

Hello, is Grandma there? Let's Read!

StoryVisit: Family Video Chat and Connected E-Books

Hayes Raffle¹, Glenda Revelle², Koichi Mori¹, Rafael Ballagas¹, Kyle Buza¹, Hiroshi Horii¹,
Joseph 'Jofish' Kaye¹, Kristin Cook³, Natalie Freed¹, Janet Go¹, Mirjana Spasojevic¹

¹ Nokia Research Center
955 Page Mill Rd, Palo Alto CA 94306
hayes.raffe | koichi.mori | tico.ballagas
| hiroshi.horii | jofish.kaye | janet.go |
mirjana.spasojevic @nokia.com

² Human Environmental
Sciences
University of Arkansas
Fayetteville, AR 72701
grevelle@uark.edu

³ Sesame Workshop
One Lincoln Plaza
New York, NY 10023
kristin.cook
@sesameworkshop.org

Abstract

StoryVisit allows children and long-distance adults to experience a sense of togetherness by reading children's story books together over a distance. StoryVisit combines video conferencing and connected books: remote grown-up and child readers can see and hear each other, and can also see and control the same e-book. We report on research with 61 families – over 200 users including parents, children and long-distance readers – who used StoryVisit in their homes with a long-distance reader for at least one reading session. In addition, we report qualitative findings regarding nineteen of the families who participated in telephone interviews and four families who were monitored and interviewed by researchers at home. Results show that connected e-book video chat sessions last about five times as long as the typical video chats reported in previous research on families with young children. Moreover, the addition of an animated character increased session lengths by another 50%. StoryVisit usage peaked for families with three year olds, showing that sustained distance interactions with very young children are possible if communication technologies incorporate joint activities that engage children and adults.

Author Keywords

Reading, children, literacy, video conferencing, agent, dialogic reading, family communication

ACM Classification Keywords

H.5.2. Information interfaces; H.4.3. Communications Applications: Computer conferencing, teleconferencing, and videoconferencing

General Terms

Design, Human Factors

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Figure 1. A three-year-old and her father read an e-book with Grandma over video chat

INTRODUCTION

Today's families are becoming increasingly dispersed, and loved ones are often far from each other. For instance, more than half of the grandparents living in North America are over 200 miles from their grandchildren [5], and working parents increasingly travel away from home for professional reasons [3]. And while children and elders often have the most time and motivation to connect over a distance, they have the fewest tools to help them create a sense of togetherness. A series of recent studies has addressed how telecommunications technologies and media are used by families to maintain their relationships over a distance [1, 2, 11, 13, 15]. Tools like phone calls, SMS, or email are not appropriate for families with young children, because they do not always make sense to children or elders. Video chat services like Skype® are growing in popularity because video allows children to express themselves through action as well as words, and (once connected) the video medium is more equally shareable and accessible to the young and old. However, video conferencing technologies require significant technical and social work to use, and families with younger children still struggle to use these technologies to create meaningful emotional connections over a distance [1].

Our previous research in family communication [2, 14] has indicated that while video conferencing allows family members to see and hear each other, they need something to

talk about, or even better, something to do together. When adults interact with young children, they do not converse – they play. The challenge is to facilitate playing together at a distance.

Our results with Family Story Play [2, 14] showed that coupling shared book reading and video conferencing could support family communication at a distance. StoryVisit (Figure 1) builds on that research, and uses larger-scale, in-situ data to reveal what works and what doesn't work for shared family activities in the real world. Research goals of this work include (1) evaluating the viability of a co-reading system in ecologically-valid environments, (2) identifying the strengths and weaknesses of such a system relative to prior lab results, and (3) evaluating how different design elements such as reading tips and use of an interactive character may affect families' success in building meaningful connections over a distance.

RELATED WORK

The idea of helping families to connect through images and video has been addressed in HCI over the years. Technology Probes suggested that a sense of togetherness could be built with always-on photo sharing devices situated in people's homes [9], and Yarosh et al. have conducted a series of studies of children's sense-making of video conferencing technologies. They state, for example, that equally sized windows for children and adults in a video chat UI will help children understand the perspective of the distant partner [17] and that shared (often physical) activities like playing board games or reading books can help families feel better connected over a distance [19]. With Video Play, Follmer et al. [7] extended these ideas by presenting a series of shared activities that are integrated in a video chat UI. While not fully implemented, their designs explore how open ended games or books can help distant family members play together and have a sense of shared context. Our previous work showed that traditional paper books, coupled with mobile video conferencing and interactive content, can help families have a sense of togetherness over a distance [2, 14]. That research also showed that children's learning and family communication are complementary goals, since talking with children about books while you read them can improve children's literacy as well as helping intergenerational family members have things to talk about.

