CONNECTING FAMILY MEMBERS ACROSS TIME THROUGH ASYNCHRONOUS AUDIO STORIES

by

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Abstract

This dissertation studies the exploration of asynchronous audio technologies and the design, creation, and evaluation of a system created for connecting family members in different time zones. The related literature on domestic technology for families in different time zones is mainly focused on synchronous usage of different mediums for connecting family members or using video for asynchronous communication. In this doctoral work, my goal was to explore and gain insights on design factors which are important in designing systems for connecting family members across time and over distance through shared audio-based media.

This dissertation consists of two studies that I conducted during my doctoral work which is presented in a cumulative format. For my doctoral research, I first conducted a qualitative study which explored the usage of a successful asynchronous audio technology called Podcasts through semi-structured interviews. Results pointed to the characteristics that made podcasts suitable for supporting people’s ability to be alone yet still feel like they were connected to others. Second, I designed and built an asynchronous media sharing web application called Mimo that allowed family members to capture and share moments with each other using audio narratives as a way to connect together. I conducted a study of Mimo and found value of connecting family members in a one-to-one, private fashion and how personalization was necessary in such system.

Third, I conducted an iterative design process for a system called FamilyStories that contained three different computational artifacts which allowed family members to share activities and experiences over distance in different time zones. The three technology probes connected family members through sharing asynchronous audio messages with different playback features specific to each of the devices. I evaluated the usage of FamilyStories with a five-week field deployment with four participants. The methods used includes semi-structured interviews, diaries, and data logs for data collection. Results showed the value of slow, flexible, and non-suggestive interfaces for asynchronous audio communication. Overall, my work illustrates the importance of delayed communication; ephemerality being helpful in expressing emotions; the specialness of dedicated in-home devices; and, how time delayed messages can ‘synchronize’ time zones in asynchronous audio communication. This work holds value in exploring design features that have potential to be beneficial for family communication across different time zones.
Keywords: Domestic Computing; Family Communication; Audio Communication Systems, Asynchronous Systems
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Chapter 1.

Introduction

The concept of family has different meanings and definitions based on the individuals who shape this group. The idea of family is not just a term which can be defined but rather a goal and aspiration that people try to achieve (Neustaedter et al. 2013). The concept of family can vary from two parents and children who are collocated, to families with extended members such as grandparents living in the same place, to single parents in different households with shared custody of children (Yarosh & Abowd 2013). Considering the variety of family demographics and the complexity of their dynamics, in this thesis I am focusing on families who have easy access to the Internet and technology, mainly residing in North America.

Family members often use technology for connecting over distance (Neustaedter et al. 2013). They typically prefer to use synchronous communication tools for connecting over distance, such as video chat and phone calls, in different time zones (Tee et al. 2009; Cao 2013). Despite these technologies being useful, there are several challenges in connecting with family members synchronously (Kirk et al. 2010; Cao et al. 2010; Cao 2013). These challenges include limited time slots for synchronous communication and a lack of lightweight and frequent contact. Asynchronous communication technologies where people can send and receive messages or communication at different points in time (e.g., instant messaging) are flexible and can help overcome some of the challenges of synchronous connections. Yet the challenge is that asynchronous communication technologies might still not provide the richness that is commonly found with real time communication. For these reasons, in this thesis, I explore ways to enliven asynchronous communication over distance through audio storytelling. I focused on audio storytelling due to its capability of capturing the essence of a moment and its sentimental value (Oleksik & Brown 2008). Audio can also stimulate one’s imagination to recreate past moments (Oleksik & Brown 2008). We also characterise people based on their voices and how they sound (Pittam 1994). Audio also could add flexibility into sharing activities over
distance in different time zones and can overcome issues such as privacy (Brubaker et al. 2012) and the camera work for sharing activities over video (Jones et al. 2015).

This dissertation first documents my exploration of the usage of a successful asynchronous technology, podcasts. Next, I discuss a web application called Mimo that I designed and created to allow family members to connect across different time zones by sharing media asynchronously. Then, I describe three technology probes—together called FamilyStories—that I designed to study the design factors that could influence one-to-one communication through asynchronous audio storytelling systems. Finally, I describe the field study I conducted to evaluate the systems and uncover lessons for the design of asynchronous audio storytelling systems.

1.1 Research Context

Human-Computer Interaction (HCI) is a field of study that is "concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them." (Hewett et al. 1992). The HCI field studies different usages and interactions between the human and computer opens a vast possibility of use cases and interaction between human and the machine just like an open-ended dialogue (Dourish, 2004). One of these use cases is domestic computing. Domestic computing focuses on the usage and opportunities for using technological systems in the home (Crabtree et al. 2003). Domestic technologies focus on different aspects of usage than workspace needs. This includes the emotional and sociocultural influences of technology (Gaver 2001). In the field of domestic technology, I narrowed down my focus on family communication to family members living in different time zones. I explored, studied and designed a domestic technology that connects family members through the use of an asynchronous audio system across different time zones.

1.2 Research Questions & Objective

Based on the challenges that family members face in connecting across different time zones, and the opportunity for creating technology in a new way to connect remote family members, my overarching research question is:
What design factors are important in designing systems to connect family members across time zones through shared audio-based media?

To answer this question, my overall objective is to find design insights on systems which are aimed at connecting family members across time zones through shared audio media. The intended audiences of this work are academic designers and researchers, as well as industry practitioners who are looking to understand family communication more deeply or create new technologies for connecting families. In my overarching research question, the family members I am considering are immediate family members including parents and adult children and siblings to scope my research. For the same reason, I also did not focus on connecting young, non-adult children with remote family members.

Current communication technologies used by family members are typically designed for all-purpose usage and, as a result, they are not specifically designed to overcome challenges such as time zone differences or the emotional nature of family communication and the wide range of family needs such as co-presence, sharing experiences, etc. Also, most of the systems that have been created have used video, text messages, photos, or calendar activities for sharing with family members (Hutchinson et al. 2003; Tsujita et al. 2010; Venolia et al. 2015). What is missing are explorations of the design space that focuses on sharing experiences between family members through the use of audio only. Audio plays an important role in sharing activities (Procyck et al. 2014). Studies on the synchronous use of shared audio with mobile phones has been done and showed benefits (Tee et al. 2009; Ames et al. 2010; Kirk et al. 2010). However, when people have a need to share an experience over different time zones, it can be very difficult to find a time to have a synchronous shared experience. This can cause family members to have less communication and not be able to convey emotions with one another (Cao 2013). For this reason, I have decided to explore the asynchronous usage of audio for sharing activities between family members living in different time zones.

As a first step, to better understand the usage of asynchronous audio sharing technologies, I explored a successful form of these systems called podcasts. Audio podcasts are digital audio files that can be downloaded or streamed online on desktop or mobile devices. Typically, a host or hosts record an audio show and make it available for download. The number of podcast listeners in the United States alone is more than 21% of the population (Baer 2016). Podcasts are used for different purposes from telling serious news to comedy to stories about everyday life (Bowie 2012). They involve a host(s)
who pre-records the content and shares it publicly for listeners. While this might be different than sharing stories amongst family members, podcasts are engaging (Bowie 2012) and this feature of podcasts could help us better understand how to engage families over distance through audio-based mediums. As such, for my initial dissertation work, I addressed the following research question:

**RQ1: What are the listening practices of frequent podcast users and how do podcasts support quality alone time?**

To address this research question, my objective was to **conduct a study to explore people’s routines around listening to podcasts**, including: when and where they listened; who they listened with, if anybody; what activities they did while listening; and, how they shared knowledge from podcasts with other people, if at all. I explored listeners’ behaviours and routines in a study of podcasts that is published as:


Eighteen participants were recruited who listened to podcasts at least once a month. Participants were from different age groups and occupations, which created a diverse sample. Semi-structured interviews were chosen as the data collection method for this study due to their ability to provide in-depth knowledge of a topic. The results of the semi-structured interviews allowed me to understand participants’ behaviours and patterns of use of the technology.

Participants primarily listened to podcasts when they were alone in order to ‘escape the mundaneness’ of everyday activities (e.g., work, chores), reconnect with themselves, relax and reduce stress, fill the time with spontaneous listening or while engaging in a physical activity. The way participants listened to podcasts highlighted the multitasking ability of audio files. In other words, participants were usually engaging in another activity while focusing on the content of the podcasts such as doing chores around the house, driving, doing exercise, etc.

Several features of podcasts suggest ways that might family members might be able to share stories with each other over distance. Such features included the flexibility to list
to content privately and nearly anywhere and anytime, the ability to multitask while listening to content, the ability to listen to a podcast and shift one’s thoughts to reflect and relax, and being able to be a “part of” a conversation while having quality alone time.

Building on this work, I next designed and studied an early software prototype of an audio podcast system for family members that will be presented in the next research question below.

**RQ2: What are the important features of an audio-sharing system for mobile devices that can allow family members to share stories over distance and across time?**

To explore how family members might share audio stories over distance, I designed a early prototype that focused on allowing family members to share the same activities while sending each other audio narratives. This work has been published as:


My objective here was to **design a system called Mimo that allows family members to connect through audio narratives similar to podcasts.** The prototype design was created through brainstorming, sketching and iterations on low and medium-fidelity prototypes designed to improve family members’ level of connectedness by using audio over distance and across different time zones. The prototype included a web application called Mimo that could run on mobile devices when out and about, or when moving throughout one’s home. The purpose of the design was to focus on sharing an activity asynchronously to have an element of flexibility over different time zones. Users could be connected across time while doing an activity (e.g., going for a walk) while also listening to audio stories containing personalized messages. The goal was to make it feel as if they are engaging in the same activity and feel ‘together’ in different time zones. This characteristic could let family members be updated and aware of each other’s life at points in time that best matched their needs. Mimo was imagined to be used between parents and their adult children, or between adult siblings who have a close relationship, where conversations are often a key part of the relationship.
The four main characteristics of Mimo were the usage of audio; the ability to postpone a message to be delivered in a specific time in future suitable for the other family member (time shift); the usage of eight categories in order to spark conversations (e.g., categories included walking, cooking, and movies); and, the usage of ephemeral messages to encourage family members to listen to them soon after receiving them. In Figure 1 you can see the Mimo web application. Figure 1.a is the activity board where eight categories are shown. Users first select a category focused on what they want to talk about as the topic of their interest. Figure 1.b is the time shifting panel where the user can change the time of the message delivery according to their family member’s availability and time zone. Figure 1.c shows the audio clips, one after another.

To understand how family members would react and possibly use such a system, I ran an early exploratory study where 21 participants were shown the system and interviewed (Heshmat et al. 2017). In the study, people saw the value of Mimo in its one-to-one style of connection rather than one-to-many. This indicated the value of a media sharing system that is very personal in nature for connecting family members. For the participants, Mimo meant that one could hear a loved one’s voice. The challenges that
participants mentioned with this technology included conversations feeling one-sided. The asynchronous nature of the software and how it was displayed also caused a few of our participants to see the functionalities of Mimo as being similar to available commercial mobile applications, such as WhatsApp. Thus, to help push people into thinking 'out of the box' and about new methods to use audio story systems, I next explored the design of a tangible system for connecting families over distance.

**RQ3: How can we use the prototyping knowledge and our study on podcasts to create a tangible system suitable for connecting family members over distance and in different time zones through audio stories?**

The goal for this system was to uncover insights on influential design factors for asynchronous audio storytelling systems. I designed three technology probes collectively called FamilyStories which allowed family members to share activities and experiences over distance in different time zones asynchronously by recording and playing back audio stories. The design process of FamilyStories is part of this publication:

The design process was iterative and started through sketching and rapid prototyping of several ideas until the final version of the product. The concept of the design was inspired by *slow technology*. Slow technologies are design in a way that allows users to engage in acts of reflection, mental rest and anticipation (Hallnäs & Redstrom 2001). I designed the technology probes and implemented them with help of a mechatronics engineering undergraduate student in training. Technology probes are open ended designs that allow researchers to explore how people use and interact with a new system in real world settings (Hutchinson et al. 2003). I designed a series of three technology probes where each allowed the user to record an audio story and send it to a family member that had the same device. The technology probes differed in terms of how people were able to listen to the recordings. The three probes were called *Spark*, *TimeKnot* and *Kinetic* (can be seen in Figure 2).

- **Spark** made the stories have a temporary lifetime, so they had to be played back in a week’s time. Spark also used ambient notification by using light, similar to systems in the literature such as Physikit (Houben et al. 2016).
• **Kinetic** made it so stories could only be listened to while doing a similar activity as the sender.

• **TimeKnot** restricted playback to the same time window of a day. For example, messages sent in a morning of one family member A can only be playable in the morning time of family member B.

We were interested in exploring how context and varying degrees of access to the stories would affect the experiences of participants. We used these probes to study how family members would use each device and what their concerns were for the different designs. The technology probes helped us to identify the features that are important for designing asynchronous systems using audio as a medium for connecting family members in different time zones.

Next, I describe the evaluation of FamilyStories, which addresses my final research question.

**RQ4: How will family members use an audio-based tangible system such as FamilyStories to connect over distance in different time zones? What are the benefits and challenges of using such a system?**

The goal of this question was to study a dedicated computational artifact which was inspired by slow technology design and used asynchronous audio for connecting family members over distance and across time zones. I investigated family members’ use of such a technology. The objective at this stage was to evaluate the system designed for connecting family members in different time zones and understand how family members use the technology to connect, communicate, and share activities or experiences over distance.

To achieve this objective, I designed and ran a field study with FamilyStories’s technology probes to understand the potentials and challenges of sharing audio stories over distance between family members in different time zones. We wanted to evaluate the three technology probes and understand the design context better. This work is in the same paper as that of RQ3:

The field study was done for a duration of five weeks with two sets of family members paired together. We recruited participants who lived in Metro Vancouver, Canada and had family members in different time zones. One remote participant was in the East Coast of Canada and one in Cambridge, England. For the first two weeks of the study they were asked to use each device at least two times per week. In the second week, they were given a task to describe a life event in order to get more comfortable using the technology probes. During the study, they also completed an online diary where they documented their thoughts on the system mostly after each time they recorded or listened to the stories on the devices. The study started with an introductory home visit for the local participants and a similar session was held for remote participants over video chat. In general, four semi-structured interviews were completed. The findings of this study showed insights into how asynchronous technologies can be designed for families to communicate more richly through audio storytelling. Insights included the benefit of scattered and delayed responses; how ephemerality can help users express a range of emotions; the specialness of dedicated in-home devices; how time delayed messages can help synchronize people across large time zone differences; and the potential for movement-triggered messages to trigger focused and thoughtful engagement. I describe these points in subsequent chapters.

I used in-depth semi-structured interviews consistently as one of the methods to collect data for all my research questions due to the exploratory nature of my work. Although a survey would have resulted in more participants, the data would not have been suitable for this stage of the research. I did not use methods such as focus groups due to the private nature of family communication and connection. Relying on observations of family communication would have been extremely privacy intrusive and taxing toward participants. Semi-structured interviews are commonly used for qualitative studies to get insights about a research problem (Creswell & Poth 2016).

1.3 Organization

The dissertation includes seven chapters.

Chapter 2 is a literature review of work related to family communication over distance and specifically family members connecting across different time zones. In this
chapter, various studies of technologies being used by family members will be presented. Technologies such as video communication, research-based prototypes and systems including asynchronous technology are described.

In Chapter 3, I introduce the qualitative study done for exploring podcasts that support the act of sharing audio-based stories over time (Objective 1). The chapter describes the results of the study of podcast listening behaviours including the major characteristics of podcasts which were important to listeners.

Chapter 4 presents the design and study of the prototype called Mimo (Objective 2). Mimo was designed to connect family members through asynchronous shared media, specifically audio stories. The results of the study include people’s appreciation for one-on-one communication. Challenges with this type of connection are presented in this chapter as well.

In Chapter 5, I describe the process of designing and creating the technology probes called FamilyStories (Objective 3). This includes sketches, pictures and different ideas used for bringing the system to life.

Chapter 6 is focused on the design and creation of the technology probes and the five-week field study done on understanding the usage of FamilyStories in real world settings (Objective 4). The chapter describes the final design and results, and concludes with lessons learned for designing asynchronous audio stories for connecting family members across different time zones.

In Chapter 7, I discuss the findings from all studies where I point to design implications for connecting family members living in different time zones. I conclude the researches introduced in this thesis, and summarize and outline the contributions. This chapter also documents limitations and future work.
Chapter 2.

Related Work

In this chapter I will introduce the related work for my research. The related work is categorized into four main sections. In the first section, I explore studies performed on how families communicate over distance, the difference between communicating with presence and absence of time difference, and what real time communication technologies are used for staying connected. In each subsection I focus on introducing each medium or technologies being used with its benefits, challenges, and their ties to my work. The second section includes literature on asynchronous systems designed for connecting families over distance and what family members desire for future communication technologies. The third section explores the body of research which has mainly focused on sharing activities with friends and family over distance. In the fourth section I have an overview of designs and technologies which have a different perspective on time and how users should interact with the system called slow technologies.

2.1. Family Communication over Distance

Families connect over distance through the use of technology. They share their lives and routines through phone calls, video calls, text messaging applications and sometimes the use of paper-based systems such as post cards and letters (Tee et al. 2009; Ames et al. 2010; Neustaedter et al. 2013). Family communication over distance depends on a personal connection between family members (Neustaedter et al. 2006). However, for most families, connecting with immediate family members means the ability to communicate, coordinate and share their experiences (Neustaedter, Harrison & Sellen, 2013). For extended families, connectedness is more about knowing their location, health issues and major life changes (Neustaedter et al. 2006).
In order to design technologies for family members and improve their communication and sense of being connected, researchers have conducted studies on the nature of family communication and how current family members stay in touch. For example, Tee, Brush & Inkpen (2009) conducted a study to better understand how extended family members communicate with each other. The results of the study showed that family members were looking for quality in their communications rather than quantity. In general, they identified challenges in family communication as time and effort for communication, the obligation to answer and being considerate of others’ schedule and availability. Similar to what Tee, Brush & Inkpen found in their study, Romero et al. found that when communication systems turn into an obligation for family members to be part of the communication, family members look at communication as a task to complete and do not feel connected (Romero et al. 2007). They created a prototype system named ASTRA. ASTRA was designed to encourage users to take photos in home (by a mobile device) and send it to family members(to see on the dedicate LCD) with a note as can be seen in Figure 3. In their research, timing was identified as a key factor in communications since family members liked to share an incident just after it happened. They also desired surprises and spontaneous messaging in systems (Romero et al. 2007). Family members also appreciated any personalized targeted efforts for communication (Romero et al. 2007).
As discussed in this section, family communication over distance through the use of technology has its own challenges. However, timezone difference makes communication over distance more complicated and it introduces new challenges for family members to stay connected. In the next subsection, I introduce related work done on family communication with and without time differences present and continue with introducing difficulties family members face when experiencing communication over different timezones.

### 2.1.2 Time Difference and Its Effect on Family Communication over Distance

Close family members (such as adult children and parents, couples etc.) in the same timezone have the advantage of being in the same context of the day. For example, both family members are experiencing morning time while they are just starting their day and then may come back home in the evening after a day of work. Experiencing the same context of the day makes synchronous connection over distance easier, more frequent, and scattered in different timing and locations (Cao 2013). Such short and frequent communication allows family members to be more involved in each other’s lives and it allows them to more easily express dedication and care (Cao 2013). Due to regular communication, family members within the same time zone can typically maintain a flow of communication easily (Cao 2013). Pre-planning and scheduling when to talk with each other can be trivial since they are in the same time of the day (Cao 2013).

As an example, Greenberg and Neustaedter (2013) studied how couples in long distance relationships connected with each other and compared two couples, one in the same timezone with a two-hour drive from one another, and the other in two different time zones with a twelve-hour time difference. The study showed couples chose different patterns to connect (Greenberg & Neustaedter 2013). The couple in the same time zone would communicate from time to time on the phone or through text. Later, after both reached home, they used a phone call to check if their partner was able and used Skype for a couple of hours while doing mundane things around the house such as cooking, cleaning and reading a book (Greenberg & Neustaedter 2013). They would start having a conversation with each other from time to time through the video channel (Greenberg & Neustaedter 2013). However, when family members live in different time zones, implicit
scheduling and availability becomes a challenging part of communicating with family members (Cao 2013). The couple in a long distance relationship with time differences would heavily rely on the usage of text during the day and would use synchronous video communication daily in their limited overlapping schedule to see each other and feel as if they were living with one another (Greenberg & Neustaedter 2013). Such a sense of sharing life was reached by leaving the video communication system on for several hours. Meanwhile, each partner would be busy with their own work based on the context of the day they were in, such as one getting ready to sleep and the other starting to work (Greenberg & Neustaedter 2013). This relates to another issue with communication over timezone differences which is understanding each other’s availability and time (Cao 2013; Wyche & Chetty 2013). For example, a twelve-hour difference can be easy to comprehend but a fifteen-hour time difference can cause family members to calculate times in their mind or use different clocks on their screen to understand what time their loved ones are in (Cao 2013; Wyche & Chetty 2013).

People show sensitivity toward their family member’s timing and schedule because they believe it is a method of indicating empathy for them (Cao 2013). Family members try to keep a positive image of themselves by creating an impression of an organized and healthy lifestyle in different time zones by calling only in the communication window scheduled before (Cao 2013; Zhou et al. 2017). Family members’ time window for having a synchronous communication is small, yet they try to have a synchronous connection. Family members usually first check in with an asynchronous method of communication, such as messaging applications, and then contact each other with a synchronous communication system (Cao 2013, Greenberg & Neustaedter 2013). Forghani and Neustaedter (2014) found that grandparents living in different time zones communicate with their grandchildren less frequently than grandparents living in the same time zone. Children, in general, have difficulties in understanding the notion of time and their window of availability for synchronous calls is much smaller than adults, which makes communication over different time zone with children harder (Modlitba and Schmandt 2008; Yarosh & Abowd 2013).
In the literature, systems have been designed for family members to understand each other’s schedule and communicate accordingly. For communication over different time zones, family members do not keep a strict scheduling, but instead base it on the culture of the family; there are favorite times for communicating such as during dining (Wei et al. 2011) or bedtime for traveling parents to connect with children (Modlitba & Schmandt 2008). A system such as BuddyClock (shown in Figure 4), a digital clock with the capability of sharing the status of sleep with others (Kim et al. 2008), created a sense of connectedness by sharing status information between family members. BuddyClock was appealing for people to use in different time zones for knowing each other’s status and when they were awake (Kim et al. 2008). Wyche and Chetty (2013) studied how African students in the U.S. connected with family members back home in Africa and designed a prototype displaying the time in their home country, its weather, and an image of their hometown with a changing sky color indicating the time of the day. The prototype provided more than a digital clock and enabled participants to revisit memories from home by reflecting on the image on the prototype (Wyche and Chetty 2013). Participants imagined how their home was currently and thought of their migration journey more often (Wyche and Chetty 2013). CoupleVIBE was a prototype device designed to inform couples of each partner’s location via vibrotactile sensations over distance (Bales et al. 2011). TempFeel is another prototype intended for couples over distance which aimed to create intimacy, coordination, and reassurance by sharing thermal information of both partners over distance (Chung et al. 2014).
In summary, challenges seen in communication with the presence of time difference includes: lack of time windows for synchronous communication (Cao 2013, Cao et. al. 2010), experiencing different context of the day which causes difference in interest to topics discussed synchronously (Cao 2013). A lack of lightweight frequent communication due to time difference in families’ daily routines can cause less awareness of each other (Cao 2013; Wyche & Chetty 2013). Family members living in different time zones are not often as aware of each other’s availability as families living in the same time zone (Cao 2013). Due to a lack of information and changes to daily life, interruptive communication in different time zones occurs (Cao 2013; Zhou et al. 2017). Such interruptions in daily life lead to challenges regarding frequent awareness of family members from each other (Romero et al. 2007).

In the next subsection, different mediums used by family members to communicate over distance is discussed.

2.1.3 Video as a Medium for Communication

Video communication provides family members with a view of the other person, real-time communication, and immediate visual feedback through facial expressions (Tee et al. 2009; Cao et al. 2010; Kirk et al. 2010). Video communication has been used for both workplace and family communication. Brubaker, Venolia & Tang (2012) performed a study on how users use video communication in personal life and the workplace. They introduce five main uses including:

- Mediated representations: People believe that body language says it all. They can feel that it’s easier to convey information over video chat but they are concerned about their appearance. They can be self-conscious using video chat when in professional areas and less in personal spaces.
- Maintaining connections at a distance: individuals tend to use video chat after the relocation of intimate family members in order to keep the connection ‘alive’.
- Group identity & shared values: Video has a high power for demonstrating group inclusion for coworkers or for people who live apart. Sometimes talking about an event over a phone call, for example, can be quite limited in comparison to actually being part of an event and seeing it live over a video call.
• Establishing new relationships with place: People can show new locations to others over distance using video chat. The spaces accessed and created by the usage of video systems have their own value and are affected by the shared cultural understanding among the group.

• Shared Activities & Co-presence: People tend to use video chat to create shared social experiences and the most common activity they use it for is sharing the location they are in.

As part of their study, they showed how video communication, especially in the workplace, brings self-consciousness and how video communication only drives the attention to what is seen in the camera’s frame, which is not a broad view of what is happening in a location (Brubaker, Venolia & Tang, 2012).

