Reading, Laughing, and Connecting with Young Children

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Abstract
In this chapter, we report on three projects that focus on storybook reading as a way to improve distance communication with very young children. "Connected Reading" builds on the insight that communication technologies for families with young children need to focus on *play* rather than *conversations*, and that having a shared activity can help structure this play. Our prototypes span a range of embodiments, from mobile video conferencing with physical books, to eBooks, and finally to video conferencing enhanced with depth camera technology. Our findings suggest guidelines to improve family communication with young children.

Introduction

According to the AARP[1], about half of grandparents live more than two hundred miles away from their grandchildren (Davies & Williams, 2002). How do families cope with this separation? In the summer of 2008, a group of researchers in Nokia Research Center Palo Alto began exploring how new tools for "Family Communication" could help families with young children maintain their relationships over a distance. We believed that young children and elders had the most time and desire to connect, but current technologies did not meet their needs. Our research goals were to understand the views and needs of long-distance families today, and to explore how new technology applications could help them form meaningful connections with each other.

Our work included field research and development of over a dozen technology prototypes. In this chapter, we report on three projects that use storybook reading as a way to interact with very young children over a distance. "Connected Reading" builds on the insight that communication technologies for families with very young children need to focus on *play* rather than *conversations*, and that having a shared activity like reading can help structure this play. Book reading is particularly successful because both the young and old understand and enjoy sharing books

[1] The AARP is a non-governmental organization formerly known as the American Association of Retired Persons (see http://www.aarp.org).

together, and the wealth of content makes it a rich playground for the young and old.

In the following sections, we will outline *Family Story Play*, *Story Visit*, and *People In Books,* three different embodiments of connected reading, and overview how each design makes long-distance interactions more playful, interactive, and fun for families to connect with young children over a distance.

Formative research with Families

In order to understand the views and needs of American families today, we conducted qualitative studies with twenty-two diverse families in the San Francisco Bay Area between summer 2008 and spring 2009. These families were selected to span the spectrum of the Bay Area, including a variety of income levels, racial and ethnic identities, and occupations. Our original recruitment criteria were that the families included at least one child between the ages of 4 and 10; the realities of field studies meant that there were frequently siblings of a variety of ages present as well, giving us a pool that included many preschoolers as well.

In the first phase of the study we visited 18 families, of whom all used the telephone to communicate with their distant family members. Family visits followed a similar pattern: two to three researchers would visit a family's home at the end of the afternoon, when children would come home from school. We had the children take us on a tour of their room and show us their toys, which made them accustomed to our presence and meant we could observe them for the next few hours without them becoming shy. We would join the family for their evening meal, often bringing dinner with us, and we would also ask the family to schedule time to talk with a remote family member – nearly always a grandparent – with whom they often communicated. We would interview the parents in an open-ended manner about a variety of topics, including parenting practices, their attitudes to technology, toys and family, their values as a family, and their ways of learning about parenting. We video recorded interviews and took photos throughout the evening. Families were compensated for their time.

Interviews were later transcribed and coded using a variety of analysis techniques. Much of the content of many of the interviews was formally coding by two researchers using Atlas.TI. In addition, researchers read through transcripts, watched videos, listened to audio recordings, labeled, selected and reviewed pictures, and

reinterpreted the results. Themes were discussed and thought through clustering sticky notes (in the manner of affinity analysis) and through shared brainstorming on whiteboards. Transcripts, video recordings and photographs were all placed on a shared drive accessible to the group, meaning that no one person held ownership or control over these materials. This enabled researchers to return to the source material at leisure to find illustrative photographs or quotes, as well providing opportunities for further reinterpretation and analysis at a later date (Kaye, 2011). And, perhaps most importantly, these studies were interpreted through the act of creation of novel technological devices and experiences.

Family Communications: Phone Conversations with Children (R. Ballagas, J. J. Kaye, M. Ames, J. Go, & H. Raffle, 2009) details the difficulties that families had in engaging with children over the phone. Many kids can't talk on the phone by themselves until 7 or 8 years old. Kids under this age have many cognitive, social, and motivational challenges that typically lead to communication breakdowns. For example, we observed one 3-year-old child during a call who repositioned the phone so that it was facing him and started kissing the speaker before clapping the phone shut, hanging up on the remote party. Clearly, he was really good at expressing himself physically through kisses and manipulating the physical affordances of the device by folding it shut. However, all of these expressions of love and action were lost on the remote party. While phones are accessible and ubiquitous, it is not obvious how to 'play' with someone over a phone.

