Patterns of Domestic Video Mediated Communication

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In

Computer Science and Applications

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Abstract

Families have a basic need to stay connected to each other. When families are separated by distance, they turn to communication technologies to stay connected with loved ones. However, most technologies do not provide the same feelings of connectedness that one feels from seeing loved ones. This dissertation explored the *design* and *use* of video-based technologies to allow families to communicate and remain connected across distance.

The first part of this dissertation explored families' use of video mediated communication (VMC) systems and focused on determining design factors that are critical for its successful adoption. This research was conducted in three phases.

Phase 1 explored families' use of a current VMC system, namely video conferencing, to uncover *how* and *why* families' use this technology to communicate with loved ones. An interview study led to findings about families' communication practices using video conferencing systems. These included initiating communication using other technologies prior to engaging in a video call, and sharing activities in each other's homes. Design recommendations that emerged from this study highlight the need for mechanisms in VMC systems that allow families to easily initiate communication and easily share everyday life.

In Phase 2, design recommendations from Phase 1 were used to design and implement a dyadic VMC system with always-on video called the Family Window (FW). A field evaluation of the system uncovered a mix of practices, some similar to the use of video conferencing systems, for example to share activities, and some new practices that were made possible by the always-on video system. Design recommendations from this field evaluation highlight the importance of dedicated displays, mobility, and privacy controlling mechanisms. In Phase 3, design recommendations from the evaluation of the FW were used to design, implement, and evaluate a multifamily VMC system with called Family Portals.

The second part of this dissertation describes the codification of families' *communication and awareness practices* using VMC systems, into patterns and a pattern language. These communication and awareness practices were codified into *Patterns of Practices* that can be used as a *design tool* to design technologies for domestic communication and as a *vocabulary* to describe domestic communication practices.

Publications

Conference Papers

Judge, T.K., Neustaedter, C., Harrison, S., and Blose, A. "Family Portals: Connecting Families Through A Multifamily Media Space." In Proceedings of *ACM Conference on Computer-Human Interaction* (*CHI 2011*), Vancouver, Canada, May 2011, ACM. Pgs. 1205-1214. *Acceptance rate 26%.*

Judge, T.K., Neustaedter, C., and Kurtz, A. "The Family Window: The Design and Evaluation of a Domestic Media Space." In Proceedings of *ACM Conference on Computer-Human Interaction (CHI 2010)*, Atlanta, Georgia, April 2010, ACM. Pgs. 2361-2370. Acceptance rate 22%. Received an "Honorable Mention". Awarded to top 5% of accepted papers.

Judge, T.K., and Neustaedter, C. "Sharing Conversation and Sharing Life: Video Conferencing in the Home." In Proceedings of *ACM Conference on Computer-Human Interaction (CHI 2010)* Atlanta, Georgia, April 2010, ACM. Pgs. 655-658. Acceptance rate 22%.

Short Papers with Videos

Neustaedter, C., and **Judge, T.K.** "Peek-A-Boo: The Design of a Mobile Family Media Space." In Adjunct Papers of ACM *International Conference on Ubiquitous Computing* (*UBICOMP 2010*), Copenhagen, Denmark, September 2010, ACM. Pgs. 449-450. *Acceptance rate 63%.*

Neustaedter, C., **Judge, T.K.**, Kurtz, A., and Federovskaya, E. "The Family Window: Connecting Families over Distance with a Domestic Media Space." In Video Proceedings of *ACM Conference on Computer Supported Cooperative Work* (*CSCW 2010*), Savannah, Georgia, February 2010, ACM.

Organized Workshop

Neustaedter, C., **Judge, T.K.,** Harrison, S., Sellen, A., and Cao, X. "Connecting Families: New Technologies, Family Communication, and the Impact on Domestic Spaces." In Proceedings of *ACM Conference on Supporting Group Work* (*GROUP 2010*), Sanibel Island, Florida, November 2010, ACM. Pgs. 363-366.

Technical Report

Judge, T.K., and Neustaedter, C. "The Family Window: Perceived Usage and Privacy Concerns." Technical Report TR-10-01, Dept of Computer Science, Virginia Tech, 2010.

Collaboration Acknowledgements

Like any other research endeavors, this research was conducted in collaboration with other researchers. Here, I would like to acknowledge the role of my collaborators and advisors and thank them for their help and support.

First and foremost, I would like to thank Kodak Research Labs (KRL) for funding the research in this dissertation. Part of this research was conducted during my internships at KRL and part of it was conducted with funding from a KRL research grant. I would especially like to thank Rodney Miller and Nancy Ferris from KRL for their support and for allowing me to conduct this research using Kodak facilities in Rochester, New York. Without their support, the idea of connecting families using always-on video might not have been materialized into a research prototype.

Second, I would like to thank my mentor Carman Neustaedter (formerly at KRL) for entrusting me with this research, giving me ownership over it, and helping me to successfully complete this research.

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Last but not least, I would like to thank Andrew Kurtz, Elene Federovskaya, and Andrew Blose, for their valuable feedback on this research and for supporting me during my internship at KRL.

The following describes research conducted in collaboration with Carman Neustaedter at KRL, as well as research conducted solely at Virginia Tech:

1. Video Conferencing Study (Chapter 3)

This study was conducted while I was an intern at KRL from June 2009 – August 2009. I designed the questionnaire for the interviews, recruited, and selected participants for this study. Due to time constraints, I conducted interviews with 18 participants and Carman conducted the remaining 3 interviews. I analyzed all data that was collected.

2. Design and Development of the Family Window (Chapter 4)

Carman created the initial design and implemented the first version of the Family Window in January 2009. From January 2009 to May 2009, he and his family used the first version of the Family Window and wrote about their usage on a shared blog. In June 2009, I led the redesign of the Family Window based on data from their self-usage. Carman implemented changes to the design and developed a fully functional prototype. The final version of the Family Window incorporated design ideas from both of us.

3. Field Evaluation of the Family Window (Chapter 4)

This study was conducted while I was an intern at KRL from June 2009 – August 2009. I planned and conducted the field evaluation of the Family Window in participants' homes. This involved designing the study methodology, constructing interview questions, recruiting participants, conducting interviews and observations, and analyzing data. Carman acted in an advisory role and suggested refinements to the study protocol and potential analytical perspectives to the data.

4. Design and Development of Family Portals (Chapter 5)

Following the field evaluation of the Family Window, between January 2010 and May 2010, I led the conceptualization and design of a multifamily system called Family Portals. This was done while I was at Virginia Tech. Carman developed the design into a fully functional prototype.

5. Field Evaluation of Family Portals (Chapter 5)

I planned and conducted the field evaluation of Family Portals in participants' homes. This involved designing the study methodology, constructing interview questions, recruiting participants, conducting interviews and observations, and analyzing data. All the instruments for the study (questionnaires, interview questions etc.) were created while I was at Virginia Tech. The field evaluation was conducted from May 2010 – August 2010 during my second internship at KRL. During the field evaluation, Andrew Blose aided with any technical difficulties that arose relating to the Family Portals software or hardware. Following the field evaluation, I performed the data analysis at Virginia Tech. All

members of my PhD advisory committee acted in an advisory role before, during, and after the field evaluation.

6. Patterns of Domestic Video Mediated Communication (Chapter 6)

Between January 2011 and August 2011, I performed a second iteration of data analysis and created the Patterns of Practices at Virginia Tech. My advisor and all members of my PhD advisory committee provided valuable feedback on the development of the patterns.

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ways others could not. You will always be on my speed dial. Mara, you have always cared for me like a sister and I'm glad our friendship has become stronger despite all the changes in your life. I love being Aunty Tej to your beautiful children and appreciated having a safe and loving place to escape to when I needed a break from grad school. You will always have a special place in my heart. Manas, thank you for always providing a shoulder to lean on and for helping me out of tough situations that I somehow always found myself in. You are the person I would like to be when I grow up.

My fellow ASS labbers — Laurian, Edgardo, Stacy, and Jason — thank you for being my support group and for providing me with the encouragement that I needed to persevere. I would also like to thank and acknowledge all my friends at Virginia Tech who created a warm and nurturing research environment, and made it fun to be a Hokie. These include but are not limited to Rhonda, Regis, Felipe, Uma, Sameer, Ramanujam, Meg, Hari, Sirong, Promita, Amine, Shaimaa, Ben, Michael, Burt, Bobby, Yonca, Chreston, Joon, and Christopher.

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Last but not least, I would like to thank all the families that participated in the field evaluation of the Family Window and Family Portals. I appreciate all of you welcoming me into your homes and lives and sharing your experiences with me. This dissertation would not be complete without the data that I collected from you and I am extremely grateful for that.

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To Mum and Dad,

For being with me at each step of this journey,
For believing in me when I did not believe in myself,
For supporting my ambitions and helping me achieve them…

This dissertation is yours as much as it is mine.

April 16th, 2007 – We will always remember…

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Chapter 1

Introduction

1.1 Background

People have a basic need and desire to stay connected with family and friends. This is especially true when families and friends become separated by distance (Neustaedter, et al., 2006b; Romero, et al., 2007; Tee, et al., 2009). When people are separated by distance, they typically use technology to *gain awareness* of each other's lives (Hindus, et al., 2001; Neustaedter, et al., 2006a) and to *feel connected* (Kirk, et al., 2010).

Awareness emerges from knowing details about someone's life. This includes knowing about their health, daily activities, and schedule (Neustaedter, et al., 2006a; Rowan and Mynatt, 2005). *Connectedness* on the other hand, is the *feeling* of being in touch with someone, being aware of what happens in their lives, and feeling that they care about you (Romero, et al., 2007). Feelings of connectedness can result from a phone call, mail, or any form of communication from a loved one (Rowan and Mynatt, 2005). Awareness of each other's lives can lead to feelings of connectedness (Rowan and Mynatt, 2005).

Previous research found that people use a combination of technologies including telephone, email, instant messenger (IM), and video conferencing to communicate, gain awareness about friends and families' lives, and to feel connected (Kirk, et al., 2010; Neustaedter, et al., 2006a; Tee, et al., 2009). When given a choice, people always choose the technology that is both easy for them to use and most likely to reach their social contacts (Neustaedter, et al., 2006a). For example, telephones and mobile phones are considered convenient to reach people at work or while mobile (Neustaedter, et al., 2006a; Tee, et al., 2009). Email and IM, on the other hand, are favored for situations that require asynchronous communication (Neustaedter, et al., 2006a; Tee, et al., 2009).

Studies of families' communication practices have also shown that people prefer in-the-moment sharing of information where sharing is directed at specific people (Romero, et al., 2007). In contrast, they dislike feeling obligated to send information to others (Hindus, et al., 2001; Romero, et al., 2007). Peoples' preferred mode of interaction with family and

friends is face-to-face conversation (Hindus, et al., 2001); thus, if they have the opportunity and it is convenient, people prefer to talk to someone in person where they can both see and hear each other.

Given families' needs to stay connected and gain awareness about each other's lives, numerous research prototypes have been designed to connect families by providing them with awareness information. *Abstracted awareness* information is provided by systems such as the Digital Family Portrait (Mynatt, et al., 2001) and the Intentional Presence Lamp (Hindus, et al., 2001). Systems such as these use lights and icons to convey awareness information. While beneficial for learning about activities in the remote[1] home, such abstract awareness information does not typically provide sufficient feelings of connectedness. This is because one is not able to see a remote person, and only certain awareness information is provided.

On the other hand, some systems provide *direct awareness* information through messages, photos, and/or videos (Brush, et al., 2008; Hindus, et al., 2001). People can see what has happened (e.g., in a photo or video), or be told about it directly (e.g. through a message). These systems can enhance feelings of connectedness. However, these systems are limited in terms of timeliness and interaction, because the information being shared is typically from the past and sharing may require explicit interaction with the system (e.g., pushing a button or writing a message).

This dissertation explores the design and use of video-based technology to support and expand the ways in which families communicate across distance, maintain awareness, and feel connected to each other. Since the 1980s, the use of Video Mediated Communication (VMC) systems such as media spaces, have been researched, developed and evaluated, for distributed workplaces (e.g. (Harrison, 2009; Mantei, et al., 1991; Pagani and Mackay, 1993; Sellen, et al., 1992; Whittaker and O'Conaill, 1993). These systems, specifically media spaces with always-on video and/or audio connections, were successful in connecting distance-separated colleagues by providing awareness information, which lets people easily move into communication (Bly, et al., 1993; Dourish and Bly, 1992; Gaver, et al., 1992). Despite the successful use and adoption of VMC systems in the workplace, due to assumptions about peoples' privacy concerns (Lipartito, 2003; Neustaedter, et al., 2006b;

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[1] When discussing systems that connect people in two or more homes/locations, the term "local" home/family is used to refer to the current home/family that is being discussed, and the term "remote" home/family is used to refer to the distant home/family that the "local" family is connected to using the awareness and/or communication system.

Noll, 1992) and network bandwidth issues (Hindus, et al., 2001), researchers have yet to explore the design, development, and evaluation of VMC systems for domestic use. Furthermore, even though VMC systems such as video conferencing systems have increased in prevalence and popularity, as a research community, we have not investigated their use for communication and awareness between families separated by distance.

1.2 Research Objectives

There are two objectives for the research presented in this dissertation. The objectives of this dissertation are:

> *Objective 1: To provide an understanding of families' communication and awareness practices using VMC systems.*
> *Objective 2: To provide an understanding of how to design future VMC systems to support families' communication and awareness practices.*

To narrow down the scope of this dissertation, I used domestic media spaces as a lens from which I explored the design of VMC systems for families. I define a domestic media space as an always-on VMC system that is used to connect non-collocated families and loved ones.

1.3 Research Questions

To achieve the research objectives mentioned in Section 1.2, this dissertation addresses two overarching research questions. First, when given the opportunity to connect to distant[2] family using VMC systems, *what are families' communication and awareness practices using domestic Video Mediated Communication (VMC) systems?* Second, based on families' usage of current VMC systems, *how should we design future domestic VMC systems to support families' communication and awareness practices?*

To address these interrelated research questions, I broke them into six sub-research questions surrounding families' communication and awareness practices using VMC systems as well as the design of these systems. The following are the research questions addressed in this dissertation.

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[2] In this dissertation, "distant family" is used interchangeably with "remote family." Distant family refers to a family that is not collocated with the local family.

Research Question 1: *Why* and *how* do families separated by distance currently *use* VMC systems to *communicate* and maintain *awareness* of each other's lives?

In recent years, video conferencing systems such as MSN Messenger, Skype, Google Talk, and iChat have become pervasive and are widely used in the workplace and at home. Despite the increase in the use of video conferencing system in homes, as a research community, we do not have a good understanding of *why* and *how* people have adopted this technology to communicate with their distant family. By learning *why* families use video conferencing systems in their home and *how* they use it, we will be able to understand families' communication and awareness practices. We will also be able to learn about families' communication and awareness needs' that are not being fulfilled by current video conferencing systems.

Research Question 2: How should *dyadic domestic media spaces* **be** *designed* **to support families' communication and awareness practices?**

An always-on media space is a progression of video conferencing, which typically involves short, planned, or impromptu video calls. Understanding families' video conferencing practices and uncovering communication needs that are not being fulfilled by current systems, will allow us to design future domestic communication technologies to support these practices and needs. Within this design space, I will apply the knowledge of families' video conferencing practices to the design of dyadic media spaces with always-on video.

Research Question 3: What *communication and awareness practices* **will emerge from families' use of** *dyadic media spaces* **in their homes?**

Given that media spaces with always-on video have not been designed and evaluated in real homes, we do not know what communication and awareness practices will emerge from their use. Will these be similar to current video conferencing practices, will new behaviors and practices emerge, or will the use of the media space be fraught with too many privacy concerns, thus prohibiting its usefulness? An understanding of the behaviors and practices that emerge from families' usage of the system will allow us to inform the design of the domestic media spaces, and more generally, domestic communication technologies.

Research Question 4: How should *multifamily media spaces* be *designed* to support families' communication and awareness practices?

Multiparty media spaces were used in the workplace to facilitate collaboration and to create a shared workspace (Dourish and Bly, 1992; Sellen, et al., 1992). These media spaces were successfully used to connect colleagues who were distributed across sites. Naturally, families would also want to connect with more than one remote household. Hence, it is important to investigate how media spaces can connect multiple households (beyond just two households that can be connected using a dyadic media space). Since multiparty media spaces have not been designed or evaluated for families, we do not know families' multiparty communication and awareness practices and needs. We also do not know how to design multifamily media spaces. More specifically, will families' needs and the design of a multifamily media space be similar to that of a dyadic media space or be altogether different? And will families have similar privacy concerns to those of a dyadic media space or will different privacy problems evolve from the use of a multifamily media space?

Research Question 5: What *communication and awareness practices* will emerge from families' use of *multifamily media spaces* in their homes?

Since multifamily media spaces have not been designed or evaluated in real homes, we do not know what communication and awareness practices will emerge from its use. Will these be similar to practices that evolve from the use of multiparty workplace media spaces, dyadic domestic media spaces, or will new behaviors and practices emerge? Furthermore, will families find a multifamily media space intrusive, and if so, will it affect their use of the system? An understanding of the behaviors and practices that emerge will allow us to inform the design of multifamily media spaces, and more generally, multifamily domestic communication technologies.

Research Question 6: How should families' *communication and awareness practices* using VMC systems be *codified* into an easily accessible design tool?

The previous research questions explored the design of VMC systems as well as communication and awareness practices that emerge from families' use of these systems. Given that there is no framework or repository within HCI literature that defines and codifies domestic video mediated communication and awareness practice, the final research

question in this dissertation addresses this problem. After learning about families' communication and awareness practices, how should we codify this knowledge to enable it to be used as a *vocabulary* to describe communication practices and as a *design tool* to design technologies for domestic communication?

1.4 Research Approach

The research approach in this dissertation is divided into two parts. Part I investigates the design of domestic VMC systems as well as the communication and awareness practices that emerge from families' use of these systems. Part II describes the codification of domestic communication and awareness practices from Part I, into Patterns of Practices. Figure 1.1 summarizes the research approach taken in this dissertation.
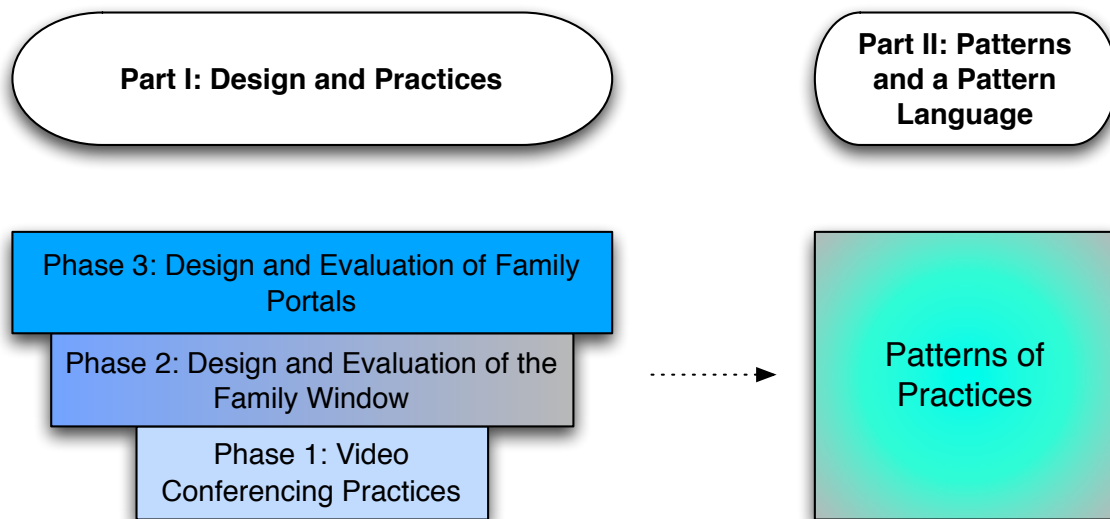
Figure 1.1: Outline of research approach.

1.4.1 Part I: Design and Practices

Part I of this dissertation involves three phases. Each phase replicates and extends findings from the previous phase. Table 1.1 summarizes the research questions and research approach in each phase.

Phase	Research Question	Approach
Phase 1	RQ 1: *Why* and *how* do families separated by distance currently *use* VMC systems to *communicate* and maintain *awareness* of each other's lives?	Interview participants about their video conferencing practices (Chapter 3).
Phase 2	RQ 2: How should *dyadic domestic media spaces* be *designed* to support families' communication and awareness practices?	Design and implementation of a dyadic domestic media space called the Family Window (Chapter 4).
	RQ3: What *communication and awareness practices* will emerge from families' use of *dyadic media spaces* in their homes?	Field evaluation of the Family Window with six families (Chapter 4).
Phase 3	RQ 4: How should *multifamily media spaces* be *designed* to support families' communication and awareness practices?	Design and implementation of a multifamily media space called Family Portals (Chapter 5).
	RQ 5: What *communication and awareness practices* will emerge from families' use of *multifamily media spaces* in their homes?	Field evaluation of Family Portals with six families (Chapter 5).

Table 1.1: Outline of research questions and approaches in Part 1: Design and Practices.

Phase 1: Video Conferencing Practices in Homes

I planned and conducted interviews with 21 individuals to understand why and how they currently use video conferencing in their home. These interviews allowed me to gain an understanding of families' current video conferencing practices in the home. I was also able to learn about communication and awareness needs that are not being fulfilled by current video conferencing systems. Findings from this study led to design recommendations for VMC systems and other domestic communication technologies. This study is presented in Chapter 3.

Phase 2: Design and Evaluation of the Family Window

Next, I designed a dyadic domestic media space called the Family Window using the design recommendations in Part 1. The Family Window was designed using an iterative design approach. The system was evaluated in homes of two families for six months and in the homes of four additional families for a period of five weeks. The design of the Family Window, description of the field evaluation, and findings from the evaluation are presented in Chapter 4.

Phase 3: Design and Evaluation of Family Portals

Based on the design recommendations from Phase 1 and Phase 2, I designed a multifamily media space called Family Portals. Family Portals was evaluated in homes of six families for two months. The design of Family Portals, description of the field evaluation, and findings from the evaluation are presented in Chapter 5.

1.4.2 Part II: Patterns and a Pattern Language

In Part 2 of the dissertation, I discuss the creation of Patterns of Practices and a pattern language. Part 2 addresses the following research question,

RQ 6: How should families' communication and awareness practices using VMC systems be codified into an easily accessible design tool?

The Patterns of Practices introduced in this chapter codify domestic video mediated communication and awareness practices from Part 1 of this dissertation. The patterns and pattern language are presented in Chapter 6.

1.5 Methodological Approach

This section describes the methodological approach used to address the research questions described in Section 1.3 and to fulfill the objectives of this dissertation.

Qualitative research and data analysis methods were the primary methods used in this dissertation. I used qualitative methods instead of quantitative methods, because I wanted to understand *how* families use VMC systems and *what* communication and awareness practices emerge from the use of these systems. According to Creswell, quantitative methods

are suitable for research that seeks to answer *why* questions instead of *how* and *what* questions. Quantitative methods are also useful for discovering relationships between various factors but are not able to explain these findings (Creswell, 2003). On the other hand, qualitative methods help explain the observed phenomena (Charmaz, 2006). This makes qualitative inquiry a suitable method to address the research questions in this dissertation.

1.5.1 Data Collection and Analysis

The primary data collected method was through interviews and contextual inquiry, I used semi-structured interview questions and performed contextual inquiry in participants' homes (Beyer, 1998) to learn about participants' experience, practices, and feedback about their use of domestic VMC systems. When possible, I also observed participants using VMC systems, took copious notes during the observations, and used these notes to create thick descriptions of the observed phenomenon (Charmaz, 2006).

Data that was collected was analyzed using open coding (Charmaz, 2006), axial coding (Charmaz, 2006), selective coding (Charmaz, 2006), and affinity diagramming (Holtzblatt, 2005). Figure 1.2 shows the steps used to analyze data in Part I (Phase 1, 2, and 3) using open coding, axial coding, and selective coding.
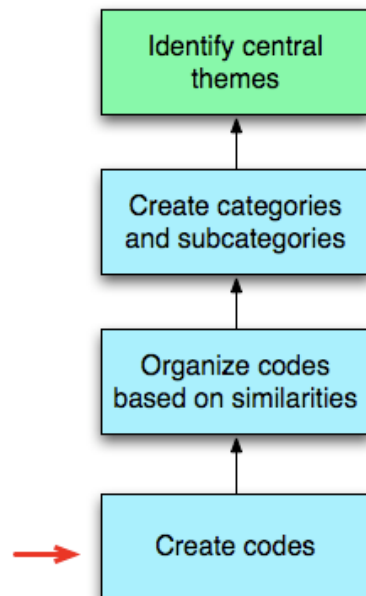
Figure 1.2: Qualitative data analysis method used in Part 1: Design and Practices.

Open coding was used to analyze interview and observation data and to draw out key themes from the data. Each unit of data (e.g. quote, paragraph, sentence) was described using a descriptive label or code. Subsequent units of data were compared to the existing codes. Data that was described by an existing code was labeled using that code and data that did not fit existing codes was given a new code. Through the process of axial coding, codes were then organized into relevant categories and subcategories based on similarities and differences in the codes. Finally, selective coding was used to draw out the central themes in the data. After the completion of Part I, themes from Part I were combined to create Patterns of Practices in Part II. Figure 1.3 summarizes the complete data analysis method that was used in Part I and Part II of this dissertation.
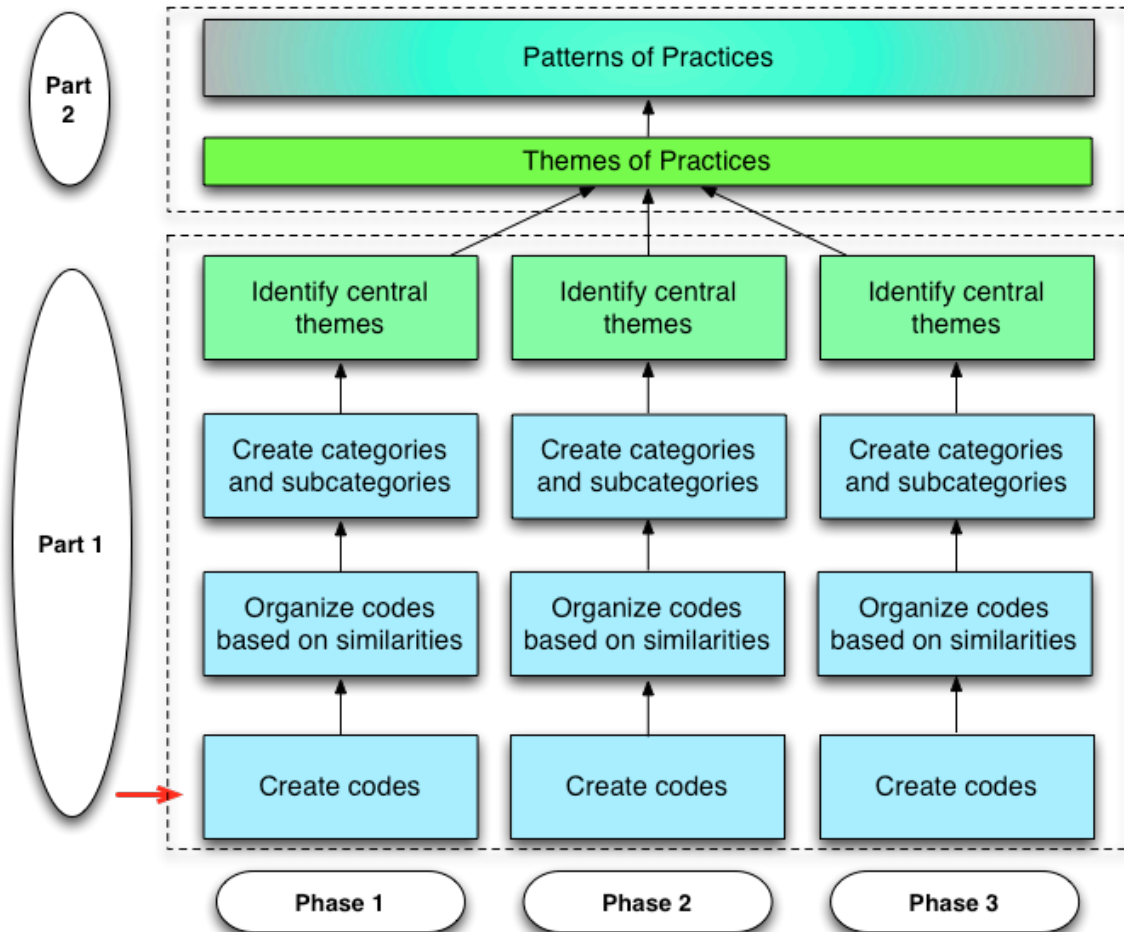
Figure 1.3: Qualitative data analysis method used in Part 1: Design and Practices and Part 2: Patterns and Pattern Language.

1.5.2 Validating Findings

I validated qualitative findings from Part I and Part II of this research using a two-step process. First, I used triangulation to increase the validity of the interviews that I conducted with participants (Charmaz, 2006). I triangulated my findings by interviewing different members of a household separately and comparing their responses. I also compared interview responses and findings between participants in different households who were connected using a VMC system. Second, I reflected on my personal biases and assumptions before beginning the data analysis for each study (Charmaz, 2006). After analyzing data from a study, I reflected on the findings to ensure that the results are based on the data that was collected and not influenced by my biases and assumptions. I also compared my findings to the existing literature on domestic communication and domestic awareness systems to compare and contrast my findings to the existing. In addition to these steps, I also presented results from these studies to colleagues and other researchers in the field and used their feedback and interpretations to further reflect on the findings. Together, both these steps have increased my confidence of the internal validity of my findings.

1.6 Overview of Dissertation

This section provides an overview of the chapters in this dissertation.

Literature Review

Chapter 2 discusses existing literature that this research draws from. The chapter presents an overview of domestic communication technologies used by families, including domestic awareness systems, domestic media spaces, and video conferencing. The chapter also discusses prior work on workplace media spaces.

Part I: Design and Practices

Chapter 3 presents the study of video conferencing practices between families. Findings from this study were used to design a dyadic domestic media space called the Family Window. Chapter 4 describes the design of the Family Window and presents results from the field evaluation. The final study in Part I is presented in Chapter 5. The chapter describes

the design of a multifamily domestic media space called Family Portals and presents results from the field evaluation.

Part II: Patterns and Pattern Language

Chapter 6 describes the creation of Patterns of Practices and a pattern language that codifies domestic video mediated communication and awareness practices.

Conclusion

And finally in Chapter 7, I summarize findings from Part I and Part II and discuss contributions of this research. I conclude this dissertation by sharing my thoughts and reflections about the use of VMC systems in peoples' homes.

Chapter 2

Literature Review

2.1 Introduction

This chapter presents an overview of existing literature on domestic communication and work place media spaces. Section 2.2 starts with a summary of technologies used by families over the last two centuries to communicate with one another. This is followed by an overview of current domestic awareness systems, domestic media spaces, and usage of video conferencing in the home. Section 2.3 describes workplace media spaces. These media spaces include media spaces for workplace awareness, media spaces for collaborative work, and ludic media spaces. Section 2.3 ends with an overview of privacy concerns that result from the use of media spaces as well as privacy protection strategies that were developed to overcome these concerns.

2.2 Domestic Communication

2.2.1 Communication Between Families

Families have used many modes of communication over the years – from postal mail to telegraphs to telephones in the 19th century. Before the advent of postal mail in Great Britain, footservants were used to deliver messages, announce social calls, and deliver invitations between households (Pool, 1977). With the introduction of the Penny Post in Great Britain, postal mail became the most pervasive and affordable means of communication between families and friends (Pool, 1977). Similarly, postal mail, and later telegraphs, was also broadly used in the United States as both were affordable and allowed families to keep in touch over distance (Melius, 1917). However, when given the choice, families and friends preferred face-to-face interactions (Laski, 1964; Pool, 1977).

When the telephone was invented by Alexander Graham Bell in 1876, this technology was first incorporated into businesses in the United States and over time, as people saw its potential for domestic communication, it was incorporated into homes

(Casson, 1910). Interestingly enough, the telephone was not considered a means of communication between households in Great Britain until the mid 20th century because of privacy concerns related to its use (Perry, 1977). The telephone "…usually inconveniently located in the flower room, in a corner of the hall, or in a lobby between the smoking-room and the gentleman's lavatory, was seldom used for chats" (Laski, 1964). According to Perry (1977), the telephone may have been "… too direct and an abrupt means of communication" to be fully accepted. The telephone was not easily worked into the etiquette of the Edwardian society even by those who owned it, because social "calls" meant visiting at a certain hour of the day and announcing one's arrival before visiting. Telephones, on the other hand, allowed the impingement of one's privacy by allowing calls to be made at any time of the day without prior notice (Perry, 1977).

In the 1960's AT&T created the Picturephone to allow people to see each other while communicating. Early picture-phones failed from many factors including privacy concerns, cost, and market timing (Lipartito, 2003). In the late 20th century and early 21st century, the Internet provides families with more ways to communicate. Families use a combination of technologies including telephones, email, instant messenger (IM), and video conferencing (Neustaedter, et al., 2006a; Tee, et al., 2009). Although families have the option of choosing from multiple technologies to communicate, the choice of technology more often than not depends on the closeness of the relationship. Boase's survey of 2,200 families in the Unites States revealed that people preferred face-to-face communication and landline phones to communicate with close family members and loved ones (Boase, 2008). Although face-to-face communication requires substantial time and effort, "… the rich amount of information and emotional exchange that in-person communication affords may make it a necessary way of staying connected…" (Stern, 2008). Researchers also found that online communication was not a preferred mode of interaction with close family members (Boase, 2008; Kavanaugh, et al., 2006). Online communication such as instant messenger and email was instead used to interact with friends, acquaintances, and relatives (Kavanaugh, et al., 2006).

In recent years we have seen people migrate to using social networking sites such as Facebook or Twitter to remain connected to a multitude of friends and family members all at the same time (Barkhuus and Tashiro, 2010; Joinson, 2008; Lampe, et al., 2006; Lampe, et al., 2008). Studies of college students have shown that users can, in theory, keep track of

hundreds of contacts through one system by monitoring status messages, wall posts, and uploaded media, a process labeled as *social searching* (Lampe, et al., 2008). Again, this is beneficial, however, I hypothesize that such sites do not provide family members with true feelings of intimacy and closeness given the large number of contacts that one can follow and the broadcast nature of the information being exchanged.

The availability of multiple modes of communication has helped families stay in touch over distance; however, there may also be a downside. For instance, a phenomenon called the "helicopter parent" is now prevalent on most college campuses. The "helicopter parent," or hovering parent, tries to control, manage, and intervene on his or her child's life by constantly checking up on them using mobile phone, text messaging, and email (White, 2005). Parents are now much more involved in the minute-by-minute lives of their children using these technologies. Interestingly enough, when these parents were in college, it was not possible for their parents to do the same, as there was typically only a pay phone located in each college dormitory (White, 2005).

2.2.2 Domestic Awareness

Besides communicating with non-collocated family members, research has shown that people have a need to gather an awareness of distant families' or close friends' activities, locations, and statuses (e.g., health) (Mynatt, et al., 2001; Neustaedter, et al., 2006a; Romero, et al., 2007; Tee, et al., 2009). Knowledge of this can help people coordinate or simply feel more connected to their loved ones (Mynatt, et al., 2001; Neustaedter, et al., 2006a). This type of awareness is most often shared through conversation, e.g., in email, on the phone, in person (Neustaedter, et al., 2006a; Tee, et al., 2009). Various research prototypes have also been designed to provide remote families with awareness. These range from systems that provide *abstracted awareness* information (described in Section 2.2.2.2) to systems that provide *direct awareness* information (described in Section 2.2.2.3).

2.2.2.1 Model of Interpersonal Awareness

Neustaedter et al. (2006) classified awareness in the domestic realm as *interpersonal awareness*, because "… awareness in the domestic realm is focused on existing interpersonal relationships." Their model of interpersonal awareness describes three social groupings that

determine peoples' needs for awareness and a breakdown of interpersonal awareness information that people seek in their social groupings (Neustaedter, et al., 2006a).

The three social groupings defined by Neustaedter et al. (2006) are home inhabitants, intimate socials, and extended socials. *Home inhabitants* are people with whom one lives and include significant others, family members, and roommates. Home inhabitants typically have a strong need to maintain daily awareness of each other. *Intimate socials* are people with whom one has a close relationship but does not live with. Examples include immediate family members such as siblings and parents as well as close friends. People in this group have a strong desire for awareness of each other's lives. Finally, *extended socials* are people with whom one has a more casual relationship. This includes friends, coworkers, and relatives. Extended socials' need for awareness of each other's lives is more discretionary and highly dependent on the individual.

Peoples' needs for awareness information falls into three interrelated categories (Neustaedter, et al., 2006a).

Location. Home inhabitants want to know detailed location information about the whereabouts of cohabitants as well as knowledge of where they plan to be each day. This is important for scheduling events and coordinating activity. Intimate socials also want similar location information but with lesser detail. They typically want location information every few days and this awareness is often of past or upcoming locations. Extended socials want even less details about location and may only be interested in one's location during special circumstances such as vacation.

Activity. People want to know about the daily activities and upcoming plans of their home inhabitants. Intimate socials want details about past or upcoming social or work activities, rather than knowledge of current activities. The exception is teenagers or significant others who did not live together and want current knowledge of the availability of their intimate social. Extended socials want activity information at an even higher level such as getting a new job or moving.

Status. For home inhabitants, status awareness involves knowing how one feels about different aspects of their lives, knowing how healthy one is, and knowing about personal relationships. Intimate socials desire the same status information but typically only about selected activities or health information. For extended socials, most people primarily want to know status information about health changes.

2.2.2.2 Abstract Awareness Systems

Abstract awareness systems use lights, icons, scents, movements, and other similar cues to provide awareness information. These systems are typically not intrusive and provide only selected awareness information. These systems are also *dyadic*; only providing awareness information between two households or locations.

Systems such as the Digital Family Portrait, Aurama, and CareNet Display were designed to provide adult children with peace of mind and a sense of connectedness with their elderly parents who live by themselves. The Digital Family Portrait (Mynatt, et al., 2001) showed the activity levels of an elderly family member in his or her home by using lights and icons around the border of a digital picture frame. Aurama (Dadlani, et al., 2010) monitored elderly parents in their home and displayed data about their sleeping patterns, weight trends, and cognitive abilities, to their children or caregivers. The CareNet Display (Consolvo, et al., 2004) was an interactive digital picture frame that augmented a photograph of an elder with information about his or her daily life and provided mechanisms to help the local members of his or her care network (such as neighbors or children who live close by) coordinate care-related activities. It provided information about medication, activities, meals, mood, falls, and calendar items.

Strong and Gaver (1996) created three systems that provide awareness information and support intimacy. The first system, Feather, was designed for couples in situations where one partner is travelling while the other remained at home. The purpose of the system was to indicate, simply and expressively, when the travelling partner was thinking of his or her remote partner. Lifting a photo frame in one location caused a feather in the other location to float. In the second system, Scent, picking up and holding a picture frame resulted in a scent filling the remote home. This, again, indicated that one person was thinking of the other. The third system, Shaker was designed for less intimate relationships (e.g., friendships) and more symmetrical communication. When one device was shaken, the other device, which was in a different location, also shook. A Shaker could be an object of any form or size that was easy for someone to carry around with them. The aim was to encourage entertaining and lighthearted play among friends (Strong and Gaver, 1996).

Familyware (Go, 2000) was also designed for awareness information and intimacy. It was defined as "… a group of computer-supported communication tools to communicate feelings to another person anytime and anywhere, but privately and without disturbing

him/her" (Go, 2000). Two Familyware prototypes were designed to meet this goal. The first prototype was a teddy bear that a child could play with while his or her parents are at work. When the child shakes the teddy bear, a pop up window showed the child's image on the parents' computer. This let the parents know that the child was thinking about them. The second prototype was a necklace that one could touch while thinking about the remote person and the remote person would feel their necklace getting warm.

Other systems such as the Remote Presence Lamp (Tollmar and Persson, 2002) and International Presence Lamp (Hindus, et al., 2001), allowed a family to know when their family in a remote location was home. A family could indicate that they were home by turning on the lamp and this presence information was displayed on the lamp in both the local and remote homes.

2.2.2.3 Direct Awareness Systems

Some systems provide *direct awareness* information through messages, photo sharing, or a combination of both. This means that the awareness information is not abstract. People can see what has happened (e.g., in a photo or video) or be told about it directly.

Systems such as CommuteBoard and messageProbe allowed families to use messaging to share awareness information. CommuteBoard (Hindus, et al., 2001) allowed carpoolers to coordinate rides each morning. It was a shared whiteboard between two households and was used to replace early morning phone calls between homes with handwritten messages. MessageProbe (Hutchinson, et al., 2003) allowed distributed families to communicate using digital Post-It notes. Families used it synchronously, by writing and drawing at the same time, or asynchronously, by checking it periodically for new messages from other households. MessageProbe was used by families to share daily updates and leave status messages in playful ways such as drawing pictures for each other.

