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Domestic Awareness and the Role of Family Calendars

by

Carman Gerard Neustaedter

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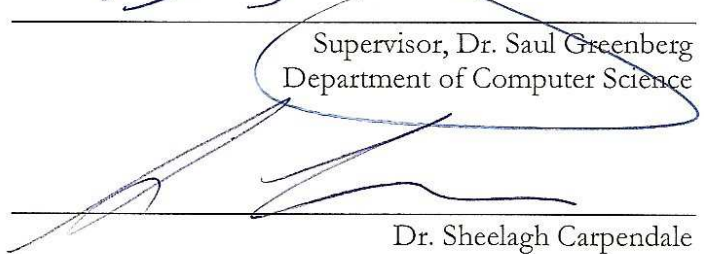
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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a dissertation entitled "Domestic Awareness and the Role of Family Calendars" submitted by Carman Gerard Neustaedter in partial fulfillment of the requirements for the degree of Doctor of Philosophy.



Supervisor, Dr. Saul Greenberg
Department of Computer Science



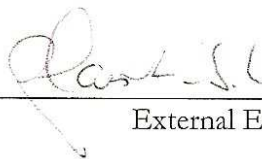
Dr. Sheelagh Carpendale
Department of Computer Science



Dr. Rob Kremer
Department of Computer Science



Dr. Ron Wardell
University of Calgary



External Examiner, Dr. Catherine Plaisant
University of Maryland

January 15, 2007
Date

Abstract

Everyday family life involves a myriad of mundane activities that need to be planned, scheduled, and coordinated. Paper calendars are one tool used by families to help stay organized; yet, the downside is they are only available in one location and can be hard to synchronize if multiple calendars are used. Digital calendars offer promise to overcome these challenges by making family calendaring information ubiquitously accessible. However, we do not yet know how to best design digital family calendars in order to meet the coordination needs of families. I address this problem through three research stages.

First, I outline a *model of interpersonal awareness* that is derived from contextual studies of 29 individuals. This model reveals how and why people maintain an awareness of individuals from three social groupings: *home inhabitants*, *intimate socials*, and *extended socials*. It shows that interpersonal awareness is fundamentally different than workplace awareness; thus, interpersonal awareness groupware should be designed to meet a range of domestic, not workplace, needs. One of these needs is groupware for family calendaring.

Second, I present an empirically-based understanding of family calendaring routines that is derived from contextual interviews with 44 families. I outline how a *typology of calendars* is used by three different family types—*Monocentric*, *Pericentric*, and *Polycentric*—where the level of family member involvement in the calendaring routine varies. I also describe the content and annotations found on family calendars. This theory is then recast as guidelines for the design of digital family calendars that are ubiquitously available to help families overcome coordination challenges.

Third, I outline the participatory design and evaluation of the LINC digital family calendar. LINC includes three systems: an awareness appliance for the home; LINC Web which allows family members to check the calendar from a web browser; and, LINC Mobile which supports calendar browsing on a mobile phone while out and about. Field trials of LINC with four families show that LINC is a viable alternative to paper calendars as it allows families to maintain the benefits of their existing calendar routine while extending it in ways not afforded by paper calendars.

Publications

Materials, ideas, and figures from this dissertation have appeared previously in the following publications. After each reference, I note the chapters in which material is used.

Conference Papers

NEUSTAEDTER, C., ELLIOT, K., AND GREENBERG, S. 2006e. Interpersonal Awareness in the Domestic Realm, In *Proceedings of the Australian Conference on Computer-Human Interaction (OzCHI 2006)*. (Chapters 2 and 3)

NEUSTAEDTER, C., AND BRUSH, A.J. 2006. "LINC-ing" the Family: The Participatory Design of an Inkable Family Calendar, In *Proceedings of the Conference on Human Factors in Computing Systems (CHI 2006)*, ACM Press, 141-150. (Chapter 8)

ELLIOT, K., NEUSTAEDTER, C., AND GREENBERG, S. 2005. Time, Ownership and Awareness: The Value of Contextual Locations in the Home, In *Proceedings of the Seventh International Conference on Ubiquitous Computing (Ubicomp 2005)*, Springer-Verlag, 251-268. (Chapters 2 and 3)