Figure 5: Mom is using Experiences2Go prototype to show remote dad a Gymnastics class. From Experiences2Go: sharing kids’ activities outside the home with remote family members (Inkpen et. al., 2013). DOI: 10.1145/2441776.2441926

A challenge with current technologies used for video communication is the way they are designed for face-to-face communication and not so much for sharing an activity (Brubaker, Venolia & Tang, 2012, Forghani, A., Venolia, G., & Inkpen, 2014, Massimi & Neustaedter). The problem is that it is not always easy to hold a camera or be physically in one place for communication (Brubaker, Venolia & Tang, 2012, Jones et al. 2015). Other researchers have focused on using video communication over specific shared activities such as watching TV together over distance (Forghani, Venolia & Inkpen, 2014), sharing a major life event with family and friends over distance (Massimi & Neustaedter, 2014) and so on. Another focal area is designing systems which use video chat for connecting grandparents and grandchildren in a playful way such as reading an interactive
book together (Ballagas & Raffle, 2013). Systems have also been created for connecting family members over distance with children and connecting children with their peer groups by using video either synchronously or asynchronously (Inkpen et al., 2012, Inkpen et al., 2013, Inkpen, 2013). As an example, Experiences2Go was a prototype that investigated how families can share outdoor activities of kids such as fishing or playing sports with remote friends or family members through the usage of a probe shown in Figure 5. Study results indicated that the remote participants enjoyed being included but still felt like an observer. They liked to see both the adults and the children’s activity to feel more included in that social moment. A major part of sharing the activity with remote users depended on the quality and clearness of audio communication.

Another application of video is for connecting family members and partners over distance. As mentioned before, Greenberg et al. performed a study on how partners in long distance relationships use video communication to maintain their relationship and somehow have the intimacy that they had when they were physically near each other (Greenberg & Neustaedter, 2013). Greenberg & Neustaedter describe challenges during video chat, including: awkwardness during intimate moments, connection problems, audio problems, a lack of gaze and mutual eye contact, mobility issues, and challenges with lighting. Couples in long distance relationships sometimes keep video chat links open for long periods of time to just feel that they are in present with each other and to help couples achieve intimacy over distance (Greenberg & Neustaedter, 2013). In Your Eyes is an example of a system created for connecting partners over distance which used Skype in the always-accessible setting for partners to connect with each other anytime they would desire (Baishya & Neustaedter, 2017). The design consisted of a smartphone in a user’s pocket that showed what the user’s partner was seeing at that moment with audio enabled that could be heard via headphones. The study was done with two different paired partners who lived in different countries. The result of the work was both positive and negative based on the nature of each couple’s relationship participating in the study. The prototype was used in the field study for a month. The usage of the probe included seeing new places and people, witnessing important events and comfort while being alone. Concerns with privacy were reported several times in user interviews especially for one of the pairs in the study.
Keeping the video channel on for long periods of time is not just for long distance partners but also for other people who feel very close together such as family members. Systems such as the Family Window (Judge, Neustaedter & Kurtz, 2010) which can be seen in Figure 6, and Family Portals (Judge et al., 2011) created an always-on video channel for connecting homes. The Family Window connected a family’s home to a grandparents’ home through an always-on video feed on a dedicated device (Judge, Neustaedter & Kurtz, 2010) and Family Portals connected two siblings’ homes with grandparents (Judge et al., 2011). The Family Window was a specially designed video media space. It had features such as slate-style privacy blinds which family members could use to increase privacy. Other features included an activity banner for when an activity was detected through the system. Family members could use a knock feature to get the attention of the other homes family members and they could write on the screen. In the user study of both prototypes, audio was not captured due to privacy reasons for always-on systems (Judge, Neustaedter & Kurtz, 2010, Judge et al., 2011). The results of both studies showed families using the prototype felt more connected because they were able to stay aware of each other’s lives. Using these prototypes allowed them to converse more often since they had more topics to talk about. An asynchronous method of communicating was also implemented as a feature of the Family Window. Family members used this method to time shift a recording which allowed users to record an event that they were not able to watch live and see it later (Judge, Neustaedter & Kurtz, 2010).
Neustaedter et al. in (2015) analyzed how different demographics use video chat systems and talked about several always-on systems that are used for awareness and communication. One of the key findings of this work is how systems designed for connecting people need to support the sharing of everyday life activities and shift the focus from conversation to usage of video chat in different situations like important events and different locations (Neustaedter et al., 2015).

In summary, as we can see from the literature, many systems take advantage of video communication because of the rich experience and its closeness to face-to-face conversations. Although video communication is one of the richest mediums to be used (Kirk et al. 2010; Brubaker et al. 2012), it is not without its own challenges. Video communication technologies (e.g., Skype, FaceTime) are typically designed for face-to-face communication and not so much for sharing an activity (Brubaker et al. 2012; Forghani et al. 2014; Massimi & Neustaedter 2014). Sometimes video can be privacy intrusive and family members might not be willing or comfortable sharing their environment or their own appearance (Kirk et al. 2010; Brubaker et al. 2012). Another challenge with video communication is that it is not always easy to hold a camera or be physically in one place for communication (Brubaker et al. 2012). Thus, sharing special moments and activities with family members over distance can be challenging (Inkpen et al. 2013). To overcome some of the challenges, researchers have created and suggested several systems which use asynchronous methods which will be discussed in the next section.

2.1.4 Audio as a Medium for Communication

Audio plays a major role in communication and helps convey an experience or an activity (Procyck et al. 2014, Inkpent et al. 2013, Oleksik & Brown 2008). Several studies have focused on sharing activities with video communication (Inkpen et al. 2013, Procyk et al. 2014). Although the media used for both studies was video, participants emphasized the importance of being able to hear the sounds and highlighted the importance of the audio in the communication (Inkpen et al. 2013, Procyk et al. 2014). A few studies have been done on the effect of soundscapes in the domestic realm (Jones et al. 2017, Petrelli et al. 2010, Oleksik & Brown 2008, Oleksik et. al. 2008, Frohlich 2004). Here the literature has explored includes audio clips recorded in the home as part of precious sonic and soundscape mementos, and the capturing, archiving and resurfacing of families’ audio (Petrelli et al. 2010, Oleksik & Brown 2008, Oleksik et. al. 2008). For example, Wilcox et al. (1997) noticed a challenge with searching for audio clips and highlighting important ones used for journaling ideas.
Oleksik and Brown (2008) studied the existing practices of audio recordings for four households in a field study. They also investigated how and when they would play audio recordings back and what they would record if they had an audio recorder. They gave each family a voice recorder and after two weeks they chose several sound recordings from what family members actually recorded during the time and used them for the Sonic Gem prototype. Sonic Gem consisted of a bowl filled with capsules where each recording could be played by scanning the RFID inside each capsule (shown in Figure 7). The results of the study showed that families value specific sounds in homes such as ambient sounds, voices (especially if its their children’s voice), spoken words, and everyday domestic sounds which represent life as it was experienced at that moment (Oleksik & Brown 2008). Participants in the study felt audio was less staged than pictures and captured the essence of the moment in time and was sentimental for participants when they heard it played back (Oleksik & Brown 2008).
KidKeeper was also a prototype that used sound as the medium chosen for the prototype (Jones et al. 2017) which can be seen in Figure 8. They used audio clips to connect children between the ages of five to ten with their parents. They used audio clips for asynchronous communication between children and parents through a plush toy (shown in Figure 8). Children could send their parents audio recordings by pushing a specific spot on the toy. Parents would receive the recording through email. The results of the study indicated a greater chance for parents to know more about the personality of their children which was especially useful for shy kids where they could learn more about them while they were by themselves during their playtime.

Another type of audio-related technology was introduced called audiophotography (Frohlich & Tallyn 1999, Frohlich 2004). With audiophotography, users could attach sounds or ambiance to a photo (Frohlich 2004, Frohlich 2015). In a study with four families in the UK, audio attached to the photos were shown to enhance the memories and participants used the photos to index or enhance the sound being recorded. However, the method mostly was used to record ambient sounds or conversation and less used for commentary (Frohlich & Tallyn 1999). Similarly, technologies such as Story Bank (Frohlich et al. 2009) and MemoryLane (Kalnikaite and Whittaker et al. 2011) allowed participants to share audio-visual stories with their community with usage of a village display or at home for reflecting on memories and collecting digital mementos respectively.
A technology that also uses audio as the medium for communication is voicemail. A challenge with audio recordings, and voicemails is in retrieving and searching an exact part of the conversation (Arons 1997, Tucker and Whittaker 2006). This is why user interfaces such as Jotmail for voicemails have been studied to explore how user interfaces that are text-based can help with using such technologies in workplaces (Whittaker et al. 2000).

![Image](image_url)

**Figure 9: From left to right, HotHand, YourGlove, HotMits. From: YourGloves, HotHands and HotMits: Devices to Hold Hands at a Distance. (Gooch & Watts, 2012). DOI: 10.1145/2380116.2380138**

### 2.1.5. Other Mediums Used for Family Communication

Excluding audio and video, other mediums for connecting families together have been used in the literature such as tangible devices and communication within minimal interaction. I talk about each in turn. First, tangible methods are often used for connecting couples to provide them with a physical connection to their partner over distance. For example, Gooch and Watts created three prototypes named YourGloves, HotHand and HotMits (Gooch & Watts, 2012) that is shown in Figure 9. YourGlove was a robotic hand attached to a string similar to an arm. HotHands used heat and was activated when a partner put their hand in the model hand. HotMits used heat as well in the imprint of the hand. All three prototypes could be personalized to look like the partner’s handprint. Participants created a better connection with HotMits than the rest of the prototypes. Another result of the study indicated that for some cases, personalized prototypes caused participants to notice their partner’s absence more and caused feeling of sadness.

While Gooch and Watt focused on recreating the warmth in the act of hand holding for couples, Singhal et al. created a prototype which could allow couples to experience touch over distance with a prototype called Flex-N-Feel (Singhal et al., 2017). The prototype included a flexing glove (Flex) and a glove equipped with three macro vibrators on each finger (Feel) which allowed the partner to feel which finger the distant partner was
bending. Study results showed participants used Flex-N-Feel for playful episodes such as massaging their partner, showing their presence by enabling the vibration on the glove; and, initiating shared actions such as pinky swears or intimate touches such as caressing a partner’s face. Shared actions were usually initiated from the person with the flex glove.

Tangible devices are also used for connecting children with their parents and grandparents (Jones et al., 2017, Yarosh & Abowd, 2013, Ballagas & Raffle, 2013). Systems such as Playpals (Bonanni et al., 2006) allowed children to have synchronous video communication with their friends through embedded systems in action figure toys which had a small monitor inside. As another example, ShareTable was a tangible prototype that was designed to improved synchronous interaction between parent and child relationship in divorced families. The prototype consisted of standard video conferencing and a shared tabletop with top-down projection that allowed joint activities for the child and parent such as doing homework together or playing games (Yarosh & Abowd 2013). Ballagas and Raffle (2013) created a prototype that used video chat for connecting grandchildren with grandparents in a playful way such as reading an interactive story book for them.

Some systems connect families with minimal interactions over distance. I have categorized these systems as an abstract approach of connecting family and friends since they used signals such as vibration, changing color of lights and objects to indicate their
care for the other members in a single tangible act. For example, Kaye (2006) created a prototype named the Virtual Intimate Object (“VIO”) shown in Figure 10, which was designed to allow partners to communicate in a minimalistic form. The prototype was a software-based system including a circle on the screen which changed its color when one of the partners clicked on it. The colored dot gradually faded away after a while. Study results showed that even minimal levels of information allowed couples to be aware of each other’s state and connect over distance. Other systems also used an abstracted version of communication with tangible devices. Angelini et al. (2015) created a lamp that displayed the emotion of the user based on their facial expression. The lamp also paired the feeling of the participant with a color. The interaction of the user is designed in an anthropomorphic form to be playful and spontaneous. The gestures that the lamp recognized were caressing, hugging and kissing for positive valence, slapping and shaking for negative valence.

Another prototype was the “messaging kettle”, which was created in order to foster communication and engagement for senior adults and their children or their friends with the same system. The prototype included connected kettles in different homes and a tea box including a display for writing messages or recording voices for people in different time zones. From the introduction of the prototype to the targeted demographic, the concept was well received. However, challenges related to timing for different time zones and a hesitance with using a new technology, especially for this demographic (Breton et al. 2015).

Figure 11: Cubbles three different approach a. hardware only, b. mobile only, c. hardware and mobile combined. From: Cubble: a multi-device hybrid approach supporting communication in long-distance relationships. (Kowalski et al. 2013).

Kowalski, Loehmann, & Hausen (2013) created a prototype with three different approaches: a tangible object, an app which only used software for communication and a
hybrid of the two previous approaches. The hybrid system has a private channel for communication between the couples. The prototype was named Cubble and allowed messaging. The three approaches are shown in Figure 11. In order to create intimacy for couples in long distance relationships, the object used colors, vibration patterns, and thermal feedback. Couples could send three types of messages: Nudges, Tap patterns, and Holding Hands. Nudge messages were sent when the sender tapped once on the object and the system would send a flash of a desired color to the recipient. Tap communicated the pattern which the sender had tapped on the object in the form of vibration patterns. The holding hands feature was when the sender and receiver were both holding the object at the same time. This resulted in yellow pulses and heating of the object as if they were holding hands. Results of the study showed that the use of the hybrid approach increased the messages and couples felt closer and more connected with each other. Color coded messages were also used for sending coded versions of intimate acts and inside jokes. Similar to what Singhal et al. (Singhal et al., 2017) found in their study, using the prototype brought feelings of closeness between partners when they used it during video calls.

2.2. Asynchronous Technology

Asynchronous communication is when a technology is used at different times for connecting individuals who are usually in different geographical locations (Baecker et al. 2014). Such technologies are designed to bring flexibility to communication. Flexibility in such systems means, for example, when a person initiates communication, the other person can interact with the technology at their own desired time. Common asynchronous communication technologies include email, text messaging and mobile messaging applications. Asynchronous communication has been studied as a part of workplace activities (Barksdale et al. 2012; Tang et al. 2012), for connecting across family homes (Hutchinson et al. 2003; Brush et al. 2008; Judge et al. 2010), for sharing specific activities between family members such as shared dining together across different timezones (Tsujita et al. 2010; Nawahdah & Inoue 2013) and general asynchronous video communication through video messaging (Du et al. 2011; Inkpen et al. 2012; Venolia et al. 2015).
Several systems have been designed for connecting distributed work groups through asynchronous systems such as Video Threads (Barksdale et al. 2012) and Time Travel Proxy (Tang et al. 2012). Video Threads, which is shown in Figure 12, was a system using asynchronous video communication for distributed software teams in different time zones. Video Threads provided a thread-based visualization of video messages. Users were able to send/receive or reply in the Video Thread interface or share their screen while having their audio on the screen. Notifications were sent through email for new conversations. Results showed such a system was more beneficial for sharing personal information and a chance for co-workers to know their remote group members better on a personal level (Barksdale et al. 2012).
Several systems have also been created for connecting homes asynchronously. These prototypes were created to explore how asynchronous communication can be used to connect family members over distance. Technology probes is one of the methods used for such studies. Technology probes are open ended designs that allow researchers to explore how people use and interact with a new type of technology in real world settings (Hutchinson et al. 2003). Hutchinson et al. (2003) created two asynchronous prototypes for connecting adult children and parents’ homes and in another case, adult siblings’ households together. This included Message Board and Video Probe depicted in Figure 13. Message Board consisted of a digital space for remote family members to send each other post-it notes by writing on a tablet with a stylus. It was deployed in three U.S. household for six weeks. A second deployment was in two houses in Sweden over a couple of months with two sisters, one living with her boyfriend and the other living with her husband and two small children. The usage of the probe differed in the two different situations. The American families used it mostly for reminders, coordination and chores while the Swedish family used it in more fun ways of interacting and awareness in the households such as the nieces playing tic-tac-toe with their aunt. Video Probe captured images within the home and shared them with the remote home’s frame, which could be
hung on a wall or placed on a counter. Images were chosen over video streaming due to network capabilities. Video Probe was deployed with two French families (two sisters and two brothers) during a summer. Both families had kids and adults and used it in a playful way by making faces or taking photos of their handwritten messages. In general, the results indicated that family members found the prototypes useful for playful interactions with the kids and the probes allowed them to connect more with remote family members (Hutchinson et al. 2003). Similarly, a technology probe was created that supported intergenerational game play for bringing grandparents and grandchildren closer together over distance (Vetere et al. 2009).

Another example of an asynchronous communication system is SPARCS which can be seen in Figure 14. SPARCS was a system allowing families to share their calendar alongside a message board that allowed family members to share photos (Brush et al. 2008). They conducted a field study for five weeks with seven pair of families to understand how to help families stay connected. The study results showed families liked the easy and lightweight method of sharing through SPARCS. Photos were seen as more valuable to participants than calendar events. A reminder which suggested when families should share a photo in SPARCS was highly valuable but participants liked to be able to change the frequency of its appearance. Participants also enjoyed the idea of having

Figure 14: SPARCS main window for sharing pictures and events. From: SPARCS: exploring sharing suggestions to enhance family connectedness. (Brush et. al., 2008). DOI: 10.1145/1460563.1460661
asynchronous chat messages since they could just write something whenever they wanted and the other person could respond when they wanted to.

![VideoPal main interface showing asynchronous video threads.
From: Video Kids: augmenting close friendships with asynchronous video conversations in VideoPal (Inkpen et. al., 2012) DOI: 10.1145/2207676.2208400](image)

Different technologies have been made by using asynchronous video communication for bringing friends and family members closer together. For example, Du et al. (2011) compared children’s use of an asynchronous video communication called VideoPal to emails for connecting children living in different countries as ‘PenPals’. They investigated the pen pal idea by combining it with video rather than just email. They conducted a 2 month study on 30 children from USA and Greece. The study was both on using email and asynchronous video-based messaging tool named VideoPal. Study results showed that children had more fun with video messages, expressed themselves more easily, and conveyed more information with video (Du et al. 2011). However, written email was easier for them to comprehend due to a lack of accent and was easier for students to have relaxed communication with the focus more on the content and answering a question deeply (Du et al. 2011). Inkpen et al. (2012) also conducted a field study with VideoPal (Figure 15) for connecting girls in their pre-teenage years in the same city. Study results showed that children used the system for more than just having a conversation asynchronously (Inkpen et al. 2012). This included sharing activities and
having fun with friends by showing performances at home, e.g., dancing (Inkpen et al. 2012).

**Figure 16:** SeeSaw while user has received a respond from a friend. From: *I See You Saw My Video Message.* (Venolia et al. 2015). DOI: 10.1145/2785830.2785847

With the increase in usage of mobile devices, and their capabilities in allowing video communication almost everywhere and at anytime, researchers became interested in exploring video usage for different purposes and designs (O’Hara et al. 2009; Juhlin et al. 2014). Several of these new designs also investigated the use of asynchronous video communication. For example, SeeSaw which is shown in Figure 16 was an asynchronous video application for mobile phones which recorded and sent back user reactions to video messages that they received (Venolia et al. 2015). Having the facial reactions of friends while viewing video messages created a sense of having synchronous communication with the added benefit of flexibility and the ability to multitask while having a conversation with a friend asynchronously (Venolia et al. 2015). Some users considered SeeSaw to be better than synchronous video chat, yet some did not like re-watching their own message to see their friends’ reactions (Venolia et al. 2015).

In summary, although asynchronous communication systems tend to have several advantages, the use of asynchronous communication tools is mainly practiced in a simultaneous fashion as an ongoing messaging (Cao 2013). In other words, despite the flexible nature of asynchronous systems, in practice they are being used in an ongoing
back and forth pattern of communication which needs immediate attention (O’ Hara et al. 2014). This may create a sense of obligation for family members to answer messages right away (Neustaedter et al. 2006). Based on the related work, families with members in different time zones can benefit from asynchronous technology. Using this method, each person can use the technology based on their own availability and, hopefully, have less interruptive patterns of communication.

### 2.3 Sharing Activity over Distance

Researchers have explored technologies to share activities over distance which can be categorised into two groups: Parallel and Asynchronous. A parallel activity is when both people over distance engage in an activity in their own location at the same time, such as geocaching together (Procyk et al. 2014). Geocaching is when individuals hunt for treasures hidden in containers in parks or urban areas using GPS coordinates. Another example of a shared activity is jogging over distance through sharing an audio communication while enjoying a jog over distance (Mueller et al. 2010). An example of a parallel indoor activity can be dining together over distance where family or friends share their mealtime over distance through usage of video communication during dining times (Wei et al. 2011; Cao 2013).
Having a parallel experience with several hours of time difference can be challenging which is why researchers have thought about the design of asynchronous methods for sharing activities over distance (Tsujita et al. 2010; Nawahdah & Inoue 2013). For example, KIZUNA (Nawahdah & Inoue 2013) was a time shifted tele-dining system which enabled people to enjoy a meal together in a virtual environment (shown in Figure 17). The authors focused more on improving the social experience side of dining together and the connectedness it brings. The KIZUNA system had an automatic recording and playback feature that corrected the speed of the remote dining video based on the amount of food being consumed. This feature gave the illusion of co-dining for the participants although their dining had happened at different times and in different locations.
In shared geocaching (Procyk et al. 2014) two users went geocaching in different areas while audio and video was streamed between them using a wearable camera and a smartphone attached to the user’s wrist (can be seen in Figure 18). Results showed that audio played a central role in creating a strong sense of presence and connection with the remote partner, while video was considered more secondary to the experience (Procyk et al. 2014). In shared bicycling, two users went for a bicycle ride with each other but in different locations (Neustaedter et. al. 2017). Video and audio was streamed between bicyclists using two smartphones mounted to the bikes. For both shared geocaching and shared bicycling, because the remote user did not have a physical embodiment (e.g., a body) in the remote location, privacy challenges emerged around streaming video and audio in public settings (Neustaedter et. al. 2017). Several studies have focused on sharing physical activities through audio alone (Heshmat et. al. 2017, O’Brian 2007). Meuller et al. (2010) ran a study where paired family or friends jogged in different locations synchronously and shared the activity over distance through an audio communication system with a headset. The way which sound was played was dependent of the partner’s heartrate during the jog. If the heartrate was higher, the audio would be played as if the
remote partner was ahead and vice versa. Users reported they appreciated the experience and felt as if they were participating in the activity together especially when they had someone with the same pace (Mueller et. al. 2010).

As we can see, a less explored design space in the literature is the ability for individuals to seamlessly share activities over distance in different time zones especially in a real world setting. Achieving such a goal with current synchronous technologies is challenging, especially when family members live in different timezones. That is why I started to explore asynchronous communication methods for connecting family members to share activities asynchronously and seamlessly in different timezones.

### 2.4 Slow Technology

Many systems that have been designed for domestic use are inherited from the workplace with workplace needs, rather than domestic ones in mind (Hallnäs & Redström 2001). This includes needs such as productivity and efficiency. As such, Hallnäs & Redström (2001) proposed the idea of creating systems and technologies that are not time-consuming and not focused on efficiency. Instead, they designed systems that could be present in our surroundings. Slow technologies aim to create a more meaningful connection between people and computational artifacts through designs that take time for users to learn how they work and why they work in a particular way (Hallnäs & Redström 2001, Odom et al. 2012, Pschetz 2017). Using such slow technologies can allow family members to have time to reflect, revisit and create anticipation when interacting with a system (Odom et al. 2012). Slow technology can add to the flexibility of asynchronous communication systems. The current culture of social networks and technology is fast paced and is based on always being available and attentive to the surrounding news in these systems. Such features of social networks do not often allow users to have time to reflect (Cheng et al. 2011; Hawkins et al. 2015). That is why technologies that are less interruptive and do not need a user’s constant and immediate attention are designed.
There have been a variety of slow technologies designed over the past two decades. For example, GoSlow is a slow technology which reminds users to take a small pause in their day to reflect on their mood without being persuasive (Cheng et al. 2011). Similar to other forms of slow technology, GoSlow was designed to give users personal space and a chance for solitude, which largely contrasts the focus of current social media systems. GoSlow informed users about the benefits of actions such as laughter, taking deep breaths and suggesting that the user take some personal time. The PhotoBox was a slow technology that was designed as a solution to better connect individuals with their massive media archives in a more meaningful way (Odom et al. 2014). Odom et al. used a wooden box equipped with a Bluetooth printer which randomly printed out Flickr photos for household members to reconnect them to their past (Odom et al. 2014). Photobox printed and chose photos randomly which meant there was no control from the user’s side. Such a lack of control caused frustrations for some participants. Balancing the control that users have with slow technology is sometimes a challenge since it plays a major role in affecting user anticipation and the element of surprise (Odom et al. 2014). Olly is another form of slow technology that is shown in Figure 19. The artifact allowed individuals to connect with...
their digital audio records and the time they were played which was kept on the last.FM website and gave them the opportunity to choose and reflect on a randomly picked track by Olly to be played or not based on the user’s interaction with the tangible technology (Odom et al. 2018, Odom et al. 2019). The longitudinal field study of Olly (Odom et al. 2019) shed light on how individuals actually live and cope with a slow technology, from the first excitement to mild tension followed by acceptance and sustained relationship with the technology. Olly connected participants with their past music archive and created an opportunity for them to reflect on the personal connection which came by the specific music being played and the temporal information shown through tangible method on Olly.

Another slow technology is Postulater, which allowed users to send image or video clips with a caption to friends and family (Figure 20). The unique feature was that they could set the sending date and time in the future (Hawkins et al. 2015). While the Photobox connected users with their digital media archives somewhat randomly, Postulater allowed users to be more in control and to choose the memory and time and date of revisiting a memory in the future for themselves or a family member or friend. Based on a field study, the uses of Postulater were: time-based greetings, reminders, creating digital time capsules, and playful methods of revealing information.

In summary, with the usage of slow technology, people reflect on the way technology affects their lives. Slow technologies represent a step toward designs that allow reflection, re-visitation, and anticipation (Odom et al. 2012, Odom et al. 2019). Few studies have
explored design ideas of more in-depth connection between family members through the use of slow technology (King et al. 2007, Odom, 2015). However, these studies focused mainly on the use of software or did not go further than proposing ideas for future work. What I proposed for this thesis was a computational artifact which can be used to share experiences in a real-world setting. To reach these goals, an asynchronous audio narrative system inspired by slow technology was proposed to try and create conversations leading to reflection and sense of anticipation in family members communication.