Other systems such as ScanBoard, ASTRA, SPARCS, and Wayve allowed families to share information in multiple ways. ScanBoard (Hindus, et al., 2001) was a follow up to CommuteBoard and allowed family and friends to interact with a shared message board. It allowed households to share writing, drawings, and digital artifacts such as pictures and newspaper clippings. ASTRA (Markopoulos, et al., 2004) connected households and mobile family members. Mobile family members used their cell phones to take pictures and share information about their day with members of their household. Members of the household

could see the pictures and messages on a display placed in the home. SPARCS (Brush, et al., 2008) allowed distributed family members to share photos and calendar entries. Every day, SPARCS proposed a sharing suggestion: a set of family photos to choose from and a few upcoming calendar events to inform others what is going on in the family's life. More recently, a system called Wayve (Lindley, et al., 2010), was created to support drawing and messaging between multiple families.

Among all the systems described in this section, only two provided awareness information between multiple families – messageProbe and Wayve. All the other systems were dyadic.

2.2.3 Domestic Media Spaces

In recent years, several media spaces were created for the home. However, none of these systems used always-on video to connect families for an extended period of time or to allow them to easily share their everyday lives.

Hindus et al. (2001) created a concept called RoomLink, which provided an always-on audio connection between two households. They also created a concept called KitchenNet, which provided a video link between two households. Both concepts were intended to help families feel more connected by allowing them to easily communicate or see each other during the day. These concepts were not developed into prototypes but were used in focus groups to gain feedback from participants. This feedback was used to design other domestic awareness systems (e.g. ScanBoard which is described in Section 2.2.2.3).

VideoProbe (Conversy, et al., 2003) captured images of activity in front of a camera and transmitted these to a remote family's display. Families enjoyed the ability to share images, routinely tried to capture themselves in front of the camera, and learned about each other's daily life by looking at the images. Yet at times, privacy was an issue and resulted in families turning the camera to face a wall.

Neustaedter et al.'s (2003) home media space connected telecommuters to office-based colleagues, however, this system was not designed to support family communication. Their home media space provided users with implicit and explicit control over their privacy. The media space also provided visual and audio feedback of the privacy level being maintained.

Several media spaces were created to support interactions over short durations, akin to phone calls. For example, Share Table (Yarosh, et al., 2009) and Family Story Play (Raffle, et al., 2010) both aimed to support families participating in specific activities with each other (e.g., reading, playing). In contrast to the other systems described in this section, Share Table and Family Story Play allowed families to see each other and feel connected but these systems do not support sharing everyday life (e.g. household activities such as cooking and having meals).

2.2.4 Video Conferencing Systems

In 2009, O'Hara' et al. explored the use of video conferencing[3] on mobile phones. Their study showed that although most people carry their mobile phones all the time, mobile video calls are typically not placed or received because they easily become intrusive. For example, the use of a speakerphone and the awkward positioning of the camera to capture oneself caused privacy challenges. The mobile design, however, does render itself important for easily capturing a variety of activities as well as groups of people. This renders mobility an important, yet a challenging, design factor for VMC systems.

More recently, Kirk et al. (2010) examined the use of video conferencing in seventeen homes in the United Kingdom. They reported that participants made video calls because it made them feel closer to their distant family. In addition, they reported about the prevalence of multiparty interactions between homes and exaggerated behaviors that were exhibited when ending a video call (e.g. gestures and waving).

Ames et al. (2010) described the "work" that goes into making video calls in the home. They described the *technical work* required to make video calls, *organizational work* to schedule the call, *presentation work* to organize the space the call will be made in and to make everyone (e.g. themselves and their children) presentable, *behavioral work* to manage children's behavior during video calls, and *scaffolding work* to aid children in participating in the video call (Ames, et al., 2010).

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[3] The terms 'video conference,' 'video chat,' and 'video call' are used interchangeably in this section.

2.3 Media Space

2.3.1 History of Media Space

Media spaces have been investigated as a means to connect distance-separated co-workers for over twenty years. The first media space connected two Xerox PARC labs (Stults, 1986), and since then media spaces have taken on many incarnations within a variety of research and academic institutions (Harrison, 2009). In most cases, video (and sometimes audio) was always-on to simulate the idea of a shared physical space. Researchers found that these media spaces allowed co-workers to gain an understanding of each other's comings and goings along with knowledge about availability for conversation (Fish, et al., 1990). This informal awareness also increased peoples' ability to easily move into casual interactions and informal encounters with others (Bly, et al., 1993; Fish, et al., 1990). Thus, the crucial design factor for workplace media spaces was the support of both awareness and interaction, plus the ease at which one could move between the two.

2.3.2 Media Space for Workplace Awareness, Communication and Collaboration

Following the successful adaptation of a media space at Xerox PARC (Stults, 1986), other media spaces were created to connect colleagues separated by distance, foster awareness, and provide opportunities for communication. These systems were also created to foster collaboration between colleagues.

Gaver et al.'s (1992) definition of collaboration was characterized by four factors – general awareness, serendipitous communication, division of labor, and focused collaboration. *General awareness* involves knowing who is around, what they are doing, and whether they are busy or can be engaged. This awareness acts as a precursor for collaboration and is easy to obtain when collocated or when connected using a media space. General awareness more often than not leads to *serendipitous communication,* which is defined as unplanned interaction that may lead to an important exchange of information. *Focused collaboration* refers to planned collaborations that involve people working closely on a shared task. These types of collaboration are more easily managed when collocated but can be made possible by media spaces. *Division of labor* is the practice of splitting a task and allowing people to work on these tasks individually. This does not require shared attention as required

by focused collaboration but still requires planning and coordination. Gaver et al. argue that there is a need to support a range of activities from spontaneous to highly planned and from disengaged to highly focused. They also argue that there is a need to move easily between these forms of work. Their definition of collaborative work led to the design and implementation of a media space infrastructure called RAVE (Gaver, et al., 1992). RAVE allowed users to choose between different levels of engagement by choosing between options such as glancing into a colleague's office, initiating a two-way audio and video connection, and obtaining an awareness of the location and activity of multiple colleagues.

Portholes (Dourish and Bly, 1992) was created on the RAVE infrastructure and was created to support awareness among distributed work groups. Portholes showed all users in a "Brady Bunch" style view, with everyone's image in a split window. Pictures were taken every few minutes and the corresponding images in the media space were refreshed. Participants could choose to initiate a video connection if and when they desired. Dourish and Bly described two ways of sharing/receiving information in Portholes. The first way was called *broadcast*, where everyone had access to all information being shared between users of the media space in the form of conversations, emails, and voice messages. The second way was called *directed*, where only particular users are recipients of the information. They found that awareness between distributed workgroups led to informal interactions, spontaneous connections, and the development of shared cultures. These are all important for maintaining working relationships among groups distributed across multiple sites.

CAVECAT (Mantei, et al., 1991) was created to enable small groups located in separate offices to engage in collaborative work. It allowed users to interact with four colleagues at a time by viewing all four video feeds on a split screen. This approach was called a picture-in-picture approach (PIP). Although CAVECAT was created to enable collaboration and to foster communication between groups of people, researchers found problems associated with the multiparty connections. They found that people tended to talk more to others who were collocated in their office, as they are more "present," compared to those in the media space. Moreover, coordinating conversations between the physical space and the media space was difficult. Due to the multiparty connections, the size of images was very small, which made it difficult to see facial expressions and nonverbal gestures. The size of the image also did not provide feedback when others were present in a user's office. Despite these problems, researchers reported that users were still able to collaborate using

the media space and this work was an important first step in the direction of multiparty media spaces.

Buxton and his colleagues created three alternatives to the picture-in-picture (PIP) method for multiparty connections (Buxton, et al., 1997). The first system was called Hydra (Sellen, et al., 1992). Hydra replaced each participant in a meeting with a video surrogate created by a camera, monitor, and speaker. Since each participant was represented by one monitor, it was easier for participants to notice others gazing in their direction when compared to a PIP system. Although Hydra was promising for meetings involving small groups of people, it was not easy to scale to larger numbers of participants because a large amount of equipment was needed. LiveWire (Sheasby, 1995) was an alternative system that changed who was visible on a monitor based on who was currently speaking. The system was voice activated and automatically gave the speaker "full screen." The drawbacks of this system included users losing track of people who were present at the meeting and who were not speaking and speakers not being able to see who they were speaking to. The third system was called the Brady Bunch (Sheasby, 1995) and was inspired by LiveWire and Portholes (Dourish and Bly, 1992). This system displayed a full screen image of the speaker in a meeting on one monitor and displayed smaller images of all participants in the meeting on a second monitor. It gave group members who were not speaking a sense of presence in the meeting and allowed the speaker to gain feedback, such as nods in agreement, from others in the meeting.

Early research investigating the use of video and audio for collaboration reported that users preferred using video to audio. However, despite users' preference for video, those who used audio performed almost as well as those having face-to-face communication or using video for collaborative tasks (Isaacs and Tang, 1993; Olson, et al., 1995; Sellen, 1995). They found that audio, while not ideal, might still be suitable for a shared media system. Following this, Hindus et al. (1996) created an audio only media space called Thunderwire to investigate the use of audio to create a shared social presence among colleagues. Thunderwire permitted colleagues to be simultaneously connected and everyone on the media space was able to hear all conversations. They found that users' interactions exhibited typical conversational characteristics such as turn taking and overlapping speech. Users also created cultural norms through their usage such as announcing one's name when signing in or signing off the media space. Despite the success of shared audio conversations,

users wanted the option of setting up two-way, private conversations similar to those in video media spaces (Hindus, et al., 1996).

The Video Window (Fish, et al., 1990) was created to foster informal communication between colleagues. The VideoWindow was an audio and video media space that acted as a "window" into a different room and allowed groups of people to see each other and to communicate. Users found that interactions via the window seemed indistinguishable from face-to-face interactions and the window provided opportunities for impromptu interaction between people in different locations.

2.3.3 Media Space for Collaborative Work

While most early media spaces allowed distance separated colleagues to communicate and foster awareness of each other's schedule and activity, other media spaces were created specifically to allow two colleagues to collaborate on specific tasks. The Virtual Window (Gaver, et al., 1995), for example, allowed a user in a local office to control camera movements in a remote office using head tracking. Participants who used the system found the ability to access a remote colleague's environment to be useful for collaborative tasks.

According to Luff et al. (2009), to successfully support collaborative work, media spaces have to address three key issues. Firstly, they have to provide local and remote users with real-time access to resources such as paper and digital documents and provide the ability to jointly produce, transform, and annotate these resources. Secondly, media spaces should allow users to manage access to each other, to each other's environment, and to the resources within those environments. And, finally, media spaces must enable users to have a shared mutual reference when pointing at or discussing resources in their environment (Luff, et al., 2009). As discussed in this section, early workplace media space researchers addressed some of these issues in the design of their systems.

Gaver et al. (1993) attempted to "… overcome the limitations of media spaces…" by providing multiple views during a collaborative task. They created the Multiple Target Video (MTV) system, which allowed users to switch among multiple cameras at a remote site. Three cameras were configured to provide a face-to-face view, an in-context view of the remote person in relation to their workstation, and a desk view to allow documentation to be shared. A fourth camera provided a view of the object central to the task or a bird's eye view

of the room. A study of users collaborating on a shared task found that users preferred viewing shared work objects instead of face-to-face views (Gaver, et al., 1993).

VideoDraw (Tang and Minneman, 1991b) allowed two or more collaborators to share a drawing surface. It consisted of an interconnection of cameras aimed at video display screens. A collaborator could add a sketch to the display screen, which, along with accompanying hand gestures, was transmitted to the other collaborator and displayed on their drawing surface. At all times, a complete image consisting of real and "video" marks was visible on all of the collaborators' screens. VideoWhiteboard (Tang and Minneman, 1991a) was a progression of VideoDraw. It provided a larger shared drawing space between remote sites and showed shadows of the remote collaborator's upper body in addition to shadows of hand gestures. This was different from VideoDraw, because VideoDraw only showed a video image of hand gestures. Tang and Minneman found that users were more easily able to share references and collaboratively draw using VideoWhiteboard as it provided a sense of co-presence between remote collaborators.

The Agora systems (Luff, et al., 2009) offered audio and a series of views that enabled remote collaborators to see and hear each other, access and share documents, and point and gesture over documents in their workspace and their remote collaborator's workspace. The initial system, AgoraG allowed users to make references by using a laser pointer to point at documents. When a user pointed at an image of a document on the shared screen, a laser spot appeared at the appropriate spot on the actual document on the remote collaborator's desk. AgoraPro, a follow up system, allowed users to make references by using gestures. When a user gestured towards an object on the shared screen, the remote collaborator saw a shadow of the hand and the associated gesture on the actual object in their workspace. Both systems allowed collaborators to share documents and seamlessly collaborate on the documents (Buxton, et al., 1997).

2.3.4 Ludic Media Spaces

The use of media spaces has not been limited to the workplace. Media spaces have also been used "*ludic*" or playful purposes, as digital bulletin boards, and as social catalysts.

The earliest ludic media space was the Hole in Space[4], which was launched between the Lincoln Center in New York City and Century City in Los Angeles in November 1980 [Figure 2.1]. It was a life-sized display of people at both sites, allowing them to see, hear, and speak with each other as if encountering each other on the same sidewalk (Harrison, 2008). No explanation was provided for why the display was there and where the remote site was but this did not prevent people from communicating and learning about each other. The Hole in Space was used for three evenings. The first evening was the evening of discovery when people tried to make sense of what and whom they were seeing. The second and third evenings consisted of intentional rendezvous among families and trans-continental loved ones, some of which had not seen each other for over twenty years. These families and friends were regularly in contact with each other using telephone, yet the opportunity to see each other led to many joyous and emotional moments (Harrison, 2008).

Figure 2.1: Hole in Space.

Described as a "ludic" media space, Gaver's Video Window (2006) transmitted outdoor images to a display inside the home. This media space was created simply to allow members of a household to enjoy the view transmitted from a webcam placed outside their

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Hole in Space, http://www.ecafe.com/getty/HIS/, Last accessed, August 2011.

home. This media space was created for recreational purposes and functioned as an additional "window" to the outside world.

Interactive digital bulletin boards were created to share information between people. As opposed to workplace media spaces which treated media content as secondary to creating connections between people, these interactive systems made content, rather than a synchronous link between people in conversation, the primary purpose of the system (Churchill and Nelson, 2009). The Plasma Poster Network (Carter, et al., 2004) was created to share content between a research lab in California and a sister lab in Tokyo. Although it was used regularly between colleagues in the California lab, those in the Tokyo lab did not use it because it was placed in a non-conducive location. Researchers also found that users preferred sharing content locally as opposed to across sites. CHIplace and CSCWplace (Churchill and Nelson, 2009) were created to allow participants who could not attend the respective conferences to share content with participants at the conferences. Both installations created a community space as they enabled users to share photos and post announcements of upcoming events and impromptu gatherings. The eyeCanvas display (Churchill, et al., 2006) was created to allow both the owner of a café and patrons to create and share content. All these systems differed in type and content of information shared, location of systems such as public place versus private, and the role participants had in creating and editing content.

The idea of a media space as a social catalyst was intended to initiate and create mutual involvement for people to engage in conversation (Karahalios, 2009). Three systems were created as social catalysts - Telemurals, Visiphone, and Chit Chat Club.

Telemurals (Karahalios and Donath, 2004) was an audio-video connection located in a public space that abstractly blended images from two remote locations. Participation from both sites was required for the system to work as it blended audio and images of users. The system was placed next to the elevator in both sites. This resulted in users interacting with the system while waiting for the elevator or while walking down the hallway. Interactions with people at the remote site were mostly opportunistic, but there were occasional planned interactions.

Visiphone (Karahalios and Viegas, 1999) allowed inhabitants of two remote sites to communicate and to be aware of each other's presence. The system transformed voice and created a "picture" of a conversation, allowing users to gain visual feedback of their

communication pattern. Users liked the way the system showed "… patterns of interruptions and of individual conversational dominance" (Karahalios and Viegas, 1999).

The Chit Chat Club "… brings people together in a mixed physical and virtual environment" by using a physical object at a coffee shop to represent a remote user (Karahalios and Dobson, 2005). Online users were able to see a view of the coffee shop and the customers seated in the shop. They could then choose to occupy a physical "avatar" seat located at a table and engage in conversation with the occupants of that table.

Part I: Design and Practices
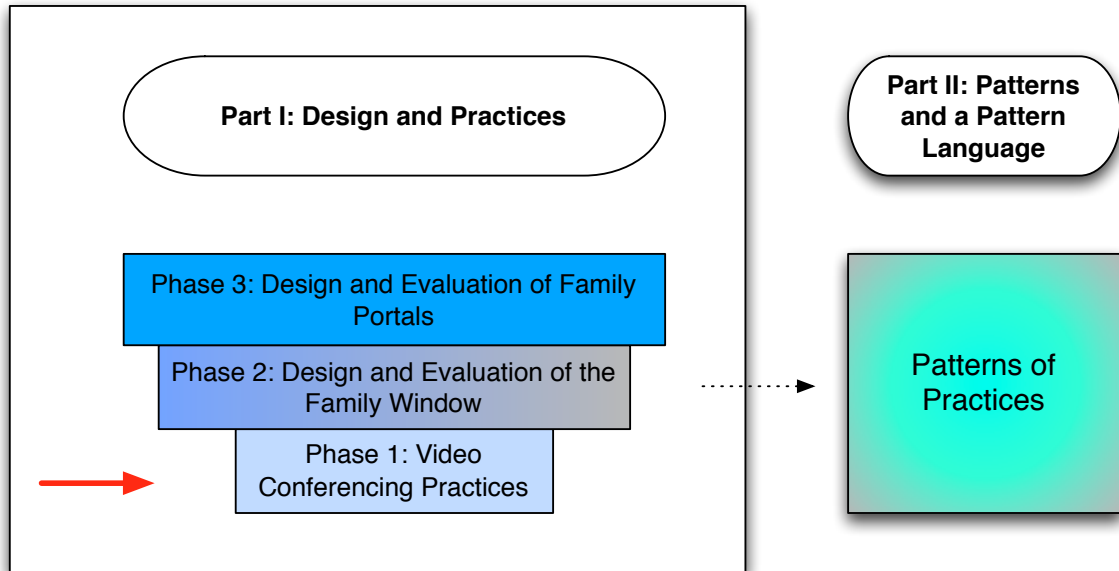
Chapter 3

Video Conferencing In The Home

3.1 Introduction

Most family members and close friends have a need and desire to stay connected, especially when they become separated by distance (Neustaedter, et al., 2006a; Romero, et al., 2007; Tee, et al., 2009). Our informal observations and self-usage suggest that video conferencing has increasingly begun to fulfill this need with the availability of inexpensive webcams and free video conferencing software such as Google Talk, Windows Messenger, and Skype. However, despite the availability and use of such systems, at the time this study was conducted in June 2009, there were no studies that investigated the use of video conferencing in the home. Noll (1992) reflected on the failure of the Picturephone of the 1970s but this predates the proliferation of present-day video conferencing systems. Video communication was investigated extensively as part of media space research, yet again this did not typically look at the domestic use of video systems (Harrison, 2009). Most studies specifically aimed at current video conferencing systems focus on assessing and improving network performance (of which there is a large number of papers, e.g., (Cicco, et al., 2008)).

Hence, although video conferencing systems are widely used in homes, we do not have a shared understanding of *why* and *how* families use video conferencing in the home. For this reason, I conducted a study aimed specifically at uncovering why readily available video conferencing systems are used within the context of the home and the ways in which families use them. Findings from this study suggest new design avenues for video conferencing systems as well as domestic technologies in general.

Most similar to this study is O'Hara' et al.'s (2009) which explores video conferencing on mobile phones. Their study showed that although most people carry their mobile phones all the time, mobile video telephony is typically not used opportunistically as it can easily become intrusive. This study builds on O'Hara' et al.'s research to specifically explore video conferencing on desktop computers and laptops from within the home More recently, in February 2010, after this study was conducted and published, two other studies

about the use of video conferencing in the home were published. The first study was published by Kirk et al. (2010) who examined the use of video conferencing in the homes of 17 people in the UK. They reported that participants made video calls because it made them feel closer to their distant family. The second study was published by Ames et al. (2010) who describe the "work" that goes into making video calls in the home. This included technical work, organizational work, presentation work, behavioral work and scaffolding work that families engage in when making video calls. I will return to these two papers in the discussion section of this chapter and compare my findings about *why* and *how* families use video conferencing in the home to findings from their studies.

3.2 Methodology

3.2.1 Participants

21 individuals (10 female, 11 male) were recruited from 15 different households in the United States. Participants were recruited from a convenience sample in Rochester, NY. An advertisement for the study was emailed to various mailing lists in the area. Recipients of the email were asked to share the advertisement with their friends or family who might be interested in participating.

Participants ranged from 22 to 62 years old and fell into four groups: single with no children (3), couples with no children (2), couples with children (10), and grandparents (6). Children ranged in age from infants to 19 years old. All participants currently used video conferencing to communicate with distant family and/or friends. Households received a gift card worth $50 for participating. Pseudonyms are used for participants to protect their identity.

3.2.2 Interview Method

Semi-structured contextual interviews (Beyer and Holtzblatt, 1998) were conducted with all participants about their existing usage of video conferencing systems. The questionnaire I created and used are in Appendix AA. Interviews were conducted in the context of participants' homes since this was the location from which they typically video conferenced with distant family and friends. Being at home helped put participants in the mindset of their

existing video conferencing routine. Interviewing participants in the location where the activity of interest is performed is a core requirement when performing contextual inquiry (Beyer and Holtzblatt, 1998). It would have been better to observe families *while* video conferencing as recommended, yet this was impractical due to the timing and sometimes opportunistic nature of the activity. Alternatively, asking participants to video conference while I was present would arguably be too contrived to gather real usage data.

With participants' permissions, I took pictures of the locations in the home that they used for video conferencing, the computer (laptop or desktop) that was used, and the video conferencing software used.

3.2.3 Data Analysis

All interviews were audio-recorded and handwritten notes were taken to aid analysis. I used open coding, axial coding, and selective coding (Charmaz, 2006) as described in Chapter 1, to analyze the interview data and draw out key themes about similarities and differences in the use of video conferencing between households. Each quote and description of use was coded with a descriptive label and compared subsequent observations to the coded ones. Observations that fit existing codes were labeled with those codes while observations that did not fit existing codes were given a new code. Codes were then organized into relevant categories that describe the main themes in the data.

The creation of codes was done in two iterations. In the first iteration, I created codes from the data. At the end of the iteration, the codes were organized into high-level categories. In the second iteration, I went through the data again to validate the codes and create new codes where necessary. Categories that had 15 or more codes were broken into two or more smaller categories. Categories with five or less codes were combined, if possible. Finally the categories were combined into themes.

At the end of this process, there were 75 codes, 8 categories, and 5 themes. The codes and subsequent categories are in Appendix AB. The themes and associated categories are found in Table 3.1. The results section (Section 3.3) is organized based on these key themes.

Theme	Category
Family Ties	Relationship with remote person/people
Initiating and Planning Communication	Scheduling a video call Initiating a video call Indicating and gathering availability information
Sharing Conversation	Sharing conversation
Sharing Life	Sharing life Mobility vs. lack of mobility
Privacy Concerns	Privacy

Table 3.1: Themes and associated categories.

3.3 Results

All participants had a preferred video conferencing system that they used for their video calls. Thirteen people used Skype, 5 used Apple iChat, and 3 used MSN/Windows Messenger. The location of remote family/friends that people connected to ranged from being in the same city to being separated by up to 12 hour's difference in time zones. I did not however, find a difference in usage pattern between domestic and international video calls. Selected results from this study can be found in Judge et al. (2010).

3.3.1 Family Ties

Participants varied in terms of who they video called[5]. Sixteen people only called family members, including parents, grandparents, and siblings. Two people only called friends who lived abroad. These were single adults with no children. The remaining three people called both family and friends who lived abroad. Video calls ranged in frequency from weekly pre-

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[5] The terms 'video conference,' 'video chat,' and 'video call' are used interchangeably in this chapter.

set times between grandparents and their children/grandchildren to impromptu calls between friends that occurred every few weeks to months.

Neustaedter et al. (2006) describe three social groupings in one's social network. *Home inhabitants* are people with whom one lives, *intimate socials* are people whom one has a close relationship with but does not live with, and *extended socials* are people with whom one has a more casual relationship. Nearly all participants in my study (90%) used video chat to communicate with their intimate socials. These are people that they were close to and thus had a strong need for awareness. This strong need for awareness and the close relationship between intimate socials motivated participants to use video conferencing and determined how they used it. The following sections further elaborate for this phenomenon was found in this study of families' use of video conferencing systems.

3.3.2 Initiating and Planning Communication

All of the video conferencing systems that the participants used showed their contacts in a "buddy" list along with availability information such as online, busy, away, etc. (based on activity at the computer or set by the user). From this list, they could place a call to someone and then turn on a video link. However, for nearly all participants (18 of 21), the video conferencing systems did not act as the first point of contact between people when initiating a video call. So-called "impromptu" video calls were not truly impromptu. These participants first communicated with remote users via phone, email, or text message *prior* to video conferencing. This was done to inform the other person that they were available and wanted to video conference and to find out the remote person's availability and willingness to do so. This even occurred when both parties had a good understanding of each other's schedule and availability or when they had preset times for calling (e.g., calling every Sunday afternoon). This is evidenced by the following participant quotes:

> *"Even if my mother sees that I am logged onto MSN she calls me first to ask if she can talk to me. She always assumes that I am busy doing something on my computer and does not want to disturb me" – Larry, Single, Age 22*

> *"My 4 year-old granddaughter calls me whenever she wants to talk and says 'Grammy, do you want to talk?' I am usually preparing dinner or doing something around the house when she calls, but I stop everything and go upstairs, turn on the computer and talk to her" – Michelle, Married, Age 58*

"I have my phone with me all the time and when my son is ready or has time to Skype he sends me a text with one word 'Skype?' I can get these texts at any time of the day, even at 6am since he knows I wake up early... We use text because I am not always around my computer even though it is turned on all the time" – Leanne, Married, Age 62

Participants reported that the reason for not immediately video calling someone was because video conferencing was perceived as being more intrusive than the other communication technologies they used. Moreover, the status indicators provided by the video conferencing software did not represent true availability and did not show one's *willingness* to video conference. Furthermore, nearly all participants (19 of 21) did not stay logged on to their video conferencing software, and some only turned on their computer for short spans of time. Only two participants logged onto their video conferencing software and waited when they were expecting their distant family to call. They usually performed other tasks while waiting. For example:

"My daughter was working in Israel last year and did not have a set schedule. We turn on Skype when we think she will be home and then wait for her to get home and have dinner before talking to us" – Thomas, Married, Age 62

There were three participants who would directly video call their remote family. In these situations, both parties knew the timeframe in which they could talk and made themselves available during that time.

3.3.3 Sharing Conversation vs. Sharing Life

Adults without children primarily used video conferencing for *conversation*. Here the webcam was used solely to watch the other person, their gestures, and body language. This augmented the voice/audio component of the conversation and was the primary reason that these participants used video conferencing as opposed to just the phone. Sometimes participants would hold up additional items (e.g., new poster, shirt, or furniture in the house) in front of the webcam because they were pertinent to the conversation. For example, Mark, a college student, periodically video calls his friend in Croatia because he likes seeing him when they talk. When he moved into a new house, Mark moved his webcam around to show the new place to his friend. Other adults without children described similar routines when augmenting their conversations with video links.

3.3.4 Sharing Life

For families with children, video conferencing was used primarily to share *activities*. During this type of video call, conversation between adults was a secondary activity and happened during lulls in children's activities, in the background, or sometimes not at all. Grandparents commented that it was especially important to *watch* their grandchildren grow up, to stay connected and to make sure their grandchildren knew them. Sharing activities and interacting through video conferencing helped them do this. In some cases, they would leave the video call going for a couple of hours, and in the extreme case (for one participant) this was as long as an entire day. These participants did not mind being watched by their distant family and enjoyed the feeling of connectedness and awareness that sharing larger portions of their life provided.

Families sharing everyday life with each other are exemplified in the following example about Paul and Megan who video called Paul's parents in the United Kingdom every Saturday morning. Their routine involved setting a laptop with webcam on the kitchen counter so it could capture their morning activities [Figure 3.1]. Paul's parents loved watching Paul and Megan cook and eat breakfast with their two year-old and three month-old child. In these situations, conversation occurred intermittently. Although they shared nothing more than their regular Saturday morning routine, it was important for both families to be able to see each other and share parts of their everyday routine. This made them feel more connected. When Megan gave birth to their daughter, Paul took their laptop to the hospital so that his parents "could visit too." The following quotes illustrate similar situations:

> *"I leave MSN on during the weekend while I am cooking or doing things around the house. I can watch my mother in China and she can watch me doing my work. I also leave MSN on while watching a movie on my laptop so my parents can continue looking at me."*
> *– Chong, Married, Age 26*

> *"I once babysat my granddaughter on iChat while my daughter was busy in another part of the room. She was in her high chair and I read to her and kept her entertained"* –
> *Michelle, Married, Age 58*

"Skype is all about grandma and [her grandson]. We focus the camera on him and that is all she wants to see for hours. She loves watching him and he loves showing her things." – Kyle, Married, Age 38

In all of these situations, children/grandchildren were the sharers of information and parents/grandparents were the receivers. For example, one grandparent in our study said she liked being "a fly on the wall in her daughter's home" and watching her grandchild's bedtime routine.
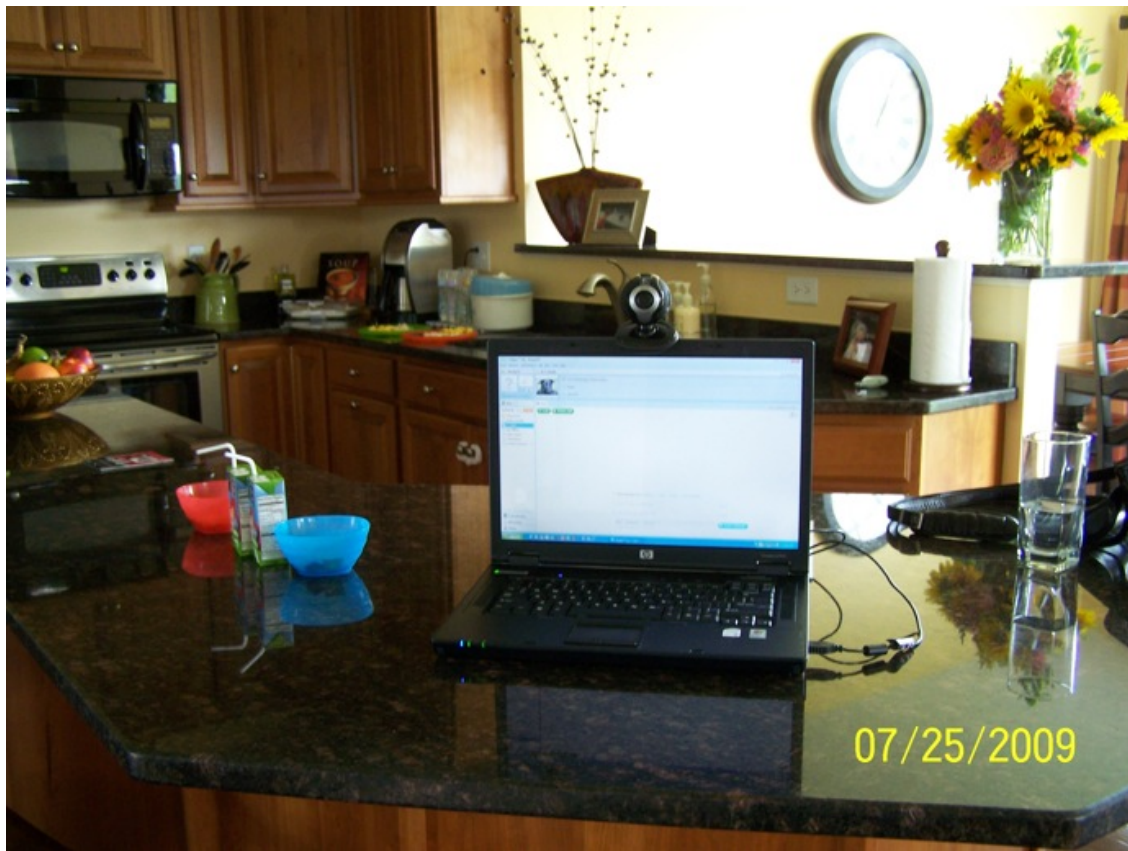
Figure 3.1: Paul and Megan set their laptop with webcam on the kitchen counter so it would capture their morning activities while video conferencing with Paul's parents in the United Kingdom.

For parents with adult children far away, it was important for them to see their children to know how they were faring. These "children" might email or phone and say that they were well, but it was important for parents to be able to see their children to know for sure. Children might also share aspects of their life through photos/video recordings, but

parents said this was not the same as seeing them in a video call. Seeing people live brought an additional sense of believing. This is exemplified by the following quotes:

> *"As a parent, I have a heightened sense of anxiety when my female child is away in another country…When my daughter is away, it is important for my wife and I to see her. Only when we see her we know if she is getting enough sleep or being worried about something. She emails us regularly but it is not the same as seeing her" –Thomas, Married, Age 62*

> *"I only turn my webcam on because my mother wants to see me. It is not important for me to see her. It is more important for her" – Larry, Single, Age 22*

The sharing of activities was strongly supported by the mobility associated with peoples' video conferencing setups. Families with laptops would move them to locations of interest. For example, one parent, Mike, set his laptop on a footstool in their living room so it could show his daughter playing to her grandmother [Figure 3.2]. He would then rotate the laptop as his daughter moved around.

Figure 3.2: Mike set his laptop on a footstool in their living room so his mother could see (via conferencing) his daughter playing with her toys.

Another parent, Lee, placed her laptop and the laptop's external webcam over her daughter's play area [Figure 3.3]. While she and her husband spoke to her parents-in-law, they could watch her daughter play. On the other hand, families who used a desktop PC often felt confined to a location. External webcams with long cords helped position or change the camera angle but participants were still confined to a single room. For example, a grandmother, Michelle, used a desktop PC in an upstairs room. When she was baking or cooking while video conferencing, she would have to keep running downstairs to check on the food [Figure 3.4].

Figure 3.3: Lee placed her laptop's external webcam over her daughter's play area.

Figure 3.4: Michelle used a desktop PC in an upstairs room. When she was baking or cooking while video conferencing, she would have to keep running downstairs to check on the food.

3.3.5 Privacy Concerns

Prior work has defined privacy in terms of three control modalities: solitude, confidentiality, and autonomy (Boyle, et al., 2009). *Solitude* can be violated if someone interrupts another at an inappropriate time, *confidentiality* is violated if someone sees things that are not intended to be revealed, and *autonomy* violations occur when someone is unable to choose when and how she participates in an activity (Boyle, et al., 2009).

None of the participants said they had concerns over what remote people could see as the result of using video. Thus, they were not concerned about confidentiality. This was largely because they were connecting with someone who they knew well. Also, since video calls were initiated using other technologies first (as described), participants could ensure they were not doing anything that they would not want the remote person to see. Given the high mobility of most webcams or the ability to easily change the camera angle, participants could control what remote people saw. For single adults, mobility let them set up their laptop and/or webcam to show as little background as possible. This was mainly so they did not have to clean up before talking to someone. Interestingly, they were unconcerned about

their own physical appearance. For instance, Larry, a single adult, set his laptop to face his bedroom wall when he video conferenced with his mother [Figure 3.5]. That way she was not able to see the mess in his room, and he did not have to clean up.
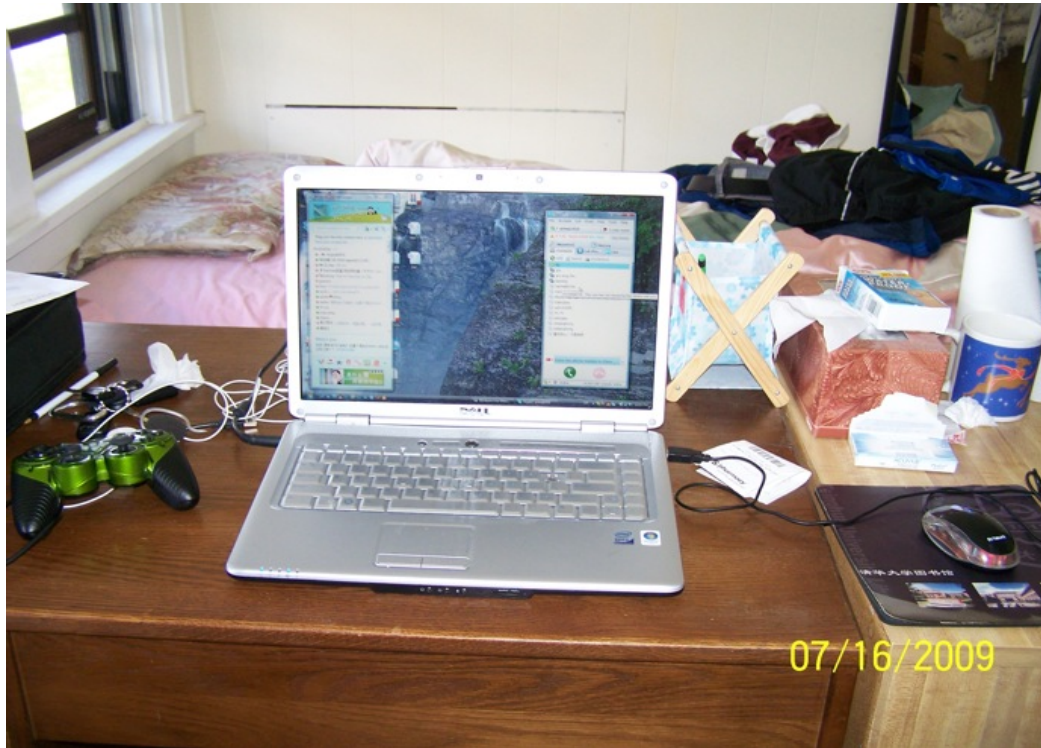
Figure 3.5: Larry set his laptop to face his bedroom wall when he video conferenced with his mother to prevent her from seeing his messy room.

Privacy was instead more strongly related to solitude and autonomy where participants chose who could video call them and when they were accessible for video calling. This was most commonly done by logging into their video conferencing system at times when they were expecting a video call or wanting to place a video call. This is different from the use of video conferencing in the workplace where users are logged on to the video conferencing system most of the time (Nardi, et al., 2000). Participants also only included certain people in their contact list. By restricting this access, others could not violate their solitude by video calling at an inappropriate time, and only certain individuals could video call, thereby regulating autonomy. This is exemplified by a situation involving Anita, a married female participant who never logged on to Skype unless someone had scheduled a conversation with her. She did this because she valued her solitude and autonomy and did not want to be disturbed by just anyone who might be logged on. When

her husband traveled overseas, she used a Skype account that only her husband knew about and remained logged on to it so he could contact her whenever his schedule permitted. These types of routines certainly work, yet this behavior causes people to be uncertain of one's availability and willingness to video conference. People have to then rely on other technologies to discern this information before video calling.

Additionally, a female participant was highly concerned about video voyeurism. In this case, her privacy concern was about confidentiality – not wanting people she does not know to watch her without her permission. To avoid anyone spying on her, she did not stay logged on to a video conferencing system and also stuck a Post-It note over the built-in webcam on her laptop [Figure 3.6]. This Post-It note was removed when she wanted to place or receive a video call.

Figure 3.6: A participant covered the built in webcam on laptop with a Post-It note to prevent video voyeurism.

3.4 Discussion and Conclusions

3.4.1 Why and How Do Families Use Video?

The findings from this study have given us insight about *why* people use video conferencing to connect with distant family, and *how* they use available video conferencing systems in their home. Four patterns of video conferencing use were evident from the families in this study. Each pattern of use is associated with different communication needs experienced by families. Among the needs expressed by families included wanting to see each other, being a part of each other's lives, and feeling connected.

First, families used video conferencing to share activities. They were able to easily share conversations using other mediums such as phone and email, but video was essential for sharing everyday activities or even showing objects of interest. Second, families used video conferencing to see each other. For instance, adults used video conferencing to enable their parents who lived far away to see their children and watch them grow up. This worked both ways as it allowed grandparents to interact with their grandchildren and allowed grandchildren to grow up knowing their grandparents. Third, families made video calls to feel connected to their distant family. They sometimes left video chat sessions running for hours to provide them and their distant family an opportunity to be a part of one another's lives. And finally, video conferencing was used by parents to see their children and to gain knowledge about their well-being. The ability to see their children, even though they might be adults, in addition to hearing about how they were faring provided parents with "peace of mind." Each family in this study used video conferencing in one of more of these ways.

Kirk et al. (2010) reported that their participants used video calls in a manner similar to participants in my study, namely to share activity and conversation. Kirk et al. also stated that people made video calls to show their dedication to their distant family. Video calls required both parties to dedicate time and attention: any distractions were quickly noticed and commented on (Kirk, et al., 2010). On the contrary, I found that families expected interruptions such as children needing attention and incoming phone calls. Families focused more on sharing daily activities as they were happening and had intermittent conversations.

Ames et al. (2010) reported that their participants used video conferencing to share conversation and not activity. This is different from my finding about families *wanting* and *choosing* to share daily activity to feel connected. Ames et al. also described the benefit that

children gain from using video conferencing. Young children were able to easily participate in video calls as it was easier to understand visual cues compared to audio cues when using a phone (Ames, et al., 2010). Parents in my study similarly commented that is was easier for their young children to remain engaged in a video call as they are able to see the person they are talking to and interact with them.