The StoryVisit project builds on these explorations of activity-based family video conferencing in the home, and adds an examination of ways in which certain features of children's content (e-books with reading tips and with an interactive character) may help families engage in longer and richer interactions over a distance. The reading tips are based on research in "dialogic reading" [16, 20] which is a style of reading picture books with young children in which adults ask children questions and engage them in conversation about what is happening in the book while they are reading together. Adults often engage in these kinds of conversations while reading traditional picture books [12] and online storybooks [6]. When they do, it facilitates children's



Figure 2. StoryVisit UI

language and vocabulary development [20], as well as helping children and adults converse at a distance [14]. Laboratory trials have shown that adults can learn dialogic techniques through training in a research setting [17].

Our approach to incorporating an interactive character in the reading session is informed by research with older children [10, 13] that shows that including interaction with social agents can improve student learning in educational contexts. In StoryVisit, we use Elmo® from Sesame Street® as an interactive social agent both to support child engagement and to model/scaffold dialogic reading techniques for adults.

In parallel with that research, a series of new web applications are also addressing how rich online media can help families connect over time and distance via story reading. AStoryBeforeBed.com is a website where grown up readers can record themselves reading an e-book, and then send that recording via email to a child who may watch the reading session later. An asynchronous sharing model sidesteps the logistical challenges families confront with synchronous video chat. However, a one-way model does not provide means for the reader to get feedback about how the child enjoyed being read to, and thus provides a more limited social connection. Readeo.com introduced shared e-book reading alongside video conferencing, and implemented a system similar to StoryVisit. Our research design addresses how two specific aspects of content – an interactive character and reading tips – might help both children and adults achieve successful distance communication, and provide rich communication channels that help families feel connected even when they are apart.

STORY VISIT

StoryVisit is a collaborative web application designed to give children and long-distance adults a sense of togetherness by enabling them to read children's story books together over a distance. The system combines browser-based video conferencing and connected books: remote grown-up and child readers can see and hear each other, and can also see and control the same story book (Figures 1, 2). When a grown-up turns the page, the child's page turns along with it, and if the child clicks on something

on his screen, the grown-up can see that on her screen too. Five titles were adapted from the Sesame Street library of illustrated e-books, which were authored for children ages 2-5 years old. We wanted to build an application that was simple and fun for children and adults to use together. We believe that reading ought to be an enjoyable activity for children and adults alike, because children who learn to love reading as preschoolers are well positioned to succeed later in school and in life.

System Features

Pointing: In addition to video and book synchronization, StoryVisit allows for a sense of “shared pointing” — if one user points to (by clicking on) something on the page, the other user will see a large hand-icon appear where the book has been clicked (Figure 2). This allows children or adults to point to things in the book they are talking about.

Tips: Reading tips were written for every page of every book in the system, giving suggestions regarding questions the Reader might ask on that page. Since the tips were designed as an aid for the long-distance adult Reader, they were viewable only by the Reader, and not by the Child. The tips were introduced to Readers with a 5 minute video explaining how adults can read to children in a “dialogic” manner.

Interactive Social Agent: Interactive video footage of Sesame Street’s Elmo character was overlaid on e-books (Figure 2). Elmo could be triggered by the Reader to talk about the book in a dialogic style, for example prompting Elmo to ask a question or make a comment about what was happening on that page of the book. The Reader could also make Elmo laugh, or answer yes and no questions. Elmo’s actions, like the rest of the book content, were synchronized for both the reader and child, but the controls were available only to the adult Reader. Because controls for Elmo are hidden from the child’s view, the Reader can create the illusion that the character is part of the family’s ongoing conversation about the book. For instance, the Reader may ask Elmo “What’s happening on this page,” and then click *Talk* to make him comment on the story. Character dialogue was produced for every page of every book, so Elmo can ask children contextually relevant questions and draw a child’s attention to aspects of the story. Elmo does not ever read the book, but instead asks questions in the spirit of “dialogic reading” that invite children and adults to engage in conversation with him and with each other.

Shared Family Accounts: User accounts were designed as shared family accounts with a “Reader” half and a “Child” half that were automatically paired for co-reading. This design allowed a single family member to set up an online account for the whole family and then share login credentials with distant family members via email or a phone call. We adopted this design to simplify sharing online, taking cues from previous work on shared accounts for the desktop environment [4]. This model also removes (as much as possible) the technical complexities of calling,

authentication and handshaking that families have described as pain points in the process of making video calls [1]. The resulting design is different from many conventional phone or video calling services in that there is no “call” or “hang up” button in the UI - families are automatically connected - and are provided with no means to connect to other people outside one’s own family account. Our goal was to simplify the video calling portion of the UI, as well as to ensure a sense of privacy and safety in the system.

UI Flow: When an adult logs in for the very first time, s/he is directed to a series of introductory pages that explain the shared account model, present a demographic survey to the user, and present appropriate instructional videos. Then, the user is directed to the default view, which is a “library” showing covers of five children’s e-books. Clicking on a book opens that book in a content pane that sits alongside two equally sized video panes (Figure 2). When users return to the site, they will see the last view that either they or their reading partner has viewed. For example, if a user closed the browser on page 5 of “Abby in Wonderland,” returning to the website will take them back to that page.