2.5. Summary

In this chapter, I explored a variety of methods of connecting family members together over distance. I introduced different mediums and systems used for connecting family members over distance and reported on what was found useful or challenging for families communicating over distance. Then I explored different asynchronous systems created for connecting mainly families over. Next, I discussed sharing activities over distance between family members and friends. Lastly, I introduced slow technology systems and designs influenced by this type of design.

In the next chapter, I will explain and discuss my first published paper, a qualitative study exploring how people listen to podcasts. I investigated the different aspects of podcast technologies from participants’ favorite characteristics about them to why podcasts have supported solitary practices and how time and location affect listeners’ patterns of usage.
Chapter 3.

Exploratory Study of Podcasts

This chapter is focused on the first study I ran for understanding podcasts. Podcasts are a successful asynchronous technology and learning about people’s patterns of usage and their listening behaviors, atmosphere, and timing could help me understand what characteristics of asynchronous audio technologies are important for people. It can help uncover design lessons that I can extract for connecting families over distance with an asynchronous audio storytelling system.

In this chapter, I present my first published paper on the subject, a study of podcasts. This qualitative study answers my first research question in this dissertation: What are the listening practices of frequent podcast users and how do podcasts support quality alone time?

My objective for my first question was to explore people’s routines around listening to podcasts, including: when and where they listened; who they listened with, if anybody; what activities they did while listening; and, how they shared knowledge from podcasts with other people, if at all. The paper was published as:


3.1.1. Authors

Yasamin Heshmat, Lilian Yang, Carman Neustaedter
3.1.2. Abstract

Audio podcasts have been widely used for more than a decade where millions of people listen to digital content on mobile devices. Despite a large amount of research on podcasts, there have not been any studies that explore the detailed listening practices of frequent podcast users, in particular, with a focus on understanding how podcasts support alone time. We conducted an interview study to understand and learn from such practices. Our results point to the characteristics of podcast technology that made it suitable for supporting people’s ability to be alone yet still feel like they were connected to others. This included being able to multitask while listening to a podcast, escape from times of boredom, and even have experiential moments of self-reflection. These behaviors were supported by the flexibility of podcasts as a storytelling medium, a feeling of intimacy and connection with the podcast host, and podcasts’ ability to make people feel like they are part of a conversation even when alone. We explore how these features suggest direction for technologies that can support alone time.

3.1.3. Keywords

Podcasts, asynchronous media consumption, reflection, solitude

3.1.4. Index Terms

H5.3. Information interfaces and presentation: Group and Organization Interfaces
– Asynchronous interaction

3.1.5. Introduction

Audio podcasts consist of a digital audio file that can be downloaded on desktop or mobile devices such as smartphones and tablets. Users can also stream them online. Podcasting has been around for more than 10 years and has grown to be used for many purposes ranging from commercial use to education (Sengers 2011, Abdous et al. 2015). Over the past two years, podcast listening has grown significantly due to the continued proliferation of mobile devices (Baer 2016, Edison Research 2017).

There is a rich history of research on audio podcasts, given their relative success. For example, studies have looked at the characteristics of podcast services
(Gunawardena et al. 2009), their influences on subjects such as education (Hew 2009) and measuring the correlation between podcast listeners and their online shopping habits (eMarketer 2009). Annual surveys by the Edison research group provide quantitative data on podcast listening, such as how many people listen and how many use each type of device (e.g., (Edison Research 2017)). This is meant to provide an overview of listening behaviors. Instead, what we do not see are studies of the routines and practices that people have created for listening to podcasts as a part of their everyday routine. This includes qualitative explorations of the ways that the flexibility, mobility, and passive nature of podcasts—their ability to be listened to nearly anywhere without requiring interaction— affect listening behaviors. As such, the goal of our research was to explore people’s routines around listening to podcasts, including: when and where they listened; who they listened with, if anybody; what activities they did while listening; and, how they shared knowledge from podcasts with other people, if at all.

While some people may refer to particular video stories posted on online sites (e.g., YouTube, Netflix) as video podcasts, our focus is on the more traditional form of podcast that comes in an audio format without accompanying video.

Our results uncovered the role that audio podcasts played in supporting people during moments when they were alone and could disengage from the world around them, yet still feel like they were connected, somewhat intimately, to a podcast host. In this way, listeners felt like they were part of an ongoing conversation or story that was unfolding, sometimes just for them. Our paper unpacks these experiences to draw out lessons for the design of technology that can allow people to, like audio podcasts, disconnect from the world around them and gain moments of solitude, while still feeling connected and not alone. Thus, while we study podcast listening practices, our design lessons are not focused on the design of podcasts or systems to support them. Instead, we use podcasts as a lens to understand how we might design for other types of asynchronous media consumption as well as technologies focused on supporting alone time and disconnection.

In our discussion, we shed light on new design paths to explore where the structure of podcasts suggests directions for designing slow technologies, designs that purposefully cause people to slow down, reflect, and reconsider everyday moments and things (Hallnäs and Redström 2001, Hawkins et al. 2014, Odom et al. 2014, Hawkins et al. 2015). Mainstream technology usage typically focuses on feelings of continuous connection and consume attention (e.g., being 'always on' Facebook and other social
media tools) (Harmon and Mazmanian 2013). There also exist new technologies focused around exploring people’s ability to disconnect and ‘turn off’ technology such as email and social media for portions of the time (Mark et al. 2012, Baumer et al. 2013, Schoenebeck 2014). Our results and lessons point to a type of technology design somewhere in the middle where people are connected but not. Here we explore the ideas of designing for flexibility so that content can be consumed almost anytime, anywhere and even while one is doing other tasks; making it feel as though listeners are part of a conversation, even when they are alone; allowing people to listen to content that draws their mind away from their current task; and, designing in a manner that allows one to connect in a somewhat intimate way with another individual, the host or narrator of content. These ideas have not generally been thought about when thinking about the design of slow technologies or those aimed at disconnecting. We build on this idea to explore the possible rethinking of how families and friends might share information with each other over distance focused around more purposeful, reflective sharing and connection.

3.1.6. RELATED WORK

Podcasts

Podcasts have been around for more than a decade and are used for a range of purposes from commercial ventures to education (Smith and Fidge 2008, Abdous et al. 2015). Podcast topics vary from news items, to self-help, to fictional stories where podcasts featured on ‘popular lists’ in app stores are more likely to be played and subscribed to (Gunawardena et al. 2009). Telephone surveys have revealed the demographic details of podcast listeners and shown that people listen to podcasts at home (51%), while commuting (25%), and at work (14%) (Edison Research 2017). On average, respondents listened to podcasts for 5 hours per week. While the sample size from these surveys is high (e.g., more than a thousand people), they do not provide a detailed understanding of the listening behaviors of podcast users, and results are mainly meant for marketing purposes.

Podcasts have, however, been extensively studied for their role in education. A comprehensive overview can be found in work by Hew (Hew 2009). In summary, we see that in educational contexts, podcasts are beneficial as they allow instructors to easily create content that can be shared with students (Evans 2008, Hew 2009, O’Bannon et al 2011, Abdous et al. 2015). For example, researchers have demonstrated the benefit of
podcasts for teaching second languages (Abdous et al. 2009, Abdous et al. 2012, Abdous et al. 2015) and computer programming (Smith and Fidge 2008). Yet the challenge is that podcasts are not always easy for people to use as some do not understand the software needed to play them or where to go to find podcasts to listen to (Hew 2009).

Despite this large amount of research on podcasts, there have not been any studies that explore the detailed listening practices of frequent podcast users, in particular, with a focus on understanding how podcasts support alone time. Our research focuses on these aspects to draw out lessons for the design of asynchronous media-sharing systems with a focus on feeling connected while alone through storytelling.

**Slow Technology**

Slow technologies are designs focused on creating more meaningful connections between people and technology (Hallnäs and Redström 2001, Odom et al. 2014, Odom et al. 2016). One aspect of the design agenda for such technology is to be used for solitary moments and mental rest for individuals (Odom et al. 2012). In other words, slow technology has the potential to create quality alone time. This is done by designing for ‘slowness’ where it takes time for users to understand how a technology works and why it works in that way (Hallnäs and Redström 2001, Odom et al. 2014, Odom et al. 2016).

For example, the PhotoBox (Odom et al. 2014) included a physical box that randomly printed photos each month to connect users with their past. Users took time to understand and think about how the PhotoBox was working and what its printed photos meant to them. GoSlow (Cheng et al. 2011) was a system designed to decrease stress for users by reminding them to reflect on themselves. The design is purposefully minimalistic and allows users to connect with themselves to reflect on their solitude as a mean to relieve stress. PostULater (Hawkins et al. 2014, Hawkins et al. 2015) targeted the way people connect over time. The system allowed people to send digital photos to family and friends where delivery would happen at a specified future data. Fieldwork showed that such systems are useful for sending reminders, sharing personal memories, and reflection where users continually reflected on the idea of themselves and media recipients in the future.

Together, research on slow technology has shown the value that can come from slow interactions with technology over time and in solitude. These designs focus on slow reveal of information to users such that people can connect in more meaningful ways with information. Podcasts, by its current definition, is not considered a slow technology but
our results on podcast use during moments of solitude build on these ideas by pointing to the value in flexible and purposeful interactions with audio content.

**Disconnecting and Solitary Moments**

Research has also explored how people can limit their time using technology and being connected with others (Baumer et al. 2013, Baumer et al. 2014). Many people in Western society struggle with feelings of over-connection and a loss of freedom over how they use their time (Sengers 2011, Harmon and Mazmanian 2013, Leshed et al. 2014). This is exacerbated by increasing feelings of the need to ‘do more’ with our time (Lindley 2015). As a result, researchers have started to think about technologies that allow people to disengage (Plaut 2015, Yang et al. 2015). Studies have shown that even in cases where technologies are designed to purposefully disconnect people, it can be challenging to do so. For example, Schoenebeck (Yang et al. 2015) studied people who tried to give up Twitter usage for Lent and found that it was hard for many people to do so. Mark et al. (Mark et al. 2012) studied information workers who tried to purposefully not use email for several workdays.

The HCI literature on designing for solitary moments has similarly gained attention (Fullerton 2010, Odour et al. 2016). This work shows a strong tie to research on slow technology when it comes the importance of solitude (Hallnäs and Redström 2001, Cheng et al. 2011, Odom et al. 2012). Several works argue that having access to large amounts of information continuously does not allow individuals to gain ‘peace of mind’ which will affect the connection that people have with their inner self (Fullerton 2010, Baumer et al. 2013, Odour et al. 2016). Fullerton (Fullerton 2010) compares it to when we connect to ourselves through the solitary act of reading a book. He encourages future designs to allow users to choose a time to not be distracted and feel completely focused on doing one task (Fullerton 2010). This is similar to several works encouraging less distracted uses of social media (Baumer et al. 2014) or less usage of mobile phones in general (Ames 2013, Hiniker et al. 2016, Odour et al. 2016). A study of mobile music listening shows that people enjoy solitary moments while commuting and in domestic space where they listen to music (Bull 2005).

As we can see, researchers are now exploring designs that are able to create a relaxing atmosphere where users can be connected to themselves for moments of reflection. We explore how podcasts fulfill the need that some people have for
disconnecting from others around them and focusing on acts of solitude, while still feeling like they are connected with a host and podcast content.

3.1.7. Study Methodology

The goal of our study was to explore when and where people listened to podcasts; who they listened to them with, if anybody; why they listened to particular podcasts; what activities they did while listening; and, if and how they shared podcasts and the knowledge received from them with others. By addressing these points, we reveal the ways in which podcasts support disconnection and alone time.

Recruitment and Participants

We recruited participants who were current podcast listeners (listening at least once a month) using snowballing sampling, emails, flyers, and social media platforms such as Facebook and Instagram. We selected 18 participants (6 male, 12 female, age=23-55, average 32), all with experience with post-secondary education from different work backgrounds (e.g., acupuncturist, pharmacist, students, software engineers, and web designers) in order to get a diverse sample. 16 participants listened to podcasts weekly and 2 listened to podcasts biweekly while doing chores or on road trips. 12 of our weekly listeners listened to podcasts for at least 2.5 hours per week and 4 of them listened between 15 and 21 hours. 15 of 18 participants lived in a major metropolitan city in North America, while 3 of 18 lived in two different large cities. 16 of our participants listened to only audio podcasts and 2 used both video and audio podcasts (they considered certain YouTube and Netflix videos to be visual podcasts). Despite the use of video podcasts by some users, our results focus on audio podcast listening behaviors and routines.

Semi-Structured Interview Method

We conducted semi-structured interviews with participants lasting between 40 and 60 minutes. 15 of 18 interviews were conducted in person and three were done over Skype due to participants’ location. Interview questions focused on five main topics: 1) podcast types (what participants listened to and why); 2) timing, location and routines of listening; 3) the factors that made participants like certain podcasts more than others; 4) the challenges faced when trying to listen to podcasts and any workarounds they used; and, 5) sharing patterns (how they learned about what
podcasts to listen to and how they shared podcasts with others, if at all). For example, we asked them questions such as, “Can you tell me what kinds of podcasts you listen to? What are the names of them?”, “Where are you when you listen to podcasts? Why? “How do you find out about podcasts to listen to?”, and “Do you ever tell other people about the podcasts you listen to or information in them? If so, how?” To ground our interviews in actual practices, we had participants tell us about specific points in time that were memorable to them when listening to podcasts. Some participants showed us their podcast application and their subscribed podcasts.

Data Collection and Analysis

Interviews were audio recorded and notes were taken during the sessions. We then transcribed the interviews. Next we conducted an open coding data analysis process where we generated codes from scratch and not a priori. We labeled findings according to themes about listening and sharing behaviors. This included codes around the specific places people listened to podcasts, their associated activities, and thoughts about what made a podcast favorable to listen to. Axial coding was used to group the key findings from these codes into main themes such as multi-tasking, locations, timing, sharing habits, and topics. Next the researchers discussed the themes as a group and selected what we thought were the most pertinent findings. These are reported in the results sections. Participant quotes are reported with a P# to maintain anonymity.

In the next section we describe the main themes from our analysis where we outline people’s feelings about using podcasts to support alone time, the activities that people did while listening to podcasts, how location and time affected listening, and the desirable characteristics of podcasts. Throughout these findings, we explore the characteristics of podcasts that emerge as being helpful for making podcasts a successful method for supporting solitary moments.

3.1.8. Podcast Listening as a Solitary Practice

Participants listened to a range of different podcast types, including storytelling podcasts about history, life, science and literature. Some people listened to podcasts about the news or politics. Other types of podcasts were targeted around special interests of the participants such as video games, meditation, or self-motivation. Podcasts were
selected and found based on web or app searches, as well as word of mouth recommendations from friends or family.

Across these behaviors, one of the strongest themes that emerged in our results was the idea that podcast listening was a very personal and solitary activity similar to listening to music with MP3 players while people are in public spaces (Bull 2005). All of our participants said that they listened to podcasts alone the majority of the time. Podcasts were seen as an individual activity despite that, many times, podcasts were listened to with others around (we describe this in more detail later). Participants really liked this attribute about podcasts and enjoyed their time listening on their own. For example, P13 told us that listening to podcasts was “me time,” indicating that it was valuable time dedicated to her.

The idea that podcast listening was a solitary activity was even so important for some participants that they strongly opposed the alternative, listening to podcasts with others. For example, P6 was disturbed by the idea of sharing the experience with a friend since she felt her bond the podcast was personal and special.

“There is something about that intimacy and that specialness of the relationship that I guess I feel I have with these podcasts that I almost don’t want to bring someone else into it. Like sometimes I am definitely eager to share the information I got from the podcast with my friends or my roommate for example…like sometimes you know, will be chatting and mention something I heard from podcast but I don’t think I ever or probably would never just be like ‘hey I am listening to this podcast would you like to hear also?’, no! It’s my special time.” -P6

**Escaping the Mundane**

First, our participants used podcasts as a way to ‘escape’ what was seen as being mundane, similar to how music players have been shown to ‘fill in the air and space’ while doing tasks such as commuting (Bull 2005). By escape, we refer to a mechanism to make somewhat simple everyday tasks more interesting. By doing so, participants were able to simultaneously perform an activity, while also engaging their minds in other topics of interest. This included the completion of activities that were not necessarily appealing. For example, ten participants regularly listened to podcasts while commuting to and from work. Listening to podcasts while cleaning or cooking was also popular.
“I listen to them on my drive to and from work and I need something to occupy my time because the drive is so boring because it’s the same every day.” -P5

These activities were solitary in nature and did not typically involve others. Podcasts helped keep our participants’ minds busy during these times since they did not need to interact with others. Such multitasking was possible for audio podcasts since they could be listened to rather than having to watch a screen. Some could also be listened to in somewhat of a passive manner.

Reconnecting with Oneself

Second, participants used podcasts to create a deeper, more experiential connection to themselves and an activity that they were engaging in. For example, P11 liked to garden and listened to podcasts while gardening. Gardening was an activity that she preferred to do alone as it allowed her to reconnect with nature. She sometimes forgot about the hours passing by while she was in her garden listening. She found the process of listening to podcasts relaxing and comforting.

“I worked on my garden this summer and I just totally got carried away while listening to podcasts for hours weeding the garden and I saw it’s getting dark.” -P11

Three participants listened to podcasts while performing crafts or other creative processes as a form of inspiration. Again, such acts were seen as being solitary in nature. For example, P6 loved to paint in her free time and alone so she could focus. Since this was a creative process, she tended to listen to podcasts that were thematic to what she was doing. One of the reasons P6 liked listening to podcasts more than music during these tasks was that she liked information and stories. Once she was drawing a Middle Eastern scene and tried to listen to a podcast that was about mythical stories of the Middle East. She believed that the podcast helped her to imagine the atmosphere in a way that helped her creative process. P6 also liked to listen to video game podcasts while she prepared slides for a class she taught.

Physical Activities

Nine participants listened to podcasts while performing physical activities. Here they were able to engage in a physical activity on their own, without others to interact with, while the podcast allowed them to mentally engage in content beyond just their physical activity. For example, P6 enjoyed nearly an hour of walking time every day before going to work. Her route consisted of an urban location and a short walk in the forest. While she
walked in the forest area she enjoyed listening to the sounds of nature around her and did not need to listen to anything while she was walking there. Yet when she walked alone in urban areas she listened to informative podcasts to stimulate her mind. This, again, contrasts the way one might listen to music in a somewhat passive manner. For P6, it was important to have a story or information being shared with her. Thus, there was more of a point to listening. Similarly, P4 listened to podcasts while she walked her dog alone, which she said usually took a long time. Podcast listening was a motivator to continue walking in her case. Again, the importance lay in hearing an interesting story about a particular topic.

“I listen most commonly when I am walking my dog because he is very slow and it’s quite boring… It’s something that makes it less of a chore because I get to listen to a story.” - P4

When P11 was going to the gym frequently, she listened to podcasts when she was working out. She preferred to listen to podcasts that empowered her to push for the most out of her physical abilities and feel more confident. These involved stories where she felt the content within them could influence her physical performance. Thus, she used the podcasts as a form of personal motivator, somewhat akin to having a personal trainer encourage her to keep working, yet she could now do the activity on her own.

“When I used to go to the gym every day I would listen to podcasts or TV shows … I imagine myself that I tried to pick more success stories to give me energy rather than something mellow.”—P11

Relaxing and Reducing Stress in Alone Time

Podcasts provided a release for some participants from their stressful daily routines. P15 told us that his job was too stressful and that he usually used podcasts as a way to relax and release his thoughts from everyday complaints, which he needed to take care of at his work. He started to listen as soon as he arrived home from work. Again, this behavior was solitary.

“Most of the time my job is just too stressful. You are listening to people all the time, all the problems they have with the motors and everything else, yeah so I just want to have a relax time that is releasing.”—P15

As a masseuse and acupuncturist, P1 felt she was required to be energetic all the time and to have a positive feeling towards clients. For this reason, while she rested
between clients, she listened to meditative and spiritual podcasts such as Deepak Chopra’s podcasts. P1 even wanted to listen to them more, such as while working with clients, but her workplace regulations did not allow her to do so.

“For meditation I’m doing it several times a day! Sometimes I need it! I need to get relaxed and get energy. Because of my work I have to keep my energy always positive and boost up. I cannot drain my energy because I am working in the aura of people - people’s energy field - so I need to revive it every couple of hours.” – P1

Listening to podcasts also helped some participants ‘collect their thoughts’ and mentally get ready for falling asleep. For example, P3 liked hearing stories that she could then think about while falling asleep.

**Filling Time and Spontaneous Listening**

Some of our participants experienced situations where they had to come up with something to do because they had time on their hands. In these situations, they were alone and podcasts were spontaneously thought of as a way to help fill the void in time similar to how music has been shown to fill in time (Bull 2005). Thus, they tried to make the ‘best’ of their situation. For example, P5 told us about a time that he needed to be at a football field for his child’s practice. He felt he did not need to watch his child constantly, so he decided to listen to podcasts. This was possible since he was not actively engaging with other parents around him and it was easy to watch the practice while doing something else. Thus, even though he was present with other people at the practice, his watching of the football practice was somewhat solitary.

“Anytime there’s kind of nothing else happening. Which I think is actually kind of critical that there’s nothing else better going on that I can do. It’s like supplements an activity, it’s never an activity on its own for me.” – P5

P12 told us about a memorable time where she was stuck in a hotel room and did not have Internet or any other means to entertain herself. She suddenly remembered that she had several podcast episodes on her phone that she could listen to offline. Listening to the podcast episodes helped to fill her alone time.

“Once I was in a hotel in London and my phone didn’t have Internet… I had 3,4 hours until my sleep time, suddenly I remembered I have my podcasts and I can listen to them without the internet. I remember I enjoyed listening to them so much.”– P12
3.1.9. Timing, Locations, and Their Challenges

Participants felt that audio podcasts were easy to listen to because they could access them on their phone or computer while either online or offline. In other words, they could access them almost everywhere and at any time. As a result, participants said they listened to podcasts in different places such as at home, while riding public transit, and also while in their vehicles. Yet locations did not dictate what kind of podcasts people listened to. The selection of a podcast was far more related to the task that they were doing in addition to listening to the podcast.

“I guess when I am home I am listening to the science podcast most but when I am on the road I would listen to the literature. When I am on the road I want to be relax and not to think about anything else. That’s the only reason I can think of but it’s not something conscious.” –P3

Participants told us that some locations were more challenging to listen to podcasts in. Loud sounds, such as that found on public transit with railroads and noise at a gym, made podcast listening more difficult. P11 was so dedicated to her podcasts that she bought a new pair of noise cancelling headphones to listen to her podcasts on what she considered to be a noisy train.

Some participants felt that time dictated when they listened to podcasts. Here they mentally associated particular times of the day with connecting with the larger world and events unfolding in it. For example, when P6 was a child, she loved bedtime stories. She also remembered how her father listened to the news in the evenings in her early ages. As a consequence, she felt that she now finds podcasts about news comforting to listen to in the evening since subconsciously it reminds her of her childhood and her father.

“I do enjoy sometimes listening to the news in the evening. I find it comforting somehow maybe it’s because when I was a kid and my dad used to listen to the news at the evening.” –P6

P6 also talked about how she liked to listen to podcasts about elections in the morning because she felt she was most alert in the mornings. On the other hand, P10 liked to hear the news in the afternoon because she believed the news was full of tragic stories and she would rather listen to it in the afternoon so it would not ruin her day. P15
talked about his habit of listening to podcasts whenever he wanted to be relaxed, which was often at night after work.

“It’s the time when I can relax. Meanwhile I am playing or taking a shower or going to sleep I can listen to something fun and it helps me imagine.” –P15

In contrast, some participants did not feel that timing played a large role in determining when they listened to podcasts. Instead, listening was tied more strongly to their current activity, which might vary from day to day.

“My listening isn’t that regular. It’s just what I’m doing, rather than time of day. So if we’re driving somewhere in the morning, I’ll listen to it in the morning. If we’re driving somewhere at night, I’ll put it on at night.” –P18

3.1.10. Desirable Characteristics

Our analysis revealed several characteristics that attracted people to particular podcasts. While our participants’ routines showed that they were largely listening to podcasts on their own, in solitary, they selected podcasts to listen to that allowed them to feel connected to the podcast’s host and its content. Thus, while disconnected from others and exploring solitary time, they wanted to feel mentally connected with someone else.

**Being Part of a Virtual Conversation**

First, participants especially enjoyed podcasts that made them feel the social effect of ‘being part of a conversation.’ That is, they preferred podcasts where it felt as though the podcast hosts were having a friendly conversation with them, the listener. Some said it was like having a friend or group of friends that they could listen to. This created a sense of attachment and belonging.

“It’s kind of listening to a conversation which is relaxing, as more people it will feel more like a conversation that you are listening to.” –P4

In some cases listening to podcasts helped our participants avoid the feeling of being lonely, even though they were still listening on their own. For them it was similar to being part of a peer group without actually being in one.

“There’s a podcast I listen to that’s just people basically just talking about video games. I think I’m sort of struck sometimes by how their conversations that they have are
very similar to the conversations that just my friends have...Listening to their conversations I can kind of feel like I’m part of the sort of social group in a way.” -P6

The Influence of Hosts

We asked our participants whether the host of a podcast affected what podcasts they chose to listen to and follow. For most of our participants, the character of the host played an important role along with his or her voice. Participants said that being able to mentally and emotionally ‘connect’ with a host was critical. Sometimes this happened very quickly, but other times it took listening to a few episodes. These feelings extended, in many cases, to feeling like one was a friend of the host. At times, participants even missed a host if the person was gone for a period of time. For example, P6 missed the host of her podcast when he was on vacation for a couple of weeks. P14 felt a strong sense of connection with the hosts of a show who talked about everyday life matters.

“I also listen to ‘stuff mom never told you’ [name of the podcast]. Because it’s two ladies who host it and it’s just like having your friends talk to you and they are really funny and they talk about female issues.” -P4

For some of our participants the relationship moved beyond ‘just a voice you like to hear’ to a trusted relationship and a degree of intimacy with the host. For example, P6 told us that she considered the recommendations of podcast hosts more often than recommendations from her friends. This reflects the depth of the bond that many participants felt with the hosts of the podcasts they listened to.