3.4.2 Design Recommendations

Findings from this study point to several important considerations for designing video conferencing systems as well as domestic communication technologies in general. First, there is a clear need for mechanisms that allow people to easily deduce other's availability and willingness to video conference. This need is echoed by O'Hara et al. (2009) in their study of mobile video conferencing. Similarly, studies about workplace communication found that people use less intrusive technology such as instant messenger to initiate communication and determine one's availability (Nardi, et al., 2000). Incorporating mechanisms that allow one to easily deduce the other person's availability and willingness to communicate will reduce peoples' needs to rely on several pieces of technology prior to communicating via video. It will also help prevent video conferencing from being deemed overly intrusive. One possible solution might be to design a more ubiquitous technology that families do not mind leaving on all the time to provide awareness information.

Second, video conferencing systems specifically and domestic communication devices in general, should enable people to easily share everyday activities as they occur. Hutchinson et al. (2003) discovered that people found value in sharing impromptu moments through photos. My findings further illustrate that families enjoyed sharing extended moments of time (e.g., everyday activities), which are not easily captured and shared with photos. Although photos/videos can now be shared immediately after an event, this event has already passed as opposed to receiving live information. Mobility also plays a large role in sharing aspects of daily life; hence, people should not be tied to their devices and/or be confined to a certain location when sharing. O'Hara et al. (2009) also point out the importance of mobility and the manner in which families exploit this for sharing everyday life with mobile phones.

Third, privacy as it relates to domestic video conferencing, is most concerned with autonomy and solitude—choosing when to connect and with whom—as opposed to

confidentiality. This contrasts the use of video media spaces in the workplace where often confidentiality is the primary concern (Boyle, et al., 2009). Thus, there is a further need for technologies that allow people to smoothly move into properly timed video calls that take into account users' needs for solitude and autonomy in the home. This contrasts privacy protection strategies commonly found in over-the-shelf video conferencing systems that provide features to obscure or alter the background of the video or even the user (e.g., by creating an avatar).

Chapter 4

The Family Window: A Dyadic Domestic Media Space

4.1 Introduction

In recent years, research has been conducted in the domestic realm to create *communication appliances* that provide families with awareness information and foster communication (Conversy, et al., 2003). Communication appliance are defined as "…simple-to-use, single-function devices that let people communicate, passively or actively, via some medium, with one or more remotely-located friends or family" (Conversy, et al., 2003). Examples of communication appliances include the Digital Family Portrait (Mynatt, et al., 2001), Feather, Scent and Shaker, (Strong and Gaver, 1996), Presence Lamp (Tollmar and Persson, 2002), Message Probe (Hindus, et al., 2001) and VideoProbe (Conversy, et al., 2003). These communication appliances typically provide domestic awareness (e.g., activities, health) using abstracted representations such as lights and icons (Dadlani, et al., 2010; Mynatt, et al., 2001; Tollmar and Persson, 2002). Other communication appliances provide direct awareness information through photo sharing, messaging, or both (Hindus, et al., 2001; Tee, et al., 2009). The challenge, however, is that abstracted or direct awareness information does not typically provide the same feeling of connectedness that one gets from actually seeing a remote family member (Romero, et al., 2007).

Although research has been conducted on the creation and use of domestic communication appliances that provide awareness information, research has not been conducted to explore the use of *communication appliances with video* to connect families separated by distance. This chapter describes the *design* of a dyadic domestic media space and identifies *communication and awareness practices* that emerged from its use in real homes.

The previous chapter (Chapter 3) described the first phase of my research on the design and use of VMC systems to connect families. The previous phase encompassed a study of families' use of video conferencing in their homes. The study revealed that families liked sharing information in the moment, and families wanted to easily share information

about their daily life with one another. When using a video conferencing system, their privacy concerns were about *autonomy* – who and when to connect to using the video conferencing system. Design recommendations for future VMC systems highlight the need to provide mechanisms to deduce the remote family's availability information and willingness to communicate, mechanisms to allow families to easily share life, and privacy controls for autonomy. This chapter describes the design of a dyadic domestic media space with always-on video that incorporates said design recommendations. This is followed by a description of a field evaluation of the media space and findings from the evaluation.

4.2 Methodology

To research families' communication and awareness practices and privacy concerns associated with their use of a domestic media space with always-on video, we[6] took a two-step approach. First, we designed and implemented a dyadic[7] domestic media space with always-on video. This media space was called the Family Window. The initial prototype was used by two families for six months from January 2009 to June 2009. This usage is described as *self-usage* in the following sections. Both families wrote about their experience using the Family Window on a shared blog. In June 2009, I led the redesign of the Family Window based on data from the self-usage. Changes in the design are described in Section 4.3. After redesigning the system, as the second step in this investigation, I deployed the revised prototype in the homes of four families for a period of five weeks. Together, these investigations provide a rich understanding of the ways in which video media spaces can be used in the home and the design factors that are critical for their success.

4.3 Design of the Family Window

The first step we took to understand how a video media space could be used in the home was to design our own system that we could test and iterate on as needed. We called this

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[6] The design and implementation of the FW was carried out in collaboration with Carman Neustaedter. Refer to Collaboration Acknowledgements for more details.

[7] The term dyadic here is used to refer to a media space that connects two non-collocated families. This differentiates research in Phase 2 (Chapter 4), from research in Phase 3 (Chapter 5) about multifamily domestic media spaces.

prototype the Family Window to reflect its role as a "window" into another family's home. The following section describes the initial design of the Family Window (FW) followed by the design iterations.

4.3.1. Initial Design

The FW was designed to be an always-on video media space that connected two households. The initial design of the FW is shown in Figure 4.1. We did not include an always-on audio link as this was felt to be overly privacy-intrusive. Hindus et al. (1996) had a similar finding during the field evaluation of their audio-only media space, Thunderwire. The FW used a basic web camera (capable of capturing 640 x 480 resolution video at 30 frames per second) connected to a Tablet PC [Figure 4.4] to simulate the idea that it was a communication appliance such as a digital picture frame as opposed to a personal computer (PC) where users multitask and switch between applications. This design also permitted the FW to be highly mobile, if desired, which sets our design apart from Picturephone concepts of the 1970s (Lipartito, 2003; Noll, 1992) and media spaces of the past (e.g., (Bly, et al., 1993; Mantei, et al., 1991; Neustaedter and Greenberg, 2003)).
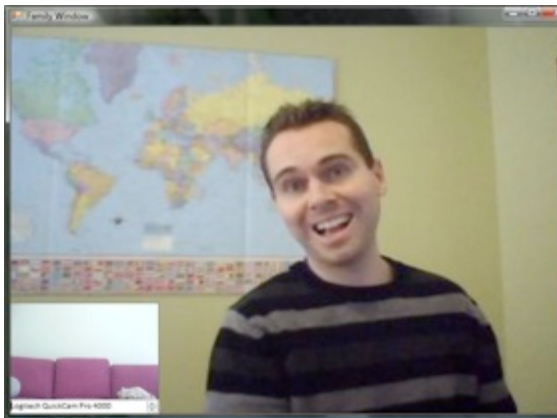
Figure 4.1 Initial design of the Family Window that consisted solely of a video stream from the remote home and a local feedback view.
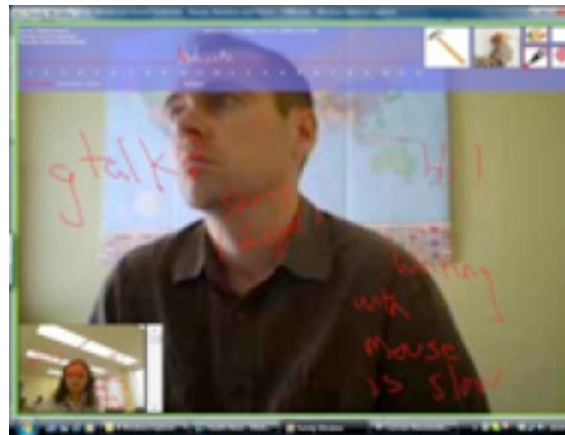
Figure 4.2 Final design of the Family Window.

Video from the remote home filled the majority of the display and, in the bottom left corner, a mirrored view of the local camera's view was shown [Figure 4.1]. Clicking this view turned the local camera on/off. The Tablet PCs supported both passive and active input, so users could interact with either a stylus or their finger. Reciprocity was purposely not

enforced, so each household could choose when their camera was on, and this was not linked to the remote household's status. Users were able to blur their video to varying degrees using a secondary dialog box.

Video was transmitted using a client-server architecture[8] (for ease of connecting) over the Internet at a rate of one frame per second, 320 × 240 resolution. We experimented with higher frame rates, but latency issues were difficult to circumvent for typical home Internet connections.[9] Despite low frame rates, the always-on nature of the video link differentiates the FW from work such as Video Probe (Conversy, et al., 2003), which bases broadcasting on motion detection in front of the camera. The always-on nature of the FW becomes important as it creates opportunities for serendipitous awareness information to be transmitted, which may or may not be triggered by motion.

4.3.2 Design Iterations and the Final Design

The FW with the initial design was used for a period of six months in two homes. This usage is referred to as *self-usage*. Both families blogged about their usage of the FW and any problems that they encountered. We iterated on the design to address a variety of needs that appeared, as well as expectations of what a broader user audience may want. Thus, we started with a basic system, and features were added as the need for them became apparent. Figure 4.2 shows the final design. A video found in (Neustaedter, C., et al., 2010) also shows the final design and its usage. The following is a description of the final design of the FW.

Notification

Very early on in the self-usage, we realized that local family members needed a way to notify remote family members that they wanted their attention at the FW. We implemented a "knock" feature to support this need. Family members can touch the knock icon [Figure 4.3, top right] and a knocking sound plays at both ends.

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[8] Our client-server architecture utilized groupware programming toolkits from the University of Calgary's GroupLab and the University of Saskatchewan's iLab.

[9] Participants in our field deployment did not comment that the low frame rate had any negative effects on their use of the system, although they were not able to compare this usage to a higher frame rate.

Handwritten Messages

We also recognized a need for family members to share short bits of communication, e.g., saying a quick hello. We implemented several types of audio features (e.g., push-to-talk, phone call), but encountered technical challenges with audio latency. As a result, we opted to provide a messaging feature instead. Families can leave handwritten messages for each other by writing on the background of the video [Figure 4.3]. Using the icons in the top right corner, users can choose ink color and change between write and erase modes. The local view in the bottom left corner shows ink as it is written so users can realize how their writing appears to the remote family. A notification appears at the bottom of the display when new writing appears. Drawing or writing on a video link is similar to several systems (Ishii, et al., 1994; Tang and Minneman, 1991b, a); however, all were meant to support shared drawing spaces for work activities and not domestic communication. Writing is also available in CommuteBoard (Hindus, et al., 2001), but this is not coupled with video.
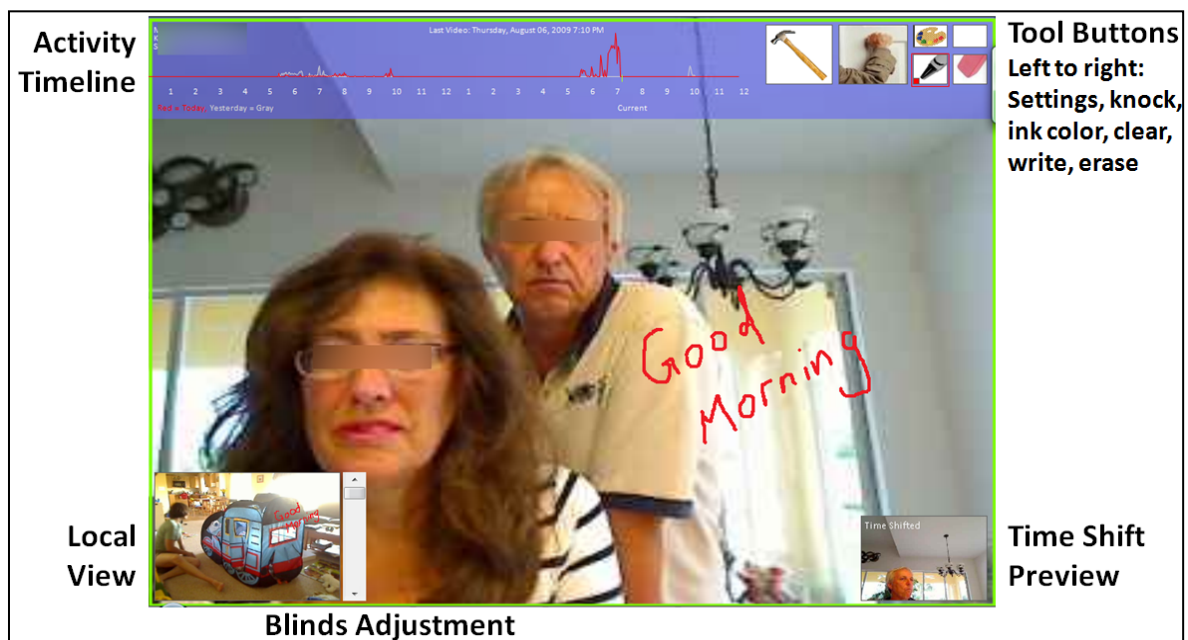
Figure 4.3 Revised Family Window used for the field evaluation.

Time Shift Recording

We also realized that families were not always in front of the FW at the same time (e.g., different time zones or work schedules) and could easily miss seeing each other. To help alleviate this, we added a basic time shift mode. If a user enables time shift mode, their FW will record video that is captured and transmitted by the remote FW. Only video containing activity is recorded. This is sensed by comparing the difference between successive video frames. The remote family sees a notification when the local family turns time shift recording on, although the remote family does not need to accept/decline. Thus, control to start/stop recording is in the hands of the viewer. We chose this approach because we felt that users would want to turn on recording when they knew they would be away from the FW. This is akin to someone who records a television show when not at home.

Users can toggle back and forth between watching live video or time shifted video by clicking on the Time Shift Preview image [Figure 4.3, bottom right]. With the hope to mitigate assumed privacy concerns over recording video, the FW deleted recorded video immediately after it was watched. If not watched within 24 hours, it was also deleted automatically. We felt this would make people more comfortable with the idea of recording by ensuring that only recent video could be watched, and that it could only be watched once (in case embarrassing acts were recorded). The FW's time shift mode is similar to the Where Were We system (Minneman and Harrison, 1993), which records meeting activities with video and audio, and yet again, their focus is on the workplace.

Activity Timeline

Since distance-separated families did not necessarily know each other's schedules, it seemed important to generate this awareness. We added a timeline [Figure 4.3, top left] that showed how much activity occurred in front of the FW. This was measured by comparing the differences between successive video frames. The timeline showed today's activity levels in red and yesterday's in grey, and a marker indicated when in the day the video had been recorded. The timeline could also be used to understand when families are typically in front of their FW (to attempt to time interactions) or provide awareness of family members' presence without actually seeing them. Several other systems offer activity timelines (Begole, et al., 2002; Hudson and Smith, 1996; Nunes, et al., 2007) although they do not offer video replay (Begole, et al., 2002; Hudson and Smith, 1996) nor are they linked to a media space (Hudson and Smith, 1996; Nunes, et al., 2007).
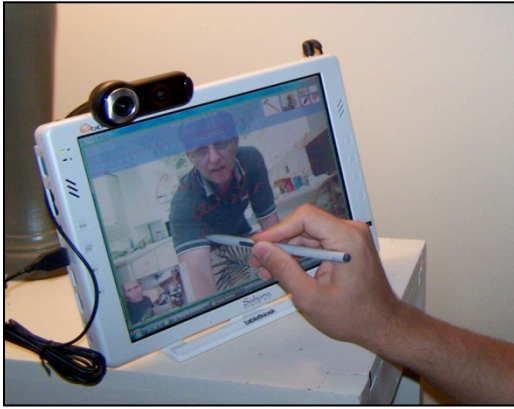
Figure 4.4. Family Window on a dedicated device.

Figure 4.5 Slate-style privacy blinds.

Privacy

We were concerned that other families would have larger issues with privacy than the self-usage had found. For this reason, and building on the metaphor of a real-world window, we added blinds to the FW. Users can adjust a slider [Figure 4.3, bottom left] to open and close blinds that cover the window [Figure 4.5]. This is similar to a technique by Coutaz et al. (Coutaz, et al., 1998). We provided slate blinds [Figure 4.5] as well as top-down or bottom-up blinds. In the latter cases, either the top or bottom of the video is blocked. The slider adjusts the amount blocked.

Comparison to Video Conferencing Systems

Aspects of the FW could also have been recreated by using an existing video conferencing system such as Skype or Google Talk, run on a dedicated laptop or Tablet PC, with two clients connected at all times. Our design builds on this with additional features (e.g., time shift recording, writing, activity timeline) that allow us to investigate broader usage patterns. Yet, the most fundamental deviation is a paradigm shift in the way people use and think about video conferencing in the home. This move to always-on awareness connections sheds light onto a unique set of routines that we highlight next.

4.4 Evaluation of the Family Window

A total of six families evaluated the FW, two families during the self-usage and an additional four families – two household pairs – during the field evaluation. I conducted the field

evaluation in July 2009, after redesigning the FW (described in Section 4.3.2). Each family in the field evaluation received gift cards worth $250 for participating.

4.4.1 Participant Selection and Recruitment

Participants were recruited from a convenience sample in Rochester, NY. An advertisement for the study was emailed to various mailing lists in the area. Recipients of the email were asked to share the advertisement with their friends or family who might be interested in participating. The recruitment email is in Appendix BA.

Potential participants who answered the study advertisement were asked initial questions to enable me to learn about them and their communication pattern with extended family. Among the questions asked were, the frequency of communication with extended family, current method of communication eg. phone, email, video conferencing, and the extended family member they would like to connect to using the FW. I wanted to study the use of the Family Window in households with different relationship dynamics such as grandparents - grandchildren, parents - children, sibling - sibling, and girlfriend/fiancée - boyfriend/fiancée. Hence I selected two households – four families – that I thought would provide interesting and different relationship dynamics. Participants were allowed to choose the extended family they wanted to connect to because I wanted to study families with a close relationship. By allowing participants to choose the family they wanted to connect to, I gave them control over their use of the FW.

These four families used the FW within their homes over a period of five weeks. All four families were told to set up and use the FW as they naturally saw fit. This included selecting its location and turning the system on/off as desired. All participants are identified using pseudonyms.

4.4.2 Study Design and Data Collection

Data collection from the self-usage families was in the form of blog entries about the families' experiences using the FW, thoughts, problems they encountered, communication and awareness needs that were not being fulfilled. At this initial stage, I was interested in understanding how these families used the FW to allow us to design the system for a broader population.

Data collection from the field study families included interviews, observations, diaries, and a log of software usage. Four semi-structured contextual interviews (Beyer and Holtzblatt, 1998) with the field study families, one each during the first and second week of usage, one at the end of five weeks, and a follow-up interview two weeks later. Protocol for the initial interview is in Appendix BB and interview questions are in Appendix BC and Appendix BD. I also sent emails and phoned between interviews to ensure families were not having technical difficulties. All interviews from the field study were audio-recorded and handwritten notes were taken to aid analysis. When possible, I tried to observe families using the FW. These observations were opportunistic and occurred while I was in a participant's home.

Each family was given a diary to record their usage of the FW and thoughts between interviews. Notes in the diary were used to seed conversation during interviews. Diaries were collected at the end of the study. Software usage was logged throughout the study (e.g., on/off state, blinds level). To respect the privacy of the participants, I did not record the video that was being transmitted between households. Software usage was used to probe participants about their use of features in the FW.

4.4.3 Data Analysis

Open coding, axial coding, and selective coding (Charmaz, 2006) as described in Chapter 1, was used to analyze the blog entries from the self-usage, interviews and diaries from the field study. Open coding was used to draw out key themes about the use of the FW. Each quote and description of use was coded with a descriptive label and compared subsequent observations to the coded ones. Observations that fit existing codes were labeled with those codes while observations that did not fit existing codes were given a new code. Codes were then organized into relevant categories that describe the main themes in the data.

The creation of codes was done in two iterations. In the first iteration, I created codes from the data. At the end of the iteration, the codes were organized into high-level categories. In the second iteration, I went through the data again to validate the codes and create new codes where necessary. Categories that had 20 or more codes were broken into two or more smaller categories. Categories with five or less codes were combined, if possible. Finally the categories were combined into themes.

At the end of this process, I came up with 87 codes, 8 categories, and 6 themes. The codes and subsequent categories are in Appendix BE. The themes and associated categories are found in Table 4.1. The results section (Section 4.5) is organized based on these key themes.

Theme	Categories
Family Ties	Relationship with remote person/people
Availability Awareness Leads to Interaction	Availability awareness and willingness to communicate Interesting observations lead to conversation
Interacting through the Family Window	Interacting using the Family Window
Sharing Everyday Life	Sharing life Mobility vs. lack of mobility
Privacy	Privacy
Time Shift Recording	Recording video

Table 4.1: Themes and associated categories.

4.5 Results

All six families left the FW running continuously throughout the study (at their choice) and it was typically only off as the result of technical difficulties, which required it to be restarted. Across all families, I saw similar usage patterns where, in many ways, the FW became the central focus of communication between the subject families. In fact, all families wanted to continue use after the study. The following sections describe the patterns of FW usage that occurred and the critical design features that led to and supported these routines. These sections also discuss the features that did not meet users' needs, thereby causing workarounds to be used. Selected results from this evaluation can be found in Judge et al. (2010).

4.5.1 Participating Families

The composition of each family, their relationship to the remote family, and location of the FW within their home are described below.

4.5.1.1 Self Usage

The Researcher family was composed of a researcher, and his wife, along with their two children, aged 3 years and 8 months. They connected with the researcher's parents. The two households were separated by a three-hour time difference with one in Canada and one in the United States. Both families communicated using phone once every few weeks and desired more communication. They visited each other 2-3 times a year. The Researcher family used the FW on a Tablet PC and placed it on a counter in the kitchen [Figure 4.6]. From this location, the FW could be turned to capture the dining area, the kitchen, or the living room. The *Researcher-Parents* used the FW on a desktop PC for three months, and a Tablet PC for the remaining three months. This was done to compare the different styles of usage. Both computers were situated at one end of a living room [Figure 4.7], because they felt having the FW in a public location of the home would cause it to capture the most interesting information.

Figure 4.6 Placement of the FW on the Researcher family's kitchen counter.

Figure 4.7 Placement of the FW in the Researcher-Parents' living room.

4.5.1.2 Sister-Siste

The Sister1 family was composed of two parents and a son who was 18 months old. They used the FW to connect with the wife's sister and her long-term male companion. This family is referred to as the *Sister2 family*. The sisters had a very close relationship, describing it as being

like a mother-daughter relationship as Sister2 is 20 years older than Sister1. Both families lived in midsized cities in New York, USA, with a two-hour drive apart. Despite this seemingly short distance, they typically saw each other in person only once every few months, yet talked on the phone or emailed regularly throughout each week. Neither had ever video conferenced. The sister families both used the FW on a Tablet PC and chose to place them in their home office near existing computers [Figures 4.8 and 4.9]. They were accustomed to keeping computer devices in this space, and this was also pragmatic – Sister1 wanted to keep the device out of reach her child and Sister2 wanted to keep the device out of reach of her large pets.
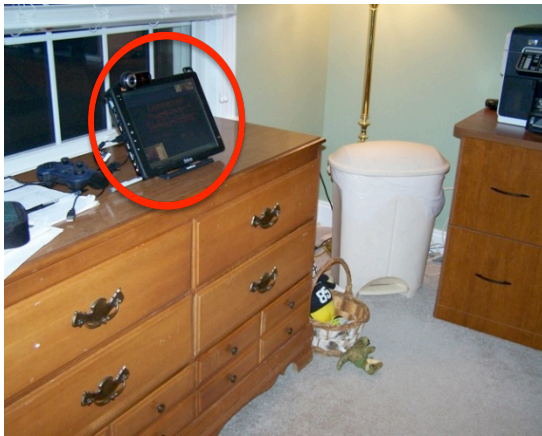
Figure 4.8 Placement of the FW in Sister1's home office.

Figure 4.9 Placement of the FW in Sister2's home office.

4.5.1.3 Daughter-Grandparents- Grandchildren

The Daughter family was composed of two parents and a son who was 2 years old. They used the FW to connect with the wife's mother and stepfather whom I will call the *Daughter-Parents family.* The daughter and mother were very close to one another and talked and emailed frequently. As a routine, they also used Skype every weekend to allow her parents to talk to and see their son at play. Both families lived in midsized cities, one in New York and one in Florida, USA. They lived in the same time zone but were a 21-hour drive apart. The Daughter family used the FW on a Tablet PC and placed it on a short stand in the corner of the living room, so that it could capture most of their living room and adjacent kitchen [Figure 4.10]. The stand also enabled their son to easily see and interact with the FW. The Daughter-Parents family used the FW on a home laptop, which was moved throughout the

home but was generally found in the kitchen or living room [Figure 4.11]. This made it possible for me to compare laptop-to-Tablet PC usage.

Figure 4.10 Placement of the FW in the Daughter family's living room.

Figure 4.11 Placement of the FW in the Daughter-Parents family's kitchen.

4.5.2 Availability Awareness Leads to Interaction

First, and most similar to the use of media spaces in the workplace, family members use the FW as a tool for discerning availability, which they could then use to easily move into interaction if desired. Here participants would check the FW before making phone calls to see if remote family members were around and then sometimes gesture at one another (e.g., making a phone shape with one's hand) or write on the FW to ask if it was alright to call. At times, this awareness acquisition and subsequent interaction was serendipitous where family members would notice something unexpected and then call to talk about it. For example, they may see someone with a new haircut, nice shirt, or home at an unexpected time, which could prompt a phone call. In addition, awareness acquisition was also part of planned interactions. For example, a family member may routinely call at a certain day and time, but they would first check the FW to ensure that, even though the interaction was planned, the other person was indeed around and available.

These types of experiences are exemplified by a situation arising between the Sister families, which began as awareness leading to impromptu interaction and evolved into awareness for planned interactions. Prior to the FW, the two sisters would normally talk several times a week on the phone, but it could be a challenge to catch the other person before 9 pm. After 9 pm, Sister1 assumed her older sister was already asleep, while Sister2

assumed her younger sister would be trying to put her son to bed. One evening during her first week of using the FW, Sister1 noticed that her sister was awake at 10 pm and on a desktop PC in the home office, which she could see on the FW. She knocked and wrote on the FW to ask if they could talk. Sister2 said yes and then called her on the phone. Since this incident, they have been talking regularly in the late evening after checking the other's availability. Thus, the FW let them to discover new opportunities for interaction. This is exemplified by a quote from Sister2:

> *"Seeing each other every day allows us to be more connected and to talk about our days. Example [my sister] would ask 'how did that meeting go today?' as opposed to weekly calls where we only used to talk about our week in general and highlight important points." –* *Sister2*

Determining availability for communication was not without its challenges. As one might expect, family members were not always in front of their FW (regardless of its location) given the large size of most homes and the varied location of family members. This is in contrast to most media spaces designed for workplaces where the media space showed an office view, and, most of the time, the office worker was in front of the camera. To overcome this, family members would sometimes push the knock button to see if people were around or they might rely on other visual cues. For example, the lighting of the room may indicate people were awake, or changes to the "background" (e.g., movement of a book on the counter) may show recent activity and, thus, presence. Another example:

> *"i [sic] could see you leave the house.I [sic] could also tell when you arrived home again as I saw the diaper bag go onto the counter". – Researcher-Parents Grandmother*

The activity timeline could have seemingly helped families determine recent presence and likely availability, although none reported using it for this. In fact, most families found this feature offered little immediate value. Instead, family members would often augment the video channel with handwritten messages to provide additional availability information. For example, both the Daughter and Daughter-Parents family left messages saying when they would return if they were going out during the day. In essence, this firsthand information provided a more trustworthy account of one's availability.

Of particular interest is the fact that family members actually *chose* to discern an awareness of presence and availability *before* phoning each other. They did not have to, and

this would have reflected their previous communication patterns of calling based on an assumption of availability or simply not concerned if they interrupted the remote family. The fact that families had additional information to help determine availability *and* acted on it points to the value of having this availability awareness.

4.5.3 Interacting through the Family Window

Families also used the FW as a communication tool for interacting with their remote family members. As previously described, the FW did not include an audio link. However it turned out that family members desired this, albeit in a limited fashion. Always-on audio was seen as a large invasion of privacy, and instead families wanted simple mechanisms that permitted sending short messages to one another. This is exemplified by the following quote:

> *"I do wish that there was a talking feature on the program. Sometimes I have said 'Hi, I love you'. Then I realize they cannot hear me. I have been trying to think and act out the words. If you could just press a button and say 'Hi, How are you? Hope you have a good day. How is the baby? How is [grandson] doing? What is the weather like? I love you. Have a good sleep'. Just some simple little chat." – Blog excerpt from Researcher-Parents Grandmother*

In addition to this, families also saw the need for longer conversations, akin to the manner in which they were accustomed to using on the phone. Given the lack of both of these types of audio, families develop workarounds.

First, as described previously, families often coupled their use of the FW with the phone or an audio conferencing tool. The FW would provide the video link to see family members, gesture, or show items of interest while the phone supported the voice conversation. Several of the families even used the phone in speakerphone mode so that multiple family members could converse simultaneously. Yet the phone calls only sufficed for situations where family members wanted to have longer conversations. In situations where they wanted to simply say a quick "hi," they relied on the writing capabilities of the FW. Families left many messages throughout the study as a form of asynchronous communication. Messages often began with a simple "good morning" at the beginning of the day and then evolved into more detailed discussions with messages left at various points in reply to one another [Figure 4.12]. Participants reported that seeing these messages in the context of the FW made them special and required less effort than email. For example:

Figure 4.12 The FW with handwritten messages.

Figure 4.13 Husband from the Daughter family "chats" with his father-in-law.

"It is nice to come home or wake up to see a message from [my sister]. A simple message like 'have a nice day' is all I need to know that she is thinking of me." – Sister1

Instances of synchronous communication also occurred where families would leave "bursts" of messages one after another in a turn-taking fashion [Figure 4.13]. In essence, they had turned the FW's drawing canvas into a handwritten "chat window." This method can cause conversations to progress slowly (handwriting is often slow), although I found that there was an enhanced feeling of connectedness that came with seeing a loved one's handwriting.

The placement of the FW in the Daughter family's house also led to rich interactions between the two-year-old grandson and his grandmother. The grandson would have exchanges with his grandmother where she would write alphabet letters on the FW for him, draw shapes, or hold up different colors to try to teach him new things [Figure 4.14]. In turn, he would draw pictures for her. For example, in Figure 4.14 the grandmother is holding up a red ladybug to teach him the color red. In Figure 4.15 the grandson is showing his grandmother his teddy bear. These types of routines became so important to the grandson that he would run to the FW each day after returning home from daycare, scribble a message on it, and kiss the video of his grandmother's face. If his grandmother was not around, his father would call her house and tell her that her grandson was looking for her. This illustrates that, if placed in an accessible location, even young children can establish new ways of interacting with remote family [Figure 4.15].

Figure 4.14 Grandmother from the Daughter-Parent's family holds up a red object and asks her grandson its color.

Figure 4.15 Son from the Daughter family shows his grandmother his stuffed animal.

Interacting through drawing on the FW is simple with a Tablet PC, yet this task quickly became onerous on the desktop PC and laptop where stylus or touch interaction was not supported. For example, the Daughter-Parents grandmother stopped trying to write on the FW at one point and developed a workaround of writing messages on a notepad and then holding them up in front of the FW. The wife from the Researcher family added that handwriting was more personal, and it was hard to write using a mouse on their laptop. According to her:

> *"I didn't realize how much [sic] LOVED the touch writing tool until the tablet was taken away and then given back to me. I find [sic] want to write more because it is so easy to use, whereas with the mouse it is hard to write perfectly. Plus, with the writing tool that is touch it LOOKS like my writing, which kind of makes it seem more personal." – Blog excerpt from Researcher Wife*

We could have enabled typed text on the FW, but this would have taken away from the richness associated with seeing the remote family member's handwriting. Clearly, a balance between ease of use and this richness is needed.

4.5.4 Sharing Everyday Life

All families routinely used the FW to share episodes of everyday life such as eating, preparing meals, child bathing, playing, etc. This went beyond simply conversing to actually showing or making the remote family members a part of the activities at one's home. For example in Figure 4.16, the grandparents from the Daughter-Parent's family are watching their daughter play with their grandson. Family members did not have to do this nor did I suggest it. It evolved out of the needs people had to make the remote family members a part of their seemingly mundane everyday activities. At first these instances were opportune, but many of them evolved into routine practices that often occurred on a daily basis. The following quotes demonstrate this:

> *"[My grandson] has tea parties with his stuffed animals and I get to watch that… One day [my daughter and son-in-law] moved [the FW] to the kitchen so I could watch them cook breakfast… [My husband] took ours to the pool one day so they could see us in the pool." – Daughter-Parents Grandmother*

"[My son-in-law] takes the Family Window up to the bathtub and we watch [my grandson] take his bath, get ready for bed, read books together and [my grandson] just loves to see us, just loves! So every night between 7:00-8:15 we set the time to see him… THAT WAS SO COOL! It was the next best thing to being there!" – Diary entry by Daughter-Parents Grandmother

"I could see [my grandson] playing and I could see the tv going with the [hockey] game. This really made me happy to see the daily activity happening. After awhile you walked by waved good night things went dark the camera was off and I knew you went upstairs to bed. This all made me feel more connected to my distant family." – Blog excerpt from Researcher Grandmother

Figure 4.16 Grandparents from the Daughter-Parent's family watch their grandson during his playtime.

According to the families, the feelings of connectedness that developed between them as a result of sharing activities surpassed that which they felt with other technologies, like email or phones. Seeing the remote family members and their activities was the crucial

aspect. This point is exemplified by the Daughter family whose son required minor dental surgery. The daughter contacted her mother several times throughout this ordeal to let her know the situation and that everything was fine after surgery. Only when she saw her grandson on the FW and he showed her the tooth and his stitches did she feel relieved and reached peace of mind. A quote from her illustrates this:

> *"He hurt his tooth the other day and the dentist had to take it out. So it was very traumatic. We were watching him when he came home and he showed me his tooth. It was nice for me to be able to see him after what happened" – Daughter-Parents Grandmother*

Sharing everyday life also involved seeing more than just the remote family members. Other visible items in the home were sometimes just as important. For the Daughter family and the Sister families, seeing pets became a surprise interest of the families [Figure 4.17]. Researcher-Parents Grandmother felt more connected by seeing the weather outside of the Researcher's home (through an outdoor window) because it provided a better understanding of the circumstances surrounding the family's day. These findings illustrate that unexpected information can become important and it is not always easy to know in advance what information may be relevant at what point in time. Patterns may develop, yet these are likely to be different for different people who may value certain information over other pieces of information.

The sharing of everyday life was supported by both the always-on nature of the FW along with its mobility. Thus, they were critical factors for supporting these behaviors. Families could easily move the FW to locations that contained activities that they wanted to share, such as a child's play area or the kitchen. A fixed location would not have sufficed for capturing all the moments families wished to share. Yet when the FW was left stationary, always-on video meant that a portion of the families' activities were shared with no additional effort placed on the family. They simply carried on life as they normally did, except now it was being captured and shared via the FW. The fact that the video was live meant that families were more a part of the remote family's life *right now*, somewhat akin to visiting the home in person.

Figure 4.17 Son from the Daughter family watches a pet in his grandparents' home.

Workplace media spaces were used to share meetings and other similar social gatherings, but a work colleague would hardly show their routine for checking email or writing a document via a video link. Thus, there is a large contrast between the workplace and home. In the home, everyday mundane activities *are* shared. Sharing these activities led to families feeling more connected and being a part of each other's lives. These findings are also similar to O'Hara et al.'s [32] study of mobile video conferencing. They too found that people enjoyed sharing everyday episodes of life where the mobility of the mobile phone played an important role.

4.5.5 Privacy

All families initially expressed concerns over privacy, specifically confidentiality, that remote family members may learn or see more details about their lives than they were willing to share. This concern was minor, however, because they were connecting with close family members. They also all chose FW locations that were comfortable to them and revealed the

same amount of information as one might gather if visiting the home in person. The difference here was that the remote family would see this space *all* of the time. Through the first week of usage, four of the families (the exceptions being the Researcher families) used the blinds periodically to indicate they were busy or did not want to be seen. This activity soon dissolved as families grew comfortable with the FW, developed patterns of use around it, and realized that what was visible to the remote household was not of particular concern. Following the first week, none of the families used the blinds again.

This acclimation is best illustrated through two stories from the Daughter family. First, the wife in the Daughter family routinely did exercises in her living room after putting her son to bed. During these times, she would close the blinds on the FW because she did not want to be watched. One night she noticed her mother's legs in the air on the FW and called her to ask what she was doing. As it turned out, her mother was also exercising. The daughter's response was that if her mother was fine with showing this, she was fine too. Following this, she never closed the blinds again.

Second, there were instances where using the FW on a laptop or desktop PC caused privacy concerns. The husband in the Daughter family usually stayed up late watching TV at night but quickly grew uncomfortable because he saw his father-in-law in the FW staring intently at him every night. After several nights of this occurring, he asked his father-in-law what he found so interesting. As it turned out, the father-in-law had minimized the FW application on his laptop and was checking his email. After understanding this behavior, the son-in-law did not feel concerned about his privacy. This does reveal, though, that non-dedicated displays can easily send mixed messages about one's actions, because it is not clear what application they are directed towards.

Some family members also felt awkward as viewers of a remote household. Thus, there existed different concerns when watching vs. being watched. For example, one family member was initially concerned because she did not know if the remote family would be fine with her watching them and did not want to "intrude." This feeling dissolved after a few days of use. Some family members were also surprised about the manner in which they saw remote children behaving and being disciplined. They chose to accept the differences in child-rearing styles or to ignore it. The Researcher family often had guests visit their home who would notice and ask about the FW. In some instances, they would sense the visitors' discomfort in watching or being watched. To alleviate this, the Researcher family turned the

FW to capture the wall or an obscure object (e.g., flowers). In other instances, visitors would be fine with the FW continuing to capture the home's activities.

A common privacy concern with domestic technologies relates to violations of solitude. People can easily interrupt home inhabitants at inopportune times (e.g., by phoning them) or not allow them to have time and space to themselves (Boyle, et al., 2009). One might expect that a media space could infringe on solitude, because it would mean that a family could be watched all the time. However, none of the families expressed concerns over solitude. In fact, the FW often acted as a passive awareness device where family members did not have to do any additional work to share information about their lives. They simply had to have it on and continue their normal routine. Families did not feel obligated to talk or interrupt their normal activities to share information (like one may have to do if phoning a family member and conversing).

4.5.6 Time Shift Recording

Although families valued "in the moment" sharing over viewing past events, they liked the ability to record video while they were away. The Daughter-Parents family and Sister2 family watched time shifted video when they got home from work to catch up on their respective grandson and nephew's daily activities. This increased feelings of connectedness as families could easily share parts of their lives even when they were not at home at the same time. Despite this, there were still instances where families wanted to record activities with the FW and have them saved *permanently*. However, the design did not support this. Here participants wanted to record video in a manner similar to capturing photos/videos of events and then save or share these clips.

The time shift feature currently gives the viewer control over saving video. Giving control to the remote user proved to be problematic. This was exemplified by a situation with the Daughter family. The Daughter family's son was having a birthday party and his Grandmother wanted to be able to see it, however she was not going to be at home. On the day of the party, the Grandmother forgot to turn on time shift recording. Because control over recording was in the hands of the viewer, the son-in-law had no way of recording the activity for her with the FW. However, he assumed that she had turned the feature on and he set the FW in the garage where the party was held. He told everyone to wave at her (grandmother) as they walked by the FW and that she would be able to watch the video.

When the grandmother got home and her son-in-law asked if she had watched the video, she was devastated. For this reason, there is a need to adjust the control mechanisms for time shift recording to permit recording at either location. A more sophisticated version of time shift may also be needed in the case that users forget to turn on recording or realize that they would like something recorded after the fact. For example, the system could automatically record activities that may be characterized as interesting based on activity or person detection.

Studies of workplace awareness have shown that recording activities can be important (Begole, et al., 2002; Hudson and Smith, 1996; Nunes, et al., 2007), however, in the workplace, the importance is not in capturing memories for sentimental value like it is in the home. At work, it is typically about capturing information to discern availability, predict future patterns of activity, or review meetings. Thus, there is a contrast between the workplace and home in this regard.

4.5.7 Post-Deployment Communication

Two weeks after the end of the deployment I interviewed the Daughter family, the Daughter-Parents family, and the Sister families. All families subjectively reported that their communication acts (e.g., serendipitous conversations, sharing of everyday life) increased during the FW usage as compared to before it was introduced. After the FW was removed, communication patterns returned to what they had been prior to the FW usage. Families felt less connected as they could not see each other anymore, and they no longer had impromptu conversations during the day.

4.6 Discussion and Conclusions

4.6.1 Communication and Awareness Practices

The field evaluation revealed many key behaviors and routines surrounding the use of a domestic media space to connect families over distance. These were similar to workplace media space usage (e.g., availability awareness, impromptu conversations) and also different (e.g., sharing everyday mundane activities) where the mobility of the FW and its always-on video played a critical role.