A note about Video: Prior to this design, we experimented with a much simpler design, which used only an audio communication channel and simple animations of Elmo. After limited trials, we found the system to be rather unsuccessful: a strong sense of emotional connection and child engagement was hard to achieve between reading partners without the video conferencing, and the animated character elements had a limited presence when displayed as simple 2-D animations. We found video conferencing created a stronger sense of emotional connection between co-readers, and video of Elmo brought the book to life in a more convincing way.

USER STUDY

StoryVisit was launched as a research-based e-book prototype with a limited-time trial. In response to promotion of the research project on the Sesame Street web site and in a Sesame Street Family Newsletter, 260 families registered to use the system for a period of 4 weeks. Sixty-one families became “active” users, using the system for at least one reading session with a long-distance reader, representing nearly 25% uptake. Families generally had at least three members (at least one child, co-located parent and remote reader) and often had more (siblings and multiple parents), resulting in a pool of over 200 individual users.

For all 61 families, basic usage data (amount of time spent per session, number of books read per session, etc.) was logged. All participants completed a pre-survey and 19 of those families volunteered in their post-survey to complete a telephone interview with a researcher.

In order to get richer qualitative insights into system usage, four of the 61 families were recruited for “home visits” by the research team. The home visits included technical support, as well as observation and recording of video and

audio streams during book-reading sessions and in-depth semi-structured interviews.

First we will report on quantitative usage data for the 57 families who did not have home visits and, separately, the quantitative usage data for the four families who had home visits. Next, we will report on the qualitative observational and interview data for the 4 home visit families, along with the phone interview data from the 19 families who volunteered to be interviewed as part of their post-surveys. Finally, we will discuss relationships between the quantitative usage data and the qualitative observational and interview data.

Quantitative Findings

The goal of this part of the research was to test StoryVisit in an ecologically-valid manner with a large number of families and see how the system might succeed or fail in people's homes under naturalistic circumstances, with neither the technical support nor the extrinsic motivation typically provided to users who participate in lab trials. We also hoped to gain some understanding regarding the relative strengths and weaknesses of various design elements, including the basic interactive book design, the dialogic reading tips (Tips) and the interactive character as participant and model (Elmo). When a family registered for StoryVisit, they were randomly assigned to one of four conditions: Elmo+Tips, Elmo Only, Tips Only, or No Elmo/No Tips. All families received video conferencing alongside shared e-books with the pointing feature. Users completed a demographic survey before using the service.

Analysis

Fifty-seven non-home-visit families engaged in at least one reading session with a remote partner. A reading session was defined as use of StoryVisit by two parties at different locations that lasted more than 30 seconds with at least 3 book pages viewed. Data only includes times that families were engaged in co-reading with books; data does not include times that families may have used the system for video conferencing alone, or times the site may have been used for eBook reading alone (e.g. co-located reading, ignoring the video conferencing feature).

In the pretest survey, families were asked to report the age

(in years) of the child who would be using StoryVisit. Four families did not report the child's age, so these families were omitted from all analyses involving age as a factor. The distribution of children's ages for the 53 families who reported age was as follows:

Age	1 yr	2 yrs	3 yrs	4 yrs	5 yrs	6+ yrs
# children	4	21	13	6	3	6

For purposes of analysis, children were divided into three Age Groups: Under Age 3 (N=25), 3 year olds (N=13), and Over Age 3 (N=15).

Families were evenly distributed across the four Study Conditions with Elmo+Tips (N=14), Elmo Only (N=12), Tips Only (N=16), No Elmo / No Tips (N=15).

Analyses of variance were performed to examine the effects of Age Group and Condition on the following dependent variables:

- Number of Reading Sessions
- Average Reading Time per Session
- Total Reading Time Across all Reading Sessions
- Total Number of Pages Read Across all Reading Sessions
- Average Reading Time per Page
- Average Amount of Pointing per Page
- Average Number of Elmo Activations per Page (for Elmo and Elmo+Tips Conditions)
- Average Number of Reading Tip Activations per Page (for Tips and Elmo+Tips Conditions)

Results

Number of Reading Sessions. The 57 participating families averaged about 1½ reading sessions across the four week time period of the study. Thirty-eight families engaged in just one reading session, fifteen had two sessions, three had three sessions and one family had five sessions. There were no significant differences in number of reading sessions by Age Group or by Study Condition.