“It’s kind of funny! Like I sort of trust the recommendation of the podcasts that I listen to but not my friends…Hearing news that I think it might disturb me from a voice that I trust is important…. I blocked my Facebook feed because I felt like I was way too anxious … getting news from CBC is better because it’s more like this is kind of trusted voice. In particularly hosts that are talking about issues that could disturb me a lot, I have a pretty strong sense of attachment to them I think because I associate with them like a secure person.” - P6

For most of our participants, listening to a podcast was not just about ‘listening to a podcast.’ Instead, it also involved trying to uncover and imagine if and how the host’s character was or was not based on his/her own voice and opinions. That is, participants wanted to understand the authenticity of the person they were listening to and whether it reflected the host in ‘real life.’ This desire to know was strongest for podcasts where our
participants felt they had created an intimate connection with the host and considered them as their friends. For example, P15 said that because he only heard the host’s voice, his imagination was open to think about who the host was and what kind of person this entailed. Like a book, his imagination could fill in the details beyond the voice.

“[The voice] it’s really important, because it makes everything, it makes the mentally image you have of them at the end so if they are happy it sounds, you can hear it in their voices the attitude they have toward the subject… so at the end it gives you whether you are going to listen to it more or not.” — P15

Sometimes it was not possible to establish a level of closeness with a podcast host. This depended on the host and the subject matter. For example, P2 only listened to journalistic pieces and he did not feel any kind of connection with the hosts of the program he listened to.

“I don’t think there is an emotional connection… well I guess when there is a personal story related to a specific person yeah… [Podcast name], it’s a very detached journalism … the host doesn’t matter.” — P2

Content and Expertise

The content of a podcast was also an important factor that determined how much participants liked it and whether they would continue listening. This related to the specific topic, but also the level of content that was shared in the podcast. Participants were looking for information that was unique and they wanted it to be shared by a host who could be considered an expert on the topic area. For example, P2 felt that if the information in a podcast could be reachable through an online search, then he was not interested in it.

“If I was interested in knowing how things work, it’s much faster to go to Wikipedia. Whereas a story about a country selling its drinking water, I don’t know where else I can get this information. Maybe a magazine like Economist or something like that.” — P2

P11 tried to listen to a podcast that explained the different functionalities of devices. Yet she stopped listening to it once she realized that the host did not have any depth knowledge about the subject. She said she was not looking for ‘an online search result’ to be talked about in an ‘hour long podcast’.
We asked participants whether they would revisit podcasts in similar way to how one might reread a good book or watch a favorite movie again. Music and spiritual podcasts were listened to many times by our participants. Participants also talked about re-listening to podcasts that contained ‘laid back’ conversations between hosts, which were filled with funny moments.

“The ‘Acquisition Corporates [name of the podcast] episodes I have listen to them more than just once because they are very funny.” – P15

Podcasts that had a lot of detailed information were listened to multiple times. This allowed the content to ‘sink in’ and was the case for two of our participants regarding a crime solving podcast series named Serial. This is similar to how one might listen to the same song multiple times while listening to music, yet the behavior was different in that people were trying to acquire specific details from the podcast so they could think more deeply about it. This also made podcasts different from radio talk shows that might be hard to replay since sometimes they were only heard at certain times and not recorded.

“Yeah so I guess with that [Serial Podcast] I played it over a little bit just because they are throwing lots of information…” – P2

3.1.11. Discussion

Our study of podcasts describes the ways in which people listen to podcasts and highlights some of the key characteristics of podcasts that have likely led to their relative success and their usage during people’s alone time. In the following sections we summarize our findings and draw out design implications for technology that might similarly be used by people as a part of ‘alone time’ where they are able to reconnect with themselves, fill time, or engage in multitasking without directly connecting with others. Overall, we found podcasts to be an interesting medium for supporting such activities. We explore what we feel are interesting and important design directions for considering and supporting ‘alone time,’ which are found in the way podcasts are designed and presented to users.

Flexibility

First, our work points to the value in supporting alone time through designs that are highly flexible in terms of how they can be used. This speaks to the need for designs to offer features that support the private review of content, access to content anytime and
anywhere, and the ability to review content while doing other activities. Podcasts present one way in which this might be done, but there are certainly others. Because podcasts are an asynchronous medium, our participants could playback pre-recorded podcast episodes at any time and any place. Ear buds or earphones made it easy to listen to content without others hearing it. The fact that podcasts came in an audio format meant that participants did not have to continually look at a screen. The ability to multitask while using podcasts was different than current asynchronous media sharing systems, such as social media applications (e.g., Facebook, Twitter), as social media tends to consume our attention and requires reading (Odour et al. 2016). This can be hard to do while fully engaging in other activities (Odour et al. 2016). Instead, podcasts allowed users to listen and reflect on their thoughts while keeping busy with other activities. This is similar to how one might listen to music while doing activities, however, a large difference was the level at which participants could connect (Bull 2005). Music selection has been shown to be based on a person mood’s (Bull 2005), while in our study, audio podcasts were chosen based on tasks and feeling the need to be connected with the content because it was part of a story or made participants feel like they were part of an ongoing conversation. This may be similar to how one might listen to a radio talk show, yet podcasts were available at any point in time and could be listened to as desired.

**Shifting Thoughts to Reflect and Relax**

Second, our results suggest value in designing systems that can take people away from their present activity, where they are engaged with content that is not a part of their own history or collection of information, or that of their social network. This can allow them to refocus their mental efforts, reflect, and relax. In many cases, our participants were able to use podcasts to shift their thinking from their own activities to other thoughts because they could engage with content that was about different things than the activities they might presently be doing. Moreover, the content was typically rich with information because it was story-based. The shift in mental focus helped create a sense of tranquility and comfort amongst our participants, which led to feelings of relaxation. Other people enjoyed listening to content about their current activity when doing it and it created a very experiential moment. In this way, there were two ways that podcasts could help people create a deep connection that either shifted or enhanced their thoughts.
Currently, most systems that have been designed to support solitude and disconnection are focused on task efficiency or connecting users with their environment rather than just the user and their thoughts (Fullerton 2010, Hiniker et al. 2016). Thus, users are meant to focus more on their own self and what they are doing. Thinking about social media, we tend to see similar things.

**Intimacy with a Narrator**

Third, our findings suggest that designs that are able to connect people with a single person might create a very personal connection to support people’s ability to disconnect. Here the details of the person can be both partially understood and imagined at the same time. We found that listening to podcasts was nearly always a solitary activity though it often involved feelings of a deep connection with the podcast host. The experience was somewhat akin to having someone whispering in your ear. Naturally, getting that ‘close’ to someone is quite intimate. We found that such a bond created trust between listeners and hosts, albeit the connection was one-sided (only the listeners felt it). Moreover, listeners were only able to get to know the host by the sound of their voice. This limited knowledge gave people the opportunity to ‘fill in the details’ and imagine the host and his or her character. For these reasons, people liked high quality narration and a host with a ‘good’ voice.

Comparing this attribute to existing technologies supporting solitude such as slow technologies (e.g., (Hallnäs and Redström 2001, Hawkins et al. 2014, Odom et al. 2014, Odour et al. 2016), we see a lack of host or narrator. Instead, content is presented to people either in a random way (e.g., (Hallnäs and Redström 2001, Hawkins et al. 2014) or the timing of content is pre-selected by friends or family (e.g., (Odom et al. 2014, Odour et al. 2016)). The idea that content is carefully crafted and narrated is generally non-existent. Thus, we feel podcasts present a different direction for technology.

**Being Part of a Conversation**

Fourth, our work suggests that there might be ways to more generally design systems to support people’s ability to be alone by focusing around the way content is presented. If the content is presented so that it unfolds like a conversation, where a person could imagine herself as part of this conversation, people may enjoy their alone time and not feel lonely when doing so. Podcasts tended to take the negativity associated with
loneliness away by ‘including’ listeners in a friendly conversation over topics they enjoyed without the pressure to be physically present in a real social group. Being part of a conversation as a passive listener allowed our participants to enjoy their alone time and bond with hosts over the subject matter of the podcast. People react to social media content like a conversation through comments, replies, and posts. Yet people must actively engage within the conversation for it to unfold (though some individuals can still passively watch). With podcasts, engagement is not necessary. People can just listen and still feel like they are part of the conversation. On the other hand, slow technologies are typically designed to create a type of conversation where conversation might come from people’s periods of reflection (Leshed et al. 2014). That is, people might talk about their past experiences when engaged with a slow technology or they might simply think about them. In this way, the conversation is somewhat different than what we see with podcasts. One could argue that slow technologies are not necessarily designed to present content such that the content itself unfolds like a conversation.

Overall, we can think about ways that our design lessons might apply more broadly to technology design beyond just podcasts.

One possible avenue, for example, is to rethink how family and friends might share information with each other over distance through technology. Family and friend communication often involves synchronous exchanges of information via phone calls or video chat where both parties are available at the same time, while asynchronous exchanges via social media support short back-and-forth conversations (Hawkins et al. 2015). In contrast, family communication technologies designed more akin to podcasts where people tell longer stories for their loved ones, such that they can be played back in a flexible way where the listener can feel like he or she is a part of a conversation across space and time, may find value in helping people connect with each other in a deeper, more meaningful way. Of course, this is speculative, yet it presents interesting and possibly fruitful future work.

**Generalizability**

Our study focuses heavily around the reactions and experiences of young to middle-aged North Americans who listen to podcasts on a regular basis. This is valuable in that these participants had a very nuanced understanding of when and how shared audio might be valuable and how it could be best listened to. Yet we do not include details on behaviors that might be found with those who are new to podcasts or less experienced in listening,
or who are located in other parts of the world. This might suggest alternative design directions. Such users should be included as part of future studies and could be compared to our results. Our work is also limited in that we draw out design lessons from podcasts to illustrate how other technologies might benefit from similar designs and experiences. While grounded in our study data, these suggestions are still speculative and meant to offer design inspiration rather than clear and concise design directions. Future work should explore our design lessons further as a part of design processes or empirical evaluations of technologies that might similarly focus around supporting people’s alone time.

3.1.12. Conclusion

In this work we focused on people’s behaviors and routines around podcast listening, which includes using the technology to support alone time and solitary moments. We interviewed 18 participants and uncovered the ways that users thought about podcasts as somewhat intimate connections with a host where they valued being able to listen and engage with content while doing other activities in their alone time. The manner in which podcasts were designed and used by our participants suggests value for the design of technologies to support alone time. Here we found value in designs that: are flexible to support engagement at nearly anytime, anywhere; allow people to shift their thinking to topics that are different from their current activity; allow people to intimately connect with a narrator or host; and, content to be created and presented in such a way that it can allow people to feel like they are part of an unfolding conversation or story, even while listening passively. Our future work involves using the findings of our study to guide the design of systems for alone time and connecting people asynchronously.

3.1.13. Acknowledgments

We thank NSERC of Canada for funding this research.
Chapter 4. The Design of Mimo

This chapter describes the early design explorations done by me which led to a prototype called Mimo. The web application allowed me to explore features that would be important to investigate for my final design of an asynchronous system for connecting family members in different time zone.

In this chapter, I will address my second research question which is: What are the important features of an audio-sharing system for mobile devices that can allow family members to share stories over distance and across time?

My objective for this question was to design a system called Mimo that allowed family members to connect through audio narratives similar to podcasts. The design process for Mimo and the result of the early evaluation study to reach this objective was published as:


4.1. Paper: Connecting Family Members Across Time Through Shared Media

4.1.1. Authors

Yasamin Heshmat, Carman Neustaedter, Lillian Yang, Thecla Schiphorst

4.1.2. Abstract

Family members often rely on technology to connect and maintain their relationships over distance. Yet because of conflicting schedules and time zone differences, it can be hard to communicate synchronously with others. To help address this problem we explored the design of an asynchronous media sharing application called Mimo. Mimo allows family members to capture and share moments with each
other using audio narratives as a way to connect time and activities together. We evaluated Mimo with participants who thought about and reflected on its design. Our results point to the value of connecting family members in a one-to-one, private fashion and how personalization is necessary in systems designed for asynchronous media sharing.

4.1.3. Author Keywords

Families; home; asynchronous communication

4.1.4. ACM Classification

H.5.m. Information interfaces and presentation (e.g. HCI) Multimedia Information Systems

4.1.5. Introduction

Many families have loved ones who live far away yet it can be hard to find an overlapping period of availability to communicate with them (Cao 2013). For these reasons, a variety of research projects have looked at the design of asynchronous communication systems for families (e.g., (O’Hara et al. 2005, Bernheim et al. 2008, Inkpen et al. 2012)). Most allow the exchange of information, yet there is not a strong tie to an activity itself (Hutchinson et al. 2003, Bernheim et al. 2008). Some exceptions have focused on the sharing of single activities across time, such as co-dining (Tsujita et al. 2010, Nawahdah and Inoue 2013, Venolia et al. 2015). In contrast, we wondered if there might be ways of connecting family members across periods of time, where they might be able to share any number of activities and feel like they are actually experiencing the activity together despite the exchange occurring asynchronously. We approached this design problem through two stages. First, we iteratively designed and built a prototype system called Mimo that allows family members to have an ongoing, asynchronous conversation through audio recordings that are similar to podcasts. We tried to make the shared moments special by having them tied to a particular activity that both the sender and the receiver could engage in.
Next, we directly explored the design of Mimo with 21 participants. Participants were shown a working demonstration of Mimo and had the chance to interact with the system. Afterwards, they were interviewed about their reactions to it. Our goals for this stage were to learn how and why people felt they would use Mimo, if at all. Results point to the value in connecting people in a personalized way through one-to-one asynchronous media sharing.

4.1.6. Related Work

Many families share a close and special bond where they place a lot of emphasis on staying connected (Neustaedter et al. 2006, Romero et al. 2006, Tee et al. 2009). However, this can be challenging when family members live apart and are separated by distance (Neustaedter and Fedorovskaya 2009, Tee et al. 2009). In these situations, family communication is less about achieving a preset goal, and much more about the sharing of everyday life such that family members can feel as though they know what is going on in the lives of their loved ones (Neustaedter and Fedorovskaya 2009).

Given the emotional connection that family members desire, they often have a strong preference for using systems that are similar to face-to-face communication, such as video chat (Neustaedter and Fedorovskaya 2009, Cao 2013). Family members are also often aware of the schedule of others, even in situations that involve time zone separation, and try to not interrupt others as much as possible (Cao 2013). They also try to not create increased feelings of obligation to communicate (Romero et al. 2006). Systems have also been designed for sharing activities synchronously outside of the home (Inkpen et al. 2013).

Of course, the challenge with the above systems is that people need to be around and available at the same time for them to be useful. For these reasons, researchers have also explored systems focused on connecting family members asynchronously across places and time. For example, we have seen a variety of message boards used within and between home(s) (Hutchinson et al. 2003, Elliot et al. 2007) and family members (Romero et al. 2006). Some systems also create suggestions for what to share as well as being able to have conversations about shared content (Bernheim et al. 2008), and a
means to connect people across time by targeting the arrival date of shared media (Hawkins et al. 2014).

Research on asynchronous video messaging shows the value of seeing user’s reactions to shared video (Venolia et al. 2015), the ability to have conversations over time via threaded video (Barksdale et al. 2012), the tying of video messages to real world locations to tell stories (Procyk and Neustaedter 2013, Procyk and Neustaedter 2014), and the targeted sharing of activities such as dining together (Tsujita et al. 2010). The Family Window offered both synchronous and asynchronous sharing between households where a time shifting feature let users re-watch video from the past (Judge et al. 2010). This is similar to how we imagined Mimo though the Family Window does not support mobile sharing, and nor does it try to tie activities together over distance.

Despite this research, we have seen few, if any, system design explorations of asynchronous media sharing systems for families with a focus on the timed-arrival of media where it is tied to activities. This was our focus with Mimo.

Figure 22: Mimo showing audio clips for a category. The top banner is for uploading new content either picture, audio or video.

Figure 21: Activity board showing categories of activities. Activities includes: biking, commute, fixing items, cooking, shopping, walking, movies, life in general
4.1.7. Mimo’s Design

In order to explore the design space of asynchronous media sharing amongst family members, we iteratively designed a web application called Mimo that could be run on mobile devices when out and about, or when moving throughout one’s home. We designed Mimo through brainstorming, sketching, iteration, and testing through our own personal usage.

The goal for Mimo was to try and support the richness of synchronous communication while supporting the flexibility that asynchronous systems can bring users in terms of when and how long they connect with each other. That is, we wanted to make asynchronous sharing feel as though it might be synchronous, where we connected users across time to share and listen to media containing personalized stories while doing an activity ‘together’. This characteristic could let family members be updated and aware of each other’s life at points in time that best matched their needs. Figure 21 shows the final design of the system. Mimo is imagined to be used between parents and their adult children, or between adult siblings who have a close relationship, where conversations are often a key part of the relationship (Neustaedter et al. 2006). The following scenario explains how Mimo works.

**Usage Scenario**

Ana is a 25-year-old woman who lives in Singapore. Her mother, Rose, lives in the United States. They have a 15 hour time zone difference with each other. Ana wants to be able to share a walk with her mother, but since they live far apart she decides to use Mimo to share this moment and a conversation around it. Ana goes for a walk and uses Mimo on her mobile phone to record a story about her workday and how her family is doing. She finishes her walk and the recording is stored in Mimo. She then chooses when her mom can access the story. Here she picks a time tomorrow, but sometime within the week. This means that Rose will have up to a week to listen to Ana’s story. The next day, Rose wakes up and looks at Mimo. She sees that she has a new notification for her ‘walking activity’, which means a story from her daughter is waiting to be heard. She can listen to it if she goes on a walk, the same activity that Ana was doing when she created the story. Rose decides to go for a walk so that she can hear Ana’s story. After she has listened to her daughter, Rose uses Mimo to record a response to Ana while still walking. This is shared back to Ana as part of their ongoing
conversation. The exchange continues across a series of days and weeks while both Rose and Ana go for walks.

**Time Shifting**

Users record audio, video or capture a photo using existing software on their device and then upload the media file within the Mimo interface. Here they select a time for the media to be made available to a remote

**Categories**

When users share media through Mimo they can assign it to one of eight different activity categories defined in the system (Figure 22). When users receive shared media, notifications appear grouped by the same categories. We chose this design idea because we wanted to try to tie shared stories with a particular activity. The hope was that the person receiving a story would listen to it while they participated in the same activity as the sender. At this design stage, we did not provide any form of ‘authentication’ to verify that users did indeed match their recording and listening activities. Instead, we left it as a suggestion in the design where users could decide themselves if they aligned their activities. We chose the eight categories based on the types of activities that family members commonly want to share but face challenges in doing so with synchronous tools like video communication systems (Brubaker et al. 2012).

**4.1.8. User Study**

Following our design work, we conducted a study to understand people’s reactions to our design ideas. We conducted semi-structured interviews with 21 participants (8 male, 13 female, age=23-55, average=31) from different work backgrounds (e.g., acupuncturist, pharmacist, students, software engineers, and web designers) in order to get a diverse sample. Interviews lasted between 20 and 60 minutes including a demo of the system and a chance to have hands-on experience with the prototype. Interview questions focused around people’s reactions to the system. For example, we asked them questions such as, “Do you think you will be able to share an activity through the categories with family members?”, “How do you feel about connecting with family members using voice recordings?”, and “If at all, when and why do you think you’d use a system like Mimo?” At the end, an open-ended question asked them about their ideal method of communication, which in two cases led to a sketch of a futuristic system.
Data Collection and Analysis

Interviews were audio recorded and notes were taken during the sessions. The interviews were transcribed afterwards. Artifacts such as sketches from participants were collected as well. Next, an open coding process was done where findings were labeled according to themes. Axial and selective coding was used to categorize the data and draw out the main themes. Participant quotes are reported with a P# to maintain anonymity.

4.1.9. User Study Results

Time Shifting

The ability to send media at particular times received positive feedback. 15 of our participants liked the idea of having the option to send their audio narratives, photo or video messages based on their family member’s availability. The idea seemed novel to them and they liked its contrast with the existing ways that they communicated. Three of our participants thought of using the time shifting feature for special occasions such as birthdays, anniversaries or reminding family of a shared experience.

“I would use it in special occasions such as birthdays, anniversaries or special events, common memories. It can help touch the common experiences you had with others.” -P2

P4 felt this feature could help him be more connected with his wife and parents who live far away with more than a 15 hour time zone difference.

“Yes I want to use it with my wife and my parents because we live in different time zones … I think it’s a good idea but I think the key is you want to send an async message to your partner, you can set the time like when to hear and how many days it can be kept in the board. I think these two make this different from the existing async sharing systems. For example, I share a video to you but it can set a time and it can set a time when it can appear, so basically I have the control of how my information looks like on your side right!” -P4

We asked participants how and who they would use Mimo with. 16 of our participants thought they could use Mimo with family members to bond around shared interests. For example, P1 thought he could use it with his sister to send her pictures of
beautiful scenery from when he was hiking since she likes photography. He said he wouldn’t do this with his parents though because the learning curve would be too much for parents who weren’t used to such systems.

P2 felt that the categories in Mimo could act as an encouragement for his family members to see him and be inspired and encouraged to do the same thing, especially for physical activities.

“Maybe you can encourage people with this for stuff that they don’t do! for example I go to gym now and my dad or brother doesn’t go, so I would show them I’m weight training and they always liked to do as well, so you’ll send this and tell them that I have started this new thing! Look at me! So maybe this will encourage them. You know humans like to see something similar to them.” –P2

Sharing Activities with Audio Narratives

15 participants thought using audio stories was a good idea since it could allow them to multitask while listening and hear a family member’s opinion on the topics they shared. Three of our participants felt that synchronous methods of communication could easily lead to communication that was one sided. Instead, they felt that the ability to send asynchronous audio narratives would help people to have a two-way conversation.

“I guess often the information exchanges are pretty one way often especially if it’s a big catch of phone call with my mom or my dad. So and I think oh with my dad I would really love it if he just give me his opinion on all the stuff that is in the news right now. My dad he loves reading Shakespeare and stuff so if my dad record a weekly podcasts about stuff I’m reading about that I like to talk to [my daughter] about I would definitely listen to that just probably the same way I’d listen to my election podcasts.” –P6

Five of our participants were opposed to using audio narratives because of two main reasons: 1) they felt listening to long audio files could lead to boredom, and 2) talking into a void was awkward for them.

“To be honest I never have the patience to listen to a podcast from the beginning to the end because podcast is you can only hear but you dont know whats going to happen in the next ten second, so you don’t have the preview or sense of what’s happening but if you have a text you will say, “ok this paragraph is interesting I might look on that” but podcast is very passive. I don’t prefer a narrative like a podcast for communication.” - P4
P5 was eager to use audio narratives with her girlfriends but not so much with family. She also believed the system would be more interesting for female users because she felt they would be more interested to share their feelings about an activity than men.

“Yes I think it’s interesting, for me, although I believe this does not work with family but for friends it would be interesting especially with girlfriends… since girls like these type of fun things, not that guys won’t like it but I think girls will like this more and the method that is designed it’s clear that has a feminine touch in the design.” -P5

Two participants drew sketches, one for how Mimo should allow sharing a narration and files to more than just one family member and the other which drew an always on video and audio system embedded in a wall connecting two houses similar to Family Window (Judge et al. 2010).

4.1.10. Discussion and Conclusion

We designed an asynchronous prototype system called Mimo and conducted an initial exploratory study to understand how people might use such a system and what its drawbacks would be. Participants saw Mimo as a way to connect with a particular individual, such as a parent, child, or sibling, and hear their views on a topic or reactions to stories they had shared. The value people saw in Mimo came with its one-to-one style of connection rather than one-to-many. This illustrates the value in designing asynchronous media sharing systems that are very personal in nature.

It is important to note that creating a single platform that works with every family dynamic would be hard. That is why the idea of giving some design choices to the user was very well received by our participants.

For family members, Mimo meant that one could hear the sound of a loved one’s voice. This illustrates that audio can act as a rich media for connecting family members. It naturally supports the ability to multi-task, but it also further instills the idea of a very personal connection through the voice of another. Yet sharing asynchronous audio was not seen without its challenges. Participants felt like recording audio clips might feel one sided. People were also concerned about ‘talking into a void’ without being able to sense the presence of their family member. Overall, our design and study results point to design opportunities for further exploring asynchronous media-sharing systems for family members.
Chapter 5.

Designing FamilyStories

In this chapter I will introduce and discuss the design process of FamilyStories, which uses a Research through Design process to learn about the design space while creating and iterating on design ideas. This chapter answers the Third Research Question in my dissertation which was: *How can we use the prototyping knowledge and our study on podcasts to create a tangible system suitable for connecting family members over distance and in different time zones through audio narratives?*

The Research Objective for this question was: *create a dedicated system that makes family members in different time zones feel more connected through the use of audio.*

![Figure 23: Final computational artifacts. From Left: Spark, TimeKnot, Kinetic.](image)

5.1. FamilyStories Technology Probes

As part of my research, I designed a system called FamilyStories that contains three technology probes. The technology probes were collectively named FamilyStories including Spark, Kinetic, TimeKnot. Spark included both ephemerality and ambient notification design features, Kinetic focused on sharing activities, and TimeKnot restricted the playback of stories to the same time window of the day for both family members. Each
of the probes and their functionality are discussed briefly in this chapter to provide context. Chapter 6 provides more details and user scenarios to fully describe each of the technology probes.

5.1.1. Spark

Spark is a technology probe designed to explore ephemerality and ambient notification (Figure 23, left device). Audio stories on this technology probe have a temporary lifetime so they have to be played back in a short amount of time. Messages are automatically deleted after one week, regardless of whether they are listened to or not. Another main feature of Spark was the usage of ambient notifications. The notification LED light blinked and resonated with a frequency similar to a heartbeat (60 bpm). After time passed by, if the message was not heard, the frequency kept going lower and the light kept getting dimmer until it turned off. The idea was to make it seem like the messages had a life of their own.

