions, such as *"What does this word mean?"*, prompting the children to interact during the reading.

The second activity consisted in reading aloud a traditional game-book. Again, children sat in a circle while the adult read the book, asking them questions when it was time to choose, and also other questions such as *"What would you have done?"*. The book was read twice, as the children wanted to see what other different stories they might have created, with the second reading slightly shorter than the first one as children were already familiar with the story. None of the children had read a game-book before, and all of them were fascinated and curious about how they worked. One children commented: *"This book is magical!"*

3.3.2   Session 2. During this session, 11 children were present. The first activity in this session consisted in reading aloud a traditional book, also marketed for the specific age range of the children; seating arrangements were the same as the previous sessions, and again the adult reader engaged the children with questions and prompts. However, the book contained several "made-up words" which significantly limited the ability of the adult reader to ask the children about vocabulary. The second activity consisted in using
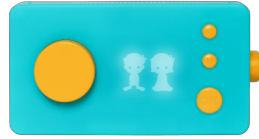
Lunii. While children's activity while using Lunii, alone or with a parent or peer, has previously been analysed [15], it was unclear whether children would respond positively by listening to Lunii in a group. This activity was still led by an adult facilitator, who frequently stopped the recording to ask questions to the children, helping them relate the story to their everyday experiences. For example, when glasses were mentioned, the facilitator asked *"Do you know anyone who wears glasses?"*.

3.3.3   Session 3. During this session, 7 children were present. The first activity consisted in "reading" a silent book, which was projected on a wall. The children sat on pillows in front of the wall where the story was projected, while the adult facilitator flipped through the pages, asking questions such as *"What do you think is happening here?"*. During this activity, we noticed that the children who had already read the book at home were the most enthusiastic and eager to answer our question. This is in accordance with Trivette and al.'s findings [48], according tho whom repeated reading of the same book is associated with positive outcomes regarding both story comprehension and story-related vocabulary. At one point, the facilitator asked the children to get up and count how many items of a kind were there in the page, by pointing at them on the wall where the book was projected. All children participated in this activity, even the younger or more reserved ones, and they seemed very engaged by it. For the second activity, children were split in two group, respectively made of three and four children; each group played, in random order, with the Storycubes and the Storycubes mobile app. Each group had an adult facilitator, and children switched from one activity to the other after around 10 minutes. While children understood how the dice worked, and were curious both about the physical dice and the tablet, they did not want to tell a story themselves; however, they would answer questions if prompted, to build on stories started by the adult facilitators.

3.3.4   Session 4. During this session, 9 children were present. The first activity consisted in playing with Tellie. We started with the "no questions" mode, then with the "ask questions" mode. For this activity, children sat at a large table. The first mode did not elicit many comments or prompts by the children; however, they were very attentive and even the youngest ones kept the focus for the whole activity. After the activity, children were asked what the best part of using Tellie was. Almost all the children answered that the part that they had liked best was the song. The second mode - storytelling with questions - elicited more comments as children promptly answered the questions. Children reported liking this mode more than the first one. After the activity, we invited children to draw how they would like to change Tellie and make it better, to furtherly explore the potential of the Drawing Intervention Method used by Barendregt and Bekker to engage young children (4-7) in co-design and evaluation activities [2]. However, even if we followed the same procedure, the children struggled to understand what they were supposed to draw, resulting in many unrelated drawings, such as rainbows (the subject of the last story to which they had listened).

Only the older children produced drawings that were related to the task; one boy drew a robot, while a group of three girls drew ideas from one another, resulting in a set of three almost identical drawings, which were relevant to the task - they drew

tablets - but did not show any real collaboration. Overall, we did not find the drawings to be sufficiently informative and agree with [2] who reckoned this method to be "probably more suitable for children from 6 years and up". However, as Xu, Read and Sheenan note [51], some elements in drawings are difficult to interpret, and extra annotations - either added by the children, or annotated by the researchers in response to clarification questions asked to the children - would go a long way in helping researchers interpret children's drawings.

3.3.5 Session 5. During this session, 4 children were present, and we only had one activity, in which we read the augmented book. The small size of the group allowed even the youngest children, who had struggled to pay attention and keep up with the group in the previous sessions, to speak and interact more. After the activity, we had some unstructured play time in which the children could choose a toy and play with it in autonomy.