After visiting the first 18 families and reviewing the transcripts, we noticed that two of the families were also using Skype or similar services to videochat with remote family in addition to telephone calls. We then recruited another five local families who used videochat. These families, along with the two from the original study, were the basis for our paper *Making Love in the Network Closet: The Benefits and Work of Family Videochat* (M. G. Ames, J. Go, J. J. Kaye, & M. Spasojevic, 2010). The procedure with these videochat families was more abbreviated than the other families, in that the visits were centered around a planned videocall with a remote family member (again, usually a grandparent) and subsequent interview. From the combination of work and the previously mentioned fieldwork we were able to build a picture of how the technically complicated and unreliable practice of videochat was a way for families to express their love and sense of identity as a family: *making love*, in the sense of creating and substantiating love – and creating and substantiating a sense of the family at the same time.

In our observations, video conferencing had clear benefits over telephone conversations in that it facilitated nonverbal communication: allowing children to show

rather than tell, express through action instead of words, and use gestures and body language including ‘skype kisses’. Families used video conferencing to include multiple parties, making it easier for parents to scaffold children in conversation. However, most families still had trouble keeping the children engaged for more than a few minutes because they primarily used videochat as an interface for conversation instead of play. In other words, videochat probably should be part of the solution, but videochat alone seems not to be sufficient for addressing families’ desires for a sense of togetherness.

These visits and their associated study had number of ramifications to our research on Connected Reading. For example, nearly all families had difficulty keeping children engaged in communication, and it was clear this was an opportunity for design intervention.

This fieldwork led us to design a range of novel connected reading solutions to improve family communications. We hypothesized that providing a shared activity – in this case, reading a book together – would give structure to the communication and lead to longer richer interactions with young children. In our designs, we push current notions of books by adding novel interactive elements that bring the book to life and make reading more like play. We also hypothesized that there were opportunities for children to have meaningful learning experiences while engaging with long-distance loved ones.

Experiments in Connected Reading

Family Story Play

Family Story Play (H. Raffle et al., 2010; R. Ballagas et al., 2010) combines traditional paper children’s books with an interactive agent (Sesame Street’s Elmo) and mobile video conferencing. The system supports traditional reading experiences, including physical page turning, and is designed to fit into typical family rituals such as reading bedtime stories together. Family Story Play supports both “co-located reading” in which a co-present child can read the book with the child and play with Elmo, and “distance reading” in which a remote reader can be invited to read to the child over a videochat connection. When connected over a distance, the readers can see and hear each other through the video conference, and can also see what page the other reader is on. This is possible because each book is instrumented with small magnets to identify their current page, and sensors in the book frame

can sense what page the reader is viewing. A remote reader's page information is displayed alongside their video image on the embedded tablet device.

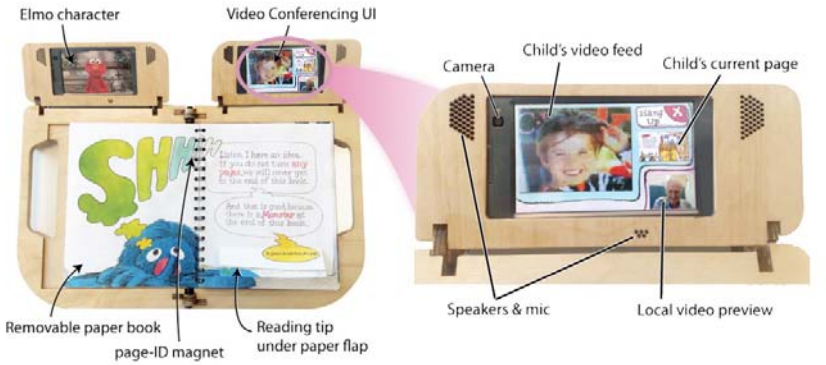

Figure 1. 'Family Story Play' allows families to read physical books together at a distance. The wooden housing holds two screens, one for video conferencing and a second for Elmo (who acts as a third member of the videochat). Sensors in the wooden housing detect the current page and update the remote reading partner's display.