First, because family members could see their distant loved ones on a regular basis, they were more aware of each other's presence. This led to families thinking about each other more often and interacting more frequently. Family members didn't necessarily feel more obligated to call, they simply *wanted* to call. The always-on video also gave new purpose to those calls where family members could ask or talk about the everyday mundane things that they saw on the FW for which they may not normally be aware. Other technologies do not provide this same level of awareness and sense of presence. One may see an email from a remote family member or see their name on an IM buddy list, but this does not engender the same feelings that one gets when they actually see someone in person.

Second, family members felt more connected, because they could actually see their distant family members, their home, and their lives. They explored and built this connection by showing and watching everyday episodes of life. This also came from seeing unexpected things such as a television turned on, a pet moving in the room, the weather outside, or even just an empty room. Families can share everyday life through photos or video recordings, or even tell others about things via email or phone conversation, but this is not the same. Seeing things live brings an additional sense of believing and increases connectedness by making the remote family a part of the activity. Currently, most communication technologies do not support this well. This calls for continued design efforts to support the sharing of everyday domestic activities.

Third, privacy concerns over the use of always-on video in the home are most commonly related to autonomy where users choose when and how to participate in such a system. Thus, the ability to easily turn on/off a domestic media space is critical. Researchers have posited about the sanctity of the home and the need for solitude within it so that people can "escape" from others (Boyle, et al., 2009). Yet my findings revealed this was not a concern for the field study families. Confidentiality has also been a large concern for workplace media spaces (Boyle, et al., 2009; Coutaz, et al., 1998; Hudson and Smith, 1996), but again this was not a large concern for media space usage in the home. What is clear is that relationships matter (Romero, et al., 2007). All of the field study families had close relationships where they had a need to connect over distance. In other situations, people will naturally not be as comfortable with always-on video.

4.6.2 Design Recommendations for a Domestic Media Space

The design iterations and use of the FW by six families has revealed key design features that aided in the successful appropriation of a domestic media space in the homes of families. Features such as a dedicated display, mobility, privacy controls, and multiple modes of interaction proved to be important for families using a media space.

A dedicated display is key in a domestic media space as it allows the media space to be a communication appliance with one primary function. The dedicated display allowed families to set up the FW and leave it in a chosen location as a passive device. If and when they wanted to communicate with the remote family, they could approach the device and interact with it. Families that used the FW on their desktop or laptop had to switch between applications and more often than not, minimized the FW application. This prevented them and other members of their household from gaining awareness information about the activities of the remote family and did not facilitate impromptu interaction.

The mobility of the device proved to be important for sharing activities. The FW was taken to areas in the house that had activity families wanted to share hence increasing the awareness and connectedness between families. Although users did not explicitly mention it, the mobility of the device might have been a means for controlling their privacy. Placing the FW in the home office may have been a practical decision for the Sister families, but it might have also been their way of controlling the activities they wanted to share and when they used the FW. Therefore deciding on the location of the FW might have been their way of controlling confidentiality, autonomy, and solitude.

Although families in the study claimed that they did not have privacy concerns and only used the blinds during the first week, it is still important for a domestic media space to provide mechanisms to control privacy. Families in this study had a close relationship that was apparent in their need to share activities, but there might be instances when families do not want to share. This could be when visitors are present, when a couple is having an argument, or while disciplining children. Privacy mechanisms could be built into the media space such as the ability to control placement or an external camera that can be focused on inanimate objects.

In a domestic media space with no audio, it is important to provide means to obtain the remote family's attention and to communicate asynchronously. Since the media space is intended to increase communication, families should be able to easily indicate their

availability and willingness to communicate. This can be done with features such as writing and knocking that is provided in the FW. Providing multiple modes of interaction such as gesturing on the video, leaving messages and knocking to gain attention gives families the option of choosing between modes of interaction with the remote family. As I found in this study, these modes of interaction were also easy for children to use, hence increasing the participation of children.

My experiences with domestic media spaces from this study can be used to inform the design of other non-media space technologies. For starters, there is a clear need for technologies that enable both availability awareness and seamless interaction amongst family members over distance. Systems such as the Whereabouts Clock (Sellen, et al., 2006) could provide information that family members could use to deduce availability, yet there is no means to seamlessly move into interaction with the same system. On the other hand, systems such as Home Note (Sellen, 2006) or BubbleBoard (Lindley, et al., 2009) could provide availability awareness via messages saved/written by family members, thereby inherently supporting both awareness and interaction in a single device. Yet, here users must explicitly provide the availability information as opposed to a media space, which transmits this information passively.

Findings from this study also illustrate that it is not always clear what awareness information is important to families. Thus, awareness appliances that preselect which content is important or are designed around specific contextual information can easily fail to provide families with the awareness information they want or need to see in order to feel connected. These findings suggest that awareness appliances should be adaptable or allow users to change what information is presented to them. For example, Elliot et al.'s (Elliot, et al., 2007) location-dependent appliances allow users to change what awareness information is presented depending on a device's location. However, even though family members can select content, it can be difficult for users to know what information is relevant until they actually see it. In the case of media spaces, this suggests the continual transmission of video. In contrast, systems like VideoProbe (Conversy, et al., 2003), which transmit intermittently and only if there is motion in front of the camera, may easily miss interesting pieces of awareness information. For example, gradual changes in weather patterns or lighting may go undetected yet be valued by some family members (as found in this evaluation).

Chapter 5

Family Portals: A Multifamily Domestic Media Space

5.1 Introduction

The previous two chapters described the first and second phase of my research about the design and use of a media space with always-on video, to connect families separated by distance. Chapter 3 described a study of families' use of video conferencing in their homes. The study revealed that families liked sharing information in the moment, families wanted to share their daily lives with each other, and their privacy concerns when using video conferencing systems were about autonomy – who and when to connect to. Current video conferencing systems also do not provide the remote family's availability information and willingness to communicate. This led to families using technology such as email, IM and text messages to determine their remote family's availability and willingness to communicate prior to initiating a video call. Chapter 4 described the design, implementation, and field evaluation of the Family Window, a dyadic domestic media space with always-on video. The design of the Family Window incorporated findings and design recommendations from the study of video conferencing in the home. The evaluation of the Family Window highlighted the importance of a dedicated display and mobility in a domestic media space, and the importance families placed in gathering awareness information about each other's lives.

This chapter outlines the third phase of Part 1 of my research – the design and evaluation of a multifamily media space with always-on video. Although a multifamily media space should be able to connect *n* families to each other at the same time, in this phase, I will be studying the use of a multifamily media space that connects three families. I chose to limit the number of connections to three, as it will reduce the complexity of the system. Studying a larger number of families is also impractical for a field study. By reducing the numbers of families, I can investigate each family's detailed usage pattern in a multifamily media space. My analysis of these results will include efforts to understand how the results do or do not generalize to larger numbers of families.

5.2 Methodology

To research families' communication and awareness practices and privacy concerns associated with their use of a multifamily media space with always-on video, I took a two-step approach. First, I designed a multifamily media space[10]. This media space was designed based on findings and recommendations from the design and evaluation of the Family Window (Chapter 4). The multifamily media space was then evaluated through a field evaluation.

5.2.1 Expected findings

Based on findings from the design and evaluation of a dyadic media space (Chapter 4), I expected the following findings from the field evaluation of the multifamily media space.

> 1) Families will use the multifamily media space in ways similar to the use of a dyadic media space. Families will use the media space to communicate, share life, create shared routines, and gather awareness information. New patterns of communication will also emerge, as families will be able to communicate with only one family at a time or with two families simultaneously using the multifamily media space.
>
> 2) Families will have privacy concerns about being connected to two remote families. These concerns will be different from privacy concerns using a dyadic media space as families might have different levels of closeness with both remote families. This may result in a family wanting to share different types or amounts of information with each of the two remote families.

5.3 Design of Family Portals

My first step in this exploration was to design and implement a multifamily media space. I call this media space Family Portals (FP) as it contains "portals" into distant families' homes [Figure 5.1].
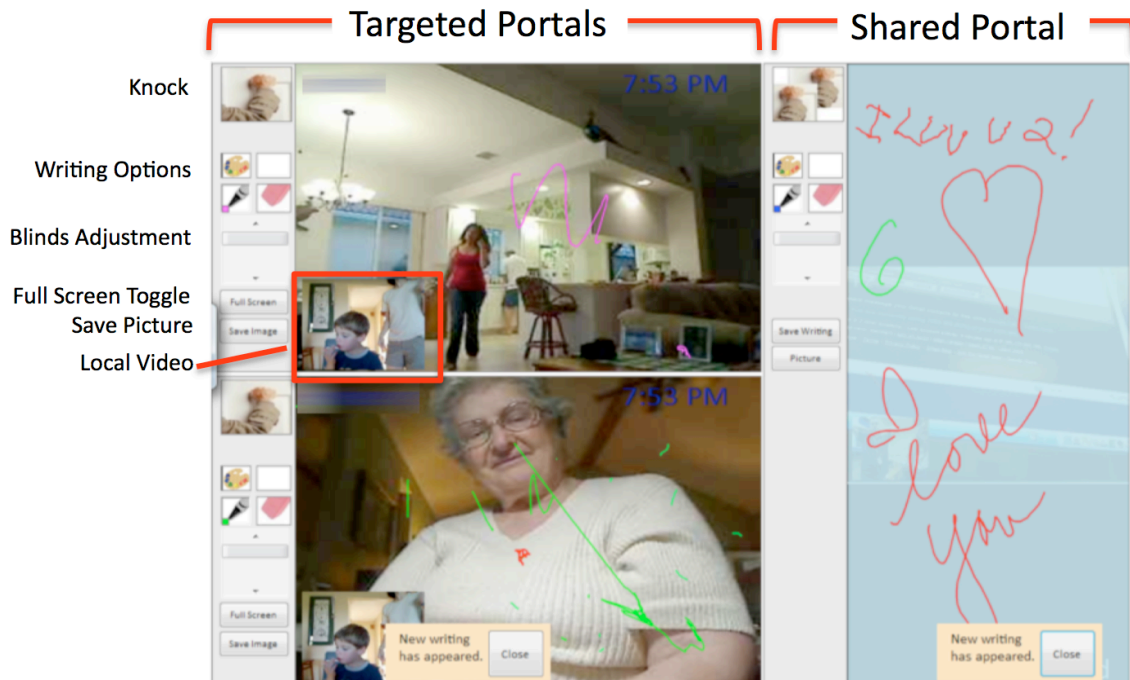
Figure 5.1. Family Portals.

5.3.1 Basic Design

FP is an always-on media space that provides a continuous video connection between three households. I omitted audio, because I wanted to focus our investigation on video for awareness and focus on asynchronous interaction (eg. writing). Although audio is a rich medium for communication, studies have shown that audio is often more privacy intrusive than video (Hindus, et al., 2001; Judge, et al., 2010). As such, I focused on features that were potentially less intrusive.

FP was prototyped on a touch and pen-sensitive Tablet PC with an external webcam to simulate the idea of it being a dedicated information appliance as opposed to a computer used for multiple tasks. The dedicated device means that FP can be easily moved throughout the home depending on where family members want to share activities.

Although FP is designed to connect three families, I did not expect the families to have the same relationship with each other. For instance, a daughter connecting to both her *mother* and *sister* might not want to share the same amount and type of information with both of them. Thus I provided two types of interactions–*targeted interactions* and *shared interactions*–to allow families to share information in a dyadic manner vs. a triadic manner. For this reason, as seen in Figure 1, the screen is divided into two areas: Targeted Portals on the left, and a

Shared Portal on the right. These will be described next.

5.3.2 Targeted Portal

The left side of the screen in Figure 5.1 shows two Targeted Portals (top and bottom), one for each family that a local user is connecting to. The Targeted Portals are intended to allow families to interact and share information with *one* of their two remote families in a dyadic manner. This is similar to the concept of *directed* in Portholes (Dourish and Bly, 1992). Interactions within each Targeted Portal affect only the remote family that is associated with that Portal. Each Portal is identical in terms of its features.

Always-On Video

The main portion of each Targeted Portal shows video from the remote family's home. Video is transmitted over the Internet at a rate of one frame per second with 320×240 resolution, using a client-server architecture. Latency issues made it difficult to maintain a continuous connection with higher frame rates. The bottom left corner of each Targeted Portal shows the local family's video feed as seen by the remote family. This provides feedback of what is shown of one's home. Family members can obscure their video feed, as seen in Figure 5.2, by adjusting slate blinds using a slider on the left side of *each* Targeted Portal. This allows families to provide a different view for each remote family, if they so desire. The slow frame rate also creates an unintended privacy filter by not broadcasting in full fidelity.
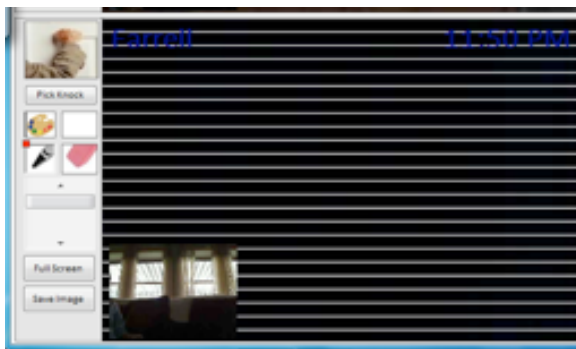
Figure 5.2. Blinds halfway down at night in one home. Figure 5.3. Full screen view.

Initiating Interaction

Studies of the use of video conferencing in the home noted that families need an easy and unobtrusive way to determine if the distant family is available for a video chat (Judge and Neustaedter, 2010a). Users can click a *Knock* button in the top left corner of the Targeted Portal and this produces a knocking sound in the local and remote home.

Messaging

Users can leave handwritten messages for specific families by writing on top of the video in each Targeted Portal using either the stylus or one's finger. Only the target family sees the writing, thus it is a private writing space for the two families. A notification appears in the remote home when a new message is written. Users can pick ink colors and erase writing using the icons on the left side of the Portal.

Full Screen

I also expected families to want to focus their attention on one remote family at a time, e.g., if the third family is not home. To enable this, users can toggle between *Full Screen* and *Split Screen* views by clicking a button on the left of the Portal. In Full Screen mode, the Portal expands to cover the entire screen, as shown in Figure 5.3. The third family's video is minimized and displayed at the bottom right corner.

5.3.3 Shared Portal

The right side of Figure 5.1 shows the Shared Portal. It provides shared interactions intended for the entire triad. Dourish et al. (1992) called this type of interaction *broadcast,* where all users of the system have access to all information. The main portion of the Shared Portal displays a whiteboard to support triadic interactions. Users can write on it to leave messages for *both* remote families. A multifamily knocking feature lets a local family knock on both remote families' portals simultaneously. The Shared Portal also contains a slider that will adjust the blinds for the local family's video. Blinds adjustments performed here affect the video that is transmitted in *both* of the Targeted Portals. This allows families to quickly show the same video feed to both remote families.

5.3.4 Comparison to existing systems

The design of FP draws from existing systems and extends them to support multifamily interaction in a media space. Family Window's knocking feature and CoMeDi's blinds (Coutaz, et al., 1998) are extended to include multifamily versions of these in the Shared Portal. CommuteBoard, messageProbe, and Wayve (Hindus, et al., 2001; Hutchinson, et al., 2003; Lindley, et al., 2010) all provided a shared writing space like our Shared Portal. However, we extended this by also providing a private message board for each family in the Targeted Portals. The appropriation of these features in combination with our understanding of domestic communication, existing domestic media spaces, and multiparty workplace media spaces led to the design of FP.

5.4 Evaluation of Family Portals

The following section describes the participant selection and study design for the evaluation of Family Portals.

5.4.1 Participant Selection and Recruitment

Two sets of families were recruited for this study. Each set consisted of three families, all of whom were connected to each other using FP. Families were recruited using a snowball sampling technique (Goodman, 1961). Snowball sampling involves picking and contacting n people from the population, and each person contacts k other people from his/her social circle. This method is effective to reach a large number of people in the population. To perform snowball sampling, I emailed an advertisement of the study to mailing lists in the Rochester, NY area. These mailings lists consisted of participants from my previous studies, residential areas, universities and businesses in Rochester, NY. Recipients of the email were asked to forward it to their friends or family who might be interested in participating. Each family who responded to the advertisement will be referred to as a *seed family*. Each seed family was connected to two *remote families* using FP.

Families that were selected for this study were given a tablet PC with FP application, an external webcam, and a stand for the tablet PC during the duration of the study. All families were compensated for their participation. I was based in Rochester, NY for the duration of this study.

5.4.1.1 Participant Selection Criteria

All seed families who responded to the advertisement were asked to fill out a questionnaire to enable me to learn about them and their current communication practices. For practical purposes, I only wanted to recruit sets of families who fulfilled the following three criteria.

1) Have a high-speed Internet connection in their home - FP requires an Internet connection to connect to a server.

2) Live within a two-hour driving distance from Rochester, NY - I wanted to help families set up FP in their home and to be able to aid them if they are having technical difficulties. If a family was not within driving distance, I had to ensure that there was at least one technically savvy member of the household. The set up of FP is fairly simple, but there is always the possibility of technical difficulties and breakdowns, which would require me to troubleshoot with a family member.

3) Not be away for vacation for more than three to five days during the duration of this study - Families had a limited time to use FP in their home, and it would not be practical to recruit families who would not be able to use the system for extended periods of time.

Given that multiple families responded to the advertisement, I used the following factors to select two sets of families for the study. I chose these factors, as families that differed along these dimensions would provide interesting insight into the use and adaptation of FP.

A) Size of household and relationship between people in household – A household could contain one person to multiple people. The size of a household might affect the family's communication needs and their use of FP. A household could be a nuclear family unit with parents and children. It could also include extended family members. Other types of households could be friends living together, an engaged couple, etc. These will all provide interesting insight into the use of FP in different types and size of households.

B) Number and age of children in household – Households with and without children will have different communication needs. Based on my previous work (Judge and Neustaedter, 2010a; Judge, et al., 2010), families with and without children also have different communication patterns. This further differs with the age of the children. It would be important to learn about the use of FP in families with and without children and with children of different ages.

C) Seed family's relationship to remote families – A seed family could want to connect to their siblings, parents, parents-in-law, friends, or others in their social circle. Each connection would provide a unique dynamic. For example, a seed family's relationship with the parents of one spouse would be different from their relationship with a sibling of the other spouse. Hence the family's use of FP to connect to these two families will be different from their use of FP to connect with other families. A variety of relationships between seed families and remote families will help shed light of the use and adaptation of FP between multiple households with different relationships.

D) Current communication between families – Families could communicate anywhere between daily to monthly with one other. Families' current communication patterns and their need to increase or decrease their existing communication could affect their use of FP. It will also be interesting to recruit families who currently communicate using different technologies: For example, phone, email, IM, video conferencing. These families would have certain patterns and behaviors associated with their current choice of technology, which may provide an interesting comparison to their use of FP.

E) Current use of video conferencing – Families who currently use video conferencing in their home could provide an interesting perspective about FP and their use of it. These families will be able to compare their experience with video conferencing systems to FP. Families who do not use video conferencing will also provide an interesting perspective, as they will be able to evaluate FP without being biased by other video conferencing systems.

Each seed family was allowed to choose two distant families that they would like to connect to using FP. Seed families were allowed to choose the distant family they wanted to connect to, because I wanted to study families with a close relationship. By allowing participants to choose the families they want to connect to, I gave them control over their use of FP.

5.4.2 Study Design and Data Collection

Six families (two triads) with interesting and different relationship dynamics were selected using Criteria 1-3 and factors *A-E* (described above). Participating households were composed of young families, blended families, a divorcee, and retirees. The field evaluation was conducted for a duration of eight weeks and was divided into three phases. I was the sole interviewer and data collector for each phase of the evaluation.

5.4.2.1 Phase 1 – Initial Interview and Setup

At the beginning of the first week, I visited each family's home and conducted an interview to learn about them and their current communication practices. One family lived outside driving distance and was interviewed using Skype. This interview was an extended version of the questionnaire given to them during the selection process (described above). Questions focused on their current communication and feelings of awareness and connectedness to the remote families. The interview allowed me to learn about the relationship between families and to compare it to families' communication, awareness, and connectedness during and after the use of FP. Interview questions used for initial interview are in Appendix CA.

After the interview, each family was asked to give me a tour of their home and to point out locations in the home where they typically communicate with extended family and friends. They were asked about each location and why it was significant to them. Examples of locations included the home office, which contains a computer that they use to send emails and the kitchen and living room that they stand/sit in while talking on the phone. This helped me learn about locations in the home that are associated with communication in general, locations that might be associated with communication with certain people, and the difference between locations used by each family member to communicate with others. Learning this allowed me to understand *how* families use the FP and more importantly *where* they place and use the FP in their home (in Phase 2).

At the conclusion of this interview, families were walked through the initial setup of FP on their home wireless Internet connection, asked to select a location for FP and use it as they naturally saw fit. The initial interview lasted 2 to 3 hours and setup took 1 to 2 hours.

5.4.2.2 Phase 2 – Deployment of Family Portals

Families used the FP within their homes over a period of six to seven weeks. During this phase, I visited families in their home and conducted semi-structured contextual interviews with them. The one distant family, again, was interviewed using Skype. Adults were interviewed individually (when possible) and children were interviewed with parents present. These interviews enabled me to learn about families' usage of the FP, patterns and behaviors that emerge, privacy concerns, and any potential problems with the design of the FP. A sample of interview questions is in Appendix CB. I also called and emailed families between scheduled interviews to ensure they were not facing any technical challenges with the FP.

When possible, I observed families using the FP when I visited their homes. These observations were not scheduled but were opportunistic. It is more beneficial to watch families communicate if and when the opportunity arises as opposed to scheduling an observation. I was able to learn more by observing impromptu communications that happened while I was in participants' homes, compared to observing prescheduled communication that happened, because I, as an observer, was there.

Each family was given a diary to record their use of the FP. Families were not required to log each use of the FP, but were encouraged to write short notes about their interactions with the remote families. They were asked to log activities that were shared, conversations, locations that the FP was moved to, new ways they were using the FP, and any thoughts and ideas they had. This diary was used by families as a form of self-reporting and was collected at the end of this phase. It allowed me to learn about patterns of use and behaviors that emerge from the use of the FP.

The FP was removed from families' homes after six to seven weeks. At the end of this phase, families were interviewed about changes in their communication practices andfeelings of awareness and connectedness with the remote families during their usage of the FP.

5.4.2.3 Phase 3 – Post-Deployment of Family Portals

After the FP was removed from families' homes, I did not maintain any contact with them for two to three weeks. This enabled families to adjust their communication practices with the remote families after using the FP. For example, families might revert back to their communication practices before the introduction of the FP or they might change their practices. After two to three weeks, I interviewed each family. This interview was intended to learn if and how the FP had changed communication between families. Questions were asked about the frequency of communication, feelings of awareness and connectedness, and technology used to communicate with remote families pre and post use of the FP.

5.4.2.4 Data Collected

Usage data was collected through the interviews as well as self-reports in diaries given to each family. The limitation of interviews and self-reports is that participants may self-censor responses and omit details. I was able to sufficiently overcome this limitation by comparing responses between family members. All interviews were audio-recorded and handwritten notes were taken to aid analysis. In total, I acquired data from approximately 108 hours of interviews and observations across all six families. Usage of features (e.g. blinds, full screen) was logged throughout the study. Snapshots of writing on FP were also taken by the system.

5.4.3 Modifications to Study Design

Unlike lab evaluations, field studies are dynamic in nature, which makes it difficult to control the environment the study is being conducted in. There were many factors that I was not able to control during the field study. These led to in-situ modifications to the study design.

Technical challenges

Although FP was placed in families' homes for eight weeks, families were only able to use the system for an average of five weeks. Despite rigorous testing before deployment, numerous technical issues related to connectivity arose. Such issues have also been reported in other field evaluations in the home (Hindus, et al., 2001; Romero, et al., 2007). This led to the weekly interview schedule being modified based on the number of days families were able to use FP in a given week. Nonetheless, I found that five weeks of usage was sufficient for participants to overcome novelty factors, develop patterns of use, and incorporate the system into their daily lives.

Scheduling challenges

Fully participating in the evaluation for eight weeks and doing weekly interviews proved challenging for some families due to their busy schedules. Like other families, adults in these families had jobs, children, school, and homes to attend to. This led to modifications in the interview schedule based on families' availabilities.

Social challenges

Besides scheduling, there are social problems that come with working with families. Families had to feel comfortable enough with me to share details about their personal life, relationships with remote families, and their use of FP. Families had to be open when sharing experiences or providing feedback. Unfortunately, some family members were not comfortable talking about their personal life, and others took a few weeks to develop rapport with me before they were comfortable sharing information with me. Frustrations with the technical issues surrounding FP also affected participants' responses to weekly interview questions. As a result of this issue, I was not able to collect the same quantity and quality of data from each family. However, this does not affect the results of the study, as overall, I was able to collect data from each family in the study and use triangulation to fill the gaps in the data.

5.4.4 Data Analysis

Open coding, axial coding, and selective coding (Charmaz, 2006) as described in Chapter 1, were used to analyze the blog entries from the self-usage, interviews, and diaries from the field study. Open coding was used to draw out key themes about the use of the FP. I coded each quote and description of use with a descriptive label and compared subsequent observations to the coded ones. Observations that fit existing codes were labeled with those codes while observations that did not fit existing codes were given a new code. Codes were then organized into relevant categories that describe the main themes in the data.

The creation of codes was done in two iterations. In the first iteration, I created codes from the data. At the end of the iteration, the codes were organized into high-level categories. In the second iteration, I went through the data again to validate the codes and create new codes where necessary. Categories that had 20 or more codes were broken into two or more smaller categories. Categories with five or less codes were combined, if possible. Finally the categories were combined into themes.

At the end of this process, I ended up with 125 codes, 17 categories, and 6 themes. The themes and associated categories are found in Table 5.1. The results section (Section 5.5) is organized based on these key themes.

Theme	Category
Family Ties	Relationship with remote person/people
	Relationship with collocated person/people
Availability Awareness	Gaining availability awareness
	Providing awareness information through messaging
Sharing Everyday Life	Sharing activities through video
	Watching activities through video
	Participating in activities through video
	Synchronous communication
	Asynchronous communication
Messaging	Messaging on Shared Portal
	Messaging on Targeted Portal
Privacy and Negotiation	Sharing with remote family
	Watching and being watched
Behavior of users	Parents share children's activities
	Children's playful interactions
	Interactions between adults
	Grandparents' interactions with grandchildren

Table 5.1: Themes and associated categories.

5.5 Results

Families left FP running continuously throughout the field evaluation with the exception of downtime due to technically difficulties. Over time, FP became the focus of communication between most families. In comparison to dyadic communication, families said they preferred the three-way video provided by FP, because they could connect to more families simultaneously and if one family was not available, the other would be. This provided ample opportunities for interaction. Families reported that their communication (using FP and other technology, such as phone) increased during the study. Once FP was removed, communication returned to its previous pattern and families felt less connected, as they could no longer see each other.

5.5.1 Participating Families

Next, I will describe the participant families and the communication patterns between families prior to using FP. Relationships are described from the point of view of the *seed family* (e.g., "Daughter," "Sister") who responded to the advertisement of the study. A seed family is connected to two *remote families*.

5.5.1.1 Triad 1
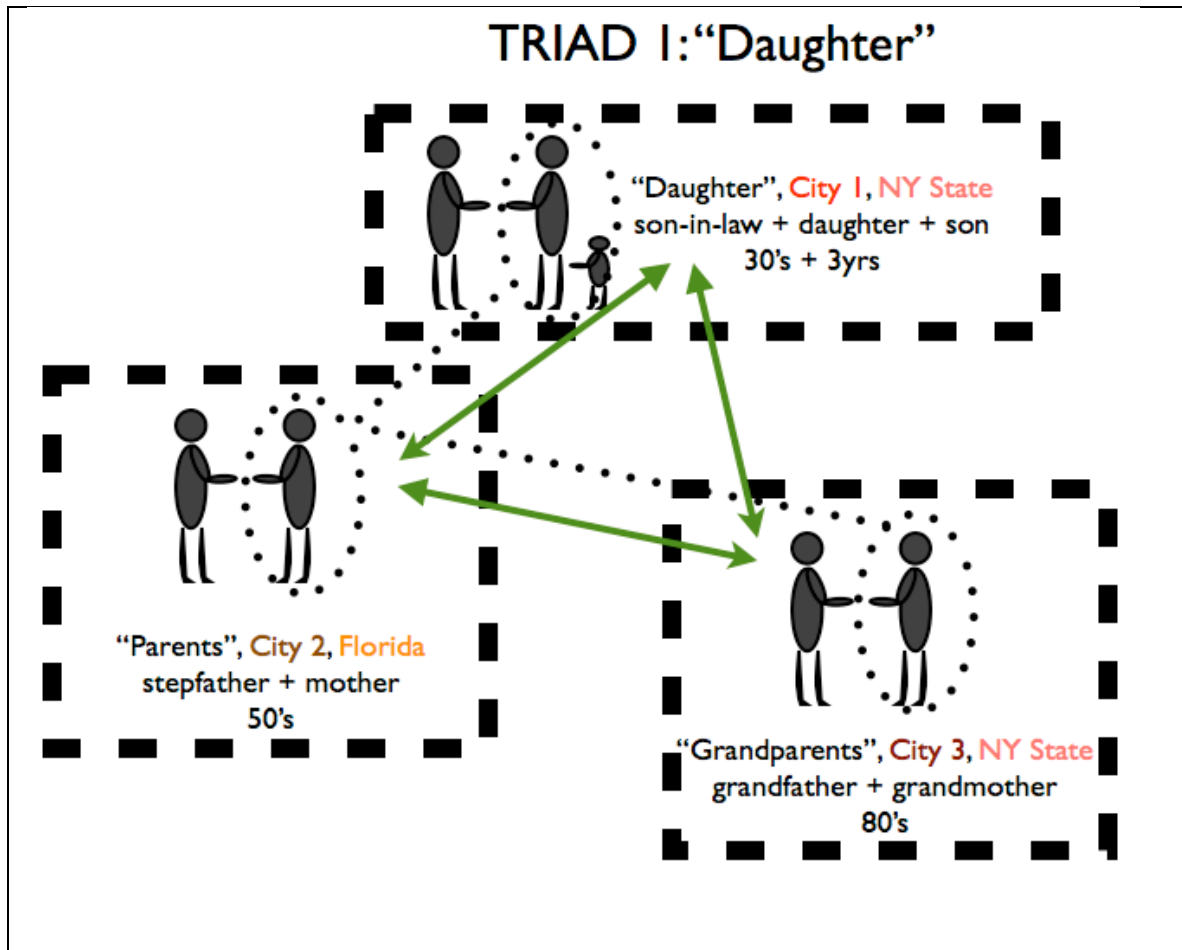
Figure 5.4. Participants in Triad 1. Primary users are circled and connected with dotted lines. Numbers refer to ages.

Triad 1 consisted of the *Daughter family*, composed of two parents and a 3-year-old son [Figure 5.4]. They used FP to connect with the wife's mother and stepfather, who are referred to as the *Daughter Parents family,* and to her maternal grandparents, who are referred to as the *Daughter Grandparents family*. All three families placed their FP in their family room.

Communication Prior to Using Family Portals

The wife in the Daughter family and her mother were very close to one another. They phoned and emailed almost daily. She also used Skype every weekend to allow her parents to interact with her son. Although she lived within an hour's drive from her grandparents, she only communicated with them over the phone once a month, but felt guilty for not

communicating more with them. The wife in the Daughter Parents family was the oldest daughter of the Daughter Grandparents. She phoned her father every morning while commuting to work and spoke to her mother once a month. The Daughter Grandparents did not like to phone their children or grandchildren, because they knew they had busy lives and did not want to disturb them. They also preferred face-to-face interactions to the telephone.

5.5.1.2 Triad 2
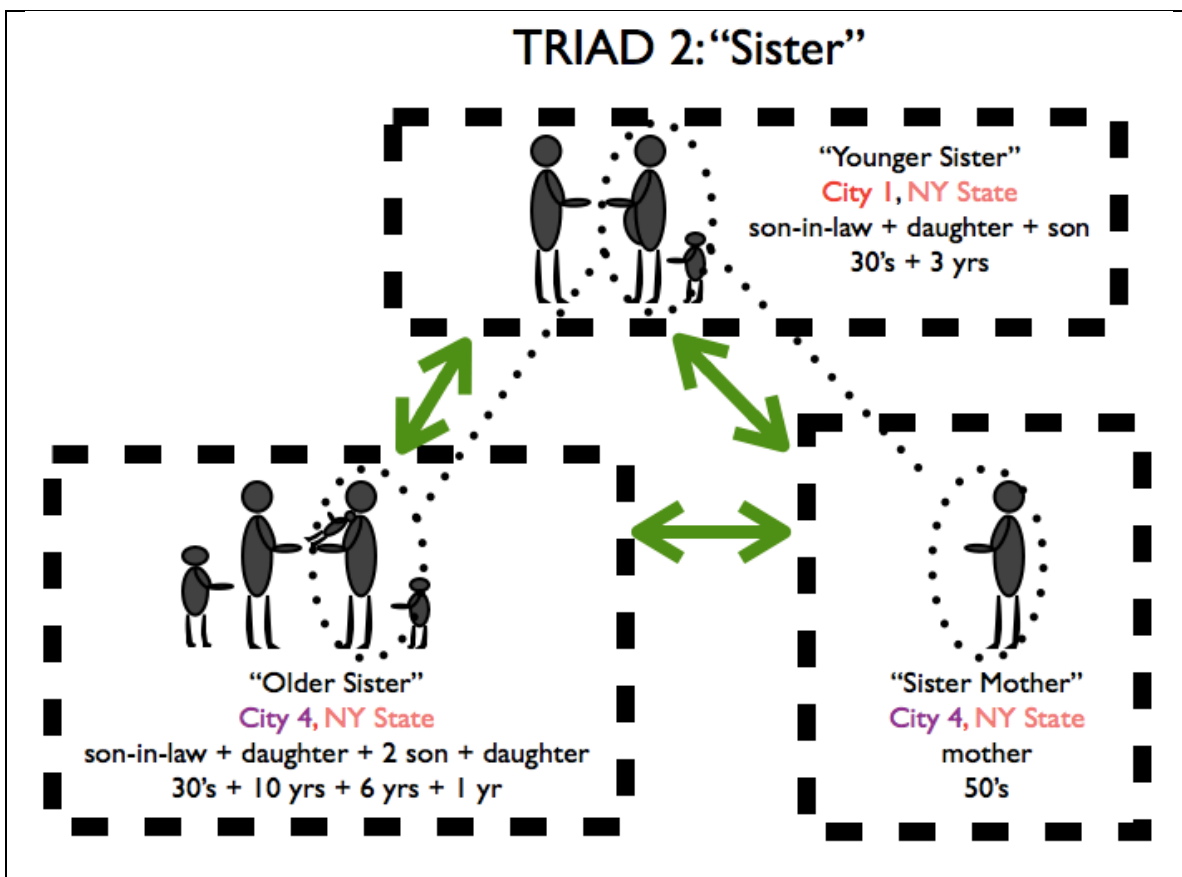
Figure 5.5. Participants in Triad 2. Primary users are circled and connected with dotted lines. Numbers refer to ages.

Triad 2 consisted of the *Younger Sister family*, composed of two parents and a 3-year-old son [Figure 5.5]. The wife in this family was in the 8th month of her pregnancy when I started the field evaluation. They were connected to the wife's mother, who is referred to as *Sister Mother*, and to her older sister and family, referred to as the *Older Sister family*. Younger Sister

placed her FP on their dining table, Older Sister in the home office, and Sister Mother in her family room. All six families had experience using dyadic communication such as email, telephone, video chat, and IM, but none had experience with multiparty interactions with these tools.

Communication Prior to Using Family Portals

The wife in the Younger Sister family and her mother spoke on the phone once a week and conversed via text or IM messages daily. Sister Mother lived in the same city as the Older Sister family, met them in person at least three times a week, and used IM daily. Younger Sister and Older Sister did not communicate much due to scheduling difficulties. The sisters spoke on the phone once a month and emailed or IM once a week. Both sisters wanted to communicate more with each other.

5.5.2 Users and Non-Adopters

The primary users in each triad were the women of the families. In Triad 1, this was the daughter, mother and grandmother. In Triad 2, it was the younger sister, older sister, and their mother. This is consistent with the findings from Hindus et al. (2001), which show women are generally the "household communicators." It is also important to note that one woman in each triad answered the advertisement for the study and determined who they would like to be connected to using FP. Surprisingly, the husband in the Daughter family (Triad 1) was also a heavy user of FP. He worked from home on a daily basis and liked having people to interact with while his wife was at work and his son was at daycare. Secondary users in each household were the families' children. Younger children (3 years and younger) used FP under their parents' supervision for the first week and then on their own when they wanted to after that.

One might expect that certain individuals may not like always-on video being broadcast from their home. Findings from the Family Window showed this type of privacy concern to be of little issue when families shared a close relationship (Judge, et al., 2010). For these reasons, it was both surprising *and* not surprising, to find out that not all members of the participant households used FP or even wanted it in their home. Three adults and one child (aged 6) did not want to use FP or did not want to be captured in the video feed. There were four reasons for this:

1) Intrusion. The husband in the Younger Sister family and live-in boyfriend in the Older

Sister family avoided FP, because they did not want to be seen by their in-laws all the time. They tried not to be captured in the video feed or moved the camera to face a different direction when in the same room as FP. Although both of them were cordial with their in-laws, they did not want to see them all the time and thought the always-on video was intrusive.

> *"It is like someone is staring at me all the time. Even if no one is there, I still think someone is staring at the back of my head while I am on the computer [FP is placed opposite the computer]" – Interview with Boyfriend in Older Sister family*

2) Intimated by Technology. The grandfather in the Daughter Grandparents family did not use FP because he was intimidated by the technology. After technical problems with the system, he was afraid to use FP because he was concerned he "might break it." He did, however, occasionally look over his wife's shoulder while she interacted with the remote families. Over time, he overcame his fear and sporadically "peeped," as he called it, into FP to see the remote families, but he never interacted.

3) Satisfaction with Communication. The grandfather in the Daughter Grandparents family also reported that that he was satisfied with the amount of communication he had with the remote families and did not need additional communication using FP:

> *"When you have 5 children, 7 grandchildren and 12 great grandchildren, you have a lot of family to keep up with." – Interview with Grandfather from Daughter Grandparents family*

4) Lack of Closeness. The only child who did not use FP was the second child in the Older Sister family. He was Older Sister's stepson who lived with them during the weekend and with his mother on weekdays. To him FP was a connection to his *step*mother's family whom he met a few times a year and was not close to.

Despite the non-adopters, there was heavy usage by the primary and secondary users. This is described in the following sections.

5.5.3 Sharing Everyday Life and Providing Awareness

The most prominent pattern of usage for FPs across all six families was to share information about each other's daily lives. This type of sharing was also found with the Family Window due to the always-on nature of the video feed.

Sharing everyday life and providing awareness emerged in two ways. First, families

used the *video* feed to share information and participate in each other's daily activities. For instance, Older Sister moved FP to her kitchen one night, to allow her mother to watch her and her son work on an art project [Figure 5.6]. Younger Sister, on the other hand, used the video to show her mother and sister the progression of her pregnancy. Because the video was always on, it was easy for her to walk up to the display and show her baby bump to her remote family.

> *"They like seeing how big I am getting." – From Interview with Younger Sister*

Figure 5.6. Sister Mother watching Older Sister and her son work on an art project.

Second, families used the shared whiteboard to share information about their *location*, *activities* and *status*, all awareness types articulated by (Neustaedter, et al., 2006a). This type of sharing was done by adults in the families. In terms of *location* and *activities*, this meant, for example, leaving messages saying where family members were going and what they planned to do that day. For *status*, it meant describing how their day was going, how they were feeling, etc. For example:

> *"Hi [Younger Sister]. How are you doing? What's going on? I'm seeing a Doc for gall bladder [sic] issues too. Had a sonogram. Waiting 4 results." – Older Sister's note on shared whiteboard to Younger Sister*

When asked about this sharing, Older Sister commented that she would not normally share this level of detail with her sister, because by the time they had their monthly phone call she would have forgotten the specifics. Other family members said this type of information was typically not shared with distant family members using other technologies (e.g., phone, email), because it was thought of as mundane and not of interest to others (Tee, et al., 2009). The fact that it became something they *did* talk about suggests families do place value in knowing this level of detail. The increased *frequency* of information exchange led to the adults in all six families (except non-adopters) feeling more connected.

5.5.4 Synchronous Communication

I had designed and expected that FP would be mostly used for ambient awareness and asynchronous interactions (e.g., "checking in" on families every now and then), especially because the device was always running and available. Indeed, I found this to be true, as previously described. However, more surprisingly, I also found that families would move into episodes of synchronous interaction where FP became the focal point for real-time communication.

5.5.4.1 Dyadic Communication

Despite FP being designed for a triad of families, as one might expect, there were many occasions where only two families were around and available for synchronous communication. Thus, a prominent use for FP was dyadic communication. These sessions were not meant to exclude the third family but typically happened serendipitously or were scheduled based on two households' availability.

There were three patterns of dyadic communication. First, families used the video in FP to see each other and supplemented the video with a phone call. This is similar to the way families used the Family Window. However, the addition of a third family in the media space led to members of the third family inadvertently feeling left out on occasion. For example, the grandmother in Triad 1 occasionally saw her daughter and granddaughter talking to each other on the phone. She sometimes tried to inconspicuously get their attention by waving, but they were usually too engrossed in their conversation to notice her. This made her feel left out. This suggests the need for design features to notify families who are conversing that another family is around and possibly available for communication.