Average Reading Time per Session. Families spent an average of 12 minutes per reading session. There were no significant differences in the length of reading sessions by

Total Reading Time (mins)				Total Number of Pages Read		
Age Group	Mean	Std Dev		Mean	Std Dev	N
Under 3	11.2	6.3		27.4	14.3	25
3 year olds	28.6	22.5		52.1	47.4	13
Over 3	17.2	17.7		29.7	23.6	15
Total	17.2	16.4		34.1	29.5	53

Total Reading Time (mins)				Average Reading Time per Session		
Condition	Mean	Std Dev		Mean	Std Dev	N
Elmo Only	30.2	22.7		18.4	10.2	12
Elmo+Tips	14.7	8.3		11.2	8.2	14
Tips Only	14.6	15.1		7.9	5.1	15
No Elmo / No Tips	11.4	10.6		10.5	11.3	16
Total	17.1	16		11.7	9.5	57

Table 1. Total Reading Time, Total Number of Pages Read and Average Reading Time per Session across all reading sessions by Age Group and Condition

Age Group, but there were significant differences by Condition ($F_{3,56}=3.22$, $p<.05$). Tukey post hoc analysis indicated that families in the Elmo Only Condition had significantly longer reading sessions than families in the No Elmo/No Tips Condition. Means and standard deviations for this and all other significant effects are shown in Table 1.

Total Reading Time Across all Reading Sessions. In analyzing a sum of all reading sessions for each family, we found a significant effect of Age Group, ($F_{2,52}=5.67$, $p<.01$) and Tukey post hoc analysis showed that the only statistically significant difference was between 3 year olds and those younger than 3, where families with 3 year olds spent a significantly greater amount of time engaging in StoryVisit reading sessions than families with children under three. This indicates that families with 3-year-olds were a demographic “sweet spot” among StoryVisit users. We also found a significant effect of Condition ($F_{3,56}=4.14$, $p<.01$). Tukey post hoc analysis indicated that families in the Elmo Only Condition spent significantly more time engaging in StoryVisit reading sessions than families in any of the other three Conditions.

Total Number of Pages Read Across all Reading Sessions. We found a significant effect of Age Group, ($F_{2,52}=3.54$, $p<.05$). Tukey post hoc analysis showed that, once again, the only statistically significant difference was between families with 3 year olds and those younger than 3, with families of 3 year olds reading significantly more pages across all their StoryVisit reading sessions than those with children under three, further indicating StoryVisit's effectiveness among families with children age 3.

Reading Time per Page. Families spent an average of 32 seconds per page across all books read in all reading sessions. There were no significant differences in reading time per page by Age Group or by Study Condition.

Pointing. Overall, the occurrence of clicking on something on the page to point to it was low: only about half of the pages read had a point by the remote adult, and less than a quarter of the pages read had a child point.

Elmo activations. Elmo or any of the Elmo controls were clicked on an average of once per page. There were no significant differences in Elmo Activations per page by Age Group or by Study Condition.

Reading Tip Activations per Page. Overall, Readers clicked on the Reading Tips infrequently. For the Conditions in which Tips were present, they were clicked on less than 5% of the pages read. That said, those families that had Elmo+Tips activated the Tips significantly less frequently than those who had Tips Only ($F_{1,29}=4.33$, $p<.05$). Families in the Elmo+Tips condition clicked on Tips on only about 2% of the pages, whereas those in the Tips Only condition clicked on Tips about 7% of the time. An examination of whether Tips were ever clicked at all yielded a similar but even more striking pattern: 75% of the Tips Only families

clicked on Tips at least once, whereas only 20% of those with Elmo+Tips ever clicked on Tips at all.

Key Take Aways that we will return to in the Discussion section include (1) relatively low rates of repeat usage of the system, with only four of the 57 families engaging in more than two reading sessions, (2) a sweet-spot for families with 3 year olds, (3) families in the Elmo Only condition spent significantly more time with the system, and (4) Readers didn't use tips, especially if Elmo was present.

Quantitative Findings — Home-Visit Families

Four families participated in “home visits,” including observation sessions in the home context, in-depth interviews, and video recording of their use of the system in exchange for compensation. Three of these families were recruited prior to the beginning of the larger scale “in-situ” study, and were assigned to the Elmo+Tips condition so that all software features could be tested prior to the larger launch of the study. A fourth family (that happened to have been assigned to the Tips Only condition) volunteered to participate in home visits after signing up for the larger scale study.

Teams of two of our researchers made an initial visit and observed during setup of the software, taking notes, videotaping the process, and offering advice when it was requested. Families used their own computers in parts of the home they chose. Three families moved laptop computers to public areas such as dining and living rooms, and the fourth family used a desktop computer in their home office. We observed an initial StoryVisit session with a remote Reader and requested that families use the system at least once a week. We then telephoned the family two weeks later to get initial feedback. Four weeks after the initial visit we visited families again, observed a reading session, and interviewed them. We also encouraged families to contact us directly if they had any problems in the course of the study.

Results

The only striking difference in usage patterns for the home-visit families was in the total number of reading sessions in which they engaged over the course of the four weeks. This pronounced difference could be attributed to biasing effects of compensation, awareness of monitoring, follow-up, or initial technical support. The characteristics of their individual reading sessions, however, were not strikingly different.