5.1.2. Kinetic

The Kinetic probe promotes a sense of shared moments while engaging in a similar physical activity (Figure 23, right device). Kinetic only plays stories back if a person has moved for four minutes. The device detects movement with an accelerometer inside the probe. Kinetic was designed so that it could be used for sharing similar physical activities which the user can do while listening to the audio stories. For example, if a person records a message while walking, Kinetic will only play the audio if the other family member is engaging in a physical activity for several minutes. The device detects movement with an accelerometer inside the probe.

5.1.3. TimeKnot

TimeKnot explores the effect of the context of the day on communication (Figure 23, middle device). This technology probe plays audio stories during the same time period of the day for family members. For example, messages sent during the morning can only be played back in the morning. I created four time slots including morning, noon, night, and late night to categorize the day into four main time windows.
A design like an older music player.

A shapeless system with the usage of soft materials like silicone.

Figure 24: Some of the early ideas of the artifact that could be used for FamilyStories
Designed so that part of the design is glass or transparent where the light can be seen from the outside.

The cube is simple while the surface has apertures for the light to be seen.

The cube can be opened and some part of it can be used as a stand for in home use of the object.

Each side of the cube would have a transparent window to see the interior of FamilyStories. The cube has two knobs for play/forward/rewind and volume.

This design can be easily carried within a pocket. The triangles in front are matt plastics for creating the illusion of large LCD lights for the notification of the system. The rest is wood.

This design is a combination of two main geometric shapes circle and rectangle. The buttons are placed on the edge of the cuboid for easier access while user is carrying the FamilyStories in their pocket.

There are similar knobs on each end. One for volume and the other for control of the audio. The body can be made of a matt transparent material so that each triangle can show the lifetime of the message.

Cylinders can be easy to use. The shape is easy to carry or use as part of home décor. This design is focused on functionality and also uses a partial cover on the body of the cylinder for ambient notifications.

The buttons are placed on the outer face for easier access for when it is carried in the pocket. The body of this design only has a few apertures for light on the cylinder.

Figure 25: Several sketches of the exterior look of the design.
Initial low-fidelity mock-up.

Initial Low-fidelity mock-up.

Testing using different colored sides instead of buttons for interaction.

Creating a 3D printed mold for shaping the silicone.

Curating the silicone skin in the mold.

Testing how the light is seen from silicone skin.

Initial 3D design for the cases and the idea to use color for distinguishing the three different artifacts.

One of first prototypes for the cases after the circuitry was designed and assembled.

Exploring the usage of silicone for button caps.

Figure 26: Different design and materials explored for the exterior design of FamilyStories.
The first 3D design of the second look for the lid. Created multi apertures to allow the voice to travel through the case and be recorded.

3D printing different switches and button caps to test.

One of the iterations of the case. Added height to create room for the battery, microphone and circuit holder.

Prototype case that allowed measuring inner features.

Testing the 3rd design for the lid. Making sure the LED is not blocked.

Exploring different colors for the lid and testing the buttons.

Testing red oak plywood for the lid and different wood stain swatches.

Testing if all the input/output cutouts are properly designed and the LED notification is visible.

Using Mahogany plywood with more grains for a darker stain and a more aesthetically pleasing look.

Figure 27: Final round of materials and prototypes created for the exterior design.
5.2. Design Approach

For designing FamilyStories, I used a Research through Design (RtD) approach. In this method, researchers use the knowledge gained in each state of the design to improve the future status of the design through an iterative process of understanding the problem at hand and learning more about it. Each step consists of reflecting on the design in hand that led to improvement of the design based on the insights gained in each step (Zimmerman & Forlizzi 2014). By using a research through design approach, researchers try to make a product as an outcome. This approach allows designers to address under-constrained problems with the capability and strength points they have (Zimmerman et al. 2007). The products made by this method are created in order to generate knowledge from the research and are not meant to be commercial products. The research contributions in this method are artifacts showing invention (Zimmerman et al. 2007). Based on Zimmerman et al. (2007), the research contribution needs to be a novel mixture of theory, technology, user need, and context.

The process of designing FamilyStories included several brainstorming sessions. Such sessions are usually used for exploring a range of different ideas for a system. Brainstorming is often used to create lots of ideas without thinking about the constraints and feasibility of the ideas, a primary step for stimulating creativity (Osborn 2012). Each session included some of the ideas being sketched and main design features being discussed. The ideas were presented several times to get insight and feedback from my supervisor and lab members. I used the SketchBook software to draw the 2D envisioned looks of the computational artifacts. Some of the ideas are shown in Figure 24 and Figure 25. For example, in Figure 24, the top left illustration shows a decorative jar at home which would light up in different colours when new messages from different categories would arrive and the light would be dimmed and turned off after a week. The second design shown in Row 1, Column 2 of Figure 24 was based on using smart lights to simulate the time of the day where the message was recorded. This was done through the colors of the LEDs. After considering several looks and shapes, I focused on cubic geometry due to its simplicity and ease in creating several devices for study purposes. I started to create several ideas of what the artifacts should look like (last row of Figure 24 and Figure 25). The majority of the first ideas were complicated and I narrowed down the focus to the main features and the most important factors of the design. The final design concept led to several low fidelity designs and later resulted in a high-fidelity prototype. High fidelity
prototypes are those that are near finished, can be used to run usability studies and interactions are realistic with the system (Walker et al. 2002).

The final look emerged after having the circuitry completed and knowing more about how much space the artifact would take. I used TinkerCad and Blender software to create the 3D printed mock-ups of the system and iterate the process until the desired final look was achieved. Some of the 3D illustrations are shown in Figure 26. Through the final process of designing the exterior of the artifacts, I explored with different materials including silicone, multi-colored 3D printed materials and wood shown in Figure 26 & 27.
Figure 28: Upper row: Process of recording a story, and feedback through the LED notification light. Lower row: Process of recording a story and deleting the recorded story.

Figure 29: All the buttons functionality in Play mode and the feedback from LED notification light

I wanted our participants to be creative with how they would use the design and feel as if the system is more than another communication application. That is, I wanted them to think of it more as a specific connection method created for them and their specific
family members. As a result, I did not include any LCDs or sounds for when the interactions were made with the artifacts. The only method used for feedback with the user was through the use of a multi-colored LED which was in the front of the device on the right side (can be seen in Figure 24). For example, when users record an audio story, the notification LED light turns red indicating their voice was being recorded. Whenever the recording ended, the notification LED light turned to dark blue, and when it was sent successfully, it flashed green and then turned off. When they wanted to cancel an audio story that was recorded, after stopping the recording, they could push on the specific cancel button and the LED light would turn off (Shown in Figure 28). The LED light turned into several colors in each record and play mode. The colors used for each functionality for play mode can be seen in Figure 29. While working on the design, I created quality assurance test cases focusing on each of the functionalities. The quality assurance process helped with making sure everything was working and helped the design to advance in features such as providing feedback to users while interacting with the design. Each artifact had nearly 55 test cases and my final field deployment study (described in the next chapter) started after each artifact passed the quality assurance test cases.
Figure 30: Front and back of the PCB. Board without the JST battery connected
Figure 31: Upper: Circuit with battery connected. Lower: Notification LED on, Circuit connected by USB cable, headphone connected.
Figure 32: Top: Final case designed, Middle: Circuit bed that holds the PCB in place. Bottom: How the circuit sits inside the case, adjustments were made to make sure the circuit was well fitted.
Figure 33: Up: front view with Aux in, on/off switch and USB charger. Middle: side view and the record/play mode switch. Down: back of the case with access to setup and restart button on Particles Photon microcontroller
Figure 34: Top: Spark, Middle: Kinetic, Bottom: TimeKnot
5.3. Circuit & Backend Design

For creating the hardware and how it should function, I tested several ideas such as having devices that can do the record and playback functionalities on the artifact but with the need to synchronize with a phone or laptop for sending and receiving new stories. However, as a team, we decided to detach the artifacts from the usage of a phone so that it could be a standalone device. The goal was to make it so people wouldn’t be distracted by their phone. After a discussion with the mechatronics undergraduate student who created the hardware for the study, we decided to use printed circuit boards (PCB) which are shown in Figure 30 and Figure 31. Having similar hardware and circuitry to work with created a smooth transition for building the artifacts. Figure 30 shows both sides of the PCB and the microprocessors and chips that were used. Figure 31 demonstrates the inputs and output of the board and also the LED used for notifications. The process is shown in Figure 32 and 33 which included creating a case and a circuit bed so that everything could be kept in place, and designing switches and button caps that would be easy to interact with. For the main microprocessor, we used Particles Photon/P Series. The photon microprocessor had an easy initial setup for an Internet connection which would hopefully be easy to follow for our study participants. I also included lithium 3.7V batteries in each artifact in order to make them portable. I decided to use headphones and not to include a speaker on the design since the experience was for individuals and not for others around their home to hear. We used the FTP protocol to send and receive the audio stories. The PCB included an On/Off switch, and a mode switch on the side which allowed participants to change between play and record mode or have the devices connect to server for updates and to check for new messages. Each artifact had a 16GB microSD card for storing audio stories (Figure 31). The artifacts could be charged with a micro USB cable (Figure 31).

5.4. Lessons Learned

As much as I tried to think, rethink and revisit every design decision made for the FamilyStories devices, looking back at the design process, completing the process and running the study, I’ve learned a few lessons which I believe would be useful to share in the following.
Lesson 1: Make early prototypes with the least time-consuming methods.

For the first few iterations of cases created, I started 3D designing and printing different prototypes. However, the 3D printing of each case with details such as button caps and switches etc. would take one business day. This sometimes included just small tweaks such as a few more millimeters here and there in the design and I needed to wait another day for the next version. If I wanted to design FamilyStories’ exterior design again, I would try to use a faster way to create several cases, such as by using laser cutting cardboard or medium-density fibreboard (MDF). This could save time as one tries to find the perfect shape and measurement.

Lesson 2: If the design includes batteries for international studies, make sure to create the artifacts in a way that the battery is easily accessible and detachable.

Based on current Canadian shipment laws, lithium batteries cannot be shipped internationally. As a workaround for the international devices that needed to be sent through courier services as part of the study described in the next chapter, we used JST pin connected batteries that were detachable. The artifacts could then be sent without the batteries and batteries could be purchased and connected to each device by the end users.

Lesson 3: When studies are done in distant locations, participants should have access to the inner circuitry.

During the process of creating the case and the design itself, I decided to leave a very small room for future study participants to open the artifact and have access to the actual board. However, while conducting the field study (described in the next chapter), incidents of needing to access the inner circuitry by participants surfaced. For example, a corrupted file was downloaded, and the microSD card needed reformatting. It was challenging to walk the participant through the process of opening the artifact and access the micro SD card. As a result, I highly recommend that researchers who are running studies in distant locations with a physical object design artifact in a way that allows participants to access the inside of the system with only a few easy steps.
5.5. Summary

In this chapter, I introduced the process of designing and creation of FamilyStories system. I addressed the design goals and main characteristics of the system. Next, I described the iterative process of designing the devices and the decision on creating three different technology probes for the study. I showed the steps taken from early idea exploration to low fidelity prototypes leading to high-fidelity prototypes through pictures taken in the process. The final high-fidelity prototypes were used in a field study described in the next chapter. The main features of each device, user scenarios, and the evaluation of FamilyStories is described in detail in the next chapter.
Chapter 6.

Evaluation and Field Study of FamilyStories

To evaluate how a slow technology inspired asynchronous audio system would actually be used in real world scenarios, I ran a five-week field study with the three different technology probes with two sets of paired family members.

This chapter is focused on my fourth research question which was: How will family members use an audio-based computational artifact such as FamilyStories to connect over distance in different time zones? What are the benefits and challenges of using such a system?

The objective for this question was: Evaluate the system designed for connecting family members in different time zones and understand how family members use the technology to connect, communicate, and share audio stories over distance.

The paper included in this chapter is my exploration toward the fourth Research Objective and is published as:


6.1.2. Authors

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6.1.3. Abstract

Family members who are separated across time zones can easily miss out on feeling connected. We designed and studied the usage of an asynchronous storytelling system, called FamilyStories, to explore the use of audio-based sharing. FamilyStories allows family members to share activities and experiences over distance in different time zones using three different devices that contain different contextual features. To evaluate the design, we conducted a five-week long field study with two family member pairs. Our results show the value of slow, flexible, and non-suggestive interfaces for asynchronous audio communication. We also found ephemerality helped in the sharing of ‘instant’ feelings, while large time zone differences could be ‘synchronized’ with time delayed messages. We raise these as design opportunities for asynchronous audio storytelling systems.

6.1.4. Keywords

Family Communication; Domestic; Audio; Asynchronous Communication; Slow Technology

6.1.5. ACM Classification Keywords

• Human-centered computing ~Human computer interaction (HCI) ~HCI design and evaluation methods ~Field studies
6.1.6. Introduction

Family members often use technology for connecting over distance, especially when time zone differences are present (Tee et al. 2009, Cao 2013, Odom 2015). Typically, this consists of using a range of synchronous communication tools, such as video chat and phone calls, as well as asynchronous systems like instant messaging (Tee et al. 2009, Cao et al. 2010, Cao 2013). Despite these technologies, communication can still be challenging. When using synchronous systems, it can be hard to find times when both people are free and available. For example, schedules may be misaligned across time zones (e.g., daytime vs. nighttime) (Cao et al. 2010, Kirk et al. 2010, Cao 2013). Asynchronous communication systems are typically flexible to use and overcome some of these challenges, yet the shared content and exchanges may not be as rich as synchronous exchanges where people can have conversations, share stories, and react to them (Kirk et al. 2010, Cao 2013).

For these reasons, we explored ways to enliven asynchronous communication through audio storytelling. Audio narratives have been shown to allow people to capture the sentimental value of a moment and stimulate people’s imaginations to mentally rebuild past moments (Oleksik and Brown 2008). This is because audio contains characteristics of people’s voices such as pitch, intonation, range and loudness, which connects people to a moment socially and personally (Pittam 1994). Audio also helps people characterize others based on their voice (Pittam 1994).

We designed three technology probes called Spark, Kinetic, and TimeKnot. Together we call them FamilyStories. Each probe allows a person to record an audio story and send it to another family member that has the same device. When received, the family member can listen to the story and send one back. As an exploratory tool, the technology probes differ in how people can listen to the recordings. We were interested in exploring how context and varying degrees of access to the stories would impact the experiences of family members. Spark, one of the probes, makes stories have a temporary lifetime so they have to be played back in a short amount of time. Kinetic tries to enforce an idea of ‘shared activities’ where stories can only be listened to if the recipient is doing a physical activity that is similar to the sender’s activity. For example, if the sender is going for a walk while recording a story, the recipient must also be walking while listening. TimeKnot restricts the playback of stories to the same general time of the day for both family
members. For example, if a story is recorded in the morning, it can only be played back in the morning. We used the technology probes to help us identify what factors are important for designing systems to connect family members across time and distance with shared audio stories.

We conducted a field study with two pairs of family members over five weeks to evaluate the technology probes and understand the design context better. Each member lived in different time zones. Our study contributes insights into how asynchronous technologies can be designed for families to communicate more richly through audio storytelling. This includes the benefit of scattered and delayed responses; how ephemerality can help users express a range of emotions; the specialness of dedicated in-home devices; how time delayed messages can help synchronize people across large time zone differences; and the potential for movement triggered messages to trigger focused and thoughtful engagement.

6.1.7. Related Work

Family Communication over Distance

The family communication literature is rich with explorations of technology design and usage. Family members face many challenges when trying to stay connected, especially when separated by distance. Some challenges are efforts for communication, creating a balance between desirable amounts of communication, and feelings of obligation to respond to family members (Romero et al. 2007). People also have varying needs for how much they want to connect with different members depending on where they live and what their relationship is like (Neustaedter et al. 2006).

Family members tend to prefer synchronous communication technologies, such as video chat, due to its real-time nature (Neustaedter et al. 2006, Tee et al. 2009, Kirk et al. 2010). For example, because it can be hard to maintain children’s attention over phone calls, video chat is desirable for communication between grandparents and grandchildren (Forghani et al. 2018). Current video communication technologies (e.g., Skype, FaceTime) are typically designed for face-to-face communication and have been shown to be challenging to use for sharing activities in the home or outdoors (Brubaker et al. 2012, Forghani et al. 2014, Massimi and Neustaedter 2014). Sometimes people are also concerned about their privacy, the way they look on camera (Brubaker et al. 2012), or
challenges with multitasking while communicating with a family member (Brubaker et al. 2012). This is because people often feel obligated to stay in the camera view during a video call (Harper et al. 2017).

Asynchronous communication systems are designed to bring flexibility to communication by allowing people to communicate with each other at different points in time. Asynchronous video communication has been studied in home contexts (Barksdale et al. 2012, Venolia et al. 2015), including connecting children to friends or remote family members (Du et al. 2011, Venolia et al. 2015). We know that asynchronous video can support self-expression and playful communication (Du et al. 2011). Asynchronous video applications have also been studied for mobile phones. Results showed such systems are able to support communication that is similar in nature to synchronous systems with the added benefit of flexibility around when video messages could be sent (Venolia et al. 2015). Asynchronous systems have even been studied for connecting family homes with shared video snapshots, recorded video, and images (Hutchinson et al. 2003, Bernheim et al. 2008, Judge et al. 2010). They were also used for sharing specific activities such as shared dining across different time zones (Tsujita et al. 2010, Nawahdah and Inoue 2013), which made participants feel more connected with their loved ones while dining. Researchers found value in this type of sharing but sometimes privacy challenges emerged (Judge et al. 2010). That is one of the reasons why we chose to focus on asynchronous audio sharing. Audio allows engagement during mundane activities (Heshmat et al. 2017b, Heshmat et al. 2018). Audio also can be used almost anywhere and anytime with relatively few privacy issues.

Audio as a Medium

Research has shown that sharing audio between two people over distance can play an important role in making them feel connected (Oleksik and Brown 2008, Procyk et al. 2014). Audio has been shown to feel less ‘staged’ and more spontaneous, it also can create sentimental feelings when they are heard back (Oleksik and Brown 2008). Several studies have explored the effect of soundscapes in the domestic realm (Oleksik and Brown 2008, Oleksik et al. 2008, Lottridge et al. 2009, Petrelli et al. 2010, Jones et al. 2017). These studies have shown that families value hearing specific sounds in their home such as ambient sounds, voices, spoken words and everyday domestic sounds, which represent life as people experience it (Oleksik and Brown 2008, Lottridge et al. 2009).
Lottridge et al. (2009) studied sharing music playlists and background sounds of mundane activities. They studied couples in long distance relationships separated across time zones. The study highlighted the importance of soundscapes for connecting couples through ambient sounds and shared music. Other studies have investigated audio clips recorded within homes. This included the archiving of soundscapes within the home or recording people’s voices (Oleksik and Brown 2008, Oleksik et al. 2008, Petrelli et al. 2010). For example, Oleksik & Brown highlighted the importance of timing in home recordings, and the power of audio in creating strong visual and emotional reactions across time and space. One of the works focused on using audio clips for asynchronous communication between children and parents through a plush toy (Jones et al. 2017). The study found that audio clips can help parents know more about the personality of their children. As part of our design work, we also explore the emotional value of audio for sharing experiences over distance. The difference, compared to these works, is an emphasis on storytelling, shared contexts (e.g., similar activities, time of day), and aspects of slow technology.

**Dedicated Devices and Connections for Family Members**

Computing artifacts have been designed for connecting family members during one-to-one communication where a single device is designed for a user to connect with just one other person (Chang et al. 2001, Mueller et al. 2005, Chen et al. 2006, Chung et al. 2006, Werner et al. 2008, Gooch and Watts 2012, Singhal et al. 2017). This includes a strong emphasis in the literature on connecting long distance couples. For example, Gooch and Watts created three prototypes to simulate holding hands over distance (Gooch and Watts 2012). Singhal et al. created a prototype that allowed couples to connect through touch over distance using vibrating gloves (Singhal et al. 2017). Studies have shown that people value the intimacy and emotional connection of dedicated devices and simulated touch (Gooch and Watts 2012, Singhal et al. 2017). Computational artifacts have been used for connecting children with their parents and grandparents by focusing on one-to-one connections (Rowan and Mynatt 2005, Romero et al. 2007, Ballagas and Raffle 2013, Yarosh et al. 2013). Systems such as PlayPals (Bonanni et al. 2006) allowed children to have synchronous video communication with their friends with systems embedded in figurines. FamilyStories uses a similar idea of a device that supports a dedicated, one-to-one connection between two people, yet differs from this work by using audio as the medium for communication.
6.1.8. Slow Technology and Reflective Designs

Slow technologies aim to create a more meaningful connection between people and computational artifacts (Hallnäs and Redström 2001, Odom et al. 2014, Pschetz and Bastian 2018, Odom et al. 2019). They are designed in a way that allows users to engage in acts of reflection while using a design (Hallnäs and Redström 2001). Slow technologies can allow family members to have time to reflect, revisit and create anticipation before and during interactions with a system (Odom et al. 2014, Odom et al. 2019). There have been a variety of slow technologies designed over the past two decades for purposes such as sending messages to family members in the future (Hawkins et al. 2014), sending photos and short videos as presents in time (Hyesook et al. 2013), reminding people to relax and reflect during a day (Cheng et al. 2011), and connecting users with their photo archives through the use of a tangible stand-alone device (Odom et al. 2014). Odom (2015) explored how the FutureMe system was used by people to connect with themselves, or their friends and family members, through emails that have been sent to a specific time in the future. King et al. (King and Forlizzi 2007) suggested the use of slow audio messaging for couples in long distance relationships, however, no systems were designed or studied.

Building on the related work, we aimed to explore and learn more about asynchronous audio storytelling systems inspired by slow technology with the goal that the system might be able to support conversations that lead to reflection and a sense of anticipation for communication. We began with the design of a series of technology probes described next.
6.1.9. FamilyStories

FamilyStories consists of three technology probes named Spark, Kinetic and TimeKnot. Each probe is designed to allow family members to connect over distance by sharing audio stories asynchronously. Technology probes are open ended designs that allow researchers to explore how people use and interact with a new type of technology in real world settings (Hutchinson et al. 2003). We created FamilyStories through an iterative design process that involved sketching, brainstorming, and creation of several low fidelity prototypes. We were inspired by the appearance of vintage personal radios. We created several mockups of physical artifacts that could be used as a communication device, ranging from prism shapes to cylinders. We ended on a simple, yet minimal look of a cuboid shown in Figure 35.

All three technology probes have the same basic design that consists of a small object that can be carried with a user or set down, e.g., placed in the home. In Figure 35, you can see the exterior of the three probes. The style is minimalistic and purposely does not suggest a type of communication. The exterior design of all three probes is the same, but they differ in the color of the wooden lid on top such that they can be identified easily. We tested several materials prior to choosing the combination shown. Our initial designs were created using cardboard, then simple 3D printed prototypes, and, at the end, we chose to use a 3D printed case with a wooden lid (Figure 35). We chose wood as it has been shown to be durable and valued (Hutchinson et al. 2003). We wanted to keep the box light to carry, hence we made the switches, circuit bed and the body of the box through 3D printing. We kept the colors neutral so that they could blend into most homes.

Participants can choose to record or play by using a switch on its side (Figure 35, middle). In the first mode they can record, send or cancel the recording (Figure 36). To
record a message, the user pushes the ‘record’ button on each device (Figure 36) and then tells their story. When the story is done, they push the ‘record’ button again to stop. Next, they push a ‘send’ button to send the message. Sound is recorded through a built-in microphone inside each of the probes. The recorded sound could not be played back for the sender. This was to keep the communication similar to a conversation in-person or on the phone. To listen to the stories, users put the device into play mode with the switch on the side. The buttons now allow users to move to the next Story, play/pause, adjust the volume up, move to the previous story and adjust the volume down (Figure 36). In Record mode, when ‘record’ is pushed, a notification LED turns red to signal to the user that audio is being recorded (Figure 36, left). In Play mode, when the ‘play’ button is pushed, the LED will turn green to signal playback of the story (Figure 36, right). Each device connects to the server to download new messages every 15 minutes or by user request.

To listen to an audio story, family members use their matching probe. For example, if a family member sent a message on TimeKnot, the receiving person must play it on TimeKnot. There is no limit on the length of a story. We wanted to let users choose what made sense given their situation. Stories can be from several minutes to as long as the family members would like to talk about a subject. Our goal was for family members to listen to the audio stories individually with headphones so as to create a more intimate experience with the remote family member. Next we describe each of the FamilyStories probes.

**Spark: Ephemerality and Ambient Notification**

The first probe is called Spark. Given a prominent focus on ephemerality in social media (Xu et al. 2016), we were inspired to explore the influence of ephemerality on family communication. This device is just like a ‘spark’, a conversation starter with a short lifetime: stories are automatically deleted after one week, regardless of whether they are listened to. We decided to use a metallic blue color for Spark so that it can catch the attention of family members and encourage them to listen to its media before messages are deleted. We used ambient notifications (Zachary and Stasko 2006) to increase the sense of ephemerality of the messages. For Spark, a white light pulsates when new stories are available, similar to the frequency of a heartbeat, indicating each message has a life of its own. When the message is near to being deleted, the intensity of the light is
lower, and the pulsating has a lower frequency until it stops beating and the message is deleted.

With Spark, users have minimal control while stories are being played. This contrasts with many existing technologies where the content is almost always accessible. Family members are only able to stop, pause, and play stories, and messages are played from oldest to newest without being able to change this order. This limited control was meant to engage people ‘in the moment.’ We also wanted the conversation to feel similar to in-person conversations.