Second, families chose to use the shared whiteboard for synchronous "chats." This is similar to findings from the Family Window where families had synchronous chats by writing on the video feed. For example, the wife in the Daughter Parents family in Triad 1 and her mother routinely had conversations this way [Figure 5.7]. This was surprising because the Great-grandmother complained about the difficulty she faced writing on FP due to her old age and left-handedness (this was awkward because the shared drawing space was on the right side). Despite that, she participated because she said it was a fun way for her to communicate with her daughter.

Figure 5.7. Wife in the Daughter Parents family engaged in synchronous messaging or "chatting" with her mother.

Third, I found families starting conversations by writing on FP and then migrating the conversation to IM. This was done by families in Triad 2 who primarily communicated via IM prior to using FP. They told us it was easier for them to have long conversations via IM because they could type faster than they could write on FP.

I had expected that most dyadic communications would involve families using the full screen feature, but this happened only occasionally. Across triads, the mother in the Daughter Parents family was the primary user of the full screen feature. She used it to

interact with her grandson almost every night. She enjoyed watching him play and have his bedtime snack. Interestingly, when not engaged in synchronous communication, families always left FP in split screen mode because it allowed them to see both families simultaneously. That is, they were interested in seeing *both* families throughout the day.

5.5.4.2 Multifamily Communication

As stated, serendipitous opportunities for multifamily communication are rare given a variety of schedules and likelihood of everyone being available at the same moment. Thus, most *multifamily* communication that participants reported was asynchronous, with families responding to each other's messages throughout the day (described above). Despite this, there were several routines that emerged around multifamily synchronous communication.

Figure 5.8. Synchronous multifamily communication in Triad 1.

Synchronous multifamily communication in Triad 1 involved video from FP supplementing three-way phone calls. These typically involved the Daughter Parents family and the Daughter Grandparents family interacting with the child in the Daughter family and happened 1-2 nights a week [Figure 5.8]. The daughter and mother scheduled three-way phone calls ahead of time and informed the grandmother about these by leaving a note on the shared whiteboard. They did this because they felt they needed to make an effort to include the grandmother in their interactions. However, despite the scheduled sessions, the grandmother sometimes forgot about them.

Synchronous multifamily communication in Triad 1 also included chat sessions on the shared whiteboard between the daughter, mother, and grandmother. These sessions were typically impromptu. They reported that this happened 1-2 nights a week and that their chats lasted around 30 minutes. These chat sessions usually happened at night after the child in the Daughter family was asleep. According to the women, they did this because it was a fun activity for them to engage in with each other, it was relaxing after a long day and they could combine this activity with other household chores such as preparing lunches and folding laundry.

> *"It is nice to have an adult conversation with my mother and grandmother without being*
> *distracted by [son]" – Interview with Wife from Daughter family*
> *"It is fun and relaxing to write back and forth. Sometimes I sit down the whole time and*
> *other times I am around the kitchen making lunches [for the next day]" – Interview with*
> *Mother from Daughter Parents family*

On the other hand, Triad 2 only had multifamily interactions twice during the entire evaluation. The first time was when there was an earthquake and the younger sister, older sister, and their mother wrote back and forth on FP about the tremor. The second instance was impromptu when the older sister saw both her younger sister and mother on FP. This triad did not have many multifamily interactions, because their schedules were simply too varied.

5.5.5 Playful Interactions

Families also had fun with FP by engaging in playful activities. This was surprising since it was not found with the Family Window. Both the video feed and writing capabilities supported families' playful activities. They drew pictures, doodled, made faces, and simply

had fun with each other. For instance, Older Sister, who was an artist, regularly drew pictures of sunsets and other scenery [Figure 5.9]. The grandmother in the Daughter Parents family drew planets for her grandson who was learning about the solar system. Such activities were made possible by the shared whiteboard and multiple ink colors in FP.

Figure 5.9. Older Sister drawing a picture.

Figure 5.10. Children in Triad 2 interacting.

The writing feature also provided a fun and easy way for younger children to communicate via drawings. Children in the families, such as Younger Sister's 3-year-old son, used FP to interact with his 10year-old cousin (Older Sister's son) by drawing [Figure 5.10]. This is similar to the way families used Wayve (Lindley, et al., 2010) for play, however, families said the video feed in FP enhanced this experience by allowing family members to *see* each other while interacting. This type of interaction was especially important for children as it kept them engaged long enough to interact with distant family members. This provides one solution to the problem of keeping children engaged while using VC systems.

Playful activities were also common between grandparents and grandchildren. For example, Sister Mother drew pictures and made funny faces while interacting with her grandson [Figure 5.11].

> *"My nanna [Sister-Mother] makes faces. She was a walrus that day. I draw on her face and she looks funny. I also drew octopus [sic]" – Interview with Older Sister's 10 year-old son*

Figure 5.11. Sister Mother interacting with her grandson.

5.5.6 Messaging on Shared Portal vs. Targeted Portals

Families had distinct patterns of messaging that differentiated their use of the Shared Portal and Targeted Portal. These are described in the following sections.

5.5.6.1 Public Asynchronous Messaging on the Shared Portal

The basic usage of the Shared Portal or shared whiteboard was to write messages, questions, and notes intended for *all* families. I found this pattern of use among families in both triads. This is similar to messaging practices found with messageProbe (Hutchinson, et al., 2003) and Family Window. The most common messages were greetings between families such as "good morning" or "good night." Figure 5.12 shows a goodnight message left by the wife in the Daughter Parents family for both the families she was connected to.

Families also used the Shared Portal to share information about where family members were going and what they were doing that day. For example, the husband in the Daughter family wrote one evening:

"[Wife] + [son] should be home at 5:30. I'm leaving to teach tonight ☺" – Message written on the Shared Portal by Husband in Daughter family
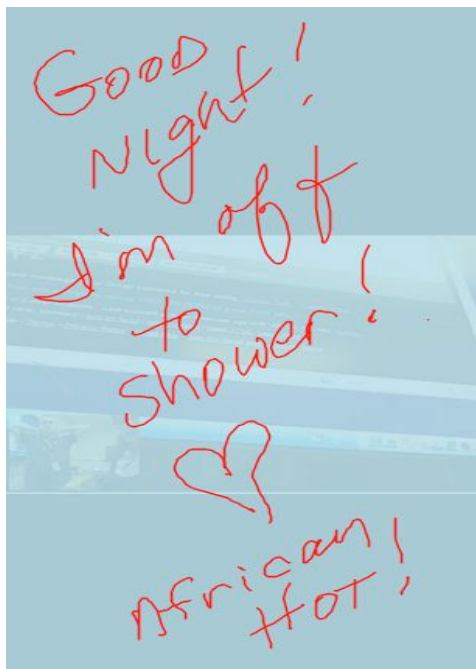
Figure 5.12. Goodnight greeting from wife in Daughter Parents family.
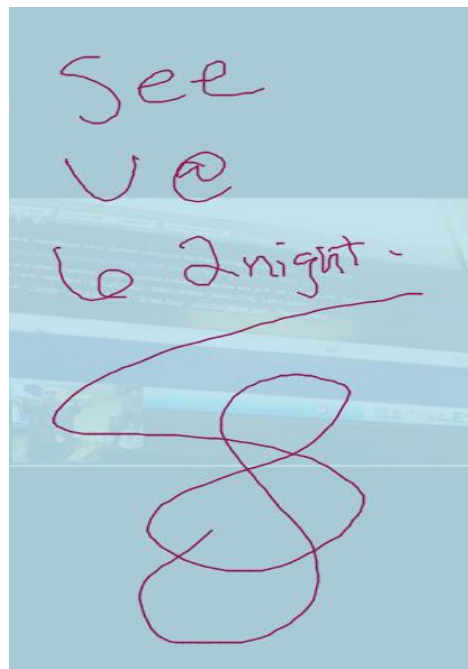
Figure 5.13. Message to Older Sister's family from Sister Mother.

Another common use of the Shared Portal was for families to share information about food they were having for dinner and playfully compared each other's menus. For example, the wife from the Daughter family wrote one night:

"What's for dinner? Ckn nug [chicken nuggets] & tater tots here…"

And her parents responded,

"M&D [Mom and Dad] having wine."

During the first few weeks of usage, families faced some confusion over the author of messages on the Shared Portal. For example, it was difficult for families to determine the author of a message if it was written in all capital letters or if the content of the message was general to all families. Some family members left their initials at the end of a message, but over time, this became unnecessary as families learned to recognize each other's handwriting or used the context of the message and their shared common ground to determine the author.

5.5.6.2 Private Asynchronous Messaging on the Shared Portal

Families also used the Shared Portal for messages intended for a *specific* family, even though the third family could see them. This pattern of use was mainly found in Triad 2. For instance, Sister Mother lived close to Older Sister's family and met them 3-4 times a week. She and Older Sister would use the Shared Portal to schedule their meetings. They did so without worrying about Younger Sister feeling excluded, because Younger Sister knew that her mother frequently visited her sister's family. Figure 5.13 shows one such message written by Sister Mother for Older Sister's family about meeting them at 6 pm one night.

In such cases, families reported that they preferred to write on the Shared Portal as opposed to the Targeted Portal, as they felt messages on the Targeted Portal may be hard to read due to being on top of the video. This suggests a usability issue in terms of readability when multiple information sources (e.g., video *and* writing) use the same region of the display. Yet families also said that in these situations, they did not mind that the third family could see the message on the Shared Portal.

5.5.6.3 Synchronous Messaging on the Shared Portal

Although I expected the writing features of FP to be mainly used for asynchronous messaging, families used FP for synchronous interaction akin to "chat sessions" (described above).

Interestingly, families used the Shared Portal and not the Targeted Portal for these dyadic communication episodes. Again, they found it easier to read messages not written on top of the video, but they also said that they were typically chatting about general topics such as family activities, an update after a doctor's visit, etc. In these situations, families were also not concerned about the third family walking in and reading their chats. They reported that that if a member from the third family became available at a certain point, they could easily join the conversation by reading the previous messages. Families also preferred using the Shared Portal for chats, because it allowed them to see each other while writing. Being able to see each other augmented the experience and they did not want to lose this by writing on each other's video feed.

If all three families were present for a synchronous chat, they naturally used the Shared Portal. Participants did mention any situations where Targeted Portals were used as backchannels between only two families when all three were conversing in the Shared Portal.

5.5.6.4 Confidential Messaging on the Targeted Portals

As one might expect, families did use the Targeted Portals for private messages and discussions that they did not want the third family to know about. For instance, Older Sister and Younger Sister used the Targeted Portal to discuss their suspicion that their mother was not following the diet her doctor recommended. In this case, both sisters would be mortified if their mother would have accidentally seen this discussion.

It was easy for family members to decide where such messages should go given the nature of the information. The readability difficulties of writing on top of the video feed were much less of a concern than the confidential information contained in the messages. In some ways, readability challenges provided a psychological "cloak," which visually suggested that the messages were private due to their (sometimes lack of) legibility.

5.5.6.5 Selective Messaging on the Targeted Portals

Families also used the Targeted Portal for situations where they wanted to leave a message for one family, but knew it did *not* involve the third family. They did this to simplify communication and to ensure that the family the message was intended for would easily know there was a message for them. For example, the wife in the Daughter family wrote the note shown in Figure 5.14 on her grandmother's Targeted Portal. While there was nothing confidential in this message, it was written on the Targeted Portal, because it did not involve the third family and was intended *specifically* for the grandmother. Thus, families recognized this, and, whether they realized it or not, reduced "information clutter" for other families.
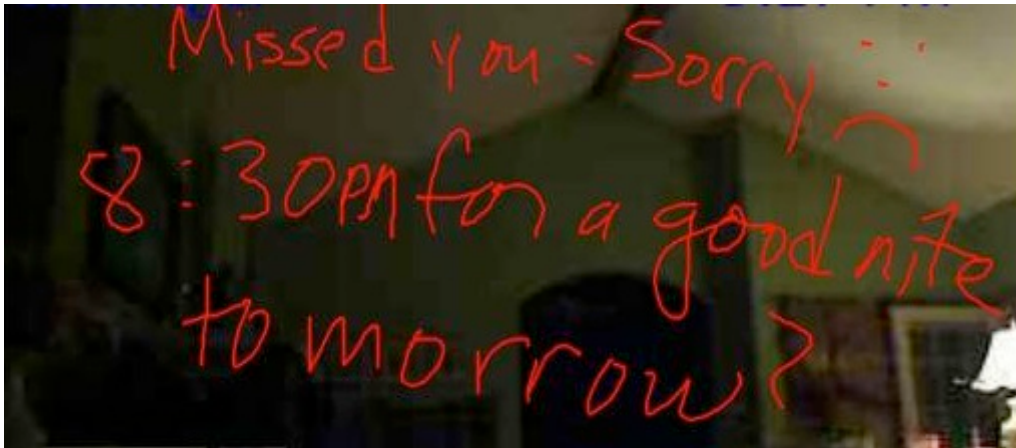
Figure 5.14. Message on Targeted Portal from wife in Daughter family to her grandmother.

Families also used the Targeted Portal for topics they had in common with one household and not the other. The shared common ground between the two households made it easy to send these messages and not feel badly about leaving out the third household.

> *"When I have a question for [daughter] it is easier to write it in her window [Targeted Portal] instead of writing it on the chalkboard [Shared Portal] and having to explain it to my mother" – Interview with wife in Daughter Parents family*

Both of these cases were found despite the fact that messages written in the Targeted Portals may be harder to read on top of the video feed. This pattern of use was mainly found in Triad 1. Both the Daughter family and Daughter Parents family made a conscious effort to reduce information clutter for the grandparents to prevent any confusion that might result in them shying away from the technology. Thus, the need to reduce information clutter for

families not involved in a conversation superseded the usability issue of writing on top of the video feed.

5.5.7 Privacy

Throughout their use of FP, participants, specifically adopters, did not report being concerned about the always-on video or multifamily connection being an infringement on their privacy (except for the non-adopters). This was because they picked the families that they wanted to connect to and families with whom they had close relationships. By choosing whom to connect to, participants were regulating their *autonomy* (Boyle, et al., 2009). There were, however, instances of intrusion on family members' *solitude* and *confidentiality*.

5.5.7.1 Solitude

Although families typically used the always-on video or availability messages to determine a remote family's availability for interaction, there were instances of intrusion on a family's solitude (as defined by Boyle et al. (Boyle, et al., 2009)). For example, one evening, the Older Sister in Triad 2 was cooking dinner when her 1-year-old daughter started crying. She was trying to pacify her daughter and prevent food on the stove from burning when Sister Mother started knocking incessantly on FP. Sister Mother had just arrived home from work and wanted to interact with Older Sister's family. Sister Mother was annoyed because nobody responded to her knocks when she knew they were home and wrote on FP:

> *"STOP ignoring me" – Note from Sister Mother to Older Sister*

Older Sister continued ignoring the knocks but was annoyed at her mother. A few hours later, when the kids were in bed and she was no longer annoyed, she called her mother and explained the situation.

> *"If there was sound [audio] in the system I would have yelled at my mom. How does she expect me to handle so many things at once?" – Interview with Older Sister about Sister Mother*

Such incidents are not easily avoidable if one family has the expectation that the other family is home at a certain time and thus available. The location of FP could help in this instance. Older Sister placed her FP in the home office, which is separated from the kitchen by the family room. If she had placed her FP in the kitchen, her mother could have seen that she was busy and might not have interrupted. Yet this would have only worked for

situations in the kitchen.

5.5.7.2 Confidentiality

An always-on media space leads to privacy risks over confidentiality: remote families seeing more than they may intend (Boyle, et al., 2009). However, families were able to control what the remote families were viewing by determining the location of FP and the position of the camera. For example, Younger Sister placed FP on their dining table with both the tablet and webcam facing the wall. She would occasionally move the webcam to point towards the family room when she and her son were in there. She did not report privacy concerns with FP, because the location she picked, consciously or unconsciously, regulated her confidentiality. It is also interesting to note that both Younger and Older Sister, whose respective husband and boyfriend were not adopters of the system, placed FP in a non-central location in their home (i.e. dining table & home office). The remaining four families placed FP in their family room.

Families preferred hardware options to control confidentiality instead of the software option provided in FP [Figure 5.2]. All families used the blinds less than three times during the field evaluation. Instead, when concerned about confidentiality, some families moved the webcam or placed inanimate objects in front of the webcam. This happened most often in Triad 2. For instance, when Older Sister and Sister Mother complained that they only saw the wall in Younger Sister's home, she started placing objects such as her son's new toy or a bowl of cherries so they would have something to look at. While Younger Sister may have done this intentionally for playful purposes, the unintentional effect was that she was regulating her and her family's confidentiality by selecting objects that would be visible to the remote families.

Although there were mixed reactions about FP not containing audio, families speculated that always-on audio would be overly intrusive and would have resulted in them not leaving FP turned on all the time. They were concerned about remote families overhearing conversations about topics such as finances and health or even conversations regarding the remote families. Families wanted the option to turn audio on and off as desired. Yet even with this option, there was concern that people might forget to turn the audio off which could result in remote families overhearing private conversations.

5.6 Discussion and Conclusions

5.6.1 Communication and Awareness Practices

This research has revealed key routines surrounding the use of a multifamily media space. First, as expected, a multifamily media space supports the same primary routine as a dyadic family media space: providing an awareness of families' lives and sharing of activities. Yet, the addition of a dedicated writing area in FP resulted in families writing more about their daily life and sharing more information. This suggests that domestic awareness systems are best when coupled with video, which permits implicit sharing of life, with interaction techniques that allow explicit sharing (e.g., writing).

Furthermore, different patterns of usage emerge that were not found with always-on dyadic media spaces. The most striking was that not all family members adopted and used the system. The successful adoption of FP in a household was greatly dependent on the relationship between members of each household. I had expected family members to form a closed circle of contacts where all wanted to stay in contact with one another. Instead, this naïve assumption proved false. Even within a closed network of families, there will be certain family members with differing awareness and communication needs. This was exposed by having more families connected using the media space (i.e. multifamily vs. dyadic media space).

Adopters were comfortable with and valued increased degrees of awareness beyond selective information. Initially, the adopters could be labeled as intimate socials as defined by (Neustaedter, et al., 2006a). However, while using FP, the adopters started sharing more information and even started participating in activities in each other's homes. This changed their relationships to resemble inhabitants of the same home, which is a remarkable change in families' patterns of communication, awareness, and connectedness. Even though the adopters in our families liked this, I expect that some families may find this to be overwhelming at times and unnecessary.

The previous study of the Family Window did not find that playful activities were a common occurrence for family pairs. My observation of such activities could simply be because of idiosyncrasies of the families or differences in demographics, yet I also believe it was, at least in part, due to the introduction of a third family. Even though the majority of ludic interactions were dyadic, because there were more users, there were more opportunities

for interaction and a more playful environment arose. This may be similar to differences in social dynamics when comparing a two-person conversation to a multi-person gathering, which typically has more banter and interactions.

Compared to a dyadic media space like the Family Window, triadic synchronous communication did not happen often in FP due to families' varied schedules and availability. Multifamily synchronous communication needed to be scheduled and was not typically impromptu. This contrasts the use of workplace media spaces, which encourage impromptu and serendipitous communication. It also suggests design features are needed in a multifamily media space to better support availability awareness. This is difficult, because families are not usually in one location the way they might be at work. Providing multiple media space links throughout the home is a potential solution, yet this would increase privacy risk. Another possibility is to provide additional information such as calendars to determine likely availability as opposed to simply video feeds. Either way, more investigation is needed.

Interestingly, there was no difference in what families shared with each of the two remote families through video. Families left the video going nearly all the time and both remote families saw the same thing, despite options to obscure one family's feed and not the other's. Families also left the video in split screen mode most of the time. Families reported issues over confidentiality breechings as a result of the video capturing, but this was not particular to one remote family over the other. Such breeches were not found in prior dyadic media space studies. To circumvent these issues, families utilized everyday objects and changed the camera's direction rather than using our software approach of blinds. This suggests that hardware privacy controls are more suitable for the home as opposed to software fixes such as blinds, blur filters, or avatars (Coutaz, et al., 1998; Neustaedter, et al., 2006b). Given this preference though, what we do not know is: If multiple cameras were present (one per remote family), would families choose the same camera view for each remote family? I suspect this to *not* be the case given the results in this study, but it suggests further exploration.

5.6.2 Design Recommendations for a Multifamily Media Space

There were several messaging practices that directly suggest design features for situated family messaging systems. First, families faced challenges in identifying who was writing in

the shared space. Although families were able to resolve this issue over time by learning each other's handwriting and using the context of the message to determine the author, this problem will be more prominent in multiparty messaging system connecting more than 3 families. This suggests mechanisms that allow families to identify which family members and/or households left which messages. For example, systems could identify different families with different colors.

Second, readability was clearly an important factor for families when choosing where to leave messages. The Targeted Portal placed writing on top of the video feed. This proved problematic in some instances because of readability and affected where family members wanted to leave messages. Writing on top of the video feed also prevented family members from seeing each other while chatting. Although families are typically not able to see each other while chatting using other tools (e.g. instant messaging), the option to *see* the other person while communicating with them was greatly valued.

Third, confidentiality and reducing information clutter were also factors that families considered when choosing where to leave messages. Although writing on the video feed in the Targeted Portal caused readability issues, at times families' needs to send confidential messages superseded this issue. Similarly, the need to selectively target content at one family and not both to reduce information clutter due to shared common ground was also more important than readability issues.

Fourth, and more generally, it is clear that families find value in the inclusion of *both* public and private messaging within a family messaging system. This is evidenced by the previous examples and also by the fact that family members recognized that even though some content might be directed at one family, it could also be interesting for another family to see. In these situations, families chose a public space for writing, despite the targeted nature of the message. This illustrates that families *are* thinking about who would likely want to see their messages beyond the intended recipient using their judgments to decide where to place messages.

The fact that both public and private messaging are valuable for families in situated messaging systems may appear to be obvious, but, as far as I know, it has yet to be reported in the literature. The presentation of this result is important as system designs that provide only public messaging between multiple families with the inability to send private messages (e.g., (Hindus, et al., 2001; Lindley, et al., 2010)) may suggest this is the preferred mode of

interaction for families. Similarly, evaluations illustrating the fun ways in which families share messages publicly (Lindley, et al., 2010) may unintentionally suggest that families never want to send each other private messages.

Part II: Patterns and Pattern Language

Part I: Design and Practices

Phase 3: Design and Evaluation of Family Portals

Phase 2: Design and Evaluation of the Family Window

Phase 1: Video Conferencing Practices

Part II: Patterns and a Pattern Language

Patterns of Practices
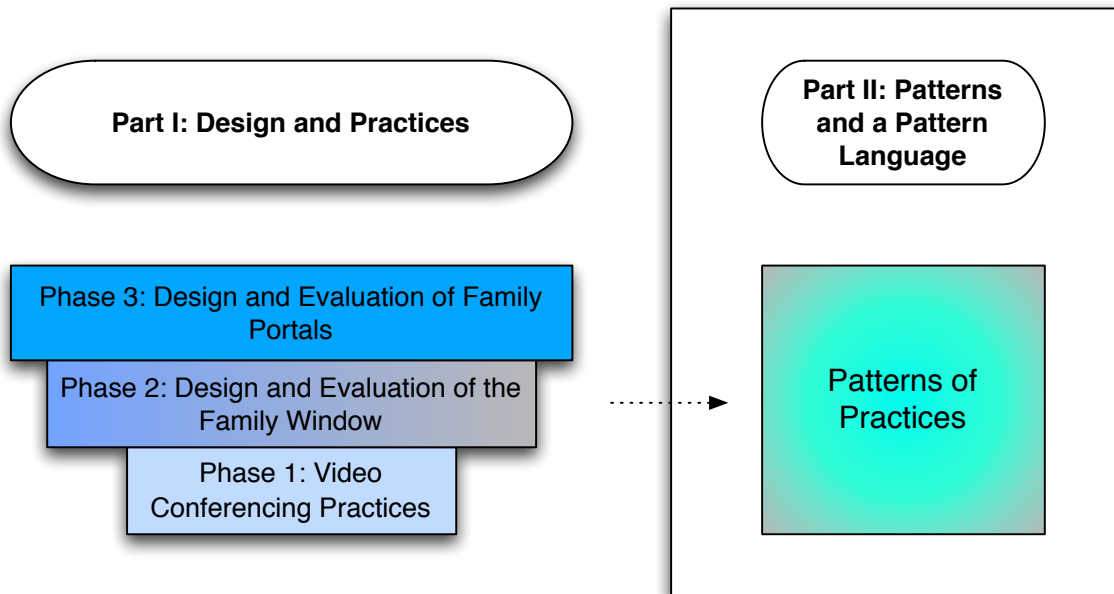
Chapter 6

A Pattern Language for Domestic Video Mediated Communication

6.1 Introduction

The previous three chapters described Part I of my research on the use of video to connect families separated by distance. All three phases of Part I, resulted in an understanding of *domestic communication, awareness, and connectedness practices* using various types of Video Mediated Communication (VMC) systems. Chapter 3 described families' practices using video conferencing systems, Chapter 4 described families' practices using a dyadic media space with always-on video, and Chapter 5 described families' practices using a multifamily media space with always-on video. The objective of Part II of my research is to codify the knowledge gained in the previous phases about domestic communication, awareness and connectedness practices, into a taxonomy that can be used as a *design tool* to design technologies for domestic communication and as a *vocabulary* to describe domestic communication practices.

After considering other taxonomies such as models, frameworks, ecologies, and ecosystems, I chose *patterns* as an appropriate medium for codifying domestic communication, awareness, and connectedness practices. According to Vlissides, patterns have the following benefits (Vlissides, 1997):

1. Patterns capture expertise and make it accessible to non-experts.
2. Patterns' names collectively form a vocabulary that helps developers communicate more effectively.
3. Patterns help people understand a system more quickly when it is documented with the patterns it uses.
4. Patterns facilitate restructuring a system whether or not it was designed with patterns in mind.

I believe that these benefits make patterns a suitable medium for documenting domestic communication, awareness, and connectedness practices.

6.1.1 Pattern Language in Architecture and Urban Design

In 1977, Christopher Alexander and his colleagues developed a *pattern language* for architecture and urban design (Alexander, 1977; Alexander, 1979). In "The Timeless Way of Building" (1979), Alexander defines a pattern as follows:

> *"Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it in the same way twice."*

In its simplest form, a pattern is the named solution to a recurring problem along with an analysis of that problem. Each of Alexander's[11] patterns is presented as several pages of illustrated text, using a very uniform structure and layout with the following components (Alexander, 1979):

- *Name*, which meaningfully and concisely identifies the pattern
- *Ranking* to indicate the validity of the pattern
- *Picture*, which gives an easily understood example of the pattern
- *Context* that explains which larger patterns it helps to implement
- *Forces*, which summarize the design tradeoffs
- *Solution*, which presents a generic set of instructions that, can be applied in varying situations
- *Diagram* that graphically describes the solution and its constituents
- *References* that point the reader to smaller patterns that can be used to implement a larger pattern.

A pattern language is a "finite combinatory system" that allows us to create a "variety of unique combinations, appropriate to different circumstances" (Alexander, 1979). A pattern language can also be thought of as an interconnected web of patterns that together form a vocabulary for a design domain.

Alexander's pattern language is a meta-language. Both the language and individual patterns are used to generate site-specific pattern languages for particular projects. Alexander's language consists of a network of 253 patterns that range in scale from a pattern for the distribution of towns and cities, down to a pattern for walls. The patterns are loosely

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[11] For ease of exposition, I will refer to "Alexander's patterns" and "Alexander's pattern language" even though he has co-authors in his book " A Pattern Language: Towns, Buildings, Construction".

connected. Any given pattern typically references smaller scale patterns which can support it and larger scale patterns in which it may participate (Alexander, 1977).

Among the goals of Alexander's pattern language, two that are widely cited are, a) supporting the design of environments that has what he called a "Quality Without A Name," and b) helping non-architects participate in the design of their own environments. Alexander's pattern language addressed the latter goal by providing its users with a common language that enabled them to reflect on their experiences and on the relationship between their experiences and their environment (Erickson, 2000).

6.1.2 Patterns in Software Engineering and Human-Computer Interaction

Over the years, Alexander's patterns have been adopted in various fields including management, pedagogy, and political sciences. In Computer Science, the use of patterns is mainly found in Software Engineering and Human-Computer Interaction (HCI). In Software Engineering, patterns are primarily used for Object Oriented Programming. One of the earliest and most widely used pattern languages in Object Oriented Programming is in a book about *design patterns* for reusable components and object classes (Gamma, 1995).

More recently, beginning with the CHI '97 workshop on pattern languages (Bayle, et al., 1998), pattern languages have begun to attract an increasing interest within the HCI community. In 2000, Erickson proposed using pattern languages as a *lingua franca* for design. Erickson argued that the increasing diversity of the design process and the complexity of interactive systems calls for a *lingua franca* or common language that is accessible to all the participants and stakeholders in the design process. Among the attributes of pattern languages that make it an appropriate *lingua franca* for design are, a) patterns are based on concrete prototypes from the design domain in which design is being done, b) patterns attempt to bridge the gap between the physical and social worlds, and c) pattern languages are amenable to gradual, piecemeal development (Erickson, 2000). Erickson also points out that *time* and *people* or *their roles* are an important addition to Alexander's patterns.

In "A Pattern Approach to Interactive Design," Borchers provides an introduction to the concepts and application of patterns in user interface design. In his book, he provides a pattern language for the interface design of interactive exhibits (Borchers, 2001). Other patterns for interaction design include Duyne et al.'s patterns for the design of websites

(Duyne, et al., 2002) and Tidwell's patterns for designing user interfaces (Tidwell, 2005).

There are also online design libraries that capture and organize design patterns from various sources and make them readily available to designers and practitioners. Examples include the Design Patterns Library (http://hillside.net/patterns) and Yahoo! Design Patterns Library (http://developer.yahoo.com/ypatterns).

More closely related to my research is Crabtree et al.'s patterns for the development of technologies for domestic settings (Crabtree, et al., 2002). Their objective was to identify a finite set of patterns that are situated in and define particular places in the home. When used together, these patterns comprise and describe the home as a whole. They presented an adapted pattern languages framework that describes *patterns of action* and *patterns of technology usage* in domestic settings. According to them, "…in contrast to the work of Alexander we are not identifying problems or proposing solutions for some unknown future designer. Rather, we are making the real world, real time sociality of the domestic setting available to a multidisciplinary design team" (Crabtree, et al., 2002). This shift in orientation required them to return to the original pattern language suggested by Alexander and alter it to reflect their new purpose.

6.2 Patterns of Domestic Video Mediated Communication

Given the benefits and appropriateness of patterns as a *lingua franca* for design, I created patterns and a pattern language to codify and describe domestic communication, awareness, and connectedness practices. I refer to these patterns and pattern language as Patterns of Domestic Video Mediated Communication.

Patterns of Domestic Video Mediated Communication encapsulate domestic communication, awareness, and connectedness practices between households connected by VMC systems. Patterns of Domestic Video Mediated Communication contain the following two interrelated components:

1. **Patterns of Practices** that describe common *user behaviors* and *practices* supported by VMC systems.
2. **Pattern Language** that describes the *relationships* between *Patterns of Practices.*

Together, the *Patterns of Practices* and the resulting Pattern Language provides a vocabulary for defining, discussing and designing future VMC systems.. These patterns can also be appropriated by users and applied to the design of other (non-video based) domestic communication technologies.

6.2.1 Goals of Patterns of Domestic Video Mediated Communication

Over the years, Alexander's pattern language has been used in domains other than the domain it was created for – architecture and urban planning. The appropriation of patterns in new domains has led to each collection of patterns having a different goal, structure and audience. For instance, according to Borchers, Alexander's goal in publishing his pattern language was not to allow architects, but the inhabitants (that is, the *users)* themselves to design their environments (Borchers, 2001). On the other hand, patterns such as Gamma et al.'s software design patterns are intended as a language for communication among software developers, not the *end users* of the software (Gamma, 1995).

Similar to Gamma et al.'s *design patterns* and Crabtree et al.'s *patterns of action* and *patterns of technology usage,* the primary goal of my *Patterns of Practices* is as a design tool for designers and practitioners. These patterns provide designers and practitioners with an understanding of domestic communication practices, help them define and discuss the design space, and to be used as a design tool to design new domestic communication technologies. These patterns also provide designers and practitioners with a *vocabulary* to define and describe domestic communication practices.

6.3 Methodology

The method I used to define and create a pattern language of domestic communication practices was a qualitative method of analysis. Starting with codes and categories from the open coding of data from the evaluation of Family Portals (Chapter 5), I created a list of communication, awareness, and connectedness practices using Family Portals. For each code that described a practice, I referred to the data that was labeled by the code. By doing so, I was able to accurately identify and categorize the associated practices. Once I identified a practice, the practice was documented with a name, description, and scenario of use. Similarly, I created a second list of practices based on codes and categories from the open coding of data from the evaluation of the Family Window (Chapter 4), followed by a third list of practices based on the data from the study of the use of video conferencing systems (Chapter 3).

The three lists of practices were then compared and contrasted to identify similar practices. Similar practices (occurring in two or more studies) were merged while distinct practices (only occurring in one study) were not changed. At the end of this process, I had a total of 34 unique communication, awareness, and connectedness practices.

Using affinity diagramming (Beyer, 1998), I organized the 34 practices into groups based on similarities in the practices. Practices in a group were combined (if there was an overlap or repetition between the practices) or remained unchanged. Over the course of 4 weeks, I created 6 affinity diagrams that allowed me to group and merge practices. At the end of the process, I ended up with 11 practices that were then described and elaborated using the patterns structure discussed in Section 6.4. The final 11 patterns are organized into 4 groups [Table 6.1].

Group	Subgroup	Pattern
A) Gaining and Providing Awareness Information		Pattern 1: Providing awareness to the remote family
		Pattern 2: Gaining awareness about the remote family
B) Initiating Interactions		Pattern 3: Initiating impromptu interactions with the remote family
		Pattern 4: Scheduling interactions with the remote family
C) Sharing Everyday Life	Sharing Activities	Pattern 5: Displaying everyday life to the remote family
		Pattern 6: Watching activities in the remote home
		Pattern 7: Participating in activities in the remote home
		Pattern 8: Local and remote families simultaneously sharing activities with each other
	Sharing Information	Pattern 9: Focused communication between local and remote families
		Pattern 10: Intermittent communication between local and remote families
D) Privacy		Pattern 11: Privacy from the remote family

Table 6.1: Patterns of Practices.

6.4 Structure of Patterns of Practices

Based on the goals, intended audience and intended use of the *Patterns of Domestic Video Mediated Communication*, I created a structure with appropriate components that is used to define and describe the *Patterns of Practices*. This structure is adapted from Alexander's patterns for architecture and urban design (Alexander, 1977), Gamma's patterns for software design (Gamma, 1995), and Crabtree's patterns for domestic activities (Crabtree, et al., 2002).

Each *Pattern of Practice* is presented using the structure and components described in Table 6.2 and Table 6.3.

Components in Patterns of Practices	Description
A) Pattern Name	The pattern's name conveys the essence of the pattern. The pattern is typically an action that is performed by primary users.
B) Purpose	A short statement that answers the following question: What is the primary users' intent, motivation, or goal for this action?
C) Interactions	A description of the interactions that leads to participants fulfilling the Purpose (*refer to B*) of this pattern. This section is the core of the pattern. Interactions are typically described based on the type of interaction: i) Participants' in the local home's interactions with the VMC system. ii) Interactions between participants in the local and remote home using VMC system.
D) Participants	A description of the participants (i.e. users of the VMC systems and/or other members of their family) and their respective roles in the Interactions (*refer to C*). Participants are typically in the local home. However some interactions may involve participants in both the local and remote homes. Participants can be classified as one of the following: i) Primary participants ii) Secondary participants iii) Nonparticipants

Table 6.2: Components in Patterns of Practices.

Components in Patterns of Practices (continued)	Description
D) Participants	A description of the participants (i.e. users of the VMC systems and/or other members of their family) and their respective roles in the Interactions (*refer to C*). Participants are typically in the local home. However some interactions may involve participants in both the local and remote homes.
	Participants can be classified as one of the following:
	i) Primary participants
	ii) Secondary participants
	iii) Nonparticipants
E) Outcomes	A short statement that answers the following question: What is the outcome of this action for the participants in the local and/or remote homes?
F) Applicability in Video Mediated Communication Systems	A list of video mediated communication systems that this pattern has/can be found in. Examples include video conferencing systems, dyadic media space, and multifamily media space.
	Note: This list ties the pattern to findings from Chapters 4, 5 and/or 6.
G) Scenario of Use	A scenario that illustrates an instantiation of this pattern.
	Note: This list ties the pattern to findings from Chapters 4, 5 and/or 6 by presenting self-reports/examples/experiences of participants in the respective studies as Scenarios of Use.
H) Related Patterns	A list of patterns that are related to this pattern in one or more of the following ways:
	i) Patterns that could occur in *conjunction* with this pattern
	ii) Patterns that could occur *before* this pattern
	iii) Patterns that could occur *after* this pattern
	iv) Patterns that could occur as a *consequence* of this pattern
	v) Patterns that are *dependent* on this pattern

Table 6.3: Components in Patterns of Practices (continued).

6.5 Breakdown and Overview of Patterns of Practices

One of the challenges in creating and defining a pattern language is defining the scope of individual patterns and defining the distinction between patterns. Granted that all patterns in a pattern language are interrelated (this is one of the premises of Alexander's definition of a pattern language), it is still important for users of the pattern language to be able to easily differentiate between patterns when using a pattern language.

The *Patterns of Practices* are differentiated from each other using two key characteristics:

1. **Purpose** of the interaction and
2. **Type** of interaction.

Both of these characteristics stood out as factors that defined and differentiated the patterns when I organized and grouped the initial 34 practices (that were identified from findings in Chapters 3, 4, and 5) using affinity diagrams. This process is described in Section 6.3. Using the purpose and type of interactions, I combined similar practices and grouped the resulting patterns[12] into 4 groups [Table 6.1].

Purpose of interaction is further broken down into six sub characteristics. Given that these patterns are based on self-reports by participations in the studies described in Chapters 3-5, the six sub characteristics are based on participants' goals when engaged in a specific *Pattern of Practice*. This also means that there may be more reasons why participants engaged in a pattern, but these reasons might not have been reported and hence not included in the respective pattern. The sub characteristics are:

- **Provide awareness**: providing awareness to the remote family.
- **Gain awareness**: gaining awareness about the remote family.
- **Communication/conversation**: conversations with the remote family.
- **Display activities**: display activities in one's home to the remote family.
- **Watch activities**: watch activities in the remote home.
- **Privacy**: autonomy, confidentiality, and/or solitude from the remote family.

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[12] Patterns originated from practices that were elaborated and described using the patterns structure in Table 7.2.

Type of interaction is broken into four subcategories. The subcategories are:

- **One-sided**: this interaction only involves the local family and it does not involve the remote family. If this interaction leads to involvement or interactions by the remote family, it becomes an asynchronous interaction.
- **Asynchronous**: this interaction involves both the local and remote families (two-sided) but both sides of the interaction do not happen at the same time.
- **Synchronous**: this interaction involves both the local and remote families (two-sided) and both families are interacting with each other simultaneously.
- **Reciprocal**: a reciprocal interaction involves both the local and remote families simultaneously sharing and receiving information from one another.

Tables 6.4 and 6.5 are intended as an overview of the Patterns of Practices based on the purpose and types of interactions in each pattern. Hence it is important to note that the purpose of the interaction reported in the table is only the *purpose* of the *primary participants* in the local home and/or remote homes. More details are provided in the patterns in Section 6.6.

	Purpose of interaction						Type of interaction			
	Provide awareness	Gain awareness	Communication /conversation	Display activities	Watch activities	Privacy	One-sided	Asynch-ronous	Synch-ronous	Recip-rocal
Pattern 1: Providing awareness to the remote family	√						√	~13		
Pattern 2: Gaining awareness about the remote family		√					√	~14		
Pattern 3: Impromptu interactions with the remote family			√						√	
Pattern 4: Scheduling interactions with the remote family	√	√						√	√	
Pattern 5: Displaying everyday life to the remote family	√			√			√	~15		

Table 6.4: Overview of purpose and types of interactions in Patterns 1-5.

[13] Pattern 1 becomes an asynchronous interaction *if it happens in conjunction with* or *when it leads to* Pattern 2.

[14] Pattern 2 becomes an asynchronous interaction *if it happens in conjunction with* or *if it is an outcome of* Pattern 1.

[15] Pattern 5 becomes an asynchronous interaction *if* or *when it leads to* Pattern 6.

	Purpose of interaction						Type of interaction			
	Provide awareness	Gain awareness	Communication / conversation	Display activities	Watch activities	Privacy	One-sided	Asynch-ronous	Synch-ronous	Recip-rocal
Pattern 6: Watching activities in the remote home		√			√		√	∼[16]		
Pattern 7: Participating in activities in the remote home		√	√		√				√	
Pattern 8: Local and remote families simulta-neously sharing activities with each other	√	√	√	√	√				√	√
Pattern 9: Focused communica-tion between local and remote families	√	√	√						√	√
Pattern 10: Intermittent communica-tion between local and remote families	√	√	√					√		
Pattern 11: Privacy from the remote family						√	√			

Table 6.5 Overview of purpose and types of interactions in Patterns 6-11.