This project used a familiar children's character – in this case Sesame Street's Elmo – to engage children and adults in conversations with *each other* over a distance. Whereas muppets are typically given center-stage to entertain and educate children, we sought an opportunity where the muppet could engage the child and help both child and adult engage with each other. As such, we approached the muppets as teachers for both the child and the parent, whose role it was to engage the child and parent in educational dialogue together. Such dialogue around book topics is known to improve young children's literacy learning (Whitehurst et al., 1988; Zevenbergen & Whitehurst, 2003), and in this system we showed that it can benefit family communication as well.

In Family Story Play, Elmo acts like a third party of the videochat. Video content of Elmo makes it appear as if he is listening to the adult as they read the story. Elmo models an interest in reading for the child. When prompted (by touching Elmo's screen), Elmo will ask questions related to the current page to inspire the child to talk more about the book. Research on literacy has shown that the more children talk about a book during a reading experience, the better their vocabulary development (Whitehurst et al., 1988), and Elmo can help young children learn in different ways. Adults may pose questions to Elmo and activate him to talk, mak-

ing it seem like he is a part of the conversation. This can help with child engagement and enjoyment of the reading experience. Elmo can also provide scaffolding to remote readers: he asks children questions in the style of "dialogic reading" and can model for adults how to engage children in dialogue around book topics. To complement Elmo's role, we also provided simple text tips to support grandparents asking questions. Hidden under paper flaps on the book pages, adults could discover advice and suggestions for questions to ask young children about the book.

In a user study with 8 families with children aged 2 to 4 (see Figure 2), we compared reading with Family Story Play to reading a typical children's book over ordinary video conferencing. Our analysis showed that the shared activity of reading books seemed to be successful across both conditions. Even the traditional video conferencing with paper books had much more success in sustaining engaged communication with children compared to our fieldwork in which young children and adults tried to converse, and lacked an activity to organize their play. However, we coded videos for smiling and laughing and found that children and parents demonstrated significantly higher levels of enjoyment with Family Story Play compared to ordinary books. Why? Elmo was an important factor in keeping kids engaged, seemingly due to his star power with children. One parent commented, *"Elmo? She loved it. You saw her. She tried to kiss him."* (Father of 2.5 y.o. girl). This star power was not a clear positive; qualitative feedback revealed that some grandparents felt as if they might be in competition with Elmo for the child's attention. *"Oh I liked [Elmo]. I mean he brought up questions that I wouldn't even ask… He is a good influence, but when he beats me to the punch, that was a little distracting. [My grandson]'s not even looking at me or I mean–I don't know if he was even looking at the book. I think he might have been actually looking at Elmo over here, waiting for the ding or something instead of looking at the picture."* (Grandfather 3 y.o. Boy). These findings suggest that designers must strike a delicate balance when incorporating interactive characters into communication tools so that children's attention is directed in ways that are rewarding for all.

Also with Family Story Play, parents were twice as likely to give children control of the book pages (70% of the time vs. 38% of the time). We saw several instances of children engaging with pretend play during the reading experience, suggesting that Family Story Play helped children emotionally connect with their grandparents despite physical and technological barriers. These positive results encouraged us to extend the concept of connected reading to understand exactly what features of the system were most effective in helping families communicate.

Figure 2. Families reading together at a distance using Family Story Play. The system is designed such that the child reads with a co-located adult (left). The two devices connect using wireless LAN.

StoryVisit

In order to evaluate our laboratory findings with a larger audience, we explored how connected reading might be brought to families anywhere in the world, for free. Our target audience was to provide the shared activity of book reading to families who were already engaging in family videochat with services like Skype. In 2010 we launched StoryVisit (H. Raffle et al., 2011), a prototype system that combined browser-based video conferencing and connected eBooks. The system included five titles from Sesame Street's ebook library, and built on learnings from our research with Family Story Play. By using digital instead of physical books, we are able to add new features to improve a sense of connectedness. In StoryVisit, pages are automatically synchronized; when the grandparent turns the page, the page also automatically advances for the child. (Either the adult or child may turn the page.) Furthermore, family members can point at objects in the book through *shared touch* — if one user points to the page, the remote user sees a large image of a hand appear in the same place (see Figure 3). This allows children and adults to point to things in the book they are talking about facilitating nonverbal expression, as is particularly suitable for touchscreen tablet devices. Finally, with digital books, it is much easier to scale up the selection of books, and eliminates the issue of making sure both sides have the same physical book.