As seen in Table 2, one of the home-visit families (F22) was clearly an outlier with regard to the total number of reading sessions, average time per session, and average number of pages read per session. Not counting that family, the home visit families engaged in at least four times as many reading sessions as the families who only had the web experience. For the Average Reading Time per Session and the Average Number of Pages Read per Session, the averages for the non home-visit families are in the range of the 3 non-outlier home visit families. With regard to all of the other usage measures logged (e.g. #pointings/page, #tips/page, #Elmo Interactions

per page), the non home-visit averages were comparable to the home visit averages across all home visit families.

Condition	Child Age(s)	# Reading Sessions	Avg mins / session	Avg # pages / session
F22: Elmo+Tips	3, 5	15	41	67
F25: Elmo+Tips	3	8	13	23
F26: Elmo+Tips	4	6	16	20
F73: Tips Only	4	6	21	33
Avg. Non H-V	3	1.5	12	24

Table 2. Total # Sessions, Home-Visit vs. Non Home-Visit families

Qualitative Findings - Emergent Patterns of Behavior

Children drive usage, but it's a family affair

Within each individual family there were different perspectives on technology and different attitudes towards adoption. A big barrier for many families was convincing other family members to use StoryVisit. Often, it seemed it was children's attraction to the system that motivated families to use it. Initially, a few home-visit families expressed skepticism about the system. For example the mother in Family 22 (Elmo+Tips) expressed that she would not trust her child to touch her computer. But after showing StoryVisit to her 5 year old - who was able to abide by her instructions - she let both her children (3 and 5) use the system repeatedly, about 15 times over a one-month period. Many other families' positive comments about the system stemmed from their children's enjoyment of it.

While parents were the social bridge connecting children to others outside the home, they could also be seen as gatekeepers for system usage, and family dynamics seemed to play a major role in who was allowed to read with children and in how people did or did not choose to use StoryVisit. The Mother in family 22 struggled with the idea of reading with her father-in-law, and was relieved when she learned she could instead connect with her brother in China, with whom she and the children were close. Grandparents were well-aware that parents were gatekeepers to the children; one grandparent pointed out that even if she wanted to read with her grandkids again, she'd have to set it up with her daughter. *We're here in St. Louis and they're in Oregon, and it's a 2 hour time difference. It depends on what they have time for and are inclined to do. They are the ones to initiate it.* (Family 27, No Elmo/No Tips)

Beyond gatekeeper, the co-located parent's role

Parents supported children in different ways, consistent with other findings [1, 14] of family video conferencing. Parents did technical setup and logistics such as arranging the call, but the UI was designed to be simple enough so that children could be left to read without a parent present. This did happen sometimes, but even when parents walked away from the computer, they consistently would keep an ear or an eye open to help children or remote readers get along. Most often, though, parents sat with their children while the

book was read to them. Family 73 mentioned, *A lot of times she (distant aunt) would say things and he wouldn't understand them the first time, so I would repeat them.* And one anonymous user commented online: *My 3 1/2 yr-old son loves using StoryVisit with his Grandparents and Aunt. He has no trouble with the mouse and likes to be the one to turn the pages. I definitely need to hang around in case he needs help or doesn't hear something the first time but in general he can do whatever he needs to himself and the grown-up on the other end can do the rest.*

When parents are present, they can connect children's experiences with StoryVisit to everyday family life. Some families in the study reported using recipes from one of the books, cooking together with their children after a StoryVisit reading (Figure 3). The aunt, who was the distance Reader in Family 73 (Tips Only) discussed with her nephew's parents:

Aunt: *You guys tried these, right? (referring to the recipe on the page)*

Father: *We did try this, yeah, yeah, many times. Banana, strawberries and yogurt.*

Aunt: *mmm*

Mother: *Yeah, we made those last week. Was that prompted by this?*

Father: *Yeah that's what started that bananas and strawberries. It was a good idea.*

Aunt: *Sounds like a delicious snack*

Father: *... and healthy too!*

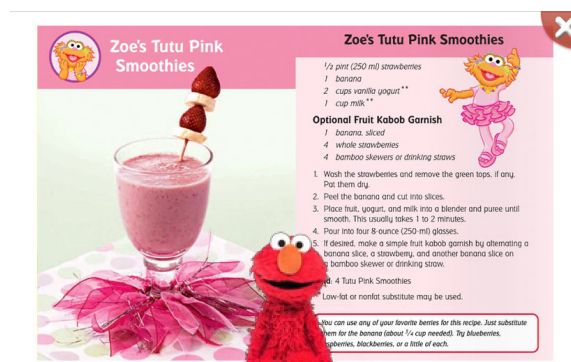


Figure 3. Smoothie recipe, from Child's perspective.

StoryVisit seemed to be supporting family togetherness by facilitating shared activities and memories that families could remember and discuss later.