3.3.6 Session 6. During this session, 7 children were present. We split them into two groups, respectively made of 4 and 3 children. Each group read, in random order, the paper version and an e-book version of the same game-book. The e-book version had been designed by us as an hypertext in which the pages, that had been scanned from the paper book and were as such identical in both versions, were dynamically linked in such a way as to follow the order in which they would be read in the paper version. So, instead of, for example, "going to the page with the seashell", the children could just touch the seashell on the screen and go to the correct page. The small group size allowed even the younger and shy children to interact a lot. Children were very curious about the paper book, wanting to touch it and flip the pages. The facilitator read the book, asking questions when there was a choice, and and also general questions. Both versions of the book - the paper and the digital - were read one page at a time, after which there was a choice that led to another page. A child, who had not attended Session 1 and therefore was not familiar with how game-books work, exclaimed that *"This page was not here before!"*.

4 RESULTS AND DISCUSSION

4.1 Coding

First, we clustered the activities that we offered according to two different dimensions: their level of technology and their level of interactivity.

According to their level of technology, we had three categories:

- **Traditional storytelling (TS)**: books, either regular or game-books, read in their paper form by an adult to a group of children. This category also includes the physical StoryCubes.
- **Digitally assisted storytelling (DAS)**: books either projected on a screen or shown on a tablet, but still read by an adult to a group of children. This category also includes the StoryCubes app.
- **Digital storytelling (DS)**: the stories are read aloud by a specific toy, with or without interaction from the children.

According to their interactivity, we had also three categories:

- **Not interactive (N)**: there is no expected interaction between the facilitator/the toy and the children; any possible interaction depends on the skill of the facilitator. This category includes regular books - with or without the app, as it only showed videos, Lunii, and Tellie in the "no questions" mode.
- **Interactive (I)**: interaction is expected between the facilitator/the toy and the children, however the interaction is not guided in any way and depends on the skills of the facilitator. This category includes the silent book and the Storycubes - both regular and digital.
- **Guided Interaction (G)**: interaction is expected between the facilitator/the toy and the children; it is clear when and what the interaction should be, as it is explicitly written or presented. This category includes Tellie in the "ask questions" mode, and the game-books - both regular and digital.

For each activity, we recorded the categories, the number of children involved **(C)** and the length in minutes **(L)**.

To quantify children's engagement during an activity, we decided to analyse the recordings of our sessions and counting the utterances spoken by the children during the activity, either spontaneously or in response to the facilitator's prompts, using the following criteria:

- Each utterance spoken by each children was counted separately, even if different children repeated the same utterance.
- To be considered for further analysis, an utterance had to be different than a simple "Yes" or "No", but "yes" or "no" followed by other words were considered valid.
- To be considered for further analysis, an utterance had to be related either to the story content, or to the activity itself - for example, mentioning that they had previously read the story.

To account for the number of children and the length of the activities, we divided the number of utterances **(U)** by these two factors. These data are shown in table 2.

4.2 Analysis

We performed both a quantitative and a qualitative analysis of the data that we obtained.

4.2.1 Quantitative analysis. First, we performed a series of one-tailed, unequal variance t-tests to examine the significance of the association between each category - both for the level of technology and interactivity dimension - and the number of utterances spoken by the children, normalised for the length of the activity and number of participants.

We found that traditional storytelling significantly outperformed non-traditional storytelling *(p=0,0125)* while digital storytelling elicited fewer utterances compared to the other levels of technology, digitally assisted and traditional *(p=0,009)*.

When analysing the activities by their level of interactivity, we found that, taken together, both kinds of interactive activities significantly outperformed non-interactive activities *(p=0,005)*. However, there was not any significant difference between interactive activities and activities with guided interaction.

Session	Activity	Technology	Interactivity	C	L	U	U/C/L
1	Standard Book 1	TS	N	7	11,5	38	0,47
1	Standard Game-Book 1, story 1	TS	G	7	9	43	0,68
1	Standard Game-Book 1, story 2	TS	G	7	6	36	0,86
2	Standard Book 2	TS	N	11	9	29	0,29
2	Lunii	DS	N	11	12	48	0,36
3	Silent Book, projected on wall	DAS	I	7	26	110	0,6
3	Storycubes (regular) group 1, story 1	TS	I	4	4	14	0,88
3	Storycubes (regular) group 1, story 2	TS	I	4	3,5	10	0,71
3	Storycubes (regular) group 2, story 1	TS	I	3	3,5	7	0,67
3	Storycubes (regular) group 2, story 2	TS	I	3	3	5	0,56
3	Storycubes (app) group 1, story 1	DAS	I	4	5	11	0,55
3	Storycubes (app) group 1, story 2	DAS	I	4	4,5	10	0,56
3	Storycubes (app) group 2	DAS	I	3	7	6	0,29
4	Tellie, story 1 - no questions mode	DS	N	9	6	6	0,11
4	Tellie, story 2 - ask questions mode	DS	G	9	4	12	0,33
5	Augmented book with app	DAS	N	4	13	28	0,54
6	Standard Game-Book 2, group 1	TS	G	4	10	45	1,13
6	Digital Game-Book 2, group 1	DAS	G	4	10	34	0,85
6	Standard Game-Book 2, group 2	TS	G	3	9	20	0,74
6	Digital Game-Book 2, group 2	DAS	G	3	10	12	0,4

Table 2: Data captured from children's activities

Finally, we discovered a statistically significant association between the number of children involved in an activity and the amount of utterances spoken, with smaller groups (4 children or fewer) eliciting significantly more utterances than bigger groups *(p=0,048)*.