The design of Elmo was informed by Family Story Play, and kept many of the same elements. Elmo sits prominently in front of the book, drawing children to look at the book contents. Elmo can be controlled by the remote Reader using a menu of phrases that is not visible to the Child reader. This allows the remote Reader to invite Elmo into the conversations, prompting him to ask questions, or

making him answer children's questions with a "laugh," a "yes" or a "no." Children may touch Elmo, causing him to do non-conversational things like laugh or dance.

Figure 3. StoryVisit is a web-based embodiment of connected reading, allowing adults and children to read books together over video conferencing. The callouts illustrate parent tips (top), shared touch (left), and extended Elmo controls (bottom).

Like Family Story Play, conversation *Tips* are included for the remote Reader. They were displayed along the top of the book, and were not visible to children.

StoryVisit was launched publicly as a free service on the web (at http://www.storyvisit.org) in 2010. In the first 4 weeks, over 250 families registered to use the system, and sixty-one of them became 'active' users, using the system for at least one reading session with a long-distance reader, a 25% uptake that reflects on the motivation and latent needs of this population to be better connected. In order to isolate the relative value of the Books, Elmo and reading Tips, families were randomly assigned to one of four different UI conditions: Elmo & Tips (similar to Family Story Play), Elmo Only, Tips only, and Book only (no Elmo and no Tips). Families completed an initial survey, and at the end of 6 weeks a post survey. Based on analysis of log data, a number of families were also

invited to participate in telephone interviews about their experiences with the system. Finally, four of our families were treated differently from the start, in that they were explicitly recruited to use the system with heavy monitoring of usage. This included technical support and logging and analysis of video data. In total, our dataset included a wealth of quantitative and qualitative usage data about usage and satisfaction with the system.

Our results show that connected reading is significantly more successful than ordinary videochat for long-distance families to connect with young children. Families who used StoryVisit engaged in videochats with such young children for an average of 15 minutes with books alone, and an average of 21 minutes in the Elmo Only condition. This was a 5-8x increase over ordinary videochat durations observed in our formative research with Bay Area families who had young children, who usually sustained conversations with young children for only 2-3 minutes.

Significantly, usage of StoryVisit peaked for families with 3-year-old children, and total reading time for 3 year olds was significantly higher than for children under 3. Number of pages read was significantly higher than for children over 3. On the one hand, this peak of usage is expected since the book content was designed for 2-4 year olds. However, these findings are important because they mark the first ecologically valid data we know of that demonstrates that sustained distance communications with such young children is even possible.

Why did StoryVisit work with such young children? Data showed that content was key. The 'Elmo Only' condition performed significantly better than 'Book Only' in terms of average reading time per session and total reading time across all sessions. We were surprised that the 'Elmo Only' condition seemed to outperform the 'Elmo & Tips' condition. The data did not provide a clear cause — perhaps having both Elmo & Tips became overwhelming for users resulting in less interaction overall. Qualitative feedback conveyed the importance of Elmo in the design. *"I like the different choices and the fact that Elmo can ask comprehensive 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' Condition).

Overall, the use of tips was very low. 75% of the families in the 'Tips Only' condition clicked on a tip at least once, but tips were activated on only 7% of all pages. Use of tips was significantly lower when Elmo was present: in the 'Elmo &

Tips' condition only 20% of families clicked on a tip at least once, and tips were activated on less than 2% of all pages. Although usage was low, some families in the 'Tips Only' condition found them valuable referring to them as *"[tips] have been 'how to be a good aunt' instructions... it's actually really helpful"* (Family 73, 'Tips Only').

In order to make connected reading sustainable for families with young children, it would likely need to be extended in several important ways. First, families expressed that they would like it to be part of their usual family videochat experience. As such, it should include ordinary videochat functionality like full-screen views. Furthermore, families wanted more content in the system. This would include larger libraries of eBooks as well as the ability to add personal content, such as existing favorite books. This type of personalization would likely expand usage of the system and allow the content to feel more personally meaningful.