Elmo — bringing the book to life

The inclusion of the interactive Elmo character almost doubled the Total Reading Time (Table 1). Many families expressed positive feelings toward Elmo and found him to be an important participant in the book reading sessions, sometimes requesting more Elmo features: *I like the different story choices and the fact that Elmo can ask comprehension questions about things on each page. It*

would be great if he could have more than one question/comment for each page. My son really liked to say, "Let's hear what Elmo says!" after his relative finished reading each page. (Family 75, Elmo Only)

Some families thought Elmo was in the way, but recognized him as an important draw for children: *That night I was mad at the webcam for not working so I was like I don't even care about this little Elmo guy, I just want to get them to read the story. So I didn't even take the time to figure it out that night, 'cause I had other things on my mind. In the future I can see using it, because Leila really likes Elmo.* (Family 101, Elmo+Tips)

The design for Elmo was based on his role in Family Story Play [14], with a major difference being that Readers had a greater degree of control over when and how Elmo would participate in the reading conversation. Children often seemed delighted that Elmo appeared to be joining their conversations, and even answering their questions as if he were alive.

We were surprised to find that families in the Elmo Only condition engaged in so much more reading than those who had Elmo+Tips. The data did not provide a clear cause—perhaps StoryVisit just got too complex for Readers when Elmo and Tips were both present.

Tips

While the presence of Tips did not have a significant effect on reading times, some users found them to be helpful. For the remote Reader in Home Visit Family 73 (Tips Only), the tips became "how to be a good aunt instructions," because they prompted her to ask age-appropriate and engaging questions of her niece:

Aunt: *What part of these boats should you not eat?*

Son: *Fruit letters(?)*. HAHHAH!

Aunt: *That was one of the questions they suggest.*

Father: *What's that? Oh, it suggests a question to you?*

Aunt: *Uh hmm.*

Father: *Oh, I didn't know it was telling you what to read.*

Aunt: *Well, like the question on "what do fireworks sound like?", I wish I had thought of that myself, but.*

Father: *Oh, oh!*

Aunt: *It says offer general and specific praise and encouragement.*

Father: *Oh, oh, oh it's giving you instructions. You mean this hasn't been really you at all, it's just been...*

Aunt: *it's been "how to be a good aunt" instructions.*

Father: *That's good*

Aunt: *No it is actually really helpful.*

Father: *Some people don't have the knack for it that you do.*

Tips were hidden from the children and co-located parent. On one hand, this may have been a mistake, in that parents were not able to coach remote readers about the use of tips

or help their children understand what was being asked of them. On the other hand, tips may have helped empower Readers to be more engaging than they would otherwise.

Home visit Family 22 (Elmo+Tips) provided an unexpected reversal of our designed use-case; it was the children who would explain the book content to the Reader, who was a native Mandarin speaker not fluent in English. Their Chinese uncle would read and ask a question, and the children, ages 3 and 5, would translate for him or explain in English what was going on. This suggests opportunities for content in other languages and support for language learning - in one's native language or otherwise - with systems like StoryVisit.

In future systems, it may be preferable to show tips to both Reader and Child so that the parents could view and make use of the tips themselves. In general, Tips may not have been accessible enough. Although we created a video to explain dialogic reading to Readers, the length (over 5 minutes) may have been too much for some viewers, and some participants reported they didn't notice Tips at all.

The design of the tips and the video are based on prior research in dialogic reading [17] and our data point to a big difference between experimental research results (parents being in a lab and doing what they're told), vs. parents in their homes doing it by choice. While not conclusive, our data suggested that each aid (tips and Elmo character) may have succeeded best on their own and may not have worked so well in combination.

Technical Difficulties

Technical complexity came up as a general issue for our users. Our video conferencing infrastructure, based on Adobe Flash Media, was the best browser-based solution we could find, yet it was flawed with audio echo and feedback problems that plagued users and severely compromised the experience for many families. It is tempting to conclude that the large difference in usage patterns between home-visit and other users was due (at least in part) to technical difficulties, because home-visit families had more technical support than others. Needless to say, video conferencing is still a rapidly evolving technology that introduces real challenges to users. This observation has been made before [1], and suggests that experiences like StoryVisit will likely not receive wide appeal until video chat infrastructure is more reliable and easy to use.

Touching the screen — children and interface usability

Standard computers are not well designed for children's use. Children routinely touched the pages of the book on-screen and many parents suggested that touch-screen computers would be better. While some parents indicated a general preference for their children to control the computer interface themselves, others were more hesitant to hand control over to their 3-year-olds. One mother wrote on her blog: *One issue for us: Touchpad vs. Touchscreen confusion. My three-year-old daughter prefers to touch the screen than use the touchpad to direct the cursor. (Seems as*

though they are confusing my laptop for my iPhone!) I really need to introduce a mouse to my kids, but have not gotten around to buying one yet. What makes matters worse, the website encourages “touching” parts of the “page” (in other words, the screen), and even shows a finger popping up when you click on an object with the mouse. Really this product would be best put on a touchscreen device.

E-books or Paper Books?