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[16] Pattern 6 becomes an asynchronous interaction *if it is an outcome of* Pattern 5.

6.6 Patterns of Practices

In this section, I present the 11 Patterns of Practices, which are organized into four groups.

6.6.1 Group A) Gaining and Providing Awareness Information

This group contains the following two patterns:

Pattern 1: Providing awareness to the remote family

Pattern 2: Gaining awareness about the remote family

Pattern 1: Providing awareness to the remote family

Purpose

For the local family to provide the remote family with information about the local family that will increase the remote family's awareness about the local family's life. Awareness information includes:

a) **Location awareness** – information about where the local family is, has been or is planning to go.

b) **Activity awareness** – information about the current, past, or upcoming activities of the local family.

c) **Status awareness** – information about the current and past well-being, feelings, or attitudes associated with situations and events in the local family's life.

d) **Availability awareness** – information about the current or future availability of the local family for interactions with the remote family.

Interactions

This pattern typically happens *implicitly* using the video feed and *explicitly* using the messaging feature of a Video Mediated Communication (VMC) system and is a one-sided interaction by the local family.

a) Providing awareness implicitly using video

A member of the local family *implicitly* provides the remote family with awareness about their life by turning on the VMC system and allowing the remote family to look into their home and gain awareness about their lives.

b) Providing awareness explicitly through messages

A member of the local family *explicitly* provides the remote family with awareness about their life by leaving a message for the remote family using the VMC system. The message informs

the remote family about the local family's location, activity, status and/or availability. The local family could *retroactively* share awareness information after an event has occurred (e.g. by leaving a message about where they had been once they return home). They could also *proactively* share awareness information before or while an event is occurring (e.g. "We are waiting for Dad to get home so we can surprise him").

A message can contain one or more than one type of awareness information (i.e. location, activity, status, and availability).

Participants

1) Primary participants

-   A member of the local family who turns on the VMC system and/or leaves messages for the remote family using the system. The primary participant could share their individual location, activity, status and/or availability. They could also share information about the other members of their family or the entire family. The primary participant could verbally inform other members of their family about the information they shared with the remote family.

-   There could be more than one primary participant who actively participates in this action. For instance:
    o   One member of the local family could ask another member of their family to leave a message for the remote family on their behalf.

2) Secondary participants

-   One or more members of the local family who are informed by the primary participant(s) about the information they shared with the remote family. Secondary participants are optional.

3) Nonparticipants

-   One or more members of the local family who are present in the local home but show no interest or have no desire to communicate with the remote family through the VMC system. Non-participants are optional.

Outcomes

1) Primary participants

-   The primary participants could share information about themselves or their family because they want the remote family to gain awareness about their life (location/activity and/or status). This could result in *reciprocity*; the remote family may share information about their life because the local family does so. Reciprocity could

lead to the primary participants feeling more connected with the remote family by learning about their life.

- The primary participants could share information about their or their family's availability for interactions because they want the remote family to have more opportunities for interactions with them.

- The primary participants could also share information about themselves or their family because they feel compelled to do so. In the long run, this could lead to the local family reducing their use of the VMC system and possibly not using it at all.

- The indirect outcome of providing awareness information could be privacy (i.e. solitude) because the remote family is less likely to get in touch with the local family if they are not home or presumed to be busy.

2) Secondary participants

- Secondary participants could have the same outcomes from this pattern as the primary participants.

- However if the secondary participants are not closely connected to the remote family, this pattern could lead to an infringement of their privacy (i.e. confidentiality).

3) Nonparticipants

- Nonparticipants are typically not closely connected with the remote family. This pattern could lead to them avoiding the space where the VMC system is placed and/or an infringement of their privacy (i.e. confidentiality).

Applicability in Video Mediated Communication Systems

This pattern can be found in:
1) Dyadic media spaces with video and messaging capabilities (e.g. Family Window).
2) Multifamily media spaces with video and messaging capabilities (e.g. Family Portals).
3) Video communication systems with messaging capabilities (e.g. Skype).

Scenarios of use

a) Location, activity and availability awareness
This scenario is from the evaluation of the Family Window (Chapter 4).

It is Saturday morning and Betsy is taking her 3 year-old son to the zoo. She knows that her mother is home all day and may want to talk to her. Before leaving, she writes a message on the Family Window to inform her mother that she and her son are going to the zoo and will not return home until later in the day. She wrote,

"Going to the zoo. Will not be home until late tonight."

b) Status awareness
This scenario is from the evaluation of Family Portals (Chapter 5).

Kendra is connected to her sister and her mother using Family Portals. One afternoon, Kendra went to her doctor's office to ask him about the abdominal pain she had been experiencing. When she got home, she decided to give her sister an update since her sister did not know about the pain she had been experiencing. She wrote on Family Portals, *""Hi [Younger Sister]. How are you doing? What's going on? I'm seeing a Doc for gall bladder [sic] issues. Had a sonogram. Waiting 4 results."*

Related patterns

This pattern could lead to the following pattern:
Pattern 2: Gaining awareness about the remote family

This pattern could be a consequence of the following pattern:
Pattern 5: Displaying everyday life to the remote family

Pattern 1: Providing awareness to the remote family

Pattern 2: Gaining awareness about the remote family

Purpose

For the local family to gain awareness about the remote family's **life** (location, activities, and/or status) or to gain awareness about the remote family's **availability for communication**.

Interactions

Gaining awareness about the remote family is a one-sided interaction by the local family. In a VMC systems with video and messaging capabilities, the local family can gain awareness about the remote family's life (location, activities, and/or status) and availability for communication in the following ways:

1) Deliberately looking at the video feed

A member of the local family deliberately looks at the video feed of the remote home to gain awareness about the remote family. They could specifically look for visual cues in the remote home (e.g. weather, a picnic basket on the counter) to learn about the remote family's life

and availability for communication or they may not be looking for anything in particular in the remote home (i.e. just looking because there is a video feed, out of habit, or out of curiosity).

If their intention is only to gain awareness about the remote family's life (e.g. to know what is going on in the remote home) and not to initiate interaction, the local family member deliberately looks at the video feed without getting the attention of the remote family. If their intention is to gain awareness about the remote family's availability for communication and to initiate interaction, they could make their presence known to the remote family.

Deliberately looking at the video feed is not dependent on the location of the VMC system, as the user will actively use the system to gain awareness about the remote family.

Note: Contrast with *Involuntary Glancing*.

2) Reading messages left by remote family

A member of the local family reads messages left by the remote family on the VMC system to gain awareness about the remote family. They gain awareness by reading messages that contain information about the remote family's location, activities, status and/or availability.

3) Requesting for awareness information from the remote family

A member of the local family looks at the video feed of the remote home and does not see any member of the remote family. They then leave a message for the remote family to *proactively* request for information from the remote family about their life (e.g. "What are you doing") or their availability (e.g. "When will you be home?").

4) Involuntary glancing at the video feed

Involuntary glancing is a passive act that leads to the user actively engaging with the VMC system. It is dependent on the location of the system and happens in two ways:

a) A member of the local family walks by the system to get to another part of their home. They look at the system as they walk by in the same way they look at any other object in their home that they happen to walk by: *without a definite intention*. A movement in the video feed or the notification of a new message catches their eye and they stop to take a closer look at the system. They then deliberately look at the video feed or read messages left by the remote family to gain awareness about them.

b) A member of the local family is in the same area of the home as the VMC system. They are engaged in an activity (e.g. cooking, reading a newspaper) when a movement in the video feed or the notification of a new message catches their eye. They step closer to the system to take a look. They then deliberately look at the video feed or read messages left by the remote family to gain awareness about them.

Participants

1) Primary participants

- A member of the local family who gains awareness about the remote family's life and/or availability for communication. The primary participant could share the awareness they gained with other members of their family.

- There could be more than one primary participant who actively participates in this pattern. For instance:
    - One member of the local family could ask another member of their family to deliberately look at the remote family's video feed, read or leave messages for the remote family on their behalf.
    - Two or more members of the local family involuntarily glance at the system at the same time or the person who involuntarily glances at the video feed notifies another family member (e.g. by asking them to come to the system) and they look at the video feed or read a new message together.

2) Secondary participants

- One or more members of the local family who gain awareness about the life or availability of the remote family through the primary participant(s). Secondary participants are optional.

3) Nonparticipants

- One or more members of the local family who are present in the local home but show no interest or have no desire to communicate with the remote family through the VMC system. Non-participants are optional.

Outcomes

1) Primary participants

- Gaining awareness information could lead to the primary participants having more awareness about the remote family's life and having more opportunities to communicate with the remote family by determining their availability.

- Awareness about the remote family's life can led to the primary participants feeling more connected with the remote family and it can lead to them having more topics for communication (e.g. "I saw a picnic basket on your counter. Where did you go for your picnic?")

- Deliberately looking at the video feed can lead to impromptu communication if the primary participant sees a member of the remote family and decides to initiate

communication with them. Reading or leaving messages to determine the remote family's availability can also lead to scheduled interactions between families.

-   Involuntary glancing typically leads to deliberately looking at the video feed and/or reading messages left by remote family. This results in the primary participants having more awareness about the remote family's life. Involuntary glancing could also lead to impromptu interactions if the primary participants see someone in the remote home and initiate interaction. If the local family sees something of interest in the remote home, involuntary glancing could lead to them watching the activities in the remote home with or without the knowledge of the remote family.

2) Secondary participants

-   Secondary participants could have the same outcomes from this pattern as the primary participants.

-   However if the secondary participants are not closely connected to the remote family or if they are not interested in gaining awareness about the remote family, this pattern could lead to them learning or gaining unnecessary information.

3) Nonparticipants

-   Nonparticipants are typically not closely connected with the remote family. This pattern could lead to them avoiding the space where the system is placed.

Applicability in Video Mediated Communication Systems

This pattern can be found in:
1) Dyadic media spaces with video and messaging capabilities (e.g. Family Window).
2) Multifamily media spaces with video and messaging capabilities (e.g. Family Portals).

This pattern can also be found in the following system **if** the *video connection has been initiated* and is *left on for an extended period of time* at *both the local and remote home(s)*.
1) Video communication systems with messaging capabilities (e.g. Skype).

Scenarios of use

1) Deliberately looking at the video feed
This scenario is from the evaluation of Family Portals (Chapter 5).

Sharon is an 80-year-old retired teacher who lives with her husband. She is connected to her daughter and granddaughter's homes using Family Portals. Since she is home all day, she frequently "peeks" at the video feed of her daughter and granddaughter's homes even when she knows nobody's home. She does this because,

"Maybe someone's in their house. It could be a robber, you know? Could be a robber in the house. Or maybe a pipe would burst and the water's running all over you never know. So I just kinda peek in there and you know, you never know what's going on."

Sharon also "peeks" at the video feed to see activities in the remote homes. For instance, one evening, she saw her son-in-law instead of her daughter making dinner. Later that night when she spoke to her daughter, she asked why her daughter did not cook that night and found out that her daughter had to work late.

2) Reading messages left by remote family
This scenario is from the evaluation of Family Portals (Chapter 5).

Caroline is connected to her daughter and mother's homes using Family Portals. Caroline and her daughter, Betsy, share a close relationship and she loves interacting with Betsy's 3-year-old son, Liam. Every evening when she gets home from work, she looks for messages left by her daughter to learn about their plans for the evening and their availability for communication. One Thursday evening, she found a message saying,
"Out biking. Be back by 6pm."
That night, while talking to Liam, she asked him about his biking trip and listened while he talked about how much he enjoyed biking.

3) Requesting for awareness information from the remote family
This scenario is from the evaluation of Family Portals (Chapter 5).

Caroline is connected to her daughter and mother's homes using Family Portals. Caroline and her daughter, Betsy, share a close relationship and she loves interacting with Betsy's 3 year-old son, Liam. Every evening when she gets home from work, she looks for messages left by her daughter to learn about their plans for the evening and their availability for communication. One evening, Caroline got home from work, looked at the video feed of her daughter's home and did not see anyone around. She also did not see any message from her daughter. Since she wanted to show her grandson the new toy she bought for him, she left a message for her daughter saying,
"When will you be home? Want to show Liam the new toy I bought for him."

4) Involuntary glancing at the video feed
This scenario is from the evaluation of the Family Window (Chapter 4).

Matthew is in his kitchen making lunch one afternoon when a movement in the Family Window catches his eye. He knows that his daughter and her family are not home at that time of the day so he walks closer to the Family Window to look into his daughter's home. He sees their dog playing with its toy near the system. He watches the dog for a few minutes and then gets back to making his lunch.

Related patterns

This pattern could take place in conjunction with the following pattern:
Pattern 1: Providing awareness to the remote family

This pattern could lead to the following patterns:
Pattern 3: Initiating impromptu interactions with the remote family
Pattern 4: Scheduling interactions with the remote family
Pattern 6: Watching activities in the remote home
Pattern 7: Participating in activities in the remote home
Pattern 8: Local and remote families simultaneously sharing activities with each other
Pattern 9: Focused communication between local and remote families
Pattern 10: Intermittent communication between local and remote families

Pattern 2: Gaining awareness about the remote family

6.6.2 Group B) Initiating Interactions

This group contains the following two patterns:

Pattern 3: Initiating impromptu interactions with the remote family

Pattern 4: Scheduling interactions with the remote family

Pattern 3: Initiating impromptu interactions with the remote family

Purpose

For the local family to initiate and engage in an unscheduled interaction (e.g. conversation) with the remote family.

Interactions

This pattern typically happens using the video and/or audio component of a VMC system. This pattern is a consequence of *Pattern 2: Gaining awareness about the remote family*. Impromptu interactions are synchronous because they require participation from both the local and remote families.

Impromptu interactions occur in two steps. First, the primary participant notices a remote family member in the system through involuntary glancing or by deliberately looking at the video feed. Second, the primary participant tries to visually or audibly get the attention of the remote family member to initiate interaction.

Step 1: Noticing the presence of the remote family

1a) Involuntary glancing leads to impromptu interaction

Involuntary glancing is a passive act that leads to actively engaging with the VMC system. It is dependent on the location of the system and happens in two ways:

(i) A member of the local family walks by the system to get to another part of their home. They look at the system as they walk by in the same way they look at any other object in their home that they happen to walk by: *without a definite intention.* A movement in the video feed or the notification of a new message catches their eye and they stop to take a closer look at the system. While looking at the VMC system, they see someone in the remote home that they would like to interact with.

(ii) A member of the local family is in the same area of the home as the VMC system. They are engaged in an activity (e.g. cooking, reading a newspaper) when a movement in the video feed or the notification of a new message catches their eye. They step closer to the system to take a look. While looking at the video feed, they see someone in the remote home that they would like to interact with.

1b) Deliberately looking leads to impromptu interaction

A member of the local family deliberately looks at the video feed of the remote home to gain awareness about the remote family. They could specifically look for visual cues in the remote home (e.g. weather, a picnic basket on the counter) to learn about the remote family's life and availability or they may not be looking for anything in particular in the remote home (i.e. just looking because there is a video feed, out of habit, or out of curiosity). While looking at the video feed, they see someone in the remote home that they would like to interact with.

Step 2: Getting the attention of the remote family
There are two ways the primary participant could get the attention of the remote family. Both could occur simultaneously or independently based on features provided in the VMC system.

2a) Visually getting the attention of the remote family
A member of the local family involuntarily or deliberately looks at the video feed and sees someone in the remote home who they would like to interact with. They then try to visually get their attention (e.g. by waving at them). Once they get the attention of the remote family member, they initiate an interaction (e.g. with a wave, a greeting, or a question).

2b) Audibly getting the attention of the remote family
A member of the local family involuntarily or deliberately looks at the video feed, sees someone in the remote home who they would like to interact with. They then try to audibly get their attention (e.g. by calling their name or using an auditory notification feature). Once they get the attention of the remote family member, they initiate an interaction (e.g. with a wave, a greeting, or a question).

Participants

1) Primary participants

- A member of the local family who initiates an impromptu interaction with the remote family by involuntarily glancing or deliberately looking at the video feed. The primary participant could share information about their impromptu interaction with other members of their family.

- There could be more than one primary participant who actively participates in this pattern. For instance:
  - o The person who initiates the interaction could invite other members of their family to participate in the interaction with the remote family.

2) Secondary participants

- One or more members of the local family who are present during the impromptu interaction but do not actively participate (e.g. someone who is watching television and overhearing the conversation) or members of the local family who learn about the interaction from the primary participant(s). Secondary participants are optional.

3) Nonparticipants

- One or more members of the local family who are present in the local home but show no interest or have no desire to communicate with the remote family through the system. Non-participants are optional.

Outcomes

1) Primary participants

- Impromptu interactions could lead to more communication between the primary participants and remote family. More communication could lead to them feeling more connected to the remote family and being more aware about the remote family's life and availability.

- If the remote family is not available for interaction when the primary participant initiates it (e.g. they are about to leave home for work), they could respond by proposing a more suitable time for them to have a scheduled interaction.

2) Secondary participants

- Secondary participants could have the same outcomes from this pattern as the primary participants. However if the secondary participants are not closely connected to the remote family or if they are not interested in interacting with the remote

family, this pattern could lead to them being directly or indirectly compelled to participate in the interaction. It could also lead to them learning more about the remote family than they want to.

3) Nonparticipants

- Nonparticipants are typically not closely connected with the remote family. This pattern could lead to them avoiding the space where the VMC system is placed.

Applicability in Video Mediated Communication Systems

This pattern can be found in:
1) Dyadic media spaces with video capabilities (e.g. Family Window).
2) Multifamily media spaces with video capabilities (e.g. Family Portals).

This pattern can also be found in the following system **if** the *video connection has been initiated* and is *left on for an extended period of time* at *both the local and remote home(s).*
1) Video communication systems (e.g. Skype).

Related patterns

This pattern is a consequence of the following pattern:
Pattern 2: Gaining awareness about the remote family

This pattern could lead to the following patterns:
Pattern 4: Scheduling interactions with the remote family
Pattern 6: Watching activities in the remote home
Pattern 7: Participating in activities in the remote home
Pattern 8: Local and remote families simultaneously sharing activities with each other
Pattern 9: Focused communication between local and remote families

Pattern 3: Initiating impromptu interactions with the remote family

Pattern 4: Scheduling interactions with the remote family

Purpose

For the local family to schedule a future (e.g. later today, tomorrow, next week) interaction (e.g. conversation, participation in activities) with the remote family.

Interactions

This pattern typically happens using the messaging component of a VMC system or using other technology (e.g. email, phone, text message). Scheduling interactions could be asynchronous interactions by the local family or synchronous interactions between local and remote families. Scheduling interactions could occur in two ways:

1) Exchanging messages with the remote family to schedule an interaction

Exchanging messages with the remote family to schedule an interaction could occur in two ways depending on the intention of the user: to *provide their availability for interaction* or to *determine the availability of the remote family for an interaction*. An interaction could be scheduled with one message from the local family or it could involve multiple messages between the local and remote family to negotiate a suitable time for the interaction.

a) A member of the local family looks at the video feed of the remote home and does not see anyone in the remote family. They then leave a message for the remote family to *proactively* provide information about their availability and to propose a time for them to interact (e.g. "Let's talk at 5pm.").

b) A member of the local family looks at the video feed of the remote home and does not see any member of the remote family. They then leave a message for the remote family to *proactively* ask the *remote family* about their availability (e.g. "When will you be home?"). They could also propose a time for them to interact (e.g. "When will you be home? Want to talk tonight?").

2) Using other technology to schedule interactions with the remote family

Users could use other technology (e.g. email, phone, text message) to schedule an interaction with the remote family. Users could use technology other than the VMC system for convenience (e.g. it is easier to make a phone call than write a message on the system) or because they do not have access to the system (e.g. cannot access VMC system in the home from a different location).

This action could occur in two ways depending on the intention of the user; to *provide their availability for interaction* or to *determine the availability of the remote family for an interaction*. An interaction could be scheduled with one message from the local family or it could involve multiple messages between the local and remote family to negotiate a suitable time for the interaction.

Sample interaction using text messages:

a) A member of the local family sends a text message to the remote family to *proactively* provide information about their availability and to propose a time for them to interact (e.g. "Let's talk at 5pm.").

b) A member of the local family sends a text message to the remote family to *proactively* ask the *remote family* about their availability (e.g. "When will you be home?"). They could also propose a time for them to interact (e.g. "When will you be home? Want to talk tonight?").

Participants

1) Primary participants

- A member of the local family who schedules an interaction with the remote family by exchanging messages using a VMC system or using other technology. The primary participant could share information about the scheduled interaction with other members of their family.

- There could be more than one primary participant who actively participates in this pattern. For instance:
    - The person who schedules the interaction could invite other members of their family to participate in the interaction with the remote family.
    - One member of the local family could ask another member of their family to schedule an interaction with the remote family on their behalf.

2) Secondary participants

- One or more members of the local family who are present during the scheduled interaction but do not actively participate (e.g. someone who is watching television and overhearing the conversation) or members of the local family who learn about the interaction from the primary participant(s). Secondary participants are optional.

3) Nonparticipants

- One or more members of the local family who are present in the local home but show no interest or have no desire to communicate with the remote family through the VMC system. Non-participants are optional.

Outcomes

1) Primary participants

- Scheduling interactions by providing and receiving availability awareness could lead to the primary participants gaining awareness and learning more about the remote family's life.

- Scheduled interactions could lead to more communication between the primary participants and remote family. More communication could lead to them feeling more connected to the remote family and being more aware about the remote family's life.

- The indirect outcome of providing awareness information could be privacy (i.e. solitude) because the remote family is less likely to get in touch with the local family before the scheduled interaction.

2) Secondary participants

- Secondary participants could have the same outcomes from this pattern as the primary participants.

- However if the secondary participants are not closely connected to the remote family or if they are not interested in interacting with the remote family, this pattern could lead to them being directly or indirectly compelled to participate in the interaction. It could also lead to them learning more about the remote family than they want to.

3) Nonparticipants

- Nonparticipants are typically not closely connected with the remote family. This pattern could lead to them avoiding the space where the system is placed.

Applicability in Video Mediated Communication Systems

Part 1 of this pattern can be found in:
1) Dyadic media spaces with video and messaging capabilities (e.g. Family Window).
2) Multifamily media spaces with video and messaging capabilities (e.g. Family Portals).

Part 1 of this pattern can also be found in the following system **if** the *video connection has been initiated* and is *left on for an extended period of time* at *both the local and remote home(s).*
1) Video communication systems with messaging capabilities (e.g. Skype).

Related patterns

This pattern could take place in conjunction with the following pattern:
Pattern 1: Providing awareness for the remote family
Pattern 2: Gaining awareness about the remote family

This pattern could lead to the following patterns:
Pattern 7: Participating in activities in the remote home
Pattern 8: Local and remote families simultaneously sharing activities with each other
Pattern 9: Focused communication between local and remote families

Pattern 4: Scheduling interactions with the remote family

6.6.3 Group C) Sharing Everyday Life

This group is further divided into two subgroups – Sharing Activities and Sharing Information.

Sharing activities

This subgroup contains the following four patterns:

Pattern 5: Displaying everyday life to the remote family

Pattern 6: Watching activities in the remote home

Pattern 7: Participating in activities in the remote home

Pattern 8: Local and remote families simultaneously sharing activities with each other

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Pattern 5: Displaying everyday life to the remote family

Purpose

For the local family to *passively* or *actively* share their life with the remote family by **displaying** a space, activities, or objects in their home for the remote family to view.

Interactions

This pattern typically happens using the video component of a VMC system. There is minimal or no communication between families since the purpose of this interaction is for the local family to provide opportunities for the remote family to see them and their home and to feel more connected to the local family. This pattern could lead to *Pattern 6: Watching activities in the remote home*.

This is typically a one-sided interaction because the remote family may or may not be present/available/interested to watch the local family when the local family is *actively* displaying their life. The local family's intention is to provide opportunities for the remote family to see them and their home, which is why they share their life without needing to determine the presence or availability of the remote family. It is also not a reciprocal interaction because the local family is *displaying their* life to the remote family who may or may not watch and who may not reciprocate by displaying their respective lives.

If this interaction leads to synchronous interactions between local and remote families while one family is displaying their life and the other is watching, it evolves into *Pattern 7: Participating in activities in the remote home*. If this interaction turns into a synchronous and reciprocal interaction between local and remote families where both families are displaying their lives and watching each other, it evolves into *Pattern 8: Local and remote*

families simultaneously sharing activities with each other.

There are two ways to share one's life with the remote family: by *passively* or *actively displaying everyday life*.

Passively displaying everyday life to the remote family

a) Displaying a specific space in one's home to remote family

A member of the local family shares a space in their home (e.g. kitchen, family room) by setting the system in the space that they would like to display to the remote family. They are *passively displaying* their life for an extended period of time (e.g. six hours, one day, a week) by giving the remote family viewing access to that space and any person, object or activity in there.

Actively displaying everyday life to the remote family
A member of the local family actively displays their everyday life in two ways:

b) Displaying activities in one's home to remote family

A member of the local family displays an activity in their home (e.g. children playing, a dinner party) by *actively* moving the system to the area in the home where the activity is happening or by *actively* changing the position of the camera to point towards the activity. The local family could also invite the remote family to view the activity or call their attention to the activity by leaving a message on the system.

Note: Displaying activities is an *active* act because the local family is actively moving the VMC system or changing the position of the camera to share an activity. This is in contrast to *passively* displaying everyday life (*refer to: 1) Displaying a specific space in one's home to remote family*) which just involves turning on the VMC system and not directing it to any specific activity. Displaying activities happens after the system has been turned on and/or the video connection between two homes has been initiated.

c) Displaying objects in one's home to the remote family

A member of the local family displays objects in their home (e.g. a new sofa, a vase filled with flowers) to the remote family. They do this by *actively* moving the system to the area in the home where the object is located, changing the position of the camera to point towards the object, or placing the object in front of the camera. The local family could call the remote family's attention to the object by leaving a message on the system.

Note: Displaying objects is an *active* act because the local family is actively moving the system or changing the position of the camera to share an object. This is in contrast to *passively* displaying everyday life (*refer to: 1) Displaying a specific space in one's home to remote family*) which just involves turning on the system and not directing it to any specific object in the local home. Displaying objects happens after the VMC system has been turned on and/or the video connection between two homes has been initiated.

Participants

1) Primary participants

- A member of the local family who decides to display their everyday life to the remote family by turning on the VMC system moving it or pointing the camera towards a space, activity or object.

- There could be more than one primary participant who actively participates in this action. For instance:
    - One member of the local family could decide to display their everyday life to the remote family and ask another member of their family to turn on the system, move it or point the camera towards a space, activity or object on their behalf.

2) Secondary participants

- One or more members of the local family who are present in the space that is being shared or who are participating in the activity that is being displayed to the remote family. Secondary participants may or may not be given the option to opt out of being watched by the remote family (e.g. young children may not be able to opt out when their parents are the primary participants who decide to share their life with a remote family).

3) Nonparticipants

- One or more members of the local family who are present in the local home but who do not want to bee seen by the remote family. Non-participants are optional.

Outcomes

1) Primary participants

- Primary participants provide opportunities for the remote family to share their lives by allowing the remote family to see them, their home and the activities they perform in their home. They are also providing the remote family with awareness about their life. This could result in *reciprocity*; the remote family may also share information about their life because the local family does so. Reciprocity could lead to the primary participants feeling more connected with the remote family. Even if the remote family does not reciprocate, displaying their lives to the remote family could result in the primary participants feeling more connected with the remote family.

- The indirect outcome of this pattern could be privacy from the remote family. For instance, the primary participants could choose to display a space in their home to

the remote family that other visitors to their home are also allowed to be in (e.g. family room as opposed to bedroom). Placing an object in front of the camera or changing the direction of the camera also intentionally or unintentionally allows the primary participants to control what and how much the remote family is able to see.

2) Secondary participants

-   Secondary participants could have the same outcomes from this pattern as the primary participants. However if the secondary participants are not closely connected to the remote family, this pattern could lead to them feeling uncomfortable about being watched.

3) Nonparticipants

-   Nonparticipants are typically not closely connected with the remote family and feel uncomfortable about being watched. This pattern could lead to them avoiding the space or the activity that is being shared with the remote family.

-   The long-term effect of this pattern could be disagreements and/or hostility between nonparticipants and primary participants who decide to share their life with the remote family even though it makes the nonparticipants uncomfortable.

Applicability in Video Mediated Communication Systems

This pattern can be found in:
1) Dyadic media spaces with video capabilities (e.g. Family Window).
2) Multifamily media spaces with video capabilities (e.g. Family Portals).

This pattern can also be found in the following system **if** the *video connection has been initiated* and is *left on for an extended period of time* at *both the local and remote home(s)*.
1) Video communication systems (e.g. Skype).

Related patterns

This pattern could lead to the following patterns:
Pattern 2: Gaining awareness about the remote family
Pattern 6: Watching activities in the remote home
Pattern 7: Participating in activities in the remote home
Pattern 8: Local and remote families simultaneously sharing activities with each other
Pattern 9: Focused communication between local and remote families

Pattern 5: Displaying everyday life to the remote family

Pattern 6: Watching activities in the remote home

Purpose

For the local family to feel more connected with the remote family by **watching** them perform everyday activities in their home (e.g. cooking, having a meal, watching television) with or without making their presence known to the remote family.

Interactions

This pattern typically happens using the video component of a VMC system. Watching activities in the remote home is typically a consequence of *Pattern 2: Gaining awareness about the remote family*. This pattern is dependent on *Pattern 5: Displaying everyday life to the remote family* because the remote family needs to be sharing and displaying their life in order for the local family to watch them.

Watching activities is a one-sided interaction and is not reciprocal because the local family is actively *watching* the remote family while the remote family is *displaying* their life with the local family. There is minimal or no communication between families since the purpose of this interaction is for the local family to watch the remote family and feel more connected to them.

If this interaction leads to synchronous interactions between local and remote families while one family is displaying their life and the other is watching, it evolves into *Pattern 7: Participating in activities in the remote home*. If this interaction turns into a synchronous and reciprocal interaction between local and remote families where both families are displaying their life and watching each other, it evolves into *Pattern 8: Local and remote families simultaneously sharing activities with each other*.

This pattern happens in two steps. First, the primary participant notices a remote family member in the system through involuntary glancing or by deliberately looking at the video feed. Second, the primary participant watches activities in the remote home with or without making their presence known to the remote family.

Step 1: Noticing the presence of the remote family

1a) Involuntary glancing leads to watching the remote family

Involuntary glancing is a passive act that leads to actively engaging with the system. It is dependent on the location of the system and happens in two ways:

(i) A member of the local family walks by the VMC system to get to another part of their home. They look at the system as they walk by in the same way they look at any other object in their home that they happen to walk by: *without a definite intention*. A movement in the video feed or the notification of a new message catches their eye and they stop to take a closer

look at the VMC system. While looking at the system, they see someone or some activity in the remote home.

(ii) A member of the local family is in the same area of the home as the system. They are engaged in an activity (e.g. cooking, reading a newspaper) when a movement in the video feed or the notification of a new message catches their eye. They step closer to the system to take a look. While looking at the system, they see someone or some activity in the remote home.

1b) Deliberately looking leads to watching the remote family

A member of the local family deliberately looks at the video feed of the remote home to gain awareness about the remote family. They could specifically look for visual cues in the remote home (e.g. weather, a picnic basket on the counter) to learn about the remote family's life and availability or they may not be looking for anything in particular in the remote home (i.e. just looking because there is a video feed, out of habit, or out of curiosity). While looking at the VMC system, they see someone or some activity in the remote home.

Step 2: Watching the remote family

2a) Watching the remote home *without* making presence known to the remote family

A member of the local family involuntarily or deliberately looks at the video feed and sees someone or some activity in the remote home.

The local family could have different intentions for this interaction:
1) they want to gain awareness about the remote family's life (e.g. to know what is going on in the remote home)
2) they could be curious about the remote family's life and want to watch activities that are happening there
3) they could enjoy watching the remote family and remote home because it makes them feel more connected to the remote family.

Since their intention is not to initiate interaction, the local family member watches the video feed without getting the attention of the remote family. The local family might also watch without making their presence known because they do not want to disturb the remote family (e.g. while they are having a meal).

2b) Watching the remote home *after* making presence known to the remote family

A member of the local family involuntarily or deliberately looks at the video feed and sees someone or some activity in the remote home. Since their intention is to gain awareness about the remote family's life and to possibly initiate interaction, they try to visually (e.g. by waving at them) or audibly (e.g. by calling their name or using an auditory notification feature) get the attention of the remote family. Once they get the attention of the remote family member, they initiate an interaction (e.g. with a wave, a greeting, or a question) and make their presence known to the remote family.

After the remote family acknowledges the presence of the local family, they continue the activity they were performing and the local family continues watching them. There is minimal or no communication between families after the remote family acknowledges the presence of the local family.

Note: The local family could watch the remote family for a certain amount of time (e.g. 1 minute or 5 minutes) before making their presence known (*refer to: 2a) Watching the remote home without making presence known to the remote family*). Alternatively, they could make their presence known as soon as they see someone in the remote home.

Participants

1) Primary participants

- A member of the local family who watches activities or people in the remote home with or without making their presence known to the remote family. The primary participant could share information about the activities and people they watched with other members of their family.

- There could be more than one primary participant who actively participates in this pattern. For instance:
  o The person who involuntarily glances or deliberately looks at the remote family's video feed could invite other members of their family to watch activities or people in the remote home.

2) Secondary participants

- One or more members of the local family who are present during the interaction but do not actively participate (i.e. by watching the remote family) or members of the local family who learn about the interaction from the primary participant(s). Secondary participants are optional.

3) Nonparticipants

- One or more members of the local family who are present in the local home but show no interest or have no desire to communicate with the remote family through the VMC system. Non-participants are optional.

Outcomes

1) Primary participants

- Watching the remote family could lead to the primary participants gaining awareness and learning more about the remote family's life. This could lead to them feeling

more connected to the remote family.

- Awareness about the remote family's life can also lead to them having more topics for communication (e.g. "I saw visitors in your house. How was the party?")

2) Secondary participants

- Secondary participants could have the same outcomes from this pattern as the primary participants. However if the secondary participants are not closely connected to the remote family or if they are not interested in learning more about the remote family, this pattern could lead to them learning more about the remote family than they want to.

3) Nonparticipants

- Nonparticipants are typically not closely connected with the remote family. This pattern could lead to them avoiding the space where the system is placed and/or the space in which the primary participants are watching the remote home.

Applicability in Video Mediated Communication Systems

This pattern can be found in:
1) Dyadic media spaces with video capabilities (e.g. Family Window).
2) Multifamily media spaces with video capabilities (e.g. Family Portals).

This pattern can also be found in the following system **if** the *video connection has been initiated* and is *left on for an extended period of time* at *both the local and remote home(s)*.
1) Video communication systems (e.g. Skype).

Related patterns

This pattern is a dependent on the following pattern:
Pattern 5: Displaying everyday life to the remote family

This pattern is a consequence of the following pattern:
Pattern 2: Gaining awareness about the remote family

This pattern could lead to the following patterns:
Pattern 7: Participating in activities in the remote home
Pattern 8: Local and remote families simultaneously sharing activities with each other
Pattern 9: Focused communication between local and remote families

Pattern 6: Watching activities in the remote home

Pattern 7: Participating in activities in the remote home

Purpose

This pattern has two purposes:
a) For the local family to feel more connected with the remote family by participating in activities in the remote home.
b) For the remote family to feel more connected with the local family by allowing them to participate in activities in their home.
The local family **participates** in activities in the remote home by **watching** the remote family perform everyday activities (e.g. cooking, having a meal) and simultaneously **interacting** with them.

Interactions

This pattern typically happens using the video component and audio and/or messaging capabilities of a VMC system. Participating in activities in the remote home is typically a synchronous interaction but it is not reciprocal. It is a synchronous interaction because the remote family is aware of the presence of the local family on the system and both families are interacting with each other (e.g. by talking). It is not a reciprocal interaction because the local family is actively *watching* and *interacting* with the remote family while the remote family is *sharing* and *displaying* their life. The local family is not displaying their life to the remote family.

If this interaction turns into a synchronous and reciprocal interaction between local and remote families where both families are displaying their life and watching each other, it evolves into *Pattern 8: Local and remote families simultaneously sharing activities with each other*.

This pattern happens in two steps. First, either the local or remote family notices the presence of the other family and/or initiates interaction. Second, the local family watches and interacts with the remote family using video and messaging or using video and audio.

Step 1: Noticing the presence of the other family and/or initiating the interaction

A) Local family initiating interaction

1a) Impromptu interactions with the remote family

A member of the local family involuntarily or deliberately looks at the video feed and sees someone or some activity in the remote home. They then try to visually or audibly get the attention of the remote family member to initiate interaction.

(Refer to: **Pattern 2: Gaining awareness about the remote family)**
(Refer to: **Pattern 3: Initiating impromptu interactions with the remote family)**

1b) Scheduling interactions with the remote family

A member of the local family schedules an interaction with the remote family by exchanging messages using the system or other technology (e.g. email, phone, text message). The local family is present at the system at the scheduled time and initiates interaction with the remote family by visually or audibly getting their attention.

(Refer to: **Pattern 4: Scheduling interactions with the remote family)**

1c) Watching activities in the remote home

A member of the local family involuntarily or deliberately looks at the video feed and sees some activity in the remote home. They then proceed to watch activities in the remote home for a certain amount of time (e.g. 1 minute, 5 minutes, 15 minutes) before making their presence known to the remote family and initiating interaction. Alternatively, they could make their presence known to the remote family and initiate interaction as soon as they see someone or some activity in the remote home.

(Refer to: **Pattern 2: Gaining awareness about the remote family)**
(Refer to: **Pattern 6: Watching activities in the remote home)**

B) Remote family initiating interaction

1d) Providing awareness to the local family

A member of the remote family provides information to the local family about their life (e.g. "We are going to open birthday presents tonight") and their availability (e.g. "Will be home to cook dinner at 6pm"). They could also directly or indirectly invite the local family to participate in activities in their home (e.g. "We are going to open birthday presents tonight. Jimmy would love to see you!").

Depending on their availability and interest in the remote family's life, the local family may or may not be present at the VMC system at the specified time. If they are present, they initiate interaction with the remote family.

(Refer to: **Pattern 1: Providing awareness to the remote family)**

1e) Scheduling interactions with the local family

A member of the remote family schedules an interaction with the local family by exchanging messages using the VMC system or other technology (e.g. email, phone, text message). Example, "Watch Simon do this art project tonight at 7pm." The local family is present at the VMC system at the scheduled time and initiates interaction with the remote family.

(Refer to: **Pattern 4: Scheduling interactions with the remote family***)*

1f) Displaying everyday life to the local family

A member of the remote family decides to display their everyday life to the local family by moving the VMC system or pointing the camera towards a space, activity or object. The remote family could also call the local family's attention to specific things or activities they might be interested in watching by leaving a message on the VMC system.

(Refer to: **Pattern 5: Displaying everyday life to the remote family***)*

Step 2: Watching and interacting with the remote family

The local or remote family initiates an interaction.
(Refer to: Step 1: Noticing the presence of the other family and/or initiating the interaction).

When the local family is present at the system, they try to visually or audibly get the attention of the remote family and make their presence on the system known to the remote family. After the remote family acknowledges the presence of the local family, they continue the activity they were performing and the local family watches them while interacting with them. The families interact using audio (i.e. talking), messaging (i.e. writing back and forth), or by using both the audio and messaging capabilities of the system.

Participants

A) Participants in the local family

1) Primary participants in the local home

- A member of the local family who notices the presence of the remote family and/or initiates interaction with them. The primary participant then proceeds to watch the remote family and interact with them. The primary participant could retroactively share information about the activities they watched and people they interacted with, with other members of their family.

- There could be more than one primary participant who actively participates in this pattern. For instance:
    - The person who notices the presence of the remote family and/or initiates interaction with them could invite other members of their family to watch the remote family and interact with them.

2) Secondary participants in the local home

- One or more members of the local family who are present near the VMC system during the interaction but do not actively participate (e.g. they doing an activity of

their own such as reading the newspaper while hearing the conversation). They could become primary participants if they decide to participate in the interaction.

- Secondary participants could also be members of the local family who learn about the interaction from the primary participant(s). Secondary participants are optional.

3) Nonparticipants in the local home

- One or more members of the local family who are present in the local home but show no interest or have no desire to participate in the interaction or to gain awareness about the remote family. Nonparticipants also typically do not want to be seen by the remote family through the VMC system. They may distance themselves from the system during the interaction. Non-participants are optional.

B) *Participants in the remote family*

1) Primary participants in the remote home

- A member of the remote family who initiates interaction with the local family by providing awareness information, scheduling interactions or displaying everyday life in their home. The primary participant also interacts with the local family once the local family is present at the system. The primary participant could retroactively share information about their interaction with the local family, and with other members of their family.

- There could be more than one primary participant who actively participates in this pattern. For instance:
  - One member of the remote family could ask another member of their family to schedule an interaction with the local family on their behalf.
  - Other members of the remote family could also interact with the local family while the local family is watching them.

2) Secondary participants in the remote home

- One or more members of the remote family who are present near the system during the interaction and are being watched by the local family but do not actively interact with the local family. They could become primary participants if they decide to interact with the local family.
- Secondary participants could also be members of the remote family who learn about the interaction from the primary participant(s). Secondary participants are optional.

3) Nonparticipants in the remote home

- One or more members of the remote family who are present in the remote home but show no interest or have no desire to interact with or to be seen by the local family through the system. They may distance themselves from the system during this interaction. Non-participants are optional.