As an example, consider Luna, a 56-year-old mom and her 22-year old son Daniel. Daniel moved to Italy for work and his mom lives in the USA. They have a nine-hour time difference. Luna wants to send her son an update of her week while she is relaxing at night. She records an audio clip on Spark and sends it to Daniel’s device. Daniel comes home (at his house in Italy) and notices that Spark is indicating a new message. He decides to listen to his mom’s message tomorrow morning since it’s his day off and he knows he has a week to listen before its deleted. This will allow him to both listen and reflect on their connection and the subject which his mom talked about. In the morning, he picks up Spark and presses the play button. He uses headphones to listen to the message. FamilyStories reminds him of the closeness that he and his mom share and makes him feel comfortable since he chose to listen to the message during his free time. While he is listening to the message, he engages in different activities at home. He presses record on Spark and records what he wants to tell his mom in return.

**Kinetic: Activity-based Sharing**

The second probe is called Kinetic. It was created to promote a sense of shared moments while engaging in a physical activity. For example, to simulate a shared walk, if a person records a message while walking, this probe will only play the audio if the other family member is engaging in a physical activity like walking. The device detects movement with an accelerometer inside the probe and does not categorize based on type of activity. While somewhat overly simplistic for mapping two activities, this does enforce the idea that if a person is moving while recording a story, movement is similarly needed while listening on the receiving end. Kinetic was designed so that it could be used for sharing walks, hikes, and activities which the user can do while listening to the audio stories.
As an example, consider Elena as an individual who likes to share a walk with her mother, Rose, while being apart. *Elena decides to use Kinetic to share a moment and conversation around it with her mom who is living in a different time zone. Elena goes for a walk and uses Kinetic to record a story about her workday and how her family is doing. She finishes her walk and the recording is sent to her mom’s device. Her mom looks at Kinetic and notices the new message LED is on. She puts on her headphones and takes Kinetic with her outside for a walk so she can listen as well. After listening to the message, her mom records a reply for Elena and sends it to her. The exchange continues across a series of days and weeks while both Rose and Elena go for walks.*

**TimeKnot: Context of the Day**

To explore the effect of the context of the day on communication, we created TimeKnot which only plays messages during the same time period of the day for family members. That is, messages sent during the morning can only be played back in the morning, etc. We created four time slots, morning (6 to 11:59am), noon (12 to 5:59pm), night (6 to 11:59pm) and late night (12 to 5:59am).

As an example, consider George and his sister living in different time zones. *George sends his sister a message about his new goals and visions about life. He has recorded the message at night. His sister will only be able to play this message during her night time. The message is not playable at other times of the day. The notification only turns on during that specific time period.*

**6.1.10. Study Design and Methods**

We designed and conducted a field study with FamilyStories to understand the potential benefits and challenges of sharing audio stories over distance. We wanted to understand how the three probes would be used and how the design factors including ephemerality, sharing tied to physical activity, and the context of the day would impact the experience.

**Participants**

We recruited participants who had family members in different time zones to participate in a five-week field study of the system. Two pairs of family members were
recruited for this study through word of the mouth. Each pair had a family member who lived in Vancouver, Canada and the other family member lived in a different time zone. We asked basic background information from our candidate participants to make sure they met the requirements of the study. For example, we checked to see if they had a ‘good’ relationship with the family member (e.g., desire to stay in contact, active communication) and comfort with using new technology. We only focused on recruiting pairs of immediate family members such as parents and their adult children, couples, and siblings for this study to scope the targeted audience. We felt these types of relationships would be most likely to find FamilyStories as being valuable. We recruited two different types of close relationships, romantic and familial, to see how people in each type of relationship would use the probes.

**Pair 1: Benjamin and Joyce - Couple**

Benjamin and Joyce were in their late 20s. At the time of the study, Benjamin was a PhD student who had been relocated to the UK for a three-month internship. The study started in the middle of his internship. He lived in a shared home with another person and so did Joyce. Joyce was a software engineer who was working in Canada. The time difference they were experiencing was eight hours. They had been in a relationship for more than a year. When they were living near each other they loved to do many things together, including cooking, walking, watching TV, and just spending time together. Now that they were in a long-distance relationship, they used video chat every day at a fixed time when Joyce came back from work and Benjamin had just woken up. They loved video chat because they could see each other’s face and express their emotions easily. Joyce

**Figure 37. Left: Benjamin’ spot for keeping the devices. Right: Joyce kept the devices either in her living room or her bedroom.**
liked voice memos too and preferred to leave voice memos in messaging applications rather than typing text.

Figure 38: Left: Ayla placed the devices on her desk. Right: Shea kept FamilyStories on her night stand in her room.

Pair 2: Shea and Ayla - Sisters

Shea and Ayla were two sisters in their early 30s who lived in Canada. Shea lived in Vancouver with her husband and their cockatiel pet and Ayla lived in Ottawa with her fiancé and her puppy. They were separated by a three-hour time zone difference. Shea was a business development manager for a pharmaceutical company and Ayla was a cancer researcher. They had a close relationship and managed to stay in touch where they lived in different cities and time zones throughout a ten-year span. They had experienced living in different continents with a 12-hour time zone difference. They usually kept in touch daily. They mostly enjoyed talking over the phone or leaving voice memos on text messaging applications, and usually had one video chat call on the weekends. When they used to live near each other, they would do many things together such as shopping, taking a walk and meeting in different restaurants and coffee shops. Now that they were away, their conversations focused on updates about health, major events, opinions about different purchases, and family related topics.

Method

After recruiting the participants, one of the researchers performed a home visit and met the local person. Then, the FamilyStories devices were setup to connect to the participants’ Internet connection and participants were shown how each device worked. The researcher had a video call with the remote participant and walked them through how
to setup and use the devices. During the first two weeks of the study, participants were suggested to send at least four messages with each of the probes, two each week. This was so that they would be sure to try out each technology to see how it might benefit them, or where they felt it created challenges. During the second week, participants were asked to choose a device and send a 'life event'. After the first two weeks, participants were told they could use the probes as frequently as they liked, without restrictions.

Participants were asked to complete an online diary either in the form of an online document or voice memos soon after using a probe. They could document their thoughts on their interaction and communication. Their usage data, such as the number of their messages and their length, was logged by the system. A group message thread was created through text messaging applications by one of the researchers as a medium to be connected with both partners. The group chat was used for sharing general information about the study or issues participants might be experiencing.

During the study, we conducted four semi-structured interviews. The first interview was at the start of the study before they used the probes and was meant to be an introduction for us to learn more about our participants' experiences with communication and connectedness over different time zones. Questions focused on collecting background information and for understanding the process of how participants currently use technologies for connecting over distance. Questions such as "What are the technologies you prefer to use to connect with your family member? Why", “How much time do you think you spend communicating with each other each week?” The first interview lasted on average 1.5 to 2.5 hours. Interviews were conducted over video chat with family members at the end of Week 2, and end of Week 3 or start of Week 4 depending on the availability of the participants. Interviews explored how participants used each of the probes and how the probes influenced their connection with their study partner. Questions such as “Tell me about your recent communication with FamilyStories”, “Can you walk me through your experience with <Name of the specific probe>?” were asked in these interviews. The field study was concluded with a summative interview. A group video chat with both study partners was done as a closing interview. These interviews lasted from 20 to 60 minutes.
6.1.11. Data collection and analysis

All the interviews were recorded and transcribed. The data log was collected. We used open, axial and selective coding to explore how the system was used as part of participants' regular routines. This included exploring the influence of each of the major design factors found in the technology probes. We also investigated whether audio storytelling could help with creating more meaningful and reflective communication compared to current communication technologies. The data was analyzed by one researcher and then codes were discussed as a group and refined. Lastly, we used a combination of selective coding and affinity diagramming to analyze the data and extract main themes such as general usage, non-urgent and expressive from the heart, ephemerality and importance of the longevity, dedicated devices, and triggered accessibility.

6.1.12. Locations and General Usage

Each of our participants chose a spot for all three of the FamilyStories devices. Figure 37 shows the locations for Pair 1. Benjamin put the devices in a special location for him that reminded him of Joyce, next to all her gifts and postcards. Benjamin usually carried two of the devices with him when going out. He left Spark at home since the messages on that device were more personal to him. Joyce setup her devices on a nightstand in her room (Figure 37, right) so she could listen to the messages privately. Joyce changed the location from the living room, to next to the kitchen, and then managed to set them up in her room.

Figure 38 shows the locations for Pair 2. Ayla setup FamilyStories on her desk in her room. Shea put the devices in her room next to the nightstand because she loved messaging her sister before going to bed.

All four participants would carry some of the devices around the house while multitasking and listening to the stories. The timing was usually when they wanted to relax.

“You might find this funny, sometimes I take a lot of it in a box and take it to the living room and have my cup of coffee. Listen to it all.” – Pair 2, Shea

Although the devices were portable and easy to carry, three of our participants rarely took the devices outside of the home. This was because they were either busy at work or they faced connection issues with the Internet.
6.1.13. Scattered Patterns of Usage

All of our participants listened to the messages on the FamilyStories devices whenever they saw them. None of them experienced the deletion of a message on Spark without being able to listen to the messages within a week. We had envisioned FamilyStories to be an always-on device at home; however, the sisters from Pair 2 would only turn on FamilyStories when they had some time to listen, usually before or after work, and before going to bed.

We had anticipated that FamilyStories would lead to a lot of back-and-forth conversations but at a slower pace. Yet this was not what we generally saw. Back-and-forth messaging did occur, however, it tended to be much slower and less than what one may see with other asynchronous technologies where conversations are nearly real time and in the form of long threads (O'Hara et al. 2014).

Sometimes participants chose to even wait a day or two to respond, or not respond at all. This was particularly the case with Pair 1. If it was an emotional message needing reflection, they would wait and gather their thoughts and respond later or mention it in their daily video chats. This ‘scattered’ pattern of answering did not usually cause frustration for our participants if it was just a couple of days. However, Shea from Pair 2 said she sent a few messages in Week 3 and did not get any response or acknowledgment from her sister within a week. This disappointed her and caused her to not use the devices for a while, since she was not sure if her messages were being sent.

Our participants used FamilyStories to share stories for a variety of topics, including greetings such as wishing each other a good night sleep, or a good start to the day. They also used it for important information about their everyday life, such as loss of a family member (will be discussed more later), asking each other how they handled a stressful situation at work, reflecting on good memories, or light topics such as decorating a new place, and general daily updates. Sometimes they used the devices to encourage each other for projects at work, or just to encourage each other to enjoy their time during weekends.
Table 1: Messages sent per week and their avg time in min:sec.

<table>
<thead>
<tr>
<th>Device: Participant’s Name</th>
<th>W1</th>
<th>W2</th>
<th>W3</th>
<th>W4</th>
<th>W5</th>
<th>Total</th>
<th>Avg Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1, Benjamin and Joyce</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spark: Benjamin</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>5:41</td>
</tr>
<tr>
<td>Spark: Joyce</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td>0:49</td>
</tr>
<tr>
<td>TimeKnot: Benjamin</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td>0:26</td>
</tr>
<tr>
<td>TimeKnot: Joyce</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>12</td>
<td>0:22</td>
</tr>
<tr>
<td>Kinetic: Benjamin</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>6</td>
<td>1:47</td>
</tr>
<tr>
<td>Kinetic: Joyce</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>0:47</td>
</tr>
</tbody>
</table>

| Pair 2, Shea and Ayla      |    |    |    |    |    |       |          |
| Spark: Shea                | 1  | 3  | 1  | 1  | 1  | 7     | 0:33     |
| Spark: Ayla                | 6  | 2  | 1  | 4  | 1  | 14    | 0:17     |
| TimeKnot: Shea             | 3  | 2  | 1  | 0  | 1  | 7     | 0:29     |
| TimeKnot: Ayla             | 2  | 1  | 1  | 1  | 2  | 8     | 0:27     |
| Kinetic: Shea              | 4  | 2  | 1  | 0  | 0  | 7     | 0:40     |
| Kinetic: Ayla              | 2  | 2  | 1  | 1  | 1  | 8     | 0:20     |

Table 1 shows the number of messages sent on each device per person during each week and the average length of the stories. As can be seen, messages were generally quite short, most often less than a minute in length. The minimum time for messages was 5 seconds and the maximum time was 20 minutes. TimeKnot was used most frequently by Pair 1, with 20 messages in total, and Spark was most frequently used by Pair 2, with 21 messages in total. However, these numbers also include messages sent per our directions for the first two study weeks to try out each device. Even still, after Week 2, TimeKnot was used most often by Pair 1, and Spark was used most often by Pair 2. Thus, frequency of use tended to stay the same for the devices.

We asked participants why messages tended to be short in duration. They said this reflected their habit of sending short voice messages on mobile applications and feeling that longer topics needed real time discussion. Longer messages usually went into more detail and included people reflecting on their life events. The couple in Pair 1, sent longer messages after the first week that included more of their thoughts about what was happening. Short messages usually included daily greetings, expressing instant feelings of joy or tiredness, reminders, and quick updates about daily life.
We asked participants how they chose between the devices and found they followed their own patterns with some shared similarities. We describe these in the following sections.

6.1.14. Non-urgent and Expressive from the Heart

Participants felt that their overall communication with their loved one improved with FamilyStories, and that it allowed them to feel a variety of emotions. First, all our participants used the devices as a non-urgent method for communication. In contrast with their usage of mobile phone applications and phone calls, audio messages sent on FamilyStories did not require one’s immediate attention. Since the messages were not urgent, family members had an opportunity to talk about things that they might have not spoken about or shared if it was through the use of existing technologies. This was because the timing of the messages might have been inappropriate for the other time zone, or the content may have felt trivial, sometimes emotional and not urgent. Thus, they did not want to interrupt the other person’s day.

For example, in Pair 2, Shea usually would record audio stories late at night before going to bed while in Ayla’s time zone it would be past midnight. Shea used FamilyStories so she would be sure she was not interrupting Ayla’s sleep. Just like when they lived together, she updated her on ‘everything’ that happened. Shea found that FamilyStories helped her to be aware of what was going on with her sister’s life and feel included even while both were experiencing very busy weeks at work and in their personal lives. Shea from Pair 2 and Benjamin from Pair 1 found that communication was similar to exchanges through handwritten letters, since they were also not shared in real time. For Shea it was like she always had something to talk with her sister about, just like when writing a letter.

“Remind me of my childhood when we used to write letters ... so it was overall a really fun experience. It made it like easy to share our daily, you know, what's happening with her. So yeah, it was definitely something very close to my heart.” – Pair 2, Shea

Because conversations were ‘one way’, participants felt they were more apt to share things that they might not have been comfortable or able to share fully synchronously. They were able to let out their feelings without feelings of being judged or interrupted by the other person. They liked the fact that it was audio and not text or video because, for them, it conveyed emotions easily, and they did not have to worry about their appearance while recording an emotional message. These conversations ranged from a deep self-
reflective message about life, and the role of the partner in it for the couple in Pair 1, and the range of emotions felt in losing and then finding a pet for Shea in Pair 2.

“Sometimes when a conversation is one way it looks like you have more freedom to express your feelings. The other person doesn’t stop you or interrupt you or they don’t tell you what they think! It’s like easier I think, when your telling your story…It was comforting to just talk about it and then know that she’s going to probably understand the way I feel and the way I felt.” – Pair 2, Shea

In Pair 1, the couple used the devices to express their love and emotions for each other. This was specifically the case for Spark due to its ambient notification feature that was seen by the couple in Pair 1 as romantic as it was like a heartbeat.

6.1.15. Ephemerality and Importance of Longevity

The longevity of the messages was a major factor for choosing between devices for both pairs. This manifested in different ways depending on the pair and specific situations that emerged across the study. For example, during the first two weeks, the couple in Pair 1 did not consider the ephemerality of the messages as a factor when choosing between the devices. They started using Spark for instant messages that were mainly expressing a feeling such as excitement, affection, tiredness from work, etc. They started thinking about considering the role of ephemerality and longevity of the messages after a particular incident. Here Benjamin sent a romantically reflective message, which was precious for Joyce to keep on Spark. Yet she started to worry about the message being gone forever and asked the researcher if there was a way they could still have the audio story. This happened after she experienced the deletion of her first two weeks’ messages. After this experience, the temporality of the messages was highlighted for them.

“Stuff close to my heart I send on Spark, although stuff that’s close to my heart that I want Joyce to be able to keep, like as a gift, I should send some other way.” – Pair 1, Benjamin

Joyce from Pair 1 said in her diary that she experienced hearing the bad news of a family member passing away. She felt heartbroken but did not want to interrupt Benjamin’s day at work. In order for him to see the message when he got home, she used Spark to express the sorrow she was feeling at the moment. She used Spark because she also did not want bad news and sadness to linger for a long time, and she wanted the message to be heard once and be gone.
For the sisters in Pair 2, longevity and the temporal nature of the messages was valuable from the beginning until the end of week two of the study. In the first two weeks both Ayla and Shea used Spark for instant and short messages. Story topics mainly revolved around “catching up” and seeing how each of them was doing. The sisters used either Kinetic or TimeKnot to share stories important to them. That was because they wanted to be sure their family member would hear them eventually, and the stories would not be deleted without them knowing about it. Thus, the sisters thought carefully about which device to use. They wanted a device that offered longevity for messages that were important for them to get a reaction from each other.

“…sometimes, it is possible that I miss a message, so I definitely want them to stay longer… I know that I could always go back and listen to the previous one. I think that’s definitely something that matters.” –Pair 2, Shea

Shea’s usage of the devices started to shift during Week 3. She mainly started using Spark, since she noticed they both were able to listen to the stories in a week’s time period of messages being available. Another major reason for the shift toward using Spark more often was that listening to Spark messages was more effortless, real-time and with less limitations. In conclusion, she could listen and relax. If she wanted to listen to the messages again within a week, she had learned a workaround that involved restarting the device so that its list of played messages would reset.

Ayla’s preferences did not change and she mainly used the ephemeral messages of Spark when she had something of lesser importance to talk about with her sister. She mentioned in her diary: “My sister could listen to them just once and that was not a big deal if she missed some of them.”

6.1.16. Dedicated Devices

All participants liked the dedicated nature of FamilyStories. That is, they liked that each device was for communication between only two people. This made the connection and each of the devices special for our participants. For example, in Pair 1, Joyce liked the fact that the messages were always from Benjamin. This was different from when she would have a notification from her mobile text messaging application, since the notification could be from anybody in her contact list. When a message came in on FamilyStories, she always knew it was from Benjamin and that made it special for her. To her, this was like receiving gifts each time she had a new message on the device.
“It’s so specific... it’s kind of like a signal telling me that it’s from Benjamin because I use, WeChat I use whatever, everyone can send me a message. but that box is like Benjamin only can send me a message” – Pair 1, Joyce

For our participants, the devices earned a special value since they were a direct representation of their loved ones in their home. This is in contrast to the all-purpose devices that they currently used for communicating with family members.

“…if it was on my phone, they’ll be all clustered together and it just wouldn’t be as fun I think either.” – Pair 1, Benjamin

In Pair 2, Shea talked about spending a great deal of time composing and recording her messages. She crafted each message carefully when she wanted to connect with her sister. This made the communication with the devices more special for her, because it was direct time that she put into her relationship with her sister. Shea also felt that the dedicated nature of FamilyStories made the conversation “their moment”. Since she knew the messages were only from her sister. Looking at the spot where the devices sat reminded her of Ayla. Her sister also expressed similar feelings about how she enjoyed sharing this exclusive method of communication with just her sister.

“I had this special feeling being in contact with my sister very exclusively, so it was like me and her had a moment of our own” – Pair 2, Shea

6.1.17. Triggered Accessibility

Two of our devices set a limitation on how participants could listen to the audio stories. One limitation was on time (TimeKnot) and the other was on activating the newest message based on a specific amount of movement (Kinetic). Each feature had benefits and challenges which we describe in the following subsections.

Time Limited Access to Messages

Waiting for the same context of the day to play stories on TimeKnot was both rewarding and valued. For example, the couple in Pair 1 liked the idea of playing messages during the same context of the day. Joyce said Timeknot had diminished the time zone difference they had with each other and created a fantasy of Benjamin living near her. This caused her to feel like they had synchronized their timing. Benjamin said that with their other methods of communication he would always do a mental calculation
of what time it would be for Joyce, or would mention in his text or voice message what time it was for him when sending the message. It was different when he used TimeKnot though. Because he knew she would receive his message when she was in the same time as him, he did not worry about interrupting her (e.g., while sleeping).

“It like creates a fantasy that Benjamin, the ‘remote Benjamin’, is not remote but also still I know that behind the fantasy it’s a fact that we are remote.” – Pair 1, Joyce

The couple in Pair 1 usually used TimeKnot for encouraging one another for starting the day, and sometimes for sharing an experience that they were having in a specific location or time. For example, Benjamin was visiting a new city. He was in the outdoors enjoying the sun and wanted to share the atmosphere and the state of mind he was in. He decided to use TimeKnot to share the experience. He thought the focus on audio would allow Joyce to both listen to him and immerse herself in the background sound and imagine his surroundings. He also debated if it would have been good to attach the story to a photo for her. Benjamin and Joyce both felt TimeKnot took away the awkwardness in sending messages that were related to time in different time zones. For example, saying good night to a loved one while in their time zone the day had just begun.

The sisters from Pair 2 usually used TimeKnot for nightly messages, reminders, discussing their plans for the night, or even celebratory messages such as wishing a Happy Birthday on time. Yet TimeKnot’s limited playback time window and the anticipation for waiting until the correct time of the day sometimes led to impatience by the sisters. We feel this may have been because Pair 2 experienced a much smaller time zone difference than Pair 1 (only 3 hours compared to 8). As a result, the sisters in Pair 2 had more overlapping time windows during the same context of the day.

TimeKnot showed notification only when the user could access the message. However, participants would have liked to know in real-time if there were any messages that were set to be playable in an upcoming time window and when.

Movement Triggered Messages

Pair 1 used Kinetic to link light activities, similar to what we expected. For example, they used it while taking a walk or during short workouts at home while listening to the messages. For workouts, one person would act as a coach to try and encourage the other person to ‘keep going.’ Pair 1 felt like they were able to multitask and engage in an activity with Kinetic. This was due to the stories being audio-based, and not needing to focus on
writing an answer, or looking at the screen to comprehend the topic. Benjamin thought it was nice to hear stories when he was walking in the peaceful, quiet night coming back from work. Sometimes he would even walk a little more than what he anticipated to trigger the message to play. This is similar to how others have reported listening to podcasts while doing a physical activity (Heshmat et al. 2018).

Rather than use Kinetic to link the same activities, the sisters in Pair 2 used Kinetic to share important topics that they needed each other’s opinion about. The added effort of having to get the device moving in order to listen meant that they knew the other person was focused and ready to engage with the message. To get Kinetic to play, they would do simple activities at home such as doing some chores, playing with the puppy, etc. Ayla said that since Kinetic was real-time and she did not experience delays or technical issues with it, it made her use it for important messages which she wanted her sister’s feedback on. She also talked about how the movement feature caused her to be sure that her sister was ready and in the right mindset to listen to the messages.

“You know it’s my favourite [Kinetic]! I usually leave those messages I really care about, and I really want my sister to listen and answer them for Kinetic.” – Pair 2, Ayla

However, the movement triggered method was interesting for Shea for the first two weeks. She experienced two very busy weeks of work and wanted to relax when she was at home. She did not want to move much to play an important message. That’s when she would start shaking Kinetic for a couple of minutes or walk around the home a little to be able to listen to the messages. She also said sometimes she was not sure if the required time of movement was met. That is when she started to use Spark more often. Since Spark was also real-time but required less effort for listening.

6.1.18. Discussion

Our overall goal was to explore the usage of asynchronous audio storytelling systems for families in different time zones. To achieve this goal, we designed three technology probes, and deployed them in a five-week study. Our findings indicate a diversity of perspectives. Next, we reflect on this variety and propose ideas for how designs could address peoples’ varied needs and perspectives with asynchronous audio sharing systems.

First, we learned that asynchronous audio systems can benefit from using a non-persuasive platform that does not emphasize a thread of back and forth communication.
Instead, designs that embrace flexibility and delayed responses in time can be beneficial. In our study, participants felt open to expressing a range of emotions, from sadness and grief to excitement and happiness. Our study showed that this was, in part, due to the asynchronous and slow nature of the audio story sharing. Another reason was that our devices did not have features built in that encouraged quick responses or the need for constant attention, which might create feelings of obligation to connect (Tee et al. 2009, Kirk et al. 2010, O’Hara et al. 2014). Communication also did not manifest itself in the form of an ongoing thread of responses, unlike the current usage of asynchronous systems such as WhatsApp (O’Hara et al. 2014) or WeChat (Zhou et al. 2017).

Second, we learned about the role that ephemerality can play in asynchronous communication systems and ways in which it could be designed for. For example, the ephemerality of messages in Spark helped participants use the system to express ‘instant’ feelings or give short updates to one another. However, such features did not seem to play a major role in encouraging family members to share more. This is in contrast with what has been seen in current trends around the use of social media for sharing temporal pictures and videos with friends on a daily basis where exchanges are frequent (Xu et al. 2016). Yet the ephemerality of Spark encouraged participants to listen to messages earlier. Participants also used this quality of ephemerality for talking about upsetting feelings or sadness. The length of stories was mainly short, similar to existing patterns when using voice notes or social media. This could also be accounted for by the fact that our participants were already frequently in contact and longer stories may not be needed. However, for family members who are not as close as our participants, the ephemerality of audio stories may encourage them to create stories that are longer where they have enough time to not feel pressured when recording them and communicating.

Third, when designing audio storytelling systems for usage of close family members, our study results reveal design opportunities for further exploring asynchronous audio story telling devices that are suitable for in-home environments. Although the technology probes were portable and could be used outside, family members mainly used them at home. This was in harmony with the non-urgent nature of the content as it did not require immediate attention. As a result, most of our participants usually played or recorded messages when they wanted to relax, and this happened to be in their homes most of the time. Participants did not feel compelled to need to take the devices outside of the home, which contrasts largely with mobile device usage more generally. It could be the case,
however, that other participants beyond our small sample may wish to listen to stories while doing other things like traveling or commuting. This could be similar to the way people listen to podcasts (Heshmat et al. 2018). Future designs could explore technologies that would include an in-home dedicated object for connecting family members and, perhaps, different designs and forms for usage outside of the home. It would also be interesting to investigate how asynchronous systems for connecting close family members could be integrated within existing home systems, such as voice assistant devices like Google Home, or Alexa.