Some families missed the familiarity and tangibility of paper books. *With IChat we can use the same book at both ends of the phone. The experience is more personal. (Fam. 140, No Elmo/No Tips).* However, most families saw real benefits to the connected e-books. Family 75 (Elmo Only) called it a *unique experience that was a step up to our usual Skype conversations.* Another family compared StoryVisit to Skype: *I have a specific memory of my mother [son's grandmother]. Yes once definitely reading to him over Skype...where grandma was holding a physical book up to the camera and turning pages. It was cumbersome and hard to follow, but it was an interesting precedent.... Obviously with StoryVisit the book is not jiggling around, turning pages. Talking about details on the page with StoryVisit is much easier. I guess arguably less lively than when mom read to him... but the fact that the book page stays in focus, you can really study it and notice things yourself, and have more control. I think those are big pluses. When my mom was holding the book for the camera, it moved around, he had trouble looking at the details. (Family 138, Tips Only).*

Similarly, Family 101 (Elmo+Tips) reported, *It's a lot easier than just trying to read a story over Skype. Otherwise the other person has to have the same copy of the book you have. [You] don't have to do gymnastics to get everything on the screen.... Bedtime reading with Daddy is such an important part of the day for our daughter, so we were grateful for the opportunity to continue the tradition even when he had to be away for a few days.*

The symmetrical control of page turning allowed families to choose how to control pacing of book-reading sessions. Sometimes, families would let children turn the pages. Other times, Readers alone turned the pages in order to control the pacing of the reading session.

A Skype Alternative

We observed emergent use of the system as a Skype alternative with book reading being just a part of the communication session. In one of our home visit families (Family 22, Elmo+Tips) over half of sessions (8/15) were longer than 30 min, and the longest was 2 hours, 41 min. Closer observation of video recordings of the sessions indicated that much of the time adults were using the system for video conferencing, and children would pop in and out to read a book with a relative or chat, smile and exchange conversation. Book reading sessions with children were interspersed throughout the longer video session.

Some other families reported video communication as their primary use. The father from Family 53 (Tips Only) read to

his daughter, *at lunchtime, while I was at work talking with my 2 Y.O. daughter at home. ACTUALLY we left it on all day and I could “pop-in” and see what was happening at home. It was nice to see her playing.*

A parent from Family 90 (Tips Only) elaborated, *I'd suggest marketing StoryVisit as one piece of a long-distance call between a child and a long-distance family member. We only have the opportunity for a webcam call every few weeks, and we'd like to spend most of the call catching up and letting our son have a conversation with his grandparents and dance, sing or do whatever he wants to do. StoryVisit is a nice part of such a call, but it should be thought of as one component, as opposed to the entire reason for having the call.*

These patterns suggest a design that is balanced between video conferencing and other child-appropriate activities, including storybook reading.

Overall Feelings about StoryVisit

Overall, many families saw an improvement in their experience when compared to existing communications means. Family 26 (Tips Only) wrote *It certainly is an incredible way to spend time with a child in another town. And in the final home-visit, Family 73 (Tips Only) explained There is clearly a lot more control than a [phone] conversation where he might be talking about whatever comes to mind. It was really fun to read a book with him. I enjoy that because it allows us to really interact more. When I ask him a question about school, he answers it and we can have a conversation, but the book sort of facilitates a little bit, within the narrow confines of the topic of the book, but still it's fun.* While not perfect, the system is beginning to meet our design goals of facilitating family communication around shared activities and content.

DISCUSSION

For most families who used StoryVisit, the system seemed to create a sense of social and emotional togetherness. Families in our home-visit group used the system repeatedly, with one requesting to keep using it past the study deadline to maintain their new family ritual. Previous work makes it clear that for families, a sense of togetherness is hard to create, and most communications media fall short of meeting young children's needs. StoryVisit seemed to provide that sense of togetherness for most of the families in our study. In this section, we'll return to the discussion items we noted earlier: the value of Elmo in video conferencing with children (and lack of value of Tips), the particular value of our system for 3 year olds, and the challenge of providing a system sufficiently engaging to encourage repeated usage.

Richer Interactions

While StoryVisit does not necessarily make home video conferencing easier for families (in terms of technicalities and logistics), it does seem to make them richer. This is evidenced, to a degree, by how much time people spent with the system. Prior ecologically-valid research on home video

conferencing reported typical child engagement times of 2-3 minutes on a Skype call [1]. Families who used StoryVisit engaged in distance activities for an average of ~12 minutes, with average session length rising to 18 minutes when Elmo was present. (We note again that the presence of tips to encourage dialogic reading did not increase session times.) This indicates quite a change in families' abilities to engage young children in using video conferencing technologies. This is a long time for a preschooler to engage in *any* activity – even typical ones like co-located reading or playing with blocks – and is especially surprising considering their reading partner was not physically present.