People In Books

People in Books (S. Follmer, R. Ballagas, H. Raffle, & Ishii, 2012; S. Follmer, H. Raffle, J. Go, R. Ballagas, & Ishii, 2010) immerses connected readers into the illustrations of a shared children's storybook. Through the use of custom depth camera, the system automatically removes people's background scenes from their video streams, allowing video of the child and remote reader to appear as if they are immersed in the storybook illustrations. Although the users are physically separated, People in Books uses videochat technologies to create the illusion that they are visiting a magical place where they can read and play together. Users' video images appear in surprising places, hanging from trees, hidden under covers, or sharing a boat ride with the story's main character (see Figure 4). The goal is to encourage play and conversation about the book and to use the story "place" to create a sense of connectedness.

Figure 4. 'People in Books' depicts remote reading partners in the context of the story world alongside the characters.

People in Books builds on some of the design principles learned from StoryVisit in that it helps a young child and remote adult connect over videochat with a connected eBook, and in that it uses interactive video to bring the book to life. Studies comparing reading experiences revealed that 'People In Books' is qualitatively different from systems like StoryVisit.

Children and parents felt closer together using People In Books. While using People In Books one mother commented, *"This one doesn't feel like we're separated. I feel like [I am] more close with Nicole."* This sentiment was also exhibited in the way people used the system. One mother reached out towards her son in the book and said, *"I'm reaching out and grabbing you."*, to which the son responded, *"I can feel you"*. This is a powerful example of how close people felt even though they were physically separated. We also saw instances of parents and children making kissing gestures and sounds towards each other on the screen echoing some of the physical expressions of love we saw in our earlier fieldwork. Other evidence of a strong sense of togetherness arose; for example one child needed a sense of security during reading, *"I can see a monster! Mama, Are you still next to me?,"* and both the mother and child leaned closer together in the story image. *"Now I am next to you, Mama."* The mother responded, *"I'm going to protect you [from the monsters]*" and the child said *"Thank you mama!"*

We also saw more evidence of both sides engaging in pretend play using People in Books. For example, when one of the books depicted a river scene, one child lay on the couch and pretended to swim saying, *"I'm going to swim, swim, swim."*

Additionally, parents and kids would pretend to physically engage with the characters on the screen. One child acted as if he was snuggling up to the main character Max and said, *"I'm cuddling with Max."* In another reading session, a parent pretended to tickle the feet of one of the monsters, making the far-away child laugh.

It seemed that immersing people's images into the same storybook illustrations achieved several effects. First, people were in a shared visual space, in contrast to the separate "windows" of typical videochat UI's. This created a sense of togetherness. Further, the playful illustrations and narratives encouraged children and adults to play together. There was a magic to "being there" with the story characters and the design seemed to support the kind of play that our early field work identified as a hallmark of successful distance communications with young children.

While the system seemed to offer many benefits for distance communication for families with young children, it still suffered from common pitfalls. Children would often hide or just disappear from the camera view because they do not always understand what the camera can "see." One parent commented that she had *"Less sense of what is going on in the room with People In Books."* This may be a result of us not including a co-located adult with the children to ensure that children were in the field of view, and to articulate the child's actions for the remote adult to understand the context in the room. Despite these challenges, the project shows that advances in videochat technologies can support a greater sense of togetherness for families with young children through a combination of design and technology development.

Implications for the Understanding of Family Communication

Our fieldwork and exploration of novel connected reading experiences have brought us a deeper understanding into how to improve family communication at a distance and allowed us to generalize a few implications for design. In common with other authors in this book, much of our work is motivated by the need to connect young children with their remote grandparents (e.g. Moffat et al.'s chapter on Connecting Grandparents and Grandchildren in this collection). The following guidelines are further applicable to many different family relationships including traveling parents, divorced parents (e.g. Yarosh et al.'s chapter on this topic), or families dealing with long-term separation because of occupation (such as military families).

**** Create an interface that is fun and facilitates play.*** One key lesson from our fieldwork is that you can't expect to have a conversation with a young child at a distance; instead you need to find a way to play with them. Although play through video conference can be challenging, our designs show a range of mechanisms that provide a playful shared activity. As designers, we should try to help families get technology out of the way so that they can play together.