Fourth, we learned how building a time-delay into a design can help to add excitement and meaning to communication, while also artificially ‘synchronizing’ time zones. With TimeKnot, because messages were playable only during a specific time window, the couple with a larger time zone difference was able to better synchronize their exchanges for appropriate times and ‘forget’ that the time zone existed when sharing a message. Yet this could also cause impatience for those who only have short time zone separations. This is similar to what has been seen in the literature as an issue of balancing the control that the user has over the slow technology (Hyesook et al. 2013, Heshmat et al. 2017, Odom et al. 2014, Odom et al. 2019). Future time-delayed asynchronous audio storytelling systems may benefit from having a real-time indication of an incoming message and when it would be playable. Such features could allow anticipation to grow, while alleviating frustrations about knowing when messages may be playable. Sometimes our devices blended into the background and participants would forget to check them for new updates. This was especially the case if the devices were not on constantly. Future designs could explore different types of ambient notifications, either through sound or actuated motion on devices.

Lastly, we learned that synchronizing activities (e.g., shared walking) during recording and playback may not be for everyone. Our participants rarely performed the same type of activity while using Kinetic. However, they did engage in light movement activities such as listening while exercising at home, walking outside, cooking, or doing chores around home. The benefit that we saw in our design was its ability to allow participants to concentrate on the content while engaging in an activity. This was a possibility because we used audio and it was easy to do other things while listening. This is similar to how people have been shown to use other asynchronous audio systems (Heshmat et al. 2018). The movement triggered feature of Kinetic was highly desired for some and, for others, it was seen as merely an extra step to listen to the stories. During
busy times, people wanted to listen to messages with little effort. Of course, we tested out only one method for triggering playback based on activity. Future asynchronous designs could explore other possible methods for enabling messages to play such that value could still be added to the listening experience.

Our research is limited in that participants only used the devices over a five-week long period. While we feel we were able to understand uses beyond an initial novelty period, longer field studies would help to uncover knowledge of what sustained usage over time may look like. It could also help to reveal more information regarding how family members cope with the slowness of the devices. Our study is also limited in that we were not able to conduct observations of usage while it happened, given the sporadic usage of the technology and the widespread locations of our participants. To counter this challenge, we asked participants to describe the context and content of their messages to us.

Our results are also naturally limited in that we only had two pairs of family members use the system during the field study. We recruited only two pairs since we wanted to closely study their usage of the system. This can be extremely challenging to do with a broader set of participants in a field study. It can also be challenging to manufacture and produce larger volumes of research prototype devices. We chose two different types of pairs and, of course, future research would find value in studying other types of relationships. For example, future studies can explore the usage of audio storytelling systems between parents and their adult children. Overall then, our research helps to open up the design space of asynchronous audio-based storytelling systems and suggests areas where there may be value in focusing future design and user research.

6.1.19. Conclusion

Our work contributes the proposal and exploration of three design probes and, within them, design factors for creating asynchronous audio storytelling systems inspired by slow technology design ideas. We created three corresponding technology probes to investigate the effect of each factor—ephemerality, sharing tied to physical activity, and the context of the day—on family communication across time zones. The study helped us understand people’s behaviors and patterns of usage of such technology. It also helped us understand the benefits and challenges of each design feature. Family members used the devices for sharing non-urgent yet important, and sometimes reflective audio stories.
They also used the system for synchronizing their time across different time zones, and for expressing a variety of emotions using the system. These results illustrate the value of designs that promote delayed communication without an emphasis on instant responses. We see how ephemerality can help with expressing emotions; the specialness that can come with dedicated in-home devices; how a synchronization of time zones can be achieved with time delayed messages; and, ways in which movement triggered stories can suggest changes in engagement with audio stories.

6.1.20. Acknowledgments

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Chapter 7

Conclusions

My doctoral research explored the usage of asynchronous audio systems, specifically a slow technology-inspired asynchronous audio storytelling technology for connecting family members in different time zones. The purpose of this chapter is to conclude my research presented in this dissertation by addressing the aforementioned research problems and my objectives for each research question in a summary. This section also includes my thoughts on the contributions made through each step of the research objectives.

This dissertation was focused on answering the overarching research question, which is: what design factors are important in designing systems to connect family members across time and over distance through shared audio-based media? This main question was divided into four research questions. In the next section, I will give a summary of each of them and discuss the contribution reached through finding an answer for each problem.

7.1. Contributions

The main objective of this dissertation was to find design insights on systems which are aimed for connecting family members across time and over distance through shared audio media. I reached this objective by answering the four research questions introduced in Chapter 1. Through reaching these objectives, contributions were made to the field of HCI, domestic technologies, and specifically family communication across time zones. Here, I outline each contribution made in detail through the process of reaching the four objectives.

Research Question 1: What are the listening practices of frequent podcast users and how do podcasts support quality alone time?

Research Objective 1: Conduct a study to explore people’s routines around listening to podcasts, including: when and where they listened; who they listened
with, if anybody; what activities they did while listening; and, how they shared knowledge from podcasts with other people, if at all.

I explored listeners’ behaviours and routines in a qualitative study of podcasts. Eighteen participants were recruited who listened to podcasts at least once a month. Participants were from different age groups and occupations, which created a diverse sample. Semi-structured interviews were chosen as the data collection method for this study due to their ability to provide in-depth knowledge of a topic. In Chapter 3, we can see the results of the semi-structured interviews and how they helped with understanding participants’ behaviors and patterns of use of the technology.

Although podcasts have been around more than 20 years, they have been studied mainly for educational purposes (Hew 2009) or quantitative marketing studies ran annually by the Edison research group (Edison Research 2019). Podcasts had not been studied in-depth in an exploratory way to understand how people actually use them. This research contributed by outlining insights on the routines and practices that people have created for listening to podcasts as a part of their everyday routine. This included qualitative explorations of the ways that the flexibility, mobility, and passive nature of podcasts—their ability to be listened to nearly anywhere without requiring interaction— affect listening behaviors. During the study, I investigated the different aspects of podcast technologies from participants’ favorite characteristics about them to why podcasts have supported solitary practices and how time and location affect listeners’ patterns of usage. The characteristics of podcasts showed potential for allowing family members to share activities. Such features included the flexibility to use them privately and nearly anywhere and anytime, the ability to multitask while listening to content, the ability to listen to a podcast and shift thoughts to reflect, relax, and to be a “part of” a conversation while having quality alone time. I also learned that the intimacy that podcasts created between the listener and the narrator could potentially be used for creating a sense of closeness between family members.

Research Question 2: What are the important features of an audio-sharing system for mobile devices that can allow family members to share stories over distance and across time?
Research Objective 2: Design a system called Mimo that allows family members to connect through audio narratives similar to podcasts.

I addressed Objective 2 by creating a web application called Mimo. I outlined the process of creating the application, which was through brainstorming, an iterative design process, and introducing different system features that led to a high-fidelity working prototype of Mimo. I also discussed the results of an exploration of the system by 21 participants who interviewed after the system was introduced and demoed to them.

The system and study contributed to my fields of study by highlighting potential features for asynchronous audio storytelling systems that needed to be explored more, and also challenges that might be faced with this type of technology. The investigation of the design features highlighted the importance and potential of personal connections through the usage of one-to-one communication patterns, which is in contrast with one-to-many that is sometimes the norm for communication applications (e.g., social media systems that broadcast updates to large groups of followers). Participants also enjoyed the usage of audio due to its richness in conveying a story and ability to multitask while connecting with family members. One of the challenges introduced was the worry of some of the participants for having communication that was felt to be one-way and talking into a void.

Mimo is different from what has been done in the literature by focusing on asynchronous sharing of and being tied to a specific activity. Most asynchronous systems in the literature are focused on using video as the medium (Du et al. 2011; Inkpen et al. 2012; Venolia et al. 2015), and a few have been focused on sharing a specific activity through a video connection (Tsujita et al. 2010; Nawahdah & Inoue 2013). As a result, we have seen few, if any, systems that explored the usage of asynchronous audio as the media to share experiences and activities between family members over distance. Mimo also explored the idea of media that arrived at a specific time which was setup by the sender. The feature was well received and was implemented as one of the features in FamilyStories.
Research Question 3: How can we use the prototyping knowledge and our study on podcasts to create a tangible system suitable for connecting family members over distance and in different time zones through audio stories?

Research Objective 3: Create a tangible system that makes family members in different time zones feel more connected through use of audio.

I approached the third objective by using the learnings from the first study ran for Research Objective 1 and 2. This included lessons learned about asynchronous technology such as Podcasts and the feedback received from the early evaluation of Mimo. In Chapter 5, I outlined the design process for FamilyStories which included brainstorming, iterative design, exploring different user scenarios, creating a variety of sketches and mock-ups of low fidelity prototypes. In Chapter 5, I also addressed the exploration of different shells, materials for the exterior design of the artifacts, and how users would interact with the designs. Finally, I discussed the final design and the three technology probes created in detail.

Previous work on using asynchronous audio recordings for connecting family members was used for connecting those who all lived in the same location and not for families over distance (Oleksik & Brown 2008; Oleksik et al. 2008). We also have seen usage of ambient background audio sounds and shared music playlists to connect couples over distance with the usage of a software system (Lottridge et al. 2009). Dedicated computational artifacts have also mainly been studied for connecting couples over distance in a tangible way (Chang et al. 2001; Chen et al. 2006; Chung et al. 2006; Gooch & Watts 2012) but there is a lack of research that explores connecting family members beyond couples, specifically in using asynchronous audio. Current text messaging applications such as WhatsApp or WeChat are also different from FamilyStories. These applications are not dedicated based on a one-to-one connection model and are not focused on the usage of audio. Also, mobile phones as a device are not designed to be used for one purpose only. FamilyStories was different from previous work by being inspired by slow technology designs, and only using audio for connecting family members in a one-to-one way. FamilyStories contributed to the field of family communication by providing an exploration of a slow asynchronous audio technology with different capabilities for playback. The evaluation of the system in the five-week study also introduced potential design features that will be discussed in the next section.
Research Question 4: How will family members use an audio-based tangible system such as FamilyStories to connect over distance in different time zones? What are the benefits and challenges of using such a system?

Research Objective 4: Evaluate the system designed for connecting family members in different time zones and understand how family members use the technology to connect, communicate, and share activities or experiences over distance.

I achieved Research Objective 4 by conducting a five-week field study with the FamilyStories technology probes. Two sets of family members were recruited for the study including siblings and a romantic relationship. The participants consisted of two sisters with a time difference of three hours and a couple with eight hours of time zone difference. The field study of FamilyStories resulted in several research contributions, such as insights on how family members actually would use a computational artifact for connecting with a slow paced system that only used asynchronous audio storytelling, and what happens when the urgency and instant back and forth is taken away from the communication.

In Chapter 6, I described the FamilyStories system and addressed the goals for the study, which was to explore the usage of asynchronous audio storytelling systems for families in different time zones. The field study contributed to the research by exploring three different design factors regarding asynchronous audio communication which were embedded in each of the technology probes, including ephemerality, sharing tied to context of the day, and sharing audio storytelling tied to motion. It also highlighted participants’ behaviors and patterns of usage of such a technology. The field study provided an understanding of the benefits and challenges of each design’s features. The results outlined in Chapter 6 illustrated the value of designs promoting delayed communication. I found that ephemerality was useful for expressing emotions; a feeling of specialness can come with dedicated in-home devices; the synchronization of time zones can be achieved with time delayed messages; and, movement-triggered stories can suggest changes in engagement with audio stories.

Prior work focused on family communication over different time zones with dedicated devices is often limited to studies of a prototype within labs or a collocated study (Lottridge
et al. 2009; Tsujita et al. 2010; Gooch & Watts 2012; Nawahdah & Inoue 2013) due to issues with having a long-lasting prototype, and also challenges with shipping and handling of the devices (Lottridge et al. 2009). The field study of FamilyStories highlighted the real-world usage of the system over distance in different time zones, which was different from what have been done previously. FamilyStories is different from prior work in that it only focuses on audio as the medium for sharing an activity or communication (Inkpen 2013; Procyk et al. 2014). FamilyStories was built to benefit from the multitasking aspect of asynchronous audio and the possibility for connecting family members for quality alone time just as has been seen with the usage of podcasts (Heshmat et al. 2018).

7.2. Reflection

The research done in this dissertation from early exploration and data gathering of understanding asynchronous audio being used in podcasts in Chapter 3, to the evaluation of a technology made for connecting families in different time zones in Chapter 6 was part of the process to address the overarching research question: **what design factors are important in designing systems to connect family members across time and over distance through shared audio-based media?** In the following sections I will discuss the major contributions of my thesis which provide answers to this question.

7.2.1. One-way Audio Communication: Benefits & Challenges

First, I learned that designing to support one-way audio communication can be valuable for connecting family members across time zones. It provides flexibility to users to express themselves and share stories at varying points in time. This was both pointed in the early exploratory study of the Mimo prototype discussed in Chapter 4, and the field study in Chapter 6. Although this type of one-way communication was described as expressive in Mimo’s exploratory study, participants indicated the desire for shorter messages. This was also indicated in the evaluation of FamilyStories system. In other words, one-way communication helps with expression of feelings but it may often be short in length because it can be accompanied with awkward feelings of talking into a void while recording a lengthy message. Future designs can benefit from using asynchronous audio communication to convey emotions. However, to fully benefit from one-way communication, different designs can be studied. For example, it could be interesting to
explore the usage of artificial intelligence systems such as voice assistants as the buffer to fill in the void during the recording of an asynchronous message.

7.2.2. Asynchronous Audio and its Ability to be Used while Multitasking

Second, I learned that it can be valuable to design audio-based technologies that allow users to multitask while recording and listening to stories, often happening in home environments. In both the usage of podcasts and FamilyStories, participants indicated that they enjoyed multitasking while listening to the audio. In the FamilyStories field study, family members also communicated during mundane activities (e.g. playing with the puppy, cleaning dishes, drinking tea, walking etc.). Future designs can benefit from considering the multitasking nature of asynchronous audio for creating a platform that can be used by family members. However, in the study, multi-tasking while listening was somewhat contradicted by the sisters in FamilyStories. They often sent messages with Kinetic when they wanted to be sure their sister desired to listen to their messages and were determined enough to move for several minutes to hear them. On the other hand, they wanted to be sure of the desire and intention of listening to be present and were less concerned about whether they engaged in another activity.

During the study of podcasts, one of the main locations where participants listened to podcasts was at home during a time when they wanted to relax and enjoy their quality alone time. During the field study of FamilyStories, the home was also where participants mainly listened to and record audio stories. The timing was when they wanted to enjoy themselves and relax while connecting with family members as well. In contrast, current communication technologies such as WhatsApp or other forms of mobile messaging applications allowing asynchronous communication are not designed for a specific location nor multitasking. Instead, they are focused on a thread of communication that is ongoing at anytime and in anyplace (O’Hara et al. 2014).

Future design paths could explore systems that allow multitasking while communicating with family members in home environments. These designs could have integration with sound systems at home as an option or allow participants to carry them while engaging in an activity.
7.2.3. Customization and Personalization of Family Communication

Third, I learned that it is important to personalize or allow customization on a method of communication. One of the requests from participants in both studies was to have some freedom for personalization and customization for one-to-one communication exchanges. Customization and personalization can have many interpretations. In this dissertation I am referring to the customization of the technology probes in the FamilyStories exterior look based on the connection each family member had with each other. In the field study, the customization of the technology probes was suggested which could have allowed for more personalized styles of communication to arise between family members. The technology probes strongly embodied family members’ presence in their home while being away, which created the desire of the artifacts to represent their loved ones more with a personalized exterior look. It could have been a photo of them on the technology probes, a painting they did on the body of the artifacts, a locket attached that had something to do with their loved ones, etc. In the study of FamilyStories, participants thought that this type of personalization could help with adding special value to the artifact and symbolize their family member in their space more while they were separated by distance.

During the study of Mimo, discussed in Chapter 4, participants wanted to be able to have different type of activities or categories which was suitable to their dynamic with the family member. In other words, participants wanted to be able to customize the application based on the personal connection they had with the specific family member. The categories were seen to be useful if they were not generic and more tailored to family members’ connection. For example, some of our participants would have liked to talk about books they read with their father but if it was their brother, they would have wanted to share the latest television series they were watching. This type of personalization in Mimo application could have led to more usage of the system and made the categories play a major role in the communication and made the topics more personalized and suitable based on the relationship.

Current technologies that support asynchronous audio messages such as WhatsApp are designed for providing a generic method for connecting individuals together. They are not targeted for customized communication specific to families’ needs (O’Hara et al. 2014). Also, they are not only being used for a specific one-to-one connection but rather a method of connecting individuals with most of the people in their contact lists. As a result, the platforms are often not responsive to families’ needs. Future
designs can explore the effect of customization and personalization for families to make the communication more engaging.

7.2.4. Topics of Asynchronous Audio Communication

Fourth, I learned that non-interruptive slow asynchronous audio messages provide opportunities for more expressive stories to be shared. Through the field study of FamilyStories, I learned how slow and asynchronous audio communication allowed non-urgent yet important topics to be discussed. This was because the method used was non-interruptive and allowed family members to tell stories which they knew would be received at a time when their family member was actually thinking about them and wanted to connect. Also, topics discussed included moments of sadness and instant excitement that were recorded in different times and locations, including messages participants sent while being ready to sleep. This was possible since the medium was audio and they did not worry about their looks and privacy issues that sometimes comes with video. Such comfort and ease of mind led to participants being focused on the story they wanted to share and sent them in moments they desired without worrying about the status of the family member while receiving the message. Future designs can explore the usage of slow technology influenced audio systems for providing a medium for more emotional contents that might be hard to share in real-time or are sparked in the moment and need to be shared right away.

7.2.5. Time Management for Communication in Different Times

Fifth, during my studies, I learned the importance of artificially synchronizing timing in different time zones. During the Mimo study, I learned that the exact hour of the day was not what was important for participants but rather the time window or context of day that the messages would be shared in, including the morning, afternoon, or night. They also did not want to choose the time to be another thing to think about or input in the system. They wanted time selection to be done seamlessly. In the second study, the TimeKnot probe explored an automatic method of sharing messages in the same context of the day. From the study, I learned that participants with larger time zone differences appreciated the feature more. Since they wanted to know more about what their family member was really experiencing in the same time of the day and it took the awkwardness away of acting as if they were both in same time window (e.g. saying good morning while
the other was experiencing night time and getting ready to sleep). Synchronizing the time also helped participants to highlight the element of time in their stories and experiences such as describing Friday night plans and seeing what their family member planned during the same time window. Future exploration of how the timing of a message can be synchronized in different time zones can help family members know more about each other’s days and routines as they are experiencing them. Since sharing messages in the same context of the day means messages being delivered with a delay, it can create anticipation for whether a message exists or not. Future systems can explore different methods of notifications that are suitable for synchronized messages in different time zones.

7.3. Limitations and Future Work

My research has not been without its limitations. In the following section, I acknowledge and discuss the limitations seen in this work and share some thoughts for future work in the field.

First, the study of podcasts introduced and discussed in Chapter 3 was an exploration of a broadcasting form of asynchronous audio system that differs in the purpose of use than a system made for usage by a family. Although podcasts are asynchronous, they are usually made by professionals and are broadcast for many other people. Hence the design suggestions drawn from my study of them are somewhat speculative when it comes to family communication since podcasts are not typically seen as a method for family communication. Future work could consider exploring the usage of voice memos or voice texts being used in messaging applications in order to understand the way people use them to connect with family members in different time zones.

Second, the exploration of Mimo only scratched the surface of using such software applications for connecting family members. The study would have benefitted if the participants could have had more time to get used to Mimo, engage with the application, and use it in a study setting for longer time. Such a study could have led to more real-world usage that could be provide insights on how family members engaged with the system, what they preferred to have within the system, and what features were used the most.

Third, our main audience for this research was family members who had easy access to the Internet, mainly in North America. This was to scope down our design
requirements for families who have steady access to the Internet. I decided to focus on families accustomed to North American culture since families living in different cultures have shown to have different expectations and ways of staying connected (Zhou et al. 2017). That said, other Western cultures may exhibit similar design needs as those presented in the thesis. Also, the number of participants I used for the field study could be considered low and I was not able to consider culture as a factor for our study. Future studies can focus on the effect of different cultures on asynchronous audio communication over different times with varying levels of connectedness to the Internet.

Fourth, the FamilyStories field study was only done with four participants in the age range of 20 to 35. We decided to start with this age range since they may adapt to new form of technologies quickly. I only studied the usage of FamilyStories with two types of family dynamics. Later research can study other types of family dynamics such as connections between other types of siblings, adult children and parents, etc. The participants I recruited all had a routine for connecting with each other and were close. Future studies could explore the effect of different dynamics between family members on communication and see if systems similar to FamilyStories can bring family members who are less in touch to have more meaningful and insightful communication with each other. A study with more participants and longer timeline could have helped with unlocking more insightful information toward usage of slow asynchronous audio stories.

Fifth, for the study of FamilyStories I tried to not focus on usability issues and, instead, look beyond these problems to gain design insights from the results of the study. However, usability issues such as:

- minimal method of feedback between the device and users,
- confusion for when the device was recording due to millisecond delays in the LED feedback,
- internet connectivity problems outside the house; and,
- the technology probes being too big for activities such as running were present in the data.

Such issues may have slightly influenced the number of times the technology probes were used, the length of the messages, and the type of activities that they did share over the distance. However, before starting the study I made sure the devices were robust with minimum usability issues that I could have thought about during designing and preparing the artifacts.
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Appendix A.

Ethics Approval

Minimal Risk Approval – Harmonized - Delegated

Study Number: 2016s0317
Study Title: Podcasts and User Listening Practice

Approval Date: 2016 July 13
Principal Investigator: Heshmat Dehkhordi, Yassamin
SFU Position: Graduate Student

Expiry Date: 2017 July 13
Supervisor: Neustaedter, Carman
Faculty/Department: Interactive Arts and Technology

SFU Collaborator: n/a
External Collaborator: Yang, Lillian
Research Personnel: n/a
Project Leader: n/a

Funding Source: none
Funding Title: n/a

Document(s) Approved in this Letter:
- Study Details, version 2, dated 2016 July 11
- Consent Form, version 2, dated 2016 July 11
- Sample Questions, uploaded 2016 June 21
- Recruitment Poster, version 2, dated 2016 July 11

The application for ethical review and the document(s) listed above have been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human participants.

The approval for this Study expires on the Expiry Date. An annual renewal form must be completed every year prior to the Expiry Date. Failure to submit an annual renewal form will lead to your study being suspended and potentially terminated. The Board reserves the right to amend decisions on subsequent amendments made independently by the authorized delegated reviewer at its regular monthly meeting.

This letter is your official ethics approval documentation for this project. Please keep this document for reference purposes.

This study has been approved by an authorized delegated reviewer.
Mineral Risk Approval – Delegated

Study Number: 2019/0198
Study Title: FamilyStories: The Design and Field Study of an Asynchronous Audio Narrative System Designed for Family Members in Different Time Zones

Approval Date: May 31, 2019
Principal Investigator: Heshmat Dehkordi, Yasamin
SFU Position: Graduate Student

Expiry Date: May 31, 2020
Supervisor: Neustaedter, Carman
Faculty/Department: Interactive Art and Technology

SFU Collaborator: Dosh, Pungwadlok
External Collaborator: N/A
Research Personnel: N/A
Project Leader: N/A

Funding Source: NSERC
Funding Title: Supporting Shared Family Experiences with Mobile Media Spaces

Document(s) Approved in this Application:
- Study Details, version 3, dated 2019 May 29
- NSERC Application, uploaded 2019 May 28
- Appendix B: Sample Questions, version 2, dated 2019 May 23
- Appendix A: Sample recruitment flyer, version 2, dated 2019 May 23
- Consent Form, version 2, dated 2019 May 23

The application for ethical review and the document(s) listed above have been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human participants.

The approval for this Study expires on the Expiry Date. An annual renewal form must be completed every year prior to the Expiry Date. Failure to submit an annual renewal form will lead to your study being suspended and potentially terminated. The Board reviews and may amend decisions or subsequent amendments made independently by the authorized delegated reviewer at its regular monthly meeting.

This letter is your official ethics approval documentation for this project. Please keep this document for reference purposes.

This study has been approved by an authorized delegated reviewer.
Appendix B.

Study Question- Chapter Three & Chapter Four

Types of Podcasts
1. How were you first introduced to podcasts? Tell me about the process.
2. Do you prefer audio podcasts or visual podcasts? Why? In each case what are your reasoning to prefer one to the other.
3. Why do you listen to podcasts? For example do you listen to learn, relax or kill time ?
4. What are your favorite podcasts? Can you please name some of them? Tell me why you like them.
5. How many podcasts are you subscribed to?
6. Do you prefer a podcast with multiple host or just one? Tell me more about how you feel about each case.
7. Tell me about the most memorable podcast you have listened or watched.
8. Tell me about the time where the podcast you listened to influenced you directly. What do you think was special about them?