Videos and Demonstrations

NEUSTAEDTER, C., BRUSH, A.J., AND GREENBERG, S. 2006a. LINC, An Inkable Digital Family Calendar: The Video, In *Video Proceedings of the ACM Conference on Computer Supported Cooperative Work (CSCW 2006)*. (Chapter 8)

NEUSTAEDTER, C., BRUSH, A.J., AND GREENBERG, S. 2006b. A Demo of Family Calendaring using LINC, *Demonstration and Extended Abstract in the ACM Conference on Computer Supported Cooperative Work (CSCW 2006)*. (Chapter 8)

BRUSH, A.J., AND NEUSTAEDTER, C. 2006. LINC: A Ubiquitous Digital Family Calendar, *Demonstration and Extended Abstract in the Eighth International Conference on Ubiquitous Computing (Ubicomp 2006)* (Chapter 8)

Workshop Papers

NEUSTAEDTER, C., ELLIOT, K., AND GREENBERG, S. 2005. Understanding Interpersonal Awareness in the Home, In *ACM CHI 2005 Workshop on Awareness Systems*. (Chapters 2 and 3)

Technical Reports

NEUSTAEDTER, C., BRUSH, A.J., AND GREENBERG, S. 2006c. "The Calendar is Crucial": Coordination and Awareness through the Family Calendar, *Report 2006-839-32, Department of Computer Science, University of Calgary, Alberta, Canada*; and as *MSR-TR-2006-107, Microsoft Research, Redmond, WA, USA*. July. (Chapters 5, 6, and 7)

NEUSTAEDTER, C., BRUSH, A.J., AND GREENBERG, S. 2006d. LINC in the Home: Field Trials of a Digital Family Calendar, *Microsoft Tech Report, MSR-TR-2006-66*. (Chapter 9)

NEUSTAEDTER, C. AND GREENBERG, S. 2005. Understanding How to Design Awareness Appliances for the Home, *Report 2005-787-18, Department of Computer Science, University of Calgary*, May. (Chapters 2 and 3)

Research Acknowledgments

Portions of my research were conducted in collaboration with others; here I make clear the role of each person.

First, I owe great thanks to Kathryn Elliot, an MSc student at the time, for her role in my research. The first study presented in this dissertation on **Interpersonal Awareness (Chapters 2/3)** was performed in collaboration with Kathryn. Kathryn and I both designed the materials and method for the study and conducted the interviews together. Analysis of the data for interpersonal awareness was performed solely by me. Analysis of the data for contextual locations (the second phase of this study) was performed solely by Kathryn.

Second, I owe great thanks to Microsoft Research (MSR) for allowing me to include portions of research in this dissertation which were conducted while I was an intern and contractor with MSR, supervised by A.J. Brush (MSR Researcher). The following describes the research conducted in conjunction with MSR which includes joint work with A.J. Brush:

1. **Family Calendar Study (Chapters 5/6):** I interviewed twenty of the 44 families in this study while an intern at MSR as part of the participatory design process of LINC (see #2). Another four of the families were interviewed while I was a contractor at MSR as part of field trials of LINC (see #3). Two of these families were interviewed by A.J. Brush and two were interviewed by me. The remaining twenty families were interviewed at the University of Calgary and *not* done in conjunction with MSR. All analyses for this study were performed by me.
2. **Participatory Design of LINC (Chapter 8):** This study was conducted while I was an intern at MSR during the summer of 2005. I created the prototype designs and A.J. Brush provided feedback on them in a supervisory role; thus, design ideas are from both A.J. and me. The remaining design and development of LINC was performed while I was a contractor with MSR from September 2005 to April 2006. The user interface for LINC Mobile was designed by A.J., while my role was to create the necessary server components for the backend of LINC Mobile.
3. **Field Trials of LINC (Chapter 9):** This study was conducted while I was a contractor with MSR from September 2005 to April 2006. A.J. Brush was responsible for

administering the two Seattle families and I was responsible for administering the two Calgary families. This included setting up and taking down the software/hardware and conducting interviews during field visits with the families. I performed the primary analysis of findings from all families and received feedback and comments from A.J. in an advisory role.

All research presented in this dissertation (with the exception of the Participatory Design of LINC) was also conducted in collaboration with my supervisor, Saul Greenberg, where he acted in an advisory role.