4.2.2 Qualitative analysis. Our qualitative analysis is based on the direct observation of the children's behaviour during the sessions.

At least two researchers were involved during each session; after each session, each researcher went through the recording separately and took notes regarding the children's behaviour during the different activities. We then compared notes in brainstorming sessions, clustered the notes and identified common themes. In the end, three main themes appeared: children's preferences for specific toys, curiosity and frustrations, age and personality.

4.2.3 Children's preference for specific toys. The children with whom we worked went to the library with their parents on a regular basis; therefore, the fact that they had a strong interest in books was not surprising. While not yet being able to read independently, children were eager to explore the books with their hands, turning the pages and making sense of the content by looking at the pictures. However, they also took a keen interest to the tangible toys that we brought with us during the sessions, and specifically Tellie. While Tellie on its own did not elicit many utterances, when listening to it children remained focused on the activity. Also, when able to play independently with Tellie children used it to play songs, which they deemed *"the best part"*. They also danced to Tellie's songs, and in general experienced the freedom of moving it around and taking it with them.

4.2.4 Curiosity and frustration. Children expressed a lot of curiosity towards books and tools they did not know; this was true both

for the gamebooks and for Tellie. However, in several cases the curiosity led to frustration. In the case of the gamebooks, for example, there was only one possible path to get to the "happy" ending, and all other paths led back to the beginning of the book. After two or three tries, children began to express their frustration: for example, they said *"We have been here before!"* and *"Isn't there any new page? I want to see a new page"*.

Tellie also caused frustration, although for different reasons. The model that we used during the sessions had both voice recognition and buttons, located on the robot's hands. Children, however, had trouble with the voice recognition, and often accidentally activated the button by playing with Tellie's hands, as they tended to touch it and explore it while it was narrating or playing music. This led to frustration, with the children complaining that Tellie *"was broken"*.

4.2.5 Age and personality. While age is undoubtedly an important factor when involving young children, we found that, by working in small groups and taking the time to build a relationship with them, even younger children can successfully and enthusiastically participate in the activities. This was also true for older children who might be particularly shy; at one point, one child said *"I am glad that [Other child's name] is not here today, because he always says everything"*. This made us aware of how we must be mindful of giving each child space to express themselves, without silencing the voices of the most extroverted children, but at the same time allowing also the more reserved ones to shine.

5 DISCUSSION

5.1 RQ1. What kind of storytelling activities work better in engaging emergent readers and meeting their needs and wishes?

We explored different activities and settings over a period of time as a means to allow children to adjust and get acquainted with us researchers, the tasks and activities as well as with the other children. The activities that attracted more interaction while also holding children's attention for longer were those involving game-books mediated by the adult readers, as they allowed for a constant back and forth between the adult reader and the children, within the fixed times in which interaction was expected.

We also noted that, during activities that were not designed for interaction such as standard book or silent book reading, the skill of the adult reader - whether it was a senior researchers with decades of experience, or a PhD student just starting out - also made a difference in children's engagement, as expert readers know how and when to ask questions, even when the activity is not designed for them. This consideration is of particular importance to us: as we explore the parent-child or child-child shared reading scenario, our goal is not to replace humans as storytellers but to help parents and caregivers who do not have the skill or time to choose stories and perform the role of narrator when reading with their children [49].

On a different note, it is worth pointing out how Tellie was a great favourite, and anytime children were left free to choose they would fight for it and showed to appreciate its cute appearance as well as the singing and colorful lights used to complement storytelling. Even if aesthetics played a role in the choice of the favourite toy, it did not seem to influence the level of engagement it generated during the reading experience. If anything, the cute aesthetics made it more likeable and approachable for children, a trait that is also supported by literature [14, 20].

On a more general note, it emerged that activities conducted in smaller groups lead to more interaction, and also allowed younger and shy children to participate more fully. We also found that, as we got to know the children better and built a relationship with them, they started to become more forthcoming in expressing their opinions and engaging with us. Because of this, we feel that when working with younger children it is important to keep a good ratio of children to researchers, to allow for smaller groups and more one-to-one interaction, and to plan longer studies with more than one session.