Is such long use of a communications system sustainable for a preschooler and adult partner? We believe so, although it happened only for a few families in our trials. While many families in the web trial group stopped using the system after only a few sessions (reportedly due to technical issues such as audio quality), all families in our home study – who had technical support available – used the system repeatedly, with one family using it almost every other day for a month, and continuing to use it after the study had concluded. We believe that the combination of a more accessible interface for children and improved video conferencing infrastructure could lead to wider acceptance and effectiveness of these kinds of family communication tools.

Distance Communication for Three Year Olds

Another surprising finding is that the data makes it clear that age plays an important role in families' uptake and use of the system. A demographic sweet spot for families with children age 3 is both understandable and surprising; on the one hand, the content provided at StoryVisit was geared towards children ages 2–5, and three-year-olds were an ideal audience. But on the other hand, we are aware of only limited lab trials that indicate that sustained distance interactions with such young children is generally *possible* [14]. The fact that usage peaked for families with children age 3 shows that it is possible for families with even very young children to create meaningful connections over a distance.

Researchers have noted that children's developmental issues provide clues as to why young children are not adept with use of communications technologies [8, 14, 18]. Challenges include children's nascent theories of mind and resulting inabilities to envision other people's perspectives, as well as their preferences for action over words as means of expression. It has also been noted that the primary way to communicate with preschoolers is play, not conversation. These findings influenced our design choices in concrete ways. For example, synchronized views between Child and Reader allow the child's perspective to be consistent with the remote adult's, and the video windows of the Child and Reader are the same size to help children understand how the Reader may see them. Also, the UI is designed to be simple and appealing to adults, but also to be fun for children. Content is bright and bold, use of text is limited,

and technical setup screens and supporting pages are hidden from the Child's view.

Ongoing User Experience Challenges

Despite our efforts to improve the user experience of family video conferencing, we did not do enough; families cited software, hardware and network problems, all typical for home video conferencing [1]. Logistics provided another key issue preventing more usage. And while technology problems may be solvable through better engineering or design, logistical problems can probably not be solved by technology. Apart from the home-visit families, families typically did only one or two reading sessions, and only one family had more than three reading sessions. Clearly, more can be done to make using systems like this not only more appealing but also more easily accessible.

Design Guidelines for shared family activities

Through the design and evolution of StoryVisit, we have experimented with different approaches to designing synchronous family activities over a distance. Many features seemed successful enough to use again for other activities:

- creating a fun and playful UI
- automatic reconnection upon launch
- display of content is symmetrical and synchronized
- single user can setup accounts for the whole family
- content structures activity, and layers of content can be used flexibly by adult

Content can have big influence on who uses the system, and how often it is used. Our e-books draw on characters and story lines scripted for 2-5 year olds, and our character is most popular with 2-3 year olds. Families cited content as a major factor in their use of the system. Allowing families to add their own content or connect to existing digital content libraries would likely expand the age range and usage of such a system, since it's important to have a rich library of content to share and to have that library feel personally meaningful.

We are inspired by the rich and personal family activities reported in previous studies, like a grandchild playing the trumpet for her delighted grandmother, and families kissing goodbye after a Skype call [1]. Grandparents appreciate these moments, no matter what. Can there be digitally distributed activities that all members of intergenerational families look forward to? StoryVisit is approaching the kind of activities that children request and can initiate themselves and that grandparents and other adult relatives already enjoy doing with their young relatives. We have already had children requesting books, turning book pages, and actively making choices about how they used the system. Children often touched the screen, indicating a need for more direct interfaces, with touch-enabled e-reader devices seeming the obvious platform for systems like StoryVisit. As high-bandwidth and high-performance computers are more commonly handed to children under age five, we may find that new forms of content and communications mean that

young children are driving technology uptake and bringing others - perhaps even their distant adult family members - to computing technologies.

CONCLUSION

Our goal with this research has been to apply findings from studies of family video conferencing [1, 11] and shared book reading in the research lab [2, 14] to shared family activities in the real world. We have conducted in-depth qualitative interviews with four families, telephone interviews with an additional nineteen families, and have analyzed quantitative usage data about how a larger number of families “in the wild” might adopt and use such a system. By pursuing an ecologically valid, in-situ test of StoryVisit, we have begun to understand how shared activities might be brought to the real-world homes of families with young children.

Our results show that engaging young children in shared activities over a distance is possible, and that technology can help increase family engagement. Content plays a key role, with reading books together accounting for a 5-fold increase in usage times compared to prior reports of family video conferencing, and the addition of an interactive character contributing another 50% increase in usage times. Usage of this system content peaked for families with 3-year-olds, demonstrating that shared activities over a distance can be quite salient even for families with very young children. While such a result had previously been demonstrated in a lab setting with simulated “distance” [2, 14], this study shows that distance communication with very young children is possible “in the wild” with technologies that families already own today, albeit with limited repeat usage in our study. One implication of this work is that communications technologies, when designed to consider young children’s developmental needs and the needs of their families, can facilitate a rewarding and sustainable experience for both the young and old.

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