Timing, Location, and Routines
1. How often do you listen to podcasts? In average how many hours do you listen to podcasts in a week. Explain more.
2. Where do you usually listen to podcasts? Why?
3. What devices do you listen or watch podcasts on? Why?
4. When do you usually listen to them? For example, do you have a favorite time to hear them such as in the evening or during a task? Why do you have such a favorite timing.
5. Do you listen to several episodes at once? Or you will listen to each when its released? Explain more.
6. Do you stream them online or would you store it for special tasks? Please describe an example.
7. Do you usually listen to them on a mobile device or would you listen to them on a computer? Please describe an example.
8. Do you have different podcasts ready for different tasks? For example, do you listen to different kind of podcasts while in the gym and while you are doing mundane house works?
9. Is there any relevance between the podcast subject and the task that you are doing? For example, while you are working are you listening to a podcast that is relevant to your work?
10. Is the duration of a podcast important for you? If yes, what duration of podcast would you prefer? Why?
Interest factors in podcasts

1. How much attention do you pay while you are listening or watching a podcast? Why?
2. Are there any podcast that you have listened to several times? What was so special about these podcasts?
3. How long does it take you to know if you want to listen to a podcast? tell me more about it.
4. Do you usually listen to all the content of podcast or just your favorite parts? Please describe an example.
5. What turns you away from a podcast? Why?
6. How technical issues such as the sound quality play a role for you in listening to podcasts?
7. How loyal are you to the podcasts you listen to? What I mean is would you forget about a podcast if they are not releasing for a while.
8. How intimate do you feel with the podcast you listen to?
9. Has there been a point while listening to a podcast that you stopped whatever you were doing to focus on the content of the podcasts? Tell me more.
10. How important is the host of a podcast character for you?

Sharing Podcasts

1. How do you find out about podcasts?
2. Do you find it easy or hard to learn about new podcasts? Why?
3. Do you listen to them alone or with your friends or family members? Why?
4. Please describe the last time someone told you about a podcast. What happened? Who told you about one? What did they tell you?
5. Do you talk to others about the podcasts you listen to? If so, what do you talk about?
6. Please describe the last time you talked about a podcast with someone. What happened? Who did you share with? Why did you decide to share the information with them?

Podcast Challenges and Workarounds

1. Tell me about the challenges that you have in listening or watching a podcast in the way that you do currently? What are your solutions for such challenges?
2. Are there any podcast that you follow but don’t like others to know about it? (Tell me more)
3. Is there a place that you like to listen to podcasts but its not easy to do so? Tell me more.
4. How do you manage to find all the podcasts that you enjoy listening to? How do you prioritize them for listening?
Mimo Demo

1. What do you think of the system and its usage of podcasts?
2. Do you think you would use it? Why or why not? With whom might you use it? When? Where?
3. What do you think about the time shifting feature? (repeat for each main feature)
4. What do you think about the categories?
5. Is there any other method that would be useful for connecting family members?
6. How long would you prefer such podcasts to be? Why?
7. What do you think about allowing people to share podcasts with each other only when they are doing the same activity?
8. Is there anything that you would like to add regarding this subject?

Background Demographics

1. Tell me about your occupation and your basic information (age and gender)?
Mimo Extended Interview

Pattern of Communication (pre prototype communication)

1. Tell me about your family and how you guys communicate? Which member of your family does live apart from you?
   - How often would you say you communicate?
   - Who would you communicate with more?
   - What type of technology would you use for such connection? Tell me why?
2. When do you usually have a call or video chat with family members? Tell me a story of your usage
3. What would best describe your method of communication with your family members who are apart?
   - How long would your communication usually take? If its short why would you prefer a short communication?
4. Tell me about a time where you were not able to connect to your family member but you really needed to?
5. Tell me about your ideal fantasy method of reaching your family members?

Mimo Design (After usage of the Mimo system)

1. What do you think of the system
2. Do you think you would use it? Why or why not?
   - With whom might you use it?
   - When? Where?
3. Do you think you will be able to share an activity through the categories with family members?
   - What type of personalization would you like to see for the categories?
4. What do you think about being able to communicate through podcast like?
   - How do you feel to connect with [family member name] through their voice?
   - Do you think you can have continuous communication through Mimo asynchronous method? What would you like to see differently?
5. How would you improved this system? Explain to me through sketches

Background Question

1. Tell me about your occupation and your basic information (age and gender)?
2. Is there anything that you would like to add regarding this subject
Appendix C.

Podcast Study Flyer

Have you listened or watched a podcast?
SFU Researchers are recruiting people who have listened to or currently listen to podcasts. Our research goal is to investigate user routines around the listening of podcasts where we explore when and where people listen to podcasts, what other activities are occurring while they listen, why they choose to listen from a certain location and at a certain time, and how they learn about and share knowledge of podcasts with others. We want to use this knowledge to design new podcast-like technologies that fit within the needs and routines that users have for asynchronous media consumption.

If you are interested, we would like to interview you for up to 60 minutes about your experiences (This can be done over Skype as well). Everything you share will remain confidential.

To be eligible, you must be over the age of 18 and have listened to or currently listen to podcasts.

To return your favor and contribution, you will be given a $10 Starbucks gift card.
Appendix D.

Study Questions- Chapter Six

Section A. Semi-Structured Interview Questions (The start of the study)

I. Living over distance and its challenges
1. Where is home for you? Are you living in your home city or have you moved?
2. How many are in your household now?
3. How would you define your dynamic with (the family member)?
   - How often do you contact each other?
   - (if not mentioned yet) how are you related?
4. How long have you been away from your family member who you are participating with in this study?
5. Can you tell me more about the experiences and activities which you connect over when you are near each other?
   - How about now?
6. What are the issues and experiences that you like to share with (your family member)?
7. What are the topics that you would have talked about if you were not in different time zones?
   - Do you have a situation like this in mind which you can tell me about?
8. What do you miss about having (your family member) near you?
9. How much time do you think you put for communicating with each other weekly?
10. Do you feel as connected as you want to be with (the family member)?
11. What information do you like to be updated about (your family member)?

II. Technology knowledge and Usage
12. How do you feel about the technologies that are currently used for communication?
   - Do you feel comfortable using different types of technology?
13. What are the technologies you prefer to use to connect with each other? (Can you walk me through your usage of each)
   - Which one is your favorite method? Can you tell me why?
   - Now can you tell me which do you feel more comfortable communicating?
14. Can you tell me about the last time you had a long conversation which caused you feel closer to (your family member)?
   - How was this conversation unique which caused such feeling?
15. How much are you interested in talking over the phone?
   - Why?
16. Have you heard of podcasts?
   - How interested are you?
   - Can you walk me through your experience of listening to podcasts?
17. Would you consider yourself as a person who likes to share experiences and talk about them or would you consider yourself more as a person who rarely would talk about their experiences or would share an activity with someone?
Section B: After the First Two Weeks
1. How was your experience with each of the technology probes so far?
2. Tell me about your communication, what happened? how did it make you feel?
3. How was it different than the normal way which you connect with (the family member)?
4. Can you walk me through how you used the system for the tasks mentioned? (Repeat for each of the probes)
5. How did the each of the systems influence your communication?

Section C: Online Diary Page Content:
Recording Diary
- Please write the name of the system that you used for connecting with your family member.
- In a higher-level context, what was the audio narrative about?
- What happened that you decided to use the specific system for recording an audio narrative?
- How do you feel about the audio narrative you recorded?

Listening Diary
- Please write the name of the system that you used for connecting with your family member.
- In a higher-level context, what was the audio narrative about?
- What happened that you decided to listen to the audio narrative sent from you family member at that moment?
- How did the audio narrative made you feel?
Appendix E.

Participant’s Instruction - Chapter Six

FamilyStories
Important Note:

Thank you for participating in our study! Without your help and participation this research would not be possible! FamilyStories’ devices are all part of a running university research for studying family communication over different timezone. Our systems are all research prototypes and are built in our lab which may not be as sturdy as commercial products. You may run into technical issues while you are using them. Whenever an issue has happened, kindly let us know and we will try our best to fix them and make your experience with the technology smoother.

While using FamilyStories, feel free to use them any way you would like. Tell us about all the creative ways you thought about and used each one of them with your family member. We are very interested in knowing about your experience. We provided this as a tool for you and your family member to communicate. This study is a learning process for us to see how you would use FamilyStories in real life. So you and your experience are very important for us. You are the glue that holds everything together in this study! Thank you again for being part of this learning experience and helping us improve technologies for future families who experience living in different timezones.
What is FamilyStories?

FamilyStories are three different devices that have similar exteriors and functionality to each other named Spark, Kinetic and TimeKnot (Figure 1). The devices have five buttons that correspond to the usual controls for audio systems such as play/pause, rewind, forward, record and on and off. The technology is meant to be used by people to record an audio story and send it to a family member who also has a similar device.

They can then play back the audio story through the device. In this way, family members can share audio stories with each other. The three devices differ in terms of the features that each contain based on what we would like to learn about. For example, one of the devices can detect movement and will only play back audio if a person is moving (Kinetic). Another device only plays the messages that were sent during the same time of day in which they were recorded (TimeKnot). For example, afternoon messages can only be heard in the afternoon by the other family member. This is to simulate the same time of the day for the family members living in different time zones. The third device only stores stories for up to a week (Spark).

![FamilyStories devices: Spark, TimeKnot and Kinetic](image-url)
Internet Setup

Connect your FamilyStories (Spark, Kinetic and Timeknot) to the computer through a USB cable provided in the kit. On your laptop go to this website: https://setup.particle.io/. Click on “I already have an account”

![Particle sign up form](image)

**Figure 2.a** Click on I already have an account

Log in to the particles dev website with this username and password.
Username: _username_  password: ****

![Particle login form](image)

**Figure 2.b** Write down the username and password given
Welcome to Particle!
To get started, select a device family you would like to set up.

Figure 2. Choose Photon/ P Series
In the setup page, choose the Photon/P Series as shown in figure one. After clicking on the image you will be taken to the page shown in Figure 3. Click on "next".

Let’s set up your Photon!
Before continuing, please make sure you have the following items available:

1. Photon
2. USB power
3. WiFi connection
4. Computer

Figure 3: Second step for connecting to the internet.
Afterwards you will be asked to download a setup page click on "Continue with the local page". And save the HTML photon setup on your computer.
Download the Photon Setup File (photonsetup.html)

The file will help you securely connect your Photon to your Wi-Fi network, therefore giving it access to the internet. The downloaded version will only work once, no more than 60 minutes after it was generated. For now, the process only works in Chrome / Firefox / Opera. If you are feeling stuck, check the docs.

Figure 4
When you click on the file downloaded then a page shown in Figure 5 will open.

Step 1. Connect your computer to the Photon

1) Hold down SETUP on your Photon for 3 seconds until the LED begins blinking **dark blue**

2) From your Wi-Fi network list, connect to the one named ‘Photon-...’

![Waiting for you to connect to your Photon](image)

This is how the Wi-Fi network created by the Photon will look

Figure 5
Turn your FamilyStories device on its back. You will see a “setup” button and a “reset button”. With the device given in your kit hold on **SETUP** button on the right side show in Figure 6 for 3 seconds and when the blinking LED in the back turned into dark blue, go to your Wifi list and choose the wifi called “Photon...”.
Step 2. Connect your Photon to the Internet

To connect your Photon to the cloud, you need to give it Internet access.
When you are connected to the Photon (FamilyStories Microcontroller), the previous page will bring you to Figure 8. In this page find your internet, insert password and then click on “Next”.

Note: If you did not find your Wifi network, refresh the page several times, if the issue still exist. Push the restart button in the back of FamilyStories and start the process from the beginning.

After clicking on Next, Photon setup will take you to the next page which will take to the page shown in Figure 9. Look at the back of your device and the light that is blinking now should have turned into a Cyan color shown in Figure 10.

**Step 3. Check if your Photon connected to the Internet**

*Is your Photon breating cyan?* The process was successful, please reconnect your computer to the Internet, so you can proceed and name your device.

*Is your Photon blinking dark blue or green for a long time?* Follow the setup process again by clicking here, paying attention to the network name and password (troubleshooting).

---

**Figure 9**

---

**Figure 10**: The Cyan color means the device is connected to the internet
FamilyStories’ Buttons and Switches

All three different artifacts (Spark, Kinetic and TimeKnot) have the same five buttons and switches. From the front view you can see five buttons on top which are shown in Figure 11. These buttons are important in two modes of FamilyStories, Play mode and Record mode. You can change between the modes with the switch on the right side of FamilyStories devices as shown in Figure 12.

Figure 11: Buttons from front view
Figure 12: The three different modes of FamilyStories

Figure 13: (From left to right): Aux or headphone jack, the on/off switch and mini USB plug-in for connecting to power
**Record Mode:**

To record a story:

1- Put the switch on the side to Record Mode (shown with red arrow in Figure 14).
2- Push on the record button and release the button (shown below) and wait for the notification light to turn red (around 5 to 10 seconds).
3- When you want to finish the story and stop recording, click on the same record button and wait for the notification light to turn blue.
4- For **sending the story** click on the send button (shown with green arrow in Figure 14). The message is sent when the notification light will flash green and pale white afterwards.

Note: if you want to **cancel a recording**, click on the record button, after the notification light turned blue, click on the cancel record button (shown in blue arrow)

![Figure 14: Record mode buttons](image-url)
Play Mode:

*play*

For all features of play mode such as listening to stories, put the side switch on the play Mode (shown in Figure 12).

1- have your headphones connected to FamilyStories.
2- Push on the play button (shown in Fig. 15 in green arrow) and wait for the notification light to turn green indicating your story is playing (around few seconds)

Note: for pausing you can push the play button again

**Note:** Play mode in Kinetic starts with auto-play. In other words, you need to be active for 4 minutes until the latest track plays. You can go back to older stories by just clicking on Next and then Play in this mode.

**Note:** in Spark device Next and Previous does not work. The stories goes to the next one after each one is fully played. (The stories in this device are organized from oldest first)

**Next & Previous Stories**
- For going to the next story, click on the next button (shown below with orange arrow) which causes the notification light to turn orange (only for Kinetic and TimeKnot)

- For previous story, click on the previous button (shown below with yellow arrow) which causes the notification light to turn yellow (only for Kinetic and TimeKnot)

**Volume Up & Down**
- For raising the volume story click on the VUp button (shown in Fig. 15 with dark blue arrow), pushing the button turns the notification light into turquoise blue for several seconds.

- For decreasing the volume, click on the VolDown button (shown in Fig. 15 with light blue arrow), pushing the button turns the notification light into light blue for several seconds.
Data Mode:
Data mode is when the side switch is set on Data (figure 12). In this mode new stories will be downloaded automatically with an interval of 30 minutes. When it is connected to the internet the notification light will turn into Cyan blue and turns off or turn into a new message notification when the process was successful.

Note: if the notification light is stuck on Cyan blue for longer than 15 minutes restart your device by turning it off and then on again.
Notifications:

New Message (white)
When new messages are downloaded the notification light will turn into bright white. In Spark, the notification light pulsates as if it has a life of its own. It will dim and pulsate with lower rate until it is completely will turn off and the story will be deleted.

Active Play (pink)
In Kinetic the files will play when you have moved for a certain amount of time. The notification light in only this case will turn into pink.

Pause/Stop (dimmed white)
Notification light will turn into dim white when pause or stop is pressed.

Record (Red)
When recording is happening the light will turn red.

Stop Record (Blue)
When the recording is ended by pressing the record button again.

Cancel Record (Intense flash of Blue)
When cancel button is pushed, the notification light will turn from dimmed blue to intense blue and then turn off or show new message notification.

Play (Green)
When play button is pressed, and a file is playing.

Next Story (Orange)
When next button is pushed and there is a next story to go to, the light will turn orange.

Previous Story (Yellow)
When previous button is pushed and there is a previous story to go to, the light will turn yellow.

Data check (Cyan Blue)
When device is on datamode and is checking for updates.
### Appendix F.

**Data Analysis Codes**

<table>
<thead>
<tr>
<th><strong>Mimo Initial Codes</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Challenges</strong></td>
<td></td>
</tr>
<tr>
<td>Not real time</td>
<td>The method is asynchronous missing real time feedback</td>
</tr>
<tr>
<td>Time consuming</td>
<td>Clicking on several forms is time consuming</td>
</tr>
<tr>
<td>Much anticipation</td>
<td>The anticipation of receiving a timeshift message was too much</td>
</tr>
<tr>
<td>Talking into a void</td>
<td>Talking asynchronously can be challenging because it is hard to talk with no one present in the room</td>
</tr>
<tr>
<td>Usability issues</td>
<td>Time picking for other time zones was seen as a hard task</td>
</tr>
<tr>
<td>Hard to adapt for elderlies</td>
<td>Not intuitive and easy to follow for senior users</td>
</tr>
<tr>
<td><strong>Advantages</strong></td>
<td></td>
</tr>
<tr>
<td>Good timing</td>
<td>The time shifting was seen useful due to allowing users to pick the time for message to be sent</td>
</tr>
<tr>
<td>Schedule</td>
<td>People could create a schedule for message arrival</td>
</tr>
<tr>
<td>One-way communication</td>
<td>You can’t talk back to the person and can talk with no interruption</td>
</tr>
<tr>
<td>Reduce bad responses</td>
<td>Gives people some time to think about their responses</td>
</tr>
<tr>
<td>Close and personal</td>
<td>Something more intimate than messaging system that feels more made for this type of connection</td>
</tr>
<tr>
<td><strong>Time Shifting Feature</strong></td>
<td></td>
</tr>
<tr>
<td>Birthday &amp; greetings</td>
<td>Useful for sending greetings and birthday wishes on time</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Connecting with families in their free time</td>
</tr>
<tr>
<td>Encouraging activities</td>
<td>Encouraging elders to have a more active life so they can hear the messages</td>
</tr>
<tr>
<td>More communication</td>
<td>Connecting to family members in different time zones with more frequency</td>
</tr>
<tr>
<td><strong>Categories Restriction</strong></td>
<td></td>
</tr>
<tr>
<td>Customization</td>
<td>Allowing users to choose themselves about what they want to include</td>
</tr>
<tr>
<td>No restriction to same activity</td>
<td>People should be able to see the content of each category without restriction because for example a grandma can’t go hiking but she might interested in what her grandchildren are telling her during their hike</td>
</tr>
<tr>
<td>Podcast Initial Codes</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>When and Where</strong></td>
<td></td>
</tr>
<tr>
<td>Driving</td>
<td>While people are driving in the car</td>
</tr>
<tr>
<td>Public transportation</td>
<td>While people are commuting using sky train</td>
</tr>
<tr>
<td>Dog walking</td>
<td>When taking dog for a walk outside</td>
</tr>
<tr>
<td>Doing boring chores</td>
<td>When people are trying to make a job feel less of a chore and more interesting, they tend to use podcast for making the situation more interesting</td>
</tr>
<tr>
<td>Gym</td>
<td>While engaging in a physical activity</td>
</tr>
<tr>
<td>Hotel</td>
<td>When the internet was an issue in places such as hotel rooms</td>
</tr>
<tr>
<td>Painting</td>
<td>For inspiration about the atmosphere of a painting</td>
</tr>
<tr>
<td>Cooking</td>
<td>While making food yet wanting to listen to something</td>
</tr>
<tr>
<td>Relax</td>
<td>When in mood for relaxing</td>
</tr>
<tr>
<td><strong>Things people hate</strong></td>
<td></td>
</tr>
<tr>
<td>Boring hosts</td>
<td>It was important for people that the host was engaging</td>
</tr>
<tr>
<td>Low audio quality</td>
<td>Quality played a major role in people’s desire to listen</td>
</tr>
<tr>
<td>Low in content</td>
<td>Content had to be something interesting and hard to find just by one google search</td>
</tr>
<tr>
<td><strong>Multitasking</strong></td>
<td></td>
</tr>
<tr>
<td>Meditation</td>
<td>Sometimes podcast was listened when people wanted to meditate</td>
</tr>
<tr>
<td>Chores</td>
<td>People listened to podcast during doing laundry, cooking, washing dishes etc.</td>
</tr>
<tr>
<td>Physical activity</td>
<td>Sometimes podcasts are listened at the gym or during walking or physical activities</td>
</tr>
<tr>
<td>Gardening</td>
<td>Podcast was listening while doing gardening, helping with relaxing while engaging in the activity.</td>
</tr>
<tr>
<td><strong>Sharing and Listening with Other</strong></td>
<td></td>
</tr>
<tr>
<td>Individual connectivity</td>
<td>The connection to the podcast was most of the time an individual connectivity</td>
</tr>
<tr>
<td>Listening alone</td>
<td>Participants liked to listen to podcasts in their “me” time</td>
</tr>
<tr>
<td>Share on social media</td>
<td>Participants often shared Podcasts on social media or talked about what they’ve learned in social gatherings</td>
</tr>
<tr>
<td>Weird sharing the experience</td>
<td>Weird to listen with someone because their connection with host was special and they didn’t want to share it</td>
</tr>
<tr>
<td>Similar to reading time</td>
<td>Often it was mentioned it is similar to reading time an individual activity</td>
</tr>
<tr>
<td><strong>Privacy Concerns</strong></td>
<td></td>
</tr>
<tr>
<td>Stream vs. Download</td>
<td>Rather download than stream due to online privacy avoiding system collecting data</td>
</tr>
<tr>
<td>Taboo Content</td>
<td>People liked to learn about what might have been taboo in their culture, but they still wanted it to be private action</td>
</tr>
<tr>
<td>Guilty pleasures</td>
<td>Sometimes participants liked to listen to something that they did not feel comfortable sharing since it was their guilty pleasures</td>
</tr>
<tr>
<td>Self help</td>
<td>Sometimes participants listened to podcast for improving their weak points and privacy was important for them.</td>
</tr>
<tr>
<td>Difference of content based on the work people are doing</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>At home</td>
<td></td>
</tr>
<tr>
<td>Often at home they listened to whatever they liked</td>
<td></td>
</tr>
<tr>
<td>At work</td>
<td></td>
</tr>
<tr>
<td>At work podcasts were often just music podcasts</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Common cause of repeating a podcast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meditation</td>
</tr>
<tr>
<td>People often repeat an inspirational or spiritual podcast to meditate and make them feel better</td>
</tr>
<tr>
<td>Mystery &amp; crime podcast</td>
</tr>
<tr>
<td>Sometimes people tend to listen to mystery podcasts several times to understand the case better.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What podcasts are worth listening to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique information</td>
</tr>
<tr>
<td>Information that are not easy to come by and collect in person.</td>
</tr>
<tr>
<td>Out of the box content</td>
</tr>
<tr>
<td>Content that you can not find anywhere like why a country is selling their drinking water</td>
</tr>
<tr>
<td>Expertise</td>
</tr>
<tr>
<td>Listening to expert whom know everything regarding a subject</td>
</tr>
<tr>
<td>Personal stories</td>
</tr>
<tr>
<td>Interesting stories about individuals that is valuable to listen to or they are just entertaining to hear.</td>
</tr>
<tr>
<td>Name</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td><strong>Audio as the Medium</strong></td>
</tr>
<tr>
<td>Freedom and no interruption</td>
</tr>
<tr>
<td>Pattern of answering</td>
</tr>
<tr>
<td>Richness of the sound</td>
</tr>
<tr>
<td>Special to Benjamin and Joyce Case</td>
</tr>
<tr>
<td><strong>Effects of Being an Artifact</strong></td>
</tr>
<tr>
<td><strong>First Impressions</strong></td>
</tr>
<tr>
<td>First excitements</td>
</tr>
<tr>
<td>Get it while its fresh!</td>
</tr>
<tr>
<td>Least effort for listening is appreciated</td>
</tr>
<tr>
<td><strong>Results</strong></td>
</tr>
<tr>
<td>Differences of the three</td>
</tr>
<tr>
<td>Longevity</td>
</tr>
<tr>
<td><strong>Kinetic</strong></td>
</tr>
<tr>
<td>Auto-Play</td>
</tr>
<tr>
<td>Focused attention</td>
</tr>
<tr>
<td>Going out</td>
</tr>
<tr>
<td>Calmness of doing an activity and listening</td>
</tr>
<tr>
<td>Cheering while commuting</td>
</tr>
<tr>
<td>Longer walk until it activates</td>
</tr>
<tr>
<td>No pressure not urgent but worthy to listen to</td>
</tr>
<tr>
<td>User friendly and mobile</td>
</tr>
<tr>
<td><strong>Spark</strong></td>
</tr>
<tr>
<td>Ambient notification</td>
</tr>
<tr>
<td>Embodiment of romantic partner</td>
</tr>
<tr>
<td>Emotional use of Spark</td>
</tr>
<tr>
<td>Excitements at the spot</td>
</tr>
<tr>
<td>Happy and Sparkly</td>
</tr>
<tr>
<td>Interesting examples</td>
</tr>
<tr>
<td>Trivial and light</td>
</tr>
<tr>
<td>No pressure, but I'm thinking about you!</td>
</tr>
<tr>
<td><strong>TimeKnot</strong></td>
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<tr>
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<tr>
<td><strong>Benefits</strong></td>
</tr>
<tr>
<td><strong>Anticipation</strong></td>
</tr>
<tr>
<td><strong>Letter</strong></td>
</tr>
<tr>
<td><strong>No time calculation</strong></td>
</tr>
<tr>
<td><strong>Syncing up</strong></td>
</tr>
<tr>
<td><strong>Awkwardness removed</strong></td>
</tr>
<tr>
<td><strong>What happens when urgency is removed?</strong></td>
</tr>
<tr>
<td><strong>Challenges with TimeKnot</strong></td>
</tr>
<tr>
<td><strong>Short time Window</strong></td>
</tr>
<tr>
<td><strong>Time shift is hard to imagine</strong></td>
</tr>
<tr>
<td><strong>Message Context for TimeKnot</strong></td>
</tr>
<tr>
<td><strong>Celebratory messages</strong></td>
</tr>
<tr>
<td><strong>Moments I wish you were next to me</strong></td>
</tr>
<tr>
<td><strong>Wish good night and good mornings</strong></td>
</tr>
<tr>
<td><strong>Suggestions</strong></td>
</tr>
<tr>
<td><strong>Social Interactions and Consequences</strong></td>
</tr>
<tr>
<td><strong>Placement in home</strong></td>
</tr>
<tr>
<td><strong>Privacy</strong></td>
</tr>
<tr>
<td><strong>Shyness regarding using it in public</strong></td>
</tr>
<tr>
<td><strong>Special Value</strong></td>
</tr>
<tr>
<td><strong>Exclusivity</strong></td>
</tr>
<tr>
<td><strong>Representative</strong></td>
</tr>
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