Outcomes

A) Participants in the local family

1) Primary participants in the local home

- Participating in activities in the remote home by watching and interacting with the remote family could lead to the primary participants gaining awareness and learning more about the remote family's life. This could lead to them feeling more connected to the remote family and having more communication with them.

2) Secondary participants in the local home

- Secondary participants could have the same outcomes from this pattern as the primary participants. However if the secondary participants are not closely connected to the remote family or if they are not interested in learning more about the remote family, this pattern could lead to them learning more about the remote family than they want to.

3) Nonparticipants in the local home

- Nonparticipants are typically not closely connected with the remote family. This pattern could lead to them avoiding the space where the VMC system is placed and/or the space in which the primary participants are interacting with the remote home.

B) Participants in the remote family

Outcomes to the remote family are similar to those described in *Pattern 5: Displaying everyday life to the remote family*.

(Refer to: Pattern 5: Displaying everyday life to the remote family)

Applicability in Video Mediated Communication Systems

This pattern can be found in:
1) Dyadic media spaces with video capabilities (e.g. Family Window).
2) Multifamily media spaces with video capabilities (e.g. Family Portals).

This pattern can also be found in the following system **if** the *video connection has been initiated* and is *left on for an extended period of time* at *both the local and remote home(s)*.
1) Video communication systems (e.g. Skype).

Related patterns

This pattern is a consequence of one or more of the following patterns:
Pattern 1: Providing awareness to the remote family
Pattern 2: Gaining awareness about the remote family
Pattern 3: Initiating impromptu interactions with the remote family
Pattern 4: Scheduling interactions with the remote family
Pattern 5: Displaying everyday life to the remote family
Pattern 6: Watching activities in the remote home

This pattern could lead to the following patterns:
Pattern 6: Watching activities in the remote home
Pattern 8: Local and remote families simultaneously sharing activities with each other
Pattern 9: Focused communication between local and remote families

Pattern 7: Participating in activities in the remote home

Pattern 8: Local and remote families simultaneously sharing activities with each other

Purpose

For the local and remote families to feel more connected with each other by sharing activities in each other's homes. Families are actively **sharing activities** with each other by **displaying** activities in their home, **watching** activities in the other home, and **interacting** with each other.

Interactions

This pattern typically happens using the video component and audio and/or messaging capabilities of a VMC system. Sharing activities between homes is typically a synchronous interaction and is reciprocal. It is a synchronous interaction because both families are aware of each other's presence on the VMC system and both families are interacting with each other (e.g. by talking). It is also a reciprocal interaction because both families are actively *displaying* activities in their respective homes while *watching* activities in the other home. Sharing activities is the focus of this pattern as opposed to having a conversation and sharing information with each other.
(*Contrast with: Pattern 9: Focused communication between local and remote families*)

This pattern happens in two steps. First, either the local or remote family notices the presence of the other family and/or initiates interaction. Second, both the local and remote

families watch activities in each other's homes while interacting with each other using video and messaging or using video and audio.

Step 1: Noticing the presence of the other family and/or initiating the interaction

A) Local family initiating interaction

1a) Impromptu interactions with the remote family

A member of the local family involuntarily or deliberately looks at the video feed and sees someone or some activity in the remote home. They then try to visually or audibly get the attention of the remote family member to initiate interaction.

(Refer to: **Pattern 2: Gaining awareness about the remote family***)*
(Refer to: **Pattern 3: Initiating impromptu interactions with the remote family***)*

1b) Scheduling interactions with the remote family

A member of the local family schedules an interaction with the remote family by exchanging messages using the VMC system or other technology (e.g. email, phone, text message). The local family is present at the system at the scheduled time and initiates interaction with the remote family by visually or audibly getting their attention.

(Refer to: **Pattern 4: Scheduling interactions with the remote family***)*

1c) Watching activities in the remote home

A member of the local family involuntarily or deliberately looks at the video feed and sees some activity in the remote home. They then proceed to watch activities in the remote home for a certain amount of time (e.g. 1 minute, 5 minutes, 15 minutes) before making their presence known to the remote family and initiating interaction. Alternatively, they could make their presence known to the remote family and initiate interaction as soon as they see someone or some activity in the remote home.

(Refer to: **Pattern 2: Gaining awareness about the remote family***)*
(Refer to: **Pattern 6: Watching activities in the remote home***)*

B) Remote family initiating interaction

1d) Providing awareness to the local family

A member of the remote family provides information to the local family about their life (e.g. "We are going to open birthday presents tonight") and their availability (e.g. "Will be home to cook dinner at 6pm"). They could also directly or indirectly invite the local family to participate in activities in their home (e.g. "We are going to open birthday presents tonight. Jimmy would love to see you!").

Depending on their availability and interest in the remote family's life, the local family may or may not be present at the system at the specified time. If they are present, they initiate interaction with the remote family.

(Refer to: **Pattern 1: Providing awareness to the remote family***)*

1e) Scheduling interactions with the local family

A member of the remote family schedules an interaction with the local family by exchanging messages using the VMC system or other technology (e.g. email, phone, text message). For example, "Watch Simon do this art project tonight at 7pm." The local family is present at the VMC system at the scheduled time and initiates interaction with the remote family.

(Refer to: **Pattern 4: Scheduling interactions with the remote family***)*

1f) Displaying everyday life to the local family

A member of the remote family decides to display their everyday life to the local family by moving the VMC system or pointing the camera towards a space, activity or object. The remote family could also call the local family's attention to specific things or activities they might be interested in watching by leaving a message on the VMC system.

(Refer to: **Pattern 5: Displaying everyday life to the remote family***)*

Step 2: Sharing activities and interacting with each other

2a) Sharing everyday activities and interacting with each other

The local or remote family initiates an interaction.
(Refer to: Step 1: Noticing the presence of the other family and/or initiating the interaction).

When the local family is present at the system, they try to visually or audibly get the attention of the remote family and make their presence on the system known to the remote family. After the remote family acknowledges the presence of the local family, they continue the activity they were performing and the local family displays activities in their home. Both families can be *sharing similar activities* (e.g. both local and remote families are making dinner) or both families could be *sharing different activities* (e.g. one family is preparing dinner and the other family is cleaning their house).

Once both families acknowledge each other's presence and are both displaying activities in their respective homes, the interaction seamlessly changes between
> (i)   One family watching the other family while performing an activity in their home
> (ii)   One family interacting with the other family while the family being watched continues performing an activity in their home
> (iii) Both families interacting with each other while performing activities in their respective homes.

The families interact using audio (i.e. talking), messaging (i.e. writing back and forth), or by

using both the audio and messaging capabilities of the VMC system.

2b) Playful interactions between families

Playful interactions are a specific type of interaction that is different from sharing everyday activities (e.g. cooking, having a meal etc.). (*Refer to: 2a) Sharing everyday activities and interacting with each other).*

Playful interactions typically take place between children in different households or between children and their remote adult relatives (e.g. grandparents, aunts, uncles). Playful interactions are characterized by (i) the involvement of children and (ii) the playful (i.e. not essential to the everyday life or function of a family e.g. cooking) nature of the interaction.

A child or adult in the local or remote family initiates an interaction.
(*Refer to: Step 1: Noticing the presence of the other family and/or initiating the interaction).*

When the local family is present at the system, they try to visually or audibly get the attention of the remote family and make their presence on the VMC system known to the remote family. After the remote family acknowledges the presence of the local family, they engage in playful interactions in one of two ways:

(i) Both local and remote participants use the messaging capabilities of the system to write playful messages, doodle, draw pictures etc. while looking at each other using the video feed.

(ii) Both local and remote participants use the video and audio capabilities of the system to have playful interactions with each other (e.g. children showing each other their toys and talking about them).

Participants

A) Participants in the local family

1) Primary participants in the local home

- A member of the local family who notices the presence of the remote family and/or initiates interaction with them. The primary participant then proceeds to display activities in their home, watch the remote family and interact with them. The primary participant could retroactively share information about the activities they watched and people they interacted with, with other members of their family.

- There could be more than one primary participant who actively participates in this pattern. For instance:
    - The person who notices the presence of the remote family and/or initiates interaction with them could invite other members of their family to watch the remote family and interact with them.

2) Secondary participants in the local home

- One or more members of the local family who are present near the system during the interaction and are being watched by the remote family but do not actively interact with the remote family. They could become primary participants if they decide to interact with the remote family and watch activities in the remote home.
- Secondary participants could also be members of the local family who learn about the interaction from the primary participant(s). Secondary participants are optional.

3) Nonparticipants in the local home

- One or more members of the local family who are present in the local home but show no interest or have no desire to participate in the interaction or to gain awareness about the remote family. Nonparticipants also typically do not want to be seen by the remote family through the system. They may distance themselves from the system during the interaction. Non-participants are optional.

B) Participants in the remote family

1) Primary participants in the remote home

- A member of the remote family who initiates interaction with the local family by providing awareness information, scheduling interactions or displaying everyday life in their home. The primary participant also interacts with the local family once the local family is present at the VMC system. The primary participant could retroactively share information about their interaction with the local family, with other members of their family.

- There could be more than one primary participant who actively participates in this pattern. For instance:
  - One member of the remote family could ask another member of their family to schedule an interaction with the local family on their behalf.
  - Other members of the remote family could also interact with the local family while the local family is watching them.

2) Secondary participants in the remote home

- One or more members of the remote family who are present near the VMC system during the interaction and are being watched by the local family but do not actively interact with the local family. They could become primary participants if they decide to interact with the local family.
- Secondary participants could also be members of the remote family who learn about the interaction from the primary participant(s). Secondary participants are optional.

3) Nonparticipants in the remote home

- One or more members of the remote family who are present in the remote home but show no interest or have no desire to interact with or to be seen by the local family through the system. They may distance themselves from the system during this interaction. Non-participants are optional.

Outcomes

1) Primary participants in the local and remote homes

- Sharing activities and interacting with each other could lead to the primary participants gaining awareness and learning more about the each other's lives. This could lead to them feeling more connected to each other and having more communication.

2) Secondary participants in the local and remote homes

- Secondary participants could have the same outcomes from this pattern as the primary participants. However if the secondary participants are not closely connected to the family that is watching them or if they are not interested in learning more about that family, this pattern could lead to them learning more about the other family than they want to.

3) Nonparticipants in the local and remote homes

- Nonparticipants are typically not closely connected with the family that is watching them. This pattern could lead to them avoiding the space where the system is placed and/or the space in which the primary participants are interacting with the other home.

Applicability in Video Mediated Communication Systems

This pattern can be found in:
1) Dyadic media spaces with video capabilities (e.g. Family Window).
2) Multifamily media spaces with video capabilities (e.g. Family Portals).

This pattern can also be found in the following system **if** the *video connection has been initiated* and is *left on for an extended period of time* at *both the local and remote home(s).*
1) Video communication systems (e.g. Skype).

Related patterns

This pattern is a consequence of one or more of the following patterns:
Pattern 1: Providing awareness to the remote family
Pattern 2: Gaining awareness about the remote family
Pattern 3: Initiating impromptu interactions with the remote family
Pattern 4: Scheduling interactions with the remote family
Pattern 5: Displaying everyday life to the remote family
Pattern 6: Watching activities in the remote home

This pattern could lead to the following patterns:
Pattern 6: Watching activities in the remote home
Pattern 7: Participating in activities in the remote home
Pattern 9: Focused communication between local and remote families

Pattern 8: Local and remote families simultaneously sharing activities with each other

Sharing information

This subgroup contains the following two patterns:

Pattern 9: Focused communication between local and remote families

Pattern 10: Intermittent communication between local and remote families

Pattern 9: Focused communication between local and remote families

Purpose

For the local and remote families to engage in communication with each other with the intention of sharing information and feeling connected with each other.

Interactions

This pattern typically happens using the video component and audio and/or messaging capabilities of a VMC system. Focused communication involves families sharing and gaining information from each other for example, through a conversation. Both families are focused on the primary activity of *sharing information* by communicating with each other. This pattern differs from ***Pattern 8: Local and remote families simultaneously sharing activities with each other*** in which families are focused on *sharing activities* and communication is a

secondary activity. Sharing information is the focus of this pattern as opposed to sharing activities.

Focused communication between families is typically a synchronous interaction and is reciprocal. It is a synchronous interaction because both families are aware about each other's presence on the VMC system and both families are communicating with each other (e.g. by talking). It is also a reciprocal interaction because both families are actively *sharing information* with each other.

This pattern happens in two steps. First, either the local or remote family notices the presence of the other family and/or initiates interaction. Second, both the local and remote families watch activities in each other's homes while interacting with each other using video and messaging or using video and audio.

Step 1: Noticing the presence of the other family and/or initiating the interaction

A) Local family initiating interaction

1a) Impromptu interactions with the remote family

A member of the local family involuntarily or deliberately looks at the video feed and sees someone or some activity in the remote home. They then try to visually or audibly get the attention of the remote family member to initiate interaction.

(Refer to: Pattern 2: Gaining awareness about the remote family)
(Refer to: Pattern 3: Initiating impromptu interactions with the remote family)

1b) Scheduling interactions with the remote family

A member of the local family schedules an interaction with the remote family by exchanging messages using the VMC system or other technology (e.g. email, phone, text message). The local family is present at the VMC system at the scheduled time and initiates interaction with the remote family by visually or audibly getting their attention.

(Refer to: Pattern 4: Scheduling interactions with the remote family)

1c) Watching activities in the remote home

A member of the local family involuntarily or deliberately looks at the video feed and sees some activity in the remote home. They then proceed to watch activities in the remote home for a certain amount of time (e.g. 1 minute, 5 minutes, 15 minutes) before making their presence known to the remote family and initiating interaction. Alternatively, they could make their presence known to the remote family and initiate interaction as soon as they see someone or some activity in the remote home.

(Refer to: Pattern 2: Gaining awareness about the remote family)
(Refer to: Pattern 6: Watching activities in the remote home)

B) Remote family initiating interaction

1d) Providing awareness to the local family

A member of the remote family provides information to the local family about their life (e.g. "We are going to open birthday presents tonight") and their availability (e.g. "Will be home to cook dinner at 6pm").

Depending on their availability and interest in the remote family's life, the local family may or may not be present at the VMC system at the specified time. If they are present, they initiate interaction with the remote family.

(Refer to: **Pattern 1: Providing awareness to the remote family***)*

1e) Scheduling interactions with the local family

A member of the remote family schedules an interaction with the local family by exchanging messages using the VMC system or other technology (e.g. email, phone, text message). Example, "Let's talk tonight at 7pm." The local family is present at the system at the scheduled time and initiates interaction with the remote family.

(Refer to: **Pattern 4: Scheduling interactions with the remote family***)*

Step 2: Engaging in focused communication

The local or remote family initiates an interaction.
(Refer to: Step 1: Noticing the presence of the other family and/or initiating the interaction).

When the local family is present at the VMC system, they try to visually or audibly get the attention of the remote family and make their presence on the VMC system known to the remote family. After the remote family acknowledges the presence of the local family, both families proceed to communicate with each other. Families can communicate in one of two ways:

(i) Communicate using audio in the VMC system while seeing each other using the video feed.
(ii) Communicate using the messaging feature in the VMC system while seeing each other using the video feed.

Participants

A) Participants in the local family

1) Primary participants in the local home

- A member of the local family who notices the presence of the remote family and/or initiates interaction with them. The primary participant then proceeds to communicate with the remote family using audio and video or using messaging and video. The primary participant could retroactively share information about their conversation with the remote family, with other members of their family.

- There could be more than one primary participant who actively participates in this pattern. For instance:
  - o The person who notices the presence of the remote family and/or initiates interaction with them could invite other members of their family to participate in their communication, with the remote family.

2) Secondary participants in the local home

- One or more members of the local family who are present near the VMC system during the interaction but do not actively interact with the remote family. They could become primary participants if they decide to join the primary participants in communicating with the remote family.
- Secondary participants could also be members of the local family who learn about the interaction from the primary participant(s). Secondary participants are optional.

3) Nonparticipants in the local home

- One or more members of the local family who are present in the local home but show no interest or have no desire to communicate with the remote family. They may distance themselves from the VMC system during the interaction. Non-participants are optional.

B) Participants in the remote family

1) Primary participants in the remote home

- A member of the remote family who initiates interaction with the local family by providing awareness information, scheduling interactions or displaying everyday life in their home. The primary participant also communicates with the local family once the local family is present at the VMC system. The primary participant could retroactively share information about their interaction with the local family, with other members of their family.

- There could be more than one primary participant who actively participates in this pattern. For instance:
  - o One member of the remote family could ask another member of their family to schedule an interaction with the local family on their behalf.
  - o Other members of the remote family could also join the person who initiates the interaction and communicate with the local family.

2) Secondary participants in the remote home

- One or more members of the remote family who are present near the system during the interaction but do not actively interact with the local family. They could become primary participants if they decide to join the primary participants in communicating with the local family.
- Secondary participants could also be members of the remote family who learn about the interaction from the primary participant(s). Secondary participants are optional.

3) Nonparticipants in the remote home

- One or more members of the remote family who are present in the remote home but show no interest or have no desire to communicate with the local family through the system. They may distance themselves from the system during this interaction. Nonparticipants are optional.

Outcomes

1) Primary participants in the local and remote homes

- Communicating with each other could lead to the primary participants gaining awareness and learning more about the each other's lives. This could lead to them feeling more connected to each other.

2) Secondary participants in the local and remote homes

- Secondary participants could have the same outcomes from this pattern as the primary participants. However if the secondary participants are not closely connected to the other family or if they are not interested in learning more about that family, this pattern could lead to them learning more about the other family than they want to.

3) Nonparticipants in the local and remote homes

- Nonparticipants are typically not closely connected with the other family. This pattern could lead to them avoiding the space where the VMC system is placed and/or the space in which the primary participants are interacting with the other home.

Applicability in Video Mediated Communication Systems

This pattern can be found in:
1) Dyadic media spaces with video capabilities (e.g. Family Window).

2) Multifamily media spaces with video capabilities (e.g. Family Portals).

This pattern can also be found in the following system **if** the *video connection has been initiated* and is *left on for an extended period of time* at *both the local and remote home(s)*.
1) Video communication systems (e.g. Skype).

Related patterns

This pattern is a consequence of one or more of the following patterns:
Pattern 1: Providing awareness to the remote family
Pattern 2: Gaining awareness about the remote family
Pattern 3: Initiating impromptu interactions with the remote family
Pattern 4: Scheduling interactions with the remote family
Pattern 5: Displaying everyday life to the remote family
Pattern 6: Watching activities in the remote home
Pattern 7: Participating in activities in the remote home
Pattern 8: Local and remote families simultaneously sharing activities with each other

This pattern could lead to the following patterns:
Pattern 5: Displaying everyday life to the remote family
Pattern 6: Watching activities in the remote home
Pattern 7: Participating in activities in the remote home
Pattern 8: Local and remote families simultaneously sharing activities with each other

Pattern 9: Focused communication between local and remote families

Pattern 10: Intermittent communication between local and remote families

Purpose

For the local and remote families to engage in intermittent communication with each other that is spread out during an extended period of time (e.g. a few hours, one day). Their intention is to share information and feel connected with each other.

Interactions

Intermittent communication involves families sharing and gaining information from each other throughout an extended period of time. This pattern differs from *Pattern 9: Focused communication between local and remote families* in which families are communicating

during a specific period of time when both families are available and willing to interact. This pattern could happen in conjunction with *Pattern 1: Providing awareness to the remote family* and *Pattern 2: Gaining awareness about the remote family.*

Intermittent communication between families is typically an asynchronous interaction and is not necessarily reciprocal. It is an asynchronous interaction because both families are not present at the VMC system at the same time and families respond to each other's messages when they are able to during different times in an extended period of time. It is not necessarily a reciprocal interaction because one family may leave a message for the other and the other family may read the message without responding or without sharing information about themselves and their life. If the other family reciprocates by sharing information about themselves and their life, it becomes a reciprocal interaction.

This pattern typically happens using the messaging capabilities of a VMC system. A member of the local family leaves a message for the remote family using the system. They could leave a message for one or more of the following reasons:

(i) They want to share information about their family's location, activity, status and/or availability. (*Refer to: Pattern 1: Providing awareness to the remote family*)
(ii) They involuntarily or deliberately look at the video feed in the remote home, notice something of interest and leave a message about it (e.g. "Saw your dog pacing around the kitchen").
(iii) They want to share information (not necessarily about themselves) that will be of interest to the remote family (e.g. "Blueberries for $1 at the farmer's market").
(iv) They want to ask the remote family a question (e.g. "Do you have a recipe for cherry pie?).
(v) They want to leave playful messages for the remote family (e.g. drawings, greetings, jokes).

When the remote family reads the message, they might do one of the following:

(i) They might respond to the message to acknowledge that they read/received it.
(ii) They might respond to the message with a follow up question or comment that leads to a response from the local family. This could lead to more back and forth messaging between families.
(iii) They might read the message and not respond to it. They could acknowledge the message in a future interaction by referencing it or discussing it.

Depending on features provided in the VMC system and the number of families the local family is connected to using the system, they could have:
(i) Intermittent communication with all families they are connected to (e.g. "Good morning everyone!").
(ii) Intermittent communication with one of the families they are connected to (e.g. "Marcy, guess who I saw today?").

Participants

A) Participants in the local family

1) Primary participants in the local home

- A member of the local family who leaves a message for the remote family and/or responds to follow up messages from the remote family. The primary participant could retroactively share information about their communication with the remote family, with other members of their family.

- There could be more than one primary participant who actively participates in this pattern. For instance:
    o One member of the local family could ask another member of their family to leave a message for the remote family on their behalf.

2) Secondary participants in the local home

- One or more members of the local family who are informed by the primary participant(s) about their communication with the remote family. Secondary participants are optional.
- Secondary participants could also be the following:
    o Members of the local family who respond to follow up messages by the remote family.
    o Members of the local family who notify the primary participants if there is a follow up message from the remote family.

3) Nonparticipants in the local home

- One or more members of the local family who are present in the local home but show no interest or have no desire to communicate with the remote family through the VMC system. Non-participants are optional.

B) Participants in the remote family

1) Primary participants in the remote home

- A member of the remote family who responds to messages by the local family. The primary participant could retroactively share information about their communication with the local family, with other members of their family.

- There could be more than one primary participant who actively participates in this pattern. For instance:
    o One member of the remote family could respond to messages left by the local family for a specific member of their family when that family member is

not available.

2) Secondary participants in the remote home

- One or more members of the remote family who are informed by the primary participant(s) about their communication with the local family. Secondary participants are optional.
- Secondary participants could also be the following:
    - Members of the remote family who notify the primary participants if there is a message from the local family.

3) Nonparticipants in the remote home

- One or more members of the remote family who are present in the remote home but show no interest or have no desire to communicate with the local family through the system. Non-participants are optional.

Outcomes

1) Primary participants in the local and remote homes

- Communicating with each other could lead to the primary participants gaining awareness and learning more about the each other's lives. This could lead to them feeling more connected to each other.

2) Secondary participants in the local and remote homes

- Secondary participants could have the same outcomes from this pattern as the primary participants. However if the secondary participants are not closely connected to the other family or if they are not interested in learning more about that family, this pattern could lead to them learning more about the other family than they want to.

3) Nonparticipants in the local and remote homes

- Nonparticipants are typically not closely connected with the other family. This pattern could lead to them avoiding the space where the VMC system is placed.

Applicability in Video Mediated Communication Systems

This pattern can be found in:
1) Dyadic media spaces with video and messaging capabilities (e.g. Family Window).
2) Multifamily media spaces with video and messaging capabilities (e.g. Family Portals).
3) Video communication systems with messaging capabilities (e.g. Skype).

Related patterns

This pattern could happen in conjunction with the following patterns:
Pattern 1: Providing awareness to the remote family
Pattern 2: Gaining awareness about the remote family
Pattern 4: Scheduling interactions with the remote family

This pattern could lead to the following patterns:
Pattern 1: Providing awareness to the remote family
Pattern 2: Gaining awareness about the remote family
Pattern 3: Initiating impromptu interactions with the remote family
Pattern 4: Scheduling interactions with the remote family
Pattern 6: Watching activities in the remote home
Pattern 7: Participating in activities in the remote home
Pattern 8: Local and remote families simultaneously sharing activities with each other
Pattern 9: Focused communication between local and remote families

Pattern 10: Intermittent communication between local and remote families

6.6.4 Group D) Privacy

This group contains the following pattern:

Pattern 11: Privacy from the remote family

Pattern 11: Privacy from the remote family

Purpose

For the local family to gain privacy (i.e. solitude and/or confidentiality) from the remote family.

Interactions

Gaining privacy from the remote family is a one-sided interaction by the local family. This interaction is typically initiated by members of the local family who are not closely connected to the remote family or who do not want to be seen by the remote family through the VMC system.
(*Refer to: Nonparticipants in Patterns 1-10*)

The local family could want privacy for one of many reasons:

(i) They do not want to be seen by the remote family but want/need to participate in the activity that is being displayed.
(ii) They do not mind displaying activities to the remote family but need solitude at that particular time.
(iii) They have visitors to their home who do not want to be seen by the remote family or who they do not want the remote family to know about.
(iv) They do not want to be interrupted by the remote family.
(v) They do not want the remote family to know about their availability.

The local family can gain privacy (i.e. solitude) from the remote family in the following ways:

a) Point camera away from household activity

A member of the local family deliberately points the camera in or on the VMC system away from household activities that they do not want to display to the remote family. They could point the camera to a different area of the home, point it to a wall or point it to the ceiling.

(*Contrast with:* **𝘗𝘢𝘵𝘵𝘦𝘳𝘯 𝟧: 𝘋𝘪𝘴𝘱𝘭𝘢𝘺𝘪𝘯𝘨 𝘦𝘷𝘦𝘳𝘺𝘥𝘢𝘺 𝘭𝘪𝘧𝘦 𝘵𝘰 𝘵𝘩𝘦 𝘳𝘦𝘮𝘰𝘵𝘦 𝘧𝘢𝘮𝘪𝘭𝘺**)

b) Place object in front of camera

A member of the local family places an object in front of the camera (e.g. a new vase or new furniture). This could be done for playful purposes (e.g. to share a new purchase with the remote family) but the unintentional effect is that the remote family is only able to see the object and not the local family's home or only have a limited view of the local family's home. The local family could also deliberately place an object in front of the camera to gain solitude and/or confidentiality.

(*Contrast with:* **𝘗𝘢𝘵𝘵𝘦𝘳𝘯 𝟧: 𝘋𝘪𝘴𝘱𝘭𝘢𝘺𝘪𝘯𝘨 𝘦𝘷𝘦𝘳𝘺𝘥𝘢𝘺 𝘭𝘪𝘧𝘦 𝘵𝘰 𝘵𝘩𝘦 𝘳𝘦𝘮𝘰𝘵𝘦 𝘧𝘢𝘮𝘪𝘭𝘺**)

c) Turn off camera or VMC system when in the same room

A member of the local family deliberately turns off the camera* on the VMC system or turns off the VMC system when they are in the room the system is placed in. They do this because they want solitude and do not want to be seen by the remote family.

*Depending on the design of the system, turning off the camera might lead to the remote family not being able to see the local family's video feed **but** the local family is still able to see the remote family's video feed.*

Participants

1) Primary participants

- A member of the local family who wants solitude and/or confidentiality and points the camera away from household activity, places an object in front of camera, or turns off the camera/system.

- There could be more than one primary participant who actively participates in this pattern. For instance:
  - One member of the local family could ask another member of their family to point the camera away from household activity, place an object in front of camera, or turn off the camera/system because they need solitude and/or confidentiality.

2) Secondary participants

- One or more members of the local family who are aware of the actions of the primary participants and may or may not agree with them. Secondary participants are optional.

3) Nonparticipants

- One or more members of the local family who do not know about the actions of the primary participants. Non-participants are optional.

Outcomes

1) Primary participants

- This pattern leads to the primary participants gaining solitude and/or confidentiality from the remote family.

- The indirect outcome of this interaction could be questions from the remote family about their inability to see activities or people in the local home (e.g. because the camera is pointed to a wall) which could lead to the primary participants feeling uncomfortable or uneasy.

2) Secondary participants

- Secondary participants could have the same outcomes from this pattern as the primary participants.

3) Nonparticipants

- Nonparticipants could have the same outcomes from this pattern as the primary participants.

Applicability in Video Mediated Communication Systems

This pattern can be found in:
1) Dyadic media spaces with video and messaging capabilities (e.g. Family Window).
2) Multifamily media spaces with video and messaging capabilities (e.g. Family Portals).

This pattern can also be found in the following system **if** the *video connection has been initiated* and is *left on for an extended period of time* at *both the local and remote home(s)*.
1) Video communication systems with messaging capabilities (e.g. Skype).

Related patterns

This pattern is not directly related to any other patterns.

Pattern 11: Privacy from the remote family

Chapter 7

Summary and Conclusions

7.1 Summary of Dissertation

This dissertation explored the *design* of domestic Video Mediated Communication (VMC) systems *based on families' communication and awareness practices*.

The first step in this exploration was to understand *why and how families currently use* VMC systems to communicate and maintain awareness of each others' lives. Since video conferencing is the most prevalent and readily available VMC system, I interviewed 21 participants to learn about their video conferencing practices with non-collocated family and loved ones (Judge and Neustaedter, 2010a). This study was presented in Chapter 3. The study revealed that participants used different technologies (e.g. text messaging, IM) to initiate a video call. They did this because status indicators provided by the video conferencing software did not represent true availability and did not show one's willingness to video chat. Additionally, unlike the workplace, participants did not typically remain logged on to their video conferencing software, and some only turned on their computer for short spans of time, which made it difficult to initiate a call using video conferencing software. Once a video call was initiated, families did not just have conversations with each other but also shared their daily lives. Privacy concerns when using video conferencing were not related to *confidentiality* as participants had little concern over what was seen by the remote family. Privacy was instead more strongly related to *autonomy* and *solitude* where participants chose who could video call them and when they were accessible for video calling.

Findings from this study led to the following design recommendations for domestic VMC systems (Chapter 3) (Judge and Neustaedter, 2010a). First, VMC systems should include mechanisms that allow people to easily deduce other's availability and willingness to video chat. This is important not only for domestic VMC systems but also for systems used in the workplace, because video is generally considered more intrusive than other communication technologies. Second, given that families want to share their lives with each other, VMC systems should enable people to easily share everyday activities as they occur.

Third, domestic VMC systems should have different privacy controls compared to systems used in the workplace. This is because privacy, as it relates to domestic video conferencing, is most concerned with autonomy and solitude—choosing when to connect and with whom—as opposed to confidentiality. This contrasts the use of video media spaces in the workplace where often confidentiality is the primary concern (Boyle, et al., 2009).

These design recommendations were used to design and implement a dyadic domestic media space with always-on video called the Family Window (FW). The design and evaluation of the FW were presented in Chapter 4 (Judge and Neustaedter, 2010b; Judge, et al., 2010; Neustaedter, C., et al., 2010). Two families used the FW for six months and an additional four families used the FW for five weeks. Families' usage of the system included a mix of practices similar to the use of video conferencing systems, for example, to share activities, as well as new practices that were made possible by the always-on video system. The new practices included families creating shared routines between households, unscheduled interactions, as well as watching the video feed for extended periods of time to learn more about their remote families' lives. The always-on video in the FW led to more opportunities for communication between families and a greater awareness of each other's daily lives. This led to families feeling more connected to each other. Although participants were initially concerned about privacy, these concerns were alleviated over time, because they chose to connect to families with whom they had close relationships and they could control what the remote family was able to see in their home.

Observations during the field evaluations and feedback from participants led to additional design recommendations for domestic VMC systems (Chapter 4) (Judge, et al., 2010). The recommendations highlight the important of dedicated displays, mobility, and privacy controlling mechanisms. A dedicated display is key in a domestic media space as it allows the media space to be a communication appliance with one primary function. Mobility of the device is important to enable families to easily share activities in their home. Although families in the study claimed that they did not have privacy concerns, it is still important for a domestic media space to provide mechanisms to control privacy. Families in this study had a close relationship and wanted to share their lives with each other but there might be families who do not want to share their lives using an always-on video system.

Design recommendations from the evaluation of the Family Window were used to design and implement a multifamily media space with always-on video called Family Portals

(FP). The design and evaluation of FP were presented in Chapter 5 (Judge, et al., 2011). During the field evaluation, six families used FP in their homes for eight weeks. The addition of a third family on the system provided participants with more opportunities to interact with their remote families. If one family was not at home or not available for interactions, the other family might be available (in contrast to the FW which only connected two families). Although FP was designed as a multifamily media space, it was mainly used in a dyadic manner. Multifamily interactions were typically scheduled ahead of time. Most of the dyadic and multifamily usage patterns were similar to the use of FW (Chapter 4). These included sharing everyday life and creating shared routines between households. Two new usage patterns were also observed. These were playful interactions between children and grandparents, as well as synchronous messaging between adults in different households. Unlike the usage of the FW, the usage of FP led to privacy concerns about intrusion caused by the always-on system and feelings of discomfort about being watched by the remote families. However these concerns were limited to 4 out of 11 adults. These adults are referred to as non-adopters of the system. For the adopters of FP, usage of the system led to an increase in communication, awareness, and connectedness with the remote families.

These three studies resulted in an understanding of families' communication and awareness practices using three different types of VMC systems – video conferencing systems, dyadic media spaces, and multifamily media spaces. The final part of my research addressed the need for a method to unify and codify these communication and awareness practices to enable them to be effectively used as a design tool to design future domestic VMC systems. Chapter 6 described the creation of Patterns of Practices and a Pattern Language for domestic video mediated communication and awareness practices. 11 Patterns of Practices were created and these patterns describe typical communication and awareness practices that a designer should consider when designing VMC systems or other domestic communication systems. These Patterns of Practices expand Alexander's definition of patterns from only being descriptions of a problem and solution, to patterns that describe users' *practices and behaviors.*

The following section presents conclusions from this research, followed by a discussion about generalizing findings from this research. And finally, I present future research directions and research questions that build on this dissertation.

7.2 Conclusions and Discussion

7.2.1 Families' Domestic VMC Practices

Designing and evaluating VMC systems in the homes of real families has given me the opportunity to gain a deep and unique understanding of families' domestic communication practices and needs.

Families' usage of VMC systems in their homes, more specifically a media space with always-on video, is analogous to inviting the remote family into the home and the remote family perpetually "visiting" or being present in the home. Despite the initial excitement about using the media space due to the novelty of the system, participants[17] did not think that they needed or wanted an always-on media space in their homes. They also did not think that their lives were interesting enough to share with the remote families on a daily basis. Interestingly enough, after the novelty effect had worn off and participants had used the media space for a few weeks, the adopters and primary users of the system could not imagine their lives without the always-on video connection to their remote families' homes. Some participants even expressed a deep sense of loss and sadness when they were no longer able to use the media space after the field evaluation. *What changed in participants' homes and lives after a few weeks of usage?*

The use of a media space in participants' homes allowed the *remote family to have a "presence" in the local family's home.* Remote family members were no longer confined to pictures on the mantel that were glanced at or thought about every now and then. They were present in the local home and their presence was incorporated into the local family's lives and vice versa. The awareness of the remote family's presence led to participants' actively sharing information about their daily lives and sharing everyday activities that took place in their homes. Participants even shared information that was previously thought mundane and not of interest to non-collocated family members (e.g. "We are having chicken for dinner."). Interestingly enough, for participants who were connected to their immediate family (e.g. a wife in a young family who was connected to her parents using the VMC system), the presence of the remote family in their home was considered natural, because all of them lived together in the same household at one point in time. The always-on video feed and

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[17] This discussion is primarily about participants who are adopters of the system.

resulting presence of the remote family was an easy and quick adjustment for these participants, because they were able to easily pick up where they left off (i.e. when they stopped living under the same roof). For adults in participating families who were related to the remote families primarily through marriage (e.g. a husband who was connected to his wife's parents' using the VMC system), it took longer to adjust and to come to terms with their in-laws always being present in their homes. Those who were not able to adjust to the presence of the remote families ended up avoiding being near the system and in extreme cases were hostile and detested the use of the VMC system in their homes[18].

The *remote family's "presence"* in the local family's home created a *new family dynamic* in which remote family members became residents of the homes they were connected to. They were no longer non-collocated family members but were instead active participants in the lives of the families they were connected to using the VMC system. The remote family members had transitioned from being *intimate socials*, people with whom one has a close relationship but does not live (Neustaedter, et al., 2006a), to becoming *home inhabitants*, people with whom one lives (Neustaedter, et al., 2006a). The transition from being intimate socials to home inhabitants led to people having a stronger desire than they initially had to gain and maintain daily awareness about the lives of the families they were connected to. The long-term effects of this new family dynamic on the relationships between collocated and non-collocated family members have yet to be observed. Observing and noting effects on users' relationships with each other will require long-term usage[19] of the VMC systems.

The always-on media space also *reduced tangible and perceived barriers to initiating communication* between non-collocated families by *creating an open channel for communication between homes. Tangible barriers* to initiating interactions are caused by limitations of VMC systems or other domestic communication technologies. For example, video conferencing systems have tangible barriers to initiating interactions, such as the constraint of only providing availability awareness when someone is logged on to the system (Judge and Neustaedter, 2010a). Interestingly enough, there were also *perceived barriers* to initiating interactions. Perceived barriers were primarily due to families not knowing about each

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[18] These participants were referred to as "non-adopters" in previous chapters.

[19] The length of the Family Window and Family Portals field evaluations were significantly longer than field evaluations of comparable domestic communication or awareness system found in HCI literature. Yet, these field evaluations were not long enough to observe the long-term effects of the use of the VMC system on family dynamics.

other's schedules, daily routines, and availability for communication. This prevented them from initiating interaction (e.g. by calling the non-collocated family on the telephone), because they did not want to "disturb" the family, "intrude" on their lives, or they simply assumed that members of the family were "always busy." The media space reduced both tangible and perceived barriers to initiating communication by providing an open channel for communication between households. This channel for communication was considered *less intrusive* than other modes of communication (e.g. telephone) and *readily available* without requiring additional work (i.e. no work is required to initiate the video connection since it is always-on). Participants who hesitated to initiate interactions with non-collocated family members due to perceived barriers, were no longer held back by these perceived concerns since they could easily alleviate these concerns by simply looking at the video feed from the other family's home. By deciding to use the media space and allowing the remote family to be present in their homes, families were reducing both the tangible and perceived barriers by implicitly providing more opportunities for interactions through the open connection between homes.

7.2.2 Patterns as a Design Tool

Designers and practitioners commonly use patterns as a design tool. Design patterns are created to provide a description of a design problem and solutions to that problem. Unlike these design patterns, the Patterns of Practices that are presented in this dissertation are based on *users' practices and behaviors.* More specifically, these patterns describe users' practices and behaviors using VMC systems in their homes. By adapting and modifying the definition of patterns from a design problem and solution, to descriptions of practices and behaviors, the creation of these Patterns of Practices provides designers, researchers, and practitioners with a new way to conceptualize the use of patterns for codifying design knowledge.

These Patterns of Practices are a first step towards the creation of a vocabulary and repository that describes users' practices and behaviors using VMC systems in their homes. Given that the home is considered a private place with its own set of rules, behaviors, and expectations, these Patterns of Practices provide designers with a starting point to demystify the sacred and private notion of the home and to understand domestic video mediated communication practices. By understanding the home as a design space, it allows designers to envision and create the boundaries of the particular design space within the home in

which they will be designing and incorporating VMC systems. The versatility of the pattern language, which allows patterns to be used in a piecemeal fashion, provides designers with the opportunity to apply these patterns to a variety of design spaces and communication technologies in the home.

7.2.3 Design Recommendations

The design recommendations provided in this dissertation place an emphasis on the *meaning of the VMC technology* to families and their *context of use* in the home. These are significantly different from typical design recommendations and design decisions that are based on tasks users can or will perform using a particular system. Consider the following:

> A VMC system designed for the workplace is used to perform tasks associated with work. Like other tools and systems used in the workplace (e.g. copy machine), the system has a particular use and purpose associated with it, for example, to have face-to face meetings with non-collocated colleagues.

> Similarly, a VMC system that is designed for the home initially has a particular use and purpose associated with it. However, over time as the system is integrated into families' lives, the system evolves from solely being an object with a purpose, to having a meaning associated with it. This meaning is typically associated with the context of the systems' usage in the home. For example, a grandmother who uses an always-on media space to connect to her children and grandchildren might consider the system a replacement for the actual presence of her children and grandchildren in her home.

By placing an emphasis on the meaning of the technology to users and their context of use within the home, we are able to design VMC systems and other domestic technologies that are based on users' practices and needs.

7.3 Generalizing and Using Patterns of Practices

The Patterns of Practices presented in this dissertation were created based on users' communication and awareness practices using three different VMC systems. Some of these

patterns describe common practices and behaviors across all three systems, while other patterns describe behaviors that were only observed in one or two of these systems. For example, *Pattern 3: Initiating impromptu interactions with the remote family*, is a practice that was only found in the dyadic and multifamily media space. This pattern was not found in participants' usage of video conferencing systems because an always-on video connection is needed for families to have opportunities for impromptu interactions.