5.2 RQ2. What insight, in the design of new technology, can we gain by exposing emergent readers to different kinds of storytelling activities?

While structured activities such as shared reading of a game-book engaged the children and were effective in getting them to express their opinions, they gave us limited insight in terms of children's actual wishes and preferences: these activities are still performed in a group and led by an adult, and as such did not empower children to fully be protagonists of the activity. They are, however, a good starting point that can inform the future design of interactive tools that can enhance the experience of parents and children, or siblings group reading together.

Unstructured activities, such as the free exploration of new tools in which we only participated as observers, allowed us to gain a deeper insight in how children play and tell stories. By allowing the children unstructured time to play and get to know the tools, we freed them from any expectation that might have come from our instructions, and this allowed us to gather honest and spontaneous feedback in the form of observations. They also allowed us to observe how young children collaborate spontaneously, so that we can also include that in the design of new tools. This lines up with [28]'s findings, according to which less structured sessions tend to elicit more reliable and valuable data.

Finally, we also explored the use of drawings to empower children to create design ideas. While children greatly enjoyed the activity, the younger children had difficulty producing drawings related to the topic - which was *"How would you make Tellie better? Can you draw a better Tellie?"*. Children's drawings were related to the story to which they had just listened; as the story featured a rainbow, almost all children drew rainbows. Also, while children discussed what they were about to draw and took inspiration from one another, they did not work together on any drawing.

In spite of these challenges, we believe that even younger children can produce more informative drawings when given more structure, in the forms of outlines or shapes to be completed; this is also supported by research, as more adult facilitation is one of the ways in which design methods can be adapted to be used with younger children [13, 19]. It is also worth noting that one of the forms of self-expression that children enjoyed the most was the use of stickers, which they also used in their drawings, and that can furtherly be explored as a mean for children to express their creativity.

5.3 Limitations and challenges

The size of our sample, although ideal for collaborative design, is small and does not allow us to generalise our findings, even if very definite trends emerge. Moreover, the fact that we worked with a children's library to recruit the participants meant that we worked with children who regularly visited the library, and whose parents already have an interest in children's literature and storytelling. This is a very difficult limitation to overcome, as we need to involve parents in order to have access to the children, and parents who are not interested in children's books are unlikely to be interested in letting their children participate in such a study.

However, we plan to address this issue in the future by collaborating with local preschools, which would give us access to a more diverse community of children. The length of the study is also a limiting factor: with only six sessions, we spent a lot of time building a rapport with the children and getting to know them, but by the time we had done that, we already had to wrap up the study. We also propose to tackle this issue by continuing to host regular collaborative design sessions at the local library, with the hope that the same group of children will continue to attend.

Having a stable group of children attending our sessions could also help us address another limitation: due to the group setting

of our activities, and the high level of variability in children's willingness to speak out during them, there is the possibility that our results could have been influenced not only by the content of the activity, but also by the different children that were participating in each session. While a certain level of variability is to be expected when offering free activities in a public setting such a library, we did manage to attract six children who attended regularly, meaning, four or more sessions out of six. In the future, we can take further steps to address this issue by working in a school setting, which will allow us to involve all the children in a class in our studies.

The biggest challenge that we encountered in our work was finding activities that could keep a group of children, all of different ages and personalities, engaged and in a state of flow, and so avoiding frustration and boredom. We believe that each child should be able to participate in design activities as a protagonist, and be empowered to create and share ideas; this means that we need to find activities that can allow younger or more reserved children to express themselves, while at the same time giving space to older, extroverted children to do the same without dominating the conversation.

5.4 Future Work

The sessions that we conducted have provided us with some interesting insights to guide the design of next prototypes. We also have a better appreciation of which design activities and methods work for eliciting children's feedback; specifically, while we plan to keep giving a big role to the researchers' direct observations, we will still look for novel methods to gather direct feedback from young children. One avenue that we propose to explore is the analysis of embodied actions during children's interaction with evaluation tools, an approach already broached by Sylla et al. [46], who studied *The Five Degrees of Happiness* and the *Sticky ladder* rating scalers with preschoolers.

Going forward we plan to do more exploration in how drawings can work as a way for very young children to express design ideas: while we did not have much success with free drawings, as reported in the findings, we aim to try different ways of eliciting feeback through drawings, such as asking children to colour and add details to existing silhouettes, to ask them to complete an outlined figure, or to use mix-and-match robot parts stickers - or similar activities - to create their own robot.

Finally, we also plan on exploring how children interact with storytelling tools when they are by themselves, or in pairs, as that is one of the social practices most frequently performed at home, as well as one of the most researched in the literature.

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