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And finally, to all those who have been puzzled in life: I leave one more puzzle. The steps for solving it and the answer that you seek are self-contained in this dissertation. Figure it out, and *never give in*.

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To my love, Kirstin

*This dissertation is yours just as much as it is mine.
Your patience, inspiration, and unending love
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Chapter 1. Introduction

Family life involves the continual organization and coordination of various activities on an everyday basis, including school events, extracurricular activities, family outings, and appointments (Beech *et al.*, 2004, Sellen *et al.*, 2004, Taylor and Swan, 2005). As a result, families often employ a complex routine for awareness and coordination to manage their everyday activities (Beech *et al.*, 2004, Taylor and Swan, 2005) that extends beyond just the home to include scheduling while at work or mobile (Crabtree *et al.*, 2003a, Beech *et al.*, 2004, Sellen *et al.*, 2004). For example, it involves scheduling appointments while at the doctor's office or checking the family calendar at work for evening events.

Families use a variety of 'tools' to help them coordinate their activities ranging from paper calendars (Brush and Turner, 2005), notes, and lists (Swan and Taylor, 2005), to technologies including telephones, mobile phones, PDAs, email, and even instant messaging (Beech *et al.*, 2004, Brush and Turner, 2005). Despite using various organization schemes and tools, family coordination still remains an everyday challenge for many people (Sellen *et al.*, 2004).

My focus in this dissertation is on the study of one type of tool used by families for coordination: the family calendar. A natural question is why study family calendaring as opposed to the many other domestic artefacts and tools that families use for coordination? The fact is that family calendars, like the one shown in Figure 1.1, are almost always the central family coordination artefact (Zimmerman *et al.*, 2001) rendering family calendars 'crucial.' A sample of quotes from participants interviewed as a part of this dissertation illustrates this critical nature:

"The calendar is crucial; it'd be a disaster without it. Anyone can look at it." – Samantha (P14), Mom and Administrative Assistant

"[The family calendar] is extremely important, we are involved in so many different events I have to be able to map it out or we would forget places, dates, times." – Mona (P20), Mom and Teacher



Figure 1.1: A sample family calendar.

“When you have kids in school you HAVE to have a schedule...there’s just too much...You can’t plan anything without looking at the calendar because if you do you’re out of luck, something will come up...when you have kids it’s not something you can just miss.” – Doug (P9), Dad and Construction Manager

One participant even faced the trauma of losing her family calendar in a house fire with no backup or record of when or where the family’s activities took place:

“I couldn’t live without [the family calendar]...at the hotel I didn’t have my calendar up for a month and a half...I was taking two university courses...so I just went with the flow, I went on autopilot...It just puts everything into perspective...it’s like my brain, you know.” – Kayla (P19), Mom and Homemaker

Paper calendars are one type of calendar used by families to help stay organized: they are easy to use, easily shared, mobile, personalizable, and create an instant archive of family activities (Brush and Turner, 2005). Yet the downside is that paper calendars are not normally available to all family members outside the home. Multiple paper calendars can be used to help overcome this (e.g., one per family member), yet this introduces the challenge of having to synchronize calendars (Brush and Turner, 2005). Technology offers promise for family calendaring. Via networking, digital calendars can make calendaring information ubiquitous and simultaneously accessible by a variety of people from a variety of locations. This lets families more easily view, coordinate and update their activities and events. The challenge is that we cannot simply migrate digital calendars developed for the workplace into the home; domestic family calendaring routines are likely to be very different than workplace calendaring routines (Crabtree *et al.*, 2003a).

We are not the only ones considering digital family calendars. Research efforts have begun to look at the design of digital family calendars focused on *inter*-family coordination (Plaisant *et al.*, 2006) where multiple families are able to share calendar information (namely grandparents and their children’s families). However, that work does not specifically address the needs of families for *intra*-family coordination, the focus of this dissertation. Commercial online calendars are also cropping up at an increasing rate (e.g., 30Boxes, Family Scheduler, Google Calendar, Our Family Wizard, Planzo, Trumba) where the goal is to support personal and family organization by providing a shared calendar that is accessible anywhere with an Internet connection. The problem is that we do not know if these online

calendarizing solutions actually match the needs of families or if families can use them effectively as a part of their coordination routines.