These Patterns of Practices are a starting point for the creation of a comprehensive vocabulary that describes domestic video mediated communication and awareness practices. Although there may be new patterns that emerge from the design and usage of future systems, some of the existing Patterns of Practices will still be applicable when designing future systems. New patterns may also emerge from the use of VMC systems in other demographics and types of families (e.g. couples separated by distance, families with teenagers). I am confident that some of these Patterns of Practices will be applicable to the design of different types of VMC systems and for different user groups, because the patterns describe *behaviors* that are abstracted and applicable across different systems.

7.4 Future Work

The research presented in this dissertation has laid the foundation for future research on the design of domestic communication systems. Although this dissertation has answered many questions, it has also led to more questions. Below are a few research problems build off of this dissertation.

Design and field evaluation of VMC systems with n connections – How should multifamily VMC systems be designed to support *n* (n>3) simultaneous connections? Having more than three families connected simultaneously leads to design challenges that were not explored in this dissertation.

Multiple VMC systems in a home – How should VMC systems be designed to support the use of multiple devices within a single home? Designing multiple VMC systems that are placed in different locations in a home presents new and interesting design challenges and can potentially lead to new Patterns of Practices that add to those described in this dissertation.

VMC systems for different types and size of devices – Both the VMC systems that were designed and evaluated in this dissertation were prototyped on 13" tablet PCs. Designing VMC systems for different types of devices (e.g. mobile phones, televisions) and devices of different sizes (e.g. a wall-sized video display in the home) presents new design challenges and could potentially lead to communication and awareness practices that were not made possible by 13" tablet PCs.

7.5 Design Challenge

I would like to conclude this dissertation by leaving readers with a design challenge. Given the different relationships and communication needs between and within families,

> *How do we design domestic communication technologies based on its meaning and context*
> *of use to accommodate different communication needs within and between families?*

I hope that this design challenge seeds discourse in the design and research community and leads to the design of future domestic communication systems that are based on and add to the repository of Patterns of Practices.

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Appendix A: Video Conferencing Study

Start recording

Participant: _____

Pre-Study Family Information

We will begin by asking you some questions about your family to help us understand your household. We define household to mean any children and adults you live with. For example, a spouse, partner, roommates, kids, or parents should all be included.

1. How many people live in your household including yourself? If you share custody of any children, please include them.

    _____

2. How many people in your household fall in these age categories (including yourself)?

	Number of people (e.g. 0, 1, 2..)
Toddler(s) age 0-2	
Kid(s) age 3-8	
Youth(s) age 9-11	
Adolescent(s) age 12-17	
Adult(s) age 18-30	
Adult(s) age 31-45	
Adult(s) age 46-60	
Adult(s) age over 60	

3. What is your family status?
a) Single
b) Couple (married, domestic partner, etc)
c) Prefer not to specify

4. Can you tell me about your extended family? (i.e. how many siblings, where they live, parents, in laws)

Experience Using Video Conferencing Systems

We would now like to ask you about your experience using video conferencing tools to communicate with your extended family and friends.

1. Which video conferencing tools do you use? (e.g. Skype, Google Talk or Windows Live Messenger)

2. What do you like about it best? What do you dislike about it most?

3. How long have you been using video conferencing?

4. Why did you start using video conferencing? (why did you stop, if you don't anymore?)

5. What type of computer do you use for video conferencing? Can you please show it to me?

6. Why is the computer located here? Do you feel it is an ideal location for video conferencing?

7. Who do you communicate with using video conferencing? Why do you use video conferencing with these people as opposed to other technologies?

8. How often do you communicate using video conferencing? Why do you use it at this frequency?

9. Why do you use video conferencing systems with these people?

10. Where do you usually communicate from?

11. Who usually initiates communication? How is it done?

12. Do you usually have a set time that you communicate or is it impromptu?

13. Do you have to turn on your computer each time you use video conferencing or is your computer always on?

14. Each time you have a conversation, how long do you talk to them for?

15. When you talk to them, what do you talk about? What information do you share? (e.g., activities, health, relationships)

16. Have you ever left the video conferencing tool on even after a conversation was over? Why?

17. (if using laptop) Do you always set your laptop/use your laptop in the same place every time you have a conversation?

18. When video conferencing, how many members of the distant family do you talk to at one time?

19. When video conferencing, how many members of your family are present at one time?

20. Do you multi-task on your laptop/desktop while video conferencing?

21. Do you perform tasks around your home while video conferencing?

22. How does video conferencing compare to having a conversation face to face?

23. What do you like about using video conferencing to communicate with your extended family and friends? What do you dislike?

24. Have you faced any challenges using video conferencing to communicate?

25. Do you have any privacy concerns about using video conferencing tools?

Relationship with remote person/people

[SPOUSE]	Husband and/or wife
[CHILD]	Son and/or daughter, might be an adult child or a dependent
[PARENT]	Mother and/or father
[SIBLING]	Brother and/or sister
[PARENT-IN-LAW]	Mother-in-law and/or father-in-law
[RELATIVE-IN-LAW]	Son-in-law and/or daughter-in-law
[GRANDPARENT]	Grandmother and/or grandfather
[GRANDCHILD]	Grandson and/or granddaughter
[FRIEND]	Friend
[EX-SPOUSE]	Ex-husband or ex-wife

Table 1: Analysis codes for relationships between family members who video chat with each other.

Scheduling a video call

[SET TIME]	Weekly set time
[AFTER NAP]	After children's nap
[CHILDREN HOME]	After children are back home (from school, sports etc.)
[AFTER MEAL]	After a family meal
[DURING MEAL]	During a family meal
[DURING PLAY TIME]	During children's play time
[KNOW AVAILABILITY]	When know the remote person is available
[LOGGED ON]	When remote person is logged on to video chat

Table 2: Analysis codes for scheduling a video call.

Initiating a video call

[CHAT]	Chat first to determine availability
[PHONE]	Phone first to determine availability
[EMAIL]	Email first to determine availability
[TEXT]	Text to indicate availability
[LOG ON]	Log on to video chat to indicate availability
[DIRECT]	Log on and video call the remote person
[WAIT]	Log on to video chat and wait for remote person to call

Table 3: Analysis codes for initiating a video call.

Indicating and gathering availability information

[LOG ON]	Log on to video chat to indicate availability
[CHAT]	Chat first to determine availability
[PHONE]	Phone call first to determine availability
[EMAIL]	Email first to determine availability
[TEXT]	Text to indicate availability
[SCHEDULE]	Know the remote person's schedule and availability
[BUDDY LIST]	Gather availability information from remote person's buddy list

Table 4: Analysis codes for indicating and gathering availability information.

Sharing conversation

[SEE PERSON]	See other person while talking
[SHOW OBJECT]	Show objects of interest (i.e. related to the conversation)
[SHOW PLACE]	Show the surrounding place/area
[SEE OBJECT]	See objects of interest (i.e. related to the conversation)
[SEE PLACE]	See the surrounding place/area
[CONVERSE]	Have conversation between adults
[CONNECTED]	To feel connected
[AWARENESS]	To gain awareness
[WELL BEING]	To gather information about each other's well being

Table 5: Analysis codes for sharing conversation.

Sharing life

[GRANDCHILDREN]	Revolves around grandchildren
[LIMITED CONVERSATION]	Limited conversation between adults, conversation is secondary
[ALWAYS-ON]	Use always-on video
[WATCH LIFE]	Watch daily activities
[SHARE LIFE]	Share daily activities
[WATCH GRANDCHILDREN]	Watch grandchildren play
[INTERACT GRANDCHILDREN]	Interact with grandchildren
[WATCH MEAL TIME]	Watch family during meal time
[READ STORIES]	Read stories to grandchildren
[BABYSIT]	Babysit grandchildren
[WATCH BEDTIME]	Watch grandchildren's bedtime routines
[SEE HOME]	See home one grew up in
[WELL BEING]	To gather information about each other's well being
[PEACE OF MIND]	Get peace of mind
[CONNECTED]	To feel connected

[AWARENESS]	To gain awareness
[KNOW GRANDPARENTS]	Grandchildren see and know grandparents

Table 6: Analysis codes for sharing life.

Mobility vs. lack of mobility

[CONFINED]	Confined to one location
[FOLLOW CHILDREN]	Follow children with laptop
[ROTATE LAPTOP]	Rotate laptop to focus on children
[PLACE WEBCAM]	Place webcam over children's play area
[SHARE ACTIVITY]	Easy to share activity around the house
[MULTITASK]	Easily multitask around the house while video chatting
[CANNOT MULTITASK]	Cannot multitask around the house while video chatting
[MORE ATTENTION]	Requires more attention

Table 7: Analysis codes for mobility and lack of mobility.

Privacy

[WHEN TO INITIATE]	Choose when to initiate call
[WHEN TO RECEIVE]	Choose when to receive call
[WHO TO CONNECT]	Choose who to connect with
[WHO TO RECEIVE]	Choose whose call to receive
[WHAT IS SHOWN]	Determine what remote person is seeing
[WHO IS SEEN]	Control who remote person is seeing
[WHEN TO LOG ON]	Choose when to log on to video conferencing tool
[BUDDY LIST]	Control who is on the buddy list
[VOYEURISM]	Video voyeurism

Table 8: Analysis codes for privacy.

Appendix B: Family Window Study

Appendix BA: Family Window Study Recruitment Email

Usage of a Futuristic Video Conferencing System (pays $200)

We have designed a futuristic video conferencing tool that tries to connect families who are separated by distance, e.g., grandparents and children/grandchildren, siblings, etc. We are looking for several families to use the video conferencing-like system for a period of roughly six weeks where they will connect between their home and that of a remote family. We will interview each family on a weekly basis about their reactions to the system.

In order to participate, you need to have a remote family household (e.g., grandparents or grandkids/children) who would also be interested in participating and connecting to your house. Both homes also need to have DSL/Cable Internet access.

This protocol will be used during the first meeting with each participant family to inform participants about the study.

Thank them for agreeing to participate in this study

Introduce yourself.

- My name is Tejinder Judge, and I will be outlining the study for you and answering any questions that you may have.

- We are researching futuristic video conferencing systems for families as part of our work at Kodak Research Labs.

  Tell them about the experiment.

- In this study, you will be asked to use a futuristic video conferencing system called Family Window as your primary video conferencing tool. Family Window is an early design of a futuristic video conferencing system that is an always-on display. It is a futuristic digital frame where instead of seeing pictures you see a video into the family's homes. Family Window will be running on a Tablet PC that we will be supplying you with for the duration of the study. We are interested in knowing how it fits into your current communication with distant family members and where it does not fit so well. Based on your feedback, our goal is to improve Family Window and also find implications for video conferencing systems for families in general. There more you tell us positive or negative things about Family Window, the more we will learn from this experience.

- The study has three main stages that your family will participate in:

1. We will start by interviewing you about your family's current communication with extended family members. Here we would like you to describe to us how connected you feel to your family members and how you stay aware of their activities. We will then ask you about your current communication pattern with the family you have chosen to use Family Window with. Finally we will ask you about your experience with video conferencing technologies. If you currently use a video conferencing technology, we ask that you show us the computer you use this technology with and describe how your family uses it. If it is fine with you, we'd like to take pictures of the computer you use in its normal location.

2. Next we will introduce you to the futuristic video conferencing system called Family Window. We'll show you how it works and will help you set it up. We would like you and your family to pick a location for it and feel free to move it around during the study. We will leave the Family Window in your home for the duration of the

study and collect information from you about your use with it using a number of techniques:

- o We will give you a family diary where we'd like each of you to write down any thoughts you may have about using Family Window, your video conferencing activities and any issues or problems you have with the Family Window. The more you write the more we will be able to understand how Family Window is fitting in, or not fitting in with your lifestyle.

- o Family Window will also be keeping track of each time you turn it on/off and each time you use a certain feature. This will help us determine which features are useful and which are not.

- o We will come by for an initial visit with you in a week to see how things are going with Family Window. After that point, we will call or email you to discuss the week's activities, and to go over your entries in the journal. Please feel free to use the journal to record experiences that you would like to share with us.

- o If you should experience any technical problems during the study, please do not hesitate to email or call me. I will be available for you on an "on-call" basis. This is a research prototype so there might be some bugs and errors in it.

3. At the end of 5 weeks, we will come back to your house and interview you about the entire deployment to gather feedback from you about Family Window. We would like to gather your thoughts as you reflect on your experience in using a Family Window as your primary video conferencing tool. We will be back a week after that to reflect on changes to your family's communication pattern with the distant family without Family Window being in your home. As you were told, you will be paid $200 and we will give you 4 $50 gift cards, one after each interview.

- Do you have any questions about the study and the different stages?

Tell the participant that it's OK to quit at any time.

- If your family experiences any discomforts during the course of the study or you feel you do not want to continue for any reason, you are free to quit at any time without any repercussions.

Go over consent form with them

- Image and Voice Consent – All images and voice recordings can be used by Kodak however we will not be capturing, viewing or recording any video transmitted using the Family Window.

- Waiver and Consent – You will not disclose information about Kodak or any of the products you learn about in this study. You give Kodak permission to use information and ideas collected from you during this study. Your permission will be asked before we take any images or voice recordings and your name will not be associated with it. You are not obligated to complete the user study.

Give them the consent form to sign. Give each person two copies of each form, one for them and one for us. If it is not signed, do not proceed. Give them the gift card.

Proceed with interview.

Ask participants if it is okay to photograph the computer the use for video conferencing.

Setup Family Window in the home location of their choosing.

Describe features in Family Window

- FW icon on desktop, how to launch it
- One touch on and off
- Who is connected to FW, how to know when video is no longer running
- Inking
- Activity timeline
- Knocking
- Slides

Thank them and ask them if they would like to schedule the next interview in a week.

Start recording

Participant:

Pre-Study Family Information

We will begin by asking you some questions about your family to help us understand your household. We define household to mean any children and adults you live with. For example, a spouse, partner, roommates, kids, parents or au pair should all be included. If you are uncomfortable answering questions, please skip them.

1. How many people live in your household including yourself? If you share custody of any children, please include them.

2. How many people in your household fall in these age categories (including yourself)?

	Number of people (e.g. 0, 1, 2..)
Toddler(s) age 0-2	
Kid(s) age 3-8	
Youth(s) age 9-11	
Adolescent(s) age 12-17	
Adult(s) age 18-30	
Adult(s) age 31-45	
Adult(s) age 46-60	
Adult(s) age over 60	

3. What is your family status?
d) Single
e) Couple (married, domestic partner, etc)
f) Prefer not to specify

Current Pattern of Communication

We would now like to talk to you about your extended family where an extended family member is defined as any immediate family member or relative (including in-laws) who does not live in the same household as you. For example, a mother-in-law, an uncle, a daughter, or a brother who does not live in your household would be considered an extended family member.

1. Can you tell me about your extended family? (i.e. how many siblings, where they live, parents, in laws)

Communication with FW-family

We will now shift gears and talk to you about the family you will be communicating with using Family Window.

1. Who will you communicate with using Family Window?

2. How often do you communicate with them now? Why?

3. Has this changed at all in the recent or distant past? (e.g., moving, death in the family, marriage, having children, etc) Why?

4. Currently, how do you communicate with your distant family? (e.g. telephone, email, video conferencing) Why did you choose this method?

5. Have you faced any challenges using said technology to communicate with your distant family?

6. What do you like about using said technology to communicate with your distant family?

7. Where do you usually communicate from?

8. Who usually initiates communication? How is it done?

9. How long do you talk to them for?

10. When you talk with them, what do you talk about? What information do you share? (e.g., activities, health, relationships)

11. How often do you meet them in person?

Obligation to FW-family

1. How obligated do you feel to communicate with them?

2. How important is it for you to keep them informed about important events in your life? What would you define as an important event?

3. How important is it for you to be informed about important events in their life?

4. Does communicating with them make you feel involved in their lives?

5. If they contact you, do you feel that you should respond? Eg. Do you feel you have to answer their call?

1. How connected do you feel to them?

2. How aware are you about their life (e.g. activities, health, relationships)?

3. Think about the last time you communicated with them. Can you walk me through what happened starting with when and why you decided to communicate? Who initiated? What did you talk about? How long? How did it end? Where were you?

Experience Using Video Conferencing Systems

We would now like to ask you about your experience using video conferencing tools to communicate with your extended family.

1. (if video conferencing is not mentioned above) Have you used video conferencing to communicate with your distant family? What tools do you use? (e.g. Skype, Google Talk or Windows Live Messenger)

2. How long have you been using video conferencing?

3. What type of computer do you use for video conferencing? Can you please show it to me?

4. (if video conferencing is not mentioned above) Who do you communicate with using video conferencing?

5. How often do you communicate using video conferencing?

6. Why do you use video conferencing systems?

7. Have you ever left the video conferencing tool on even after a conversation was over? Why?

8. (if using laptop) Do you always set your laptop/use your laptop in the same place every time you have a conversation?

9. Do you feel the need to tidy up the area you will be talking in, before having a conversation?

10. When video conferencing, how many members of the distant family do you talk to at one time?

11. When video conferencing, how many members of your family are present at one time?

12. Do you multi-task on your laptop/desktop while video conferencing?

13. Do you perform tasks around your home while video conferencing?

14. How does video conferencing compare to having a conversation face to face?

15. (if video conferencing is not mentioned above) What do you like about using video conferencing to communicate with your extended family?

16. (if video conferencing is not mentioned above) Have you faced any challenges using video conferencing to communicate?

17. Do you have any privacy concerns about using video conferencing tools?

18. Think about the last time you communicated with them. Can you walk me through what happened starting with when and why you decided to communicate? Who initiated? What did you talk about? How long? How did it end? Where were you?

Weekly schedule

1. What are your work hours?

2. When are you at home?

3. When are you out for social activities?

4. When are you home on weekends?

5. Will you be going on vacation during the next 5 weeks?

Participant: _____

Experience using Family Window

We would like to start by learning about how your family used the Family Window in this last week.

<u>General questions</u>

1. Did you and your family use Family Window?

2. How often do you turn it on?

3. How often do you communicate using Family Window in a day? In a week?

4. How do you use it? (E.g stand in front of it and wave at distant family member)

5. What is your overall impression of the Family Window?

6. What do you like about the Family Window?

7. What don't you like about the Family Window?

<u>Placement of Family Window</u>

1. Where did you place the Family Window?

2. Why did you decide to place it there?

3. Did you move the Family Window around until you decided on that position?

4. Do you think there is a better position that you can place the Family Window? If yes, why didn't you place it there?

5. What can the remote family see from the current placement of the Family Window?

6. Did the remote family ask you to place the Family Window in any specific place?

7. Did the remote family provide feedback about the position of your Family Window? (i.e. did they say that they liked or did not like the view they are getting from the Family Window?)

8. Where did the remote family place the Family Window in their home?

9. Which part of their home can you see through the Family Window?

10. Are you happy with the placement of their Family Window? If no, why not? What do you think will be a better place for them to set their Family Window?

Awareness, connectedness and peace of mind

1. What activities have you and your family observed in the remote home? How comfortable were you observing these activities?

2. How connected do you feel to your distant family since you started using the Family Window?

3. Is there anything in particular that you saw in the distant family's home that made you feel more connected to them?

4. How aware are you about the life and daily on goings of your distant family since you started using the Family Window?

5. Is there anything in particular that you saw in the distant family's home that helped increase your awareness of their life?

Disconnected/Away

(If families are disconnected (due to technical failure or just being away) for a few hours/days)

1. When were you disconnected/away from the Family Window? How long did this last?

2. How did you feel when you were unable to see your distant family?

3. Did you feel disconnected?

4. Did you communicate in any other way?

Privacy, camera and blinds

1. How do you and your family feel about having video broadcasted from your home using the Family Window?

2. Did you ever move the camera to a different position to get more privacy? Why?

3. Did you ever turn off the Family Window to get some privacy? Why?

4. Did you ever blur the video? Why?

5. Did you use the blinds?

6. Which type of blinds did you use? Why?

7. When did you use it?

8. How did you use it?

9. Why did you use it?

10. What is your opinion about the blinds? Does it help you and your family have some privacy?

<u>Using the Family Window when there are visitors</u>

1. Have you had any visitors since you started using the Family Window?

2. Did you tell your visitors about the Family Window?

3. How did they feel about the distant family watching them?

4. If there are visitors to the distant family's home, how would you feel about them watching you?

Experience using specific features in the Family Window

We will now ask you questions about specific features in the Family Window to learn about how you used these features and what you liked or did not like about them.

<u>Knocking</u>

1. Did you use the knocking feature?

2. When did you use it?

3. How did you use it?

4. Why did you use it?

5. Who used the inking feature most often?

6. Was the knocking feature easy to use?

<u>Inking</u>

1. Did you use the inking feature?

2. What did you write?

3. When did you use it?

4. How did you use it?

5. Why did you use it?

6. Who used the inking feature most often?

7. Was the inking feature easy to use?

<u>Activity Timeline</u>

1. Did you use the activity timeline?

2. When did you use it?

3. How did you use it?

4. Why did you use it?

5. Was the activity timeline easy to use?

6. Did it help you predict when your distant family will be around the Family Window?

7. Did it help you feel more connected to your distant family or increase your awareness of their daily life?

<u>Using the Family Window on a laptop or desktop and task switching</u>

(Only for families that did use it on their laptop/desktop)

1. How did you use Family Window when you were doing work on your laptop/desktop?

   (e.g. surfing the Internet) Did you turn it off or just minimize it?

2. Would you prefer having a laptop or any device that you can use solely for the Family

   Window?

Relationship with remote person/people

[CHILD]	Son and/or daughter, might be an adult child or a dependent
[PARENT]	Mother and/or father
[SIBLING]	Brother and/or sister
[PARENT-IN-LAW]	Mother-in-law and/or father-in-law
[RELATIVE-IN-LAW]	Son-in-law and/or daughter-in-law, brother-in-law and/or sister-in-law
[GRANDPARENT]	Grandmother and/or grandfather
[GRANDCHILD]	Grandson and/or granddaughter

Table 1: Analysis codes for relationships between members of families who used the Family Window.

Availability awareness and willingness to communicate

[CHECK FOR AVAILABILITY]	Check video for availability before making unscheduled or scheduled phone call
[GESTURE TO DETERMINE INTEREST]	Gesture to determine interest before making a phone call
[GESTURE TO INDICATE AVAILABILITY]	Gesture to indicate availability to make a phone call
[WRITE TO DETERMINE INTEREST]	Write on FW to ask if interested in talking on the phone
[WRITE TO INDICATE AVAILABILITY]	Write on FW to indicate availability for phone calls
[KNOCK TO INDICATE AVAILABILITY]	Knock to indicate availability
[KNOCK TO DETERMINE AVAILABILITY]	Knock to determine remote family's availability
[MORE IMPROMPTU]	More impromptu conversations because see each other more often
[TALK MORE]	Talk more because the FW is a constant reminder of remote family
[BLINDS WHEN NOT HOME]	Use blinds to indicate no one is home
[VISUAL CUES]	Use visual cues of background eg. light are turned on to determine remote family's availability
[LEAVE MESSAGE WHEN HOME]	Leave messages to indicate availability and presence at home
[LEAVE MESSAGE NOT HOME]	Leave messages to notify remote family when leaving home e.g. to run errand

Table 2: Analysis codes for availability and willingness to communicate.

Interesting observations lead to conversation

[CHANGE IN APPEARANCE]	Notice a change in appearance e.g. new haircut, new shirt
[HOME AT IRREGULAR TIME]	Remote family is home at an unexpected time
[AVAILABLE AT IRREGULAR TIME]	Remote family is available for conversation an unexpected time

Table 3: Analysis codes for interesting observations leading to conversation.

Interacting using the Family Window

[SEE PERSON]	See other person while talking on phone
[SHOW OBJECT]	Show objects of interest (i.e. related to the conversation)
[SHOW PLACE]	Show the surrounding place/area
[SEE OBJECT]	See objects of interest (i.e. related to the conversation)
[SEE PLACE]	See the surrounding place/area
[WANT AUDIO]	Want audio to talk to each other
[HAVE SHORT CONVERSATIONS]	Want to have short conversations
[HAVE LONG CONVERSATIONS]	Want to have long conversations akin the telephone
[USE SPEAKERPHONE]	Use speakerphone so multiple people can talk simultaneously
[WRITE MESSAGES]	Leave messages for each other using writing feature
[ASYNCHRONOUS MESSAGING]	Asynchronous messaging i.e. leave messages throughout the day
[SYNCHRONOUS MESSAGING]	Synchronous messaging i.e. both families write messages at the same time in response to the other
[CHILDREN DRAW]	Children scribble or draw pictures for grandparents
[GRANDPARENTS DRAW]	Grandparents draw pictures for grandchildren
[DIFFICULT TO WRITE]	Difficult to write on FW when using laptop or desktop
[WRITE ON NOTEPAD]	Write messages on notepad and hold up notepad

Table 4: Analysis codes for interacting using the Family Window.

Sharing life

[WATCH LIFE]	Watch daily activities e.g. watching television, preparing lunch
[SHARE IN THE MOMENT]	Like sharing events as they occur, not after the event
[LEARN ROUTINE]	Learn remote family's daily routine
[SHARE LIFE]	Share daily activities

[DISAPPOINTED WHEN NO MESSAGE]	Disappointed when want to talk to remote family, cannot see them and there is no message explaining why they are not there
[LOOK FOR GRANDPARENTS]	Grandchildren look for grandparents in the FW
[WATCH GRANDCHILDREN]	Watch grandchildren play
[INTERACT GRANDCHILDREN]	Interact with grandchildren
[WATCH MEAL TIME]	Watch remote family during meal time
[READ STORIES]	Read stories to grandchildren
[WATCH BATH TIME]	Watch grandchildren's bath time routines
[WATCH BEDTIME]	Watch grandchildren's bedtime routines
[WELL BEING]	Gather information about each other's well being
[PEACE OF MIND]	Get peace of mind
[CONNECTED]	Feel connected
[AWARENESS]	Gain awareness of remote family's life
[WATCH PETS]	Watch pets when remote family is not home
[AWARENESS OF SURROUNDING]	Gain awareness by seeing the household, weather and pets
[SHOW OBJECT]	Show objects of interest (i.e. related to the conversation)
[SHOW PLACE]	Show the surrounding place/area
[SEE OBJECT]	See objects of interest (i.e. related to the conversation)
[SEE PLACE]	See the surrounding place/area
[KNOW GRANDPARENTS]	Grandchildren see and know grandparents

Table 5: Analysis codes for sharing life.

Mobility vs. lack of mobility

[CHILDEN CAN USE]	Children can use FW if it is in accessible location
[CHILDREN CANNOT USE]	Place it out of young children's reach
[EASILY MOVE]	Move FW to the area of the house that the family is in
[SHARE ACTIVITY]	Easy to share activity around the house
[MULTITASK]	Easy to multitask around the house while looking at each other at certain intervals

Table 6: Analysis codes for mobility vs. lack of mobility.

Privacy

[CONFIDENTIALITY]	Initial concern about confidentiality i.e. remote family will see more details about their lives than they were willing to share
[WHO TO CONNECT]	Chose to connect to close family members
[VISITING]	The remote family is "visiting"
[BLINDS FOR PRIVACY]	Blinds down when exercise
[STARING]	Remote family is "staring"
[INTRUDING WHEN WATCH]	Feel like intruding when watching remote home
[IN-LAWS WATCHING]	Uncomfortable to be watched by in-laws all the time
[TURN CAMERA]	Turn the camera to face wall or other object when do not want to be watched
[VISITORS]	Visitors do not like being watched
[WHAT IS SHOWN]	Determine what remote person is seeing
[WHO IS SEEN]	Control who remote person is seeing

Table 7: Analysis codes for privacy.

Recording video

[WHILE AWAY]	Record video in remote home while away
[WATCH WHEN HOME]	Watch recorded video when get home
[RECORD EVENTS]	"Record" events for distant family
[DO NOT MISS EVENTS]	Do not miss events in remote home while away eg. at work
[SAVE VIDEO]	Want to save video permanently
[FORGET TO TURN ON RECORDING]	Forget to turn on time shift feature
[CONTROL WITH VIEWER]	Control of recording in the hands of viewer, not family who is being recorded
[NO NOTIFICATION]	No notification if remote family has turn on/off time shift feature
[SHARE BIRTHDAY]	Share son's birthday party

Table 8: Analysis codes for recording video.

Appendix C: Family Portals Study

Start recording

Participant:　　　　_____

Current Pattern of Communication

We would like to talk to you about your extended family where an extended family member is defined as any immediate family member or relative (including in-laws) who does not live in the same household as you. For example, a mother-in-law, an uncle, a daughter, or a brother who does not live in your household would be considered an extended family member.

1. Can you tell me about your extended family? (i.e. how many siblings, where they live, parents, in laws)

Communication with FP-family

1. Who will you communicate with using Family Portal?

2. How often do you communicate with them now? Why?

3. Has this changed at all in the recent or distant past? (e.g., moving, death in the family, marriage, having children, etc) Why?

4. Currently, how do you communicate with your distant family? (e.g. telephone, email, video conferencing) Why did you choose this method?

5. Have you faced any challenges using said technology to communicate with your distant family?

6. What do you like about using said technology to communicate with your distant family?

7. Where do you usually communicate from?

8. Who usually initiates communication? How is it done?

9. How long do you talk to them for?

10. When you talk with them, what do you talk about? What information do you share? (e.g., activities, health, relationships)

11. How often do you meet them in person?

1. How obligated do you feel to communicate with them?

2. How important is it for you to keep them informed about important events in your life? What would you define as an important event?

3. How important is it for you to be informed about important events in their life?

4. Does communicating with them make you feel involved in their lives?

5. If they contact you, do you feel that you should respond? Eg. Do you feel you have to answer their call?

Connectedness and awareness to FP-family

1. How connected do you feel to them?

2. How aware are you about their life (e.g. activities, health, relationships)?

Experience Using Video Conferencing Systems

We would now like to ask you about your experience using video conferencing tools to communicate with your extended family.

1. (if video conferencing is not mentioned above) Have you used video conferencing to communicate with your distant family? What tools do you use? (e.g. Skype, Google Talk or Windows Live Messenger)

2. How long have you been using video conferencing?

3. What type of computer do you use for video conferencing? Can you please show it to me?

4. (if video conferencing is not mentioned above) Who do you communicate with using video conferencing?

5. How often do you communicate using video conferencing?

6. Why do you use video conferencing systems?

7. (if video conferencing is not mentioned above) Where do you usually communicate from?

8. (if video conferencing is not mentioned above) Who usually initiates communication? How is it done?

9. Do you usually have a set time that you communicate or is it impromptu?

10. Do you have to turn on your computer each time you use video conferencing or is your computer always on?

11. (if video conferencing is not mentioned above) Each time you have a conversation, how long do you talk to them for?

12. (if video conferencing is not mentioned above) When you talk with them, what do you talk about? What information do you share? (e.g., activities, health, relationships)

13. How do you know when a conversation is over? How do you end a conversation?

14. Have you ever left the video conferencing tool on even after a conversation was over? Why?

15. (if using laptop) Do you always set your laptop/use your laptop in the same place every time you have a conversation?

16. (if video conferencing is not mentioned above) Have you faced any challenges using video conferencing to communicate?

17. Do you have any privacy concerns about using video conferencing tools?

Weekly schedule

1. What are your work hours?

2. When are you at home?

3. When are you out for social activities?

4. When are you home on weekends?

5. Will you be going on vacation during the next 5 weeks?

Overall experience using Family Portal

We would like to start by learning about how your family used the Family Portal in this last week.

<u>General questions</u>

1. Did you and your family use Family Portal?

2. How often do you turn it on?

3. How often do you communicate using Family Portal in a day? In a week?

4. How do you use it? (E.g stand in front of it and wave at distant family member)

5. What is your overall impression of the Family Portal?

6. What do you like about the Family Portal?

7. What don't you like about the Family Portal?

<u>Placement of Family Portal</u>

1. Where did you place the Family Portal?

2. Why did you decide to place it there?

3. Did you move the Family Portal around until you decided on that position? Why is this position better that previous positions?

4. Did the remote families ask you to place the Family Portal in any specific place?

5. Did the remote families provide feedback about the position of your Family Portal? (i.e. did they say that they liked or did not like the view they are getting from the Family Portal?)

6. Where did the remote families place the Family Portal in their home?

7. Which part of their home can you see through the Family Portal?

8. Are you happy with the placement of their Family Portal? If no, why not? What do you think will be a better place for them to set their Family Portal?

Awareness, connectedness and peace of mind

1. What activities have you and your family observed in the remote homes? How comfortable were you observing these activities?

2. How connected do you feel to your distant families since you started using the Family Portal?

3. Is there anything in particular that you saw in the distant families' home that made you feel more connected to them?

4. How aware are you about the life and daily on goings of your distant family since you started using the Family Portal?

5. Is there anything in particular that you saw in the distant families' home that helped increase your awareness of their life?

Disconnected/Away

(If families are disconnected (due to technical failure or just being away) for a few hours/days)

1. When were you disconnected/away from the Family Portal? How long did this last?

2. How did you feel when you were unable to see your distant family?

3. Did you feel disconnected?

4. Did you communicate in any other way?

Privacy, camera and blinds

1. How do you and your family feel about having video broadcasted from your home using the Family Portal?

2. Did you ever move the camera to a different position to get more privacy? Why?

3. Did you ever turn off the Family Portal to get some privacy? Why?

4. Did you use the blinds?

5. When did you use it?

6. How did you use it?

7. Why did you use it?

8. What is your opinion about the blinds? Does it help you and your family have privacy?

Experience using specific features in the Family Portal

We will now ask you questions about specific features in the Family Portal to learn about how you used these features and what you liked or did not like about them.

<u>Knocking</u>

1. Did you use the knocking feature?

2. When did you use it?

3. How did you use it?

4. Why did you use it?

5. Who used the inking feature most often?

6. Was the knocking feature easy to use?

<u>Writing</u>

1. Did you use the writing feature?

2. What did you write?

3. When did you use it?

4. How did you use it?

5. Why did you use it?

6. Who used the writing feature most often?

7. Was the writing feature easy to use?

Specific scenario

Can you walk me through the most recent interaction you have had with your distant family using Family Portal? How did it start? How did it end? What did you do? How long did it last?

Appendix CCA: Informed Consent Form

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Informed Consent For Participants
In Research Projects Involving Human Subjects

Title of Project: Evaluation of the Family Portals

Investigator(s): Tejinder Judge, Carman Neustaedter, Steve Harrison, Deborah Tatar, Dennis Kafura, Andrea Kavanaugh, Manuel Perez-Quinonez

I. Purpose of this Research/Project

Families have a strong need to connect with their loved ones over distance. However, most technologies do not provide the same feelings of connectedness that one feels from seeing remote family members. Our goal is to understand if a video connection, in the form of a media space, can help families feel more connected and the privacy concerns that family members may have from using a media space in their home.

Participants for this study will consist of families recruited in the state of New York. Each family will pick two other families to be connected to using the Family Portals.

II. Procedures

This study will take five to eight weeks. During the first week, families will be interviewed about their current pattern of communication. Families will then be asked to take photos of locations in their home and technologies that are used in those locations to communicate with distant family.

Next, families will be given the Family Portals and will use it in their homes for about five weeks. Weekly interviews will be conducted and observation will be conducted when necessary. Photos might also be taken.

A few weeks after the families stop using the Family Portals, they will be interviewed again about changes in their patterns of communication.

All interviews will be held in participant's homes and will last 45-60 minutes. The interviews will be audio recorded.

III. Risks

There are no more than minimal risks to the participants in this research beyond those encountered by them on a day-to-day basis. Their participation will make it possible for us investigate the use of a media space in their home.

IV. Benefits

Immediate direct benefits to participants will be the educational value in learning about the use of video to connect with distance-separated family. In the long run, society may benefit from having a better way for distance-separated families to communicate and stay connected.

No promise or guarantee of benefits has been made to participants to encourage participation in this study.

V. Extent of Anonymity and Confidentiality

Each participant will be given a number for identification purposes. No further information about the participant will be recorded. There will be full anonymity for each participant.

At no time will the researchers release the data from the study to anyone other than individuals working on the project without written consent. Results from the study may be submitted for publication to suitable peer-reviewed conferences and journals in Computer Science.

VI. Compensation

Each family will be awarded gift cards worth $200 for participation.

VII. Freedom to Withdraw

Participants are free to withdraw from a study at any time without penalty. Participants are also free not to answer any questions that they choose without penalty.

VIII. Subject's Responsibilities and Permission

I voluntarily agree to participate in this study. I have read the Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

_____ Date_____
Subject signature

_____
Name (please print)

Should I have any pertinent questions about this research or its conduct, and research subjects' rights, and whom to contact in the event of a research-related injury to the subject, I may contact:

Investigators:

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<u>Review Board:</u>

<u>Dr. David Moore</u>
Chair, Institutional Review Board For the Protection of Human Subjects,
Virginia Tech
(540) 231-4991 moored@vt.edu

Appendix CCB: Parental Permission Form

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

**Parental Permission Form For Participants
In Research Projects Involving Human Subjects**

Title of Project: Evaluation of the Family Portals

Investigator(s): Tejinder Judge, Carman Neustaedter, Steve Harrison, Deborah Tatar, Dennis Kafura, Andrea Kavanaugh, Manuel Perez-Quinonez

I. Purpose of this Research/Project

Families have a strong need to connect with their loved ones over distance. However, most technologies do not provide the same feelings of connectedness that one feels from seeing remote family members. Our goal is to understand if a video connection, in the form of a media space, can help families feel more connected and the privacy concerns that family members may have from using a media space in their home.

Participants for this study will consist of families recruited in the state of New York. Each family will pick two other families to be connected to using the Family Portals.

II. Procedures

This study will take five to eight weeks. During the first week, families will be interviewed about their current pattern of communication. Families will then be asked to take photos of locations in their home and technologies that are used in those locations to communicate with distant family.

Next, families will be given the Family Portals and will use it in their homes for about five weeks. Weekly interviews will be conducted and observation will be conducted when necessary. Photos might also be taken.

A few weeks after the families stop using the Family Portals, they will be interviewed again about changes in their patterns of communication.

All interviews will be held in participant's homes and will last 45-60 minutes. The interviews will be audio recorded.

With parental consent, children between the ages of 12 years old and 18 years old will be interviewed in each stage of this study. We will use a simplified version of questions that we ask adults in the family. The involvement of children between 12 years old and 18 years old will allow us to learn about their communication patterns and their use of the Family Portals.

III. Risks

There are no more than minimal risks to the participants in this research beyond those encountered by them on a day-to-day basis. Their participation will make it possible for us investigate the use of a media space in their home.

IV. Benefits

Immediate direct benefits to participants will be the educational value in learning about the use of video to connect with distance-separated family. In the long run, society may benefit from having a better way for distance-separated families to communicate and stay connected.

No promise or guarantee of benefits has been made to participants to encourage participation in this study.

V. Extent of Anonymity and Confidentiality

Each participant will be given a number for identification purposes. No further information about the participant will be recorded. There will be full anonymity for each participant.

At no time will the researchers release the data from the study to anyone other than individuals working on the project without written consent. Results from the study may be submitted for publication to suitable peer-reviewed conferences and journals in Computer Science.

VI. Compensation

Each family will be awarded gift cards worth $200 for participation.

VII. Freedom to Withdraw

Participants are free to withdraw from a study at any time without penalty. Participants are also free not to answer any questions that they choose without penalty.

VIII. Subject's Responsibilities and Permission

I voluntarily agree to participate in this study. I have read the Parental Permission Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my consent for the participation of my child:

_____   _____
Name of child (please print)   Date

_____   _____
Name (please print)   Parent/guardian's signature

_____   _____
Name (please print)   Parent/guardian's signature

Should we have any pertinent questions about this research or its conduct, and research subjects' rights, and whom to contact in the event of a research-related injury to the subject, we may contact:

Investigators:

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Appendix CCC: Child Assent Form

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Child Assent Form For Participants
In Research Projects Involving Human Subjects

Title of Project: Evaluation of the Family Portals

Investigator(s): Tejinder Judge, Carman Neustaedter, Steve Harrison, Deborah Tatar, Dennis Kafura, Andrea Kavanaugh, Manuel Perez-Quinonez

I. What is this project about?

Families want to stay connected. However, most technologies do not provide the same feelings of connectedness as seeing family members. Our goal is to understand if a video connection can help families feel more connected.

We would like you to participate in this study, as we would like to learn about the communication patterns of 12 - 18 year olds. We also would like to learn how you would use a video connection in the home.

II. What will we do?

During this study, your family will be using a video conferencing technology called the Family Portals. We will be interviewing your family each week. In addition to interviewing your parents, we would like to interview you to learn what you think about the Family Portals and how you use it.

III. Risks and benefits

There are no more than minimal risks to you besides the risks that you encounter on a day-to-day basis. Your participation will make it possible for us investigate the way 12 - 18 year olds use a video connection in the home. In the long run, society may benefit from having a better way for distance-separated families to communicate and stay connected.

IV. Participating in this study

You have the option to participate in the interviews or not too. Your participation is purely voluntary.

If you chose to participate, we will interview you weekly when we visit your home. During the interviews, you can choose not to answer any questions that we ask you.

If you chose not to participate in the interviews, you can still use the Family Portals whenever you want to as this system is for you and your family.

V. Freedom to Withdraw

You are free to withdraw from the study at any time. You do not need permission from your parents to withdraw, you can let us know at any time that you would like to withdraw.

VI. Questions

Feel free to ask questions that you may have.

VIII. Subject's Responsibilities and Permission

I voluntarily agree to participate in this study. I have read the Child Assent Form. I have had all my questions answered. I hereby acknowledge the above and give my consent for my participation:

_____   _____
Name (please print)   Date