**** Children need scaffolding.*** As we saw in our trials, parents play a critical role in ensuring a smooth communication experience. Co-located parents actively articulated their children's actions and prompted them with questions to ensure that the remote partner understood the context on the child's side. When designing experiences for connecting families we need to consider how to better engage the co-located adult. Our designs currently lack an explicit role for co-located parents, which could impact adoption of these experiences over the longer term. Experiences will likely be most successful if they are designed to give co-located parents a clear role that is both enjoyable and rewarding.

**** Adults need scaffolding, too.*** Remote adults sometimes forget how to engage children, especially if they are not with the children on a day-to-day basis. Remote adults can also benefit from scaffolding and prompting to help them be more successful in engaging with children. Our designs used different kinds of scaffolding including the reading tips to encourage parents. In all of the designs, the reading activity scaffolded the interaction by giving remote adults and children something to talk about. In Family Story Play and StoryVisit, Elmo modeled dialogic reading techniques by asking open-ended questions about each page. We expect that with time, parents exposed to Elmo would be more likely to ask questions to children even when reading traditional paper books.

**** Allow for personalization of content.*** Many parents expressed that content was one of the key reasons that motivated usage of a system. However, parents and children said that they wanted to be able to also read their favorite books. Expanding the library will help, and allowing families to scan and upload their own collections of books, images, drawings and personal mementos can be a different way of addressing this need.

**** Design for offline use.*** Our fieldwork showed that many families had difficulty scheduling communication sessions with remote family members. In addition, many families expressed a desire to use these reading experiences at home, with-

out a remote participant. We explicitly designed for offline use in Family Story Play, and designs should allow fluidly switching between co-located and remote reading activities in the same application.

**** Usability for children***. Many of the children using StoryVisit's shared pointing feature tried to touch the screen directly. This was partly caused by our use of a hand image to convey the shared touch. However, this indicates that perhaps the design would be more successful if it was implemented on tablet hardware allowing for touching and swiping of the page instead of requiring interaction through the mouse.

**** There are synergies between family communication, child development, emotional expression, and literacy.*** Interaction with adults is key to helping children learn across a number of dimensions. Designers should remember that any interaction with a child is an opportunity for learning and growth.

Looking Ahead

With the emergence of social media on the Internet, our motivating questions are especially relevant today. Technology is creating new ways for people to connect, but most of today's tools still do not meet the needs of the young and old. Our research on Connected Reading shows that the combination of real-time communications channels with motivating content can help provide safe and compelling activities for families to engage in together over a distance. With Family Story Play we showed that books and children's characters can help children connect and learn from people they know and love. StoryVisit demonstrated that such systems can engage children as young as 3 years old, in the wild. And People in Books shows how people have a greater sense of connectedness by using Internet technologies to "travel to magical places" (like storybook worlds) together.

How will our research transition from laboratory studies and pilots to widespread tools that help families to connect more often and more successfully? One step is to begin developing products that address families as a group, and not just parents or children separately. Nokia, a company that does not market to children for ethical reasons, understood that families' needs – which include children's needs – could be met without treading into an ethically complex area of children's products. This can lead in a number of directions. For example, we are now working

hard to commercialize some of our connected reading solutions. Our efforts are beginning with mobile eBook applications for co-located reading between a parent and child (see Figure 5). 'Interactive Rich Reading' (K. Mori et al., 2011) maintains the interactivity of the StoryVisit eBook design without video conferencing. The application allows for a parent and child to read together, and Elmo keeps young children engaged by bringing the book to life.

In the mobile devices marketplace, screen space is a limiting factor for designs like StoryVisit. As mobile devices become more powerful and capable, immersive designs like People In Books can be more successful. With larger touch screen devices becoming more prevalent, our work can change what "social media" means for families, for example by showing that families can share a story together to have a playful and educational experience over a distance.

Figure 5. Interactive Rich Reading is a mobile phone application that enables parents to read together with their children while co-located. Elmo is present to help bring the book to life.

The laugh of a child or smile of a loved one is what families treasure most—these are the experiences people want to have, to remember and to cherish. Connected Reading is a humble attempt to help families with young children to form connections over a distance. We hope to form a foundation for how companies like Nokia can get better at "connecting people" to the ones they love the most.

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