In the remainder of this chapter, I describe how my research focus of family calendarizing fits within the domains of Human-Computer Interaction and Computer Supported Cooperative Work. Following this, I introduce the specific research problems that this dissertation addresses and the objectives it meets to solve these problems. I conclude with an organizational overview outlining the dissertation’s structure.

1.1 Research Context

This dissertation is focused on understanding *family calendarizing* routines and designing *groupware* to support them. Figure 1.2 illustrates how this topic fits into the broad categories of *Human-Computer Interaction* (HCI) and *Computer-Supported Cooperative Work* (CSCW). HCI is a multi-disciplinary field that investigates the human factors of computing systems to understand how to design computational devices that are both usable and useful for individuals (Dix *et al.*, 1998). CSCW is a sub-discipline of HCI that studies the behaviours and work patterns of groups, the effects of technologies on this group work, and the design of software—*groupware*—to support the efforts of these groups (Greenberg, 1991). Within these areas, my focus is on *Ubiquitous Computing for CSCW*. Here research straddles the subfields of CSCW and ubiquitous computing to investigate how technologies that are continuously available and spread throughout our environment (Weiser, 1991, Abowd and

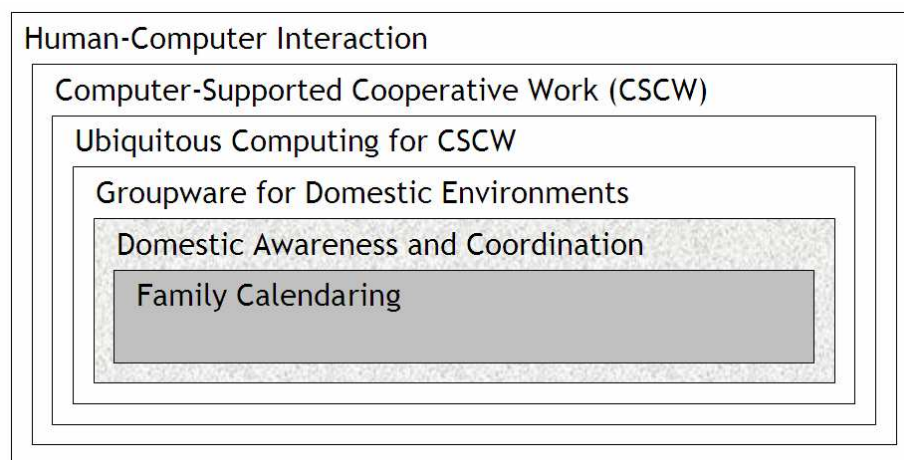


Figure 1.2: Context of my research; shaded regions indicate areas of focus.

Mynatt, 2000) can be used to support the everyday practices of groups of individuals for collaborative purposes.

I further narrow my focus to *Groupware for Domestic Environments*. This subfield involves studying the everyday domestic practice of groups through ethnographic explorations (e.g., Crabtree *et al.*, 2003a, 2003b, Taylor and Swan, 2005), technology design (e.g., Hindus *et al.*, 2001, Mynatt *et al.*, 2001, Nagel *et al.*, 2001), and field evaluations of technology (e.g., O'Brien *et al.*, 1999, Tollmar and Persson, 2002, Rowan and Mynatt, 2005, Sellen *et al.*, 2006b) to better inform the design of groupware systems. The distinction between groupware for the workplace and that of the domestic environment is that home inhabitants are not focussing on work *per se*, but rather on the everyday mundane activities they undertake throughout the day (Crabtree *et al.*, 2003b). These practices are collocated in nature when people are located in the home at the same time, and are also distributed as people come and go between the home, work, and other locations.

The first part of this dissertation looks generally at *Domestic Awareness and Coordination* (Figure 1.2, lightly shaded region). Here I study how people naturally maintain some semblance of *interpersonal awareness* of their family members and friends (Mynatt *et al.*, 2001, Tollmar and Persson, 2002, Beech *et al.*, 2004). I focus on understanding how interpersonal awareness is acquired and used between individuals with established relationships, where all have a real need and desire to know about each other. This does not include investigations of how these relationships are formed and maintained, which is described in detail in the disciplines of sociology and social psychology (e.g., Smith and Williamson, 1977, Schutte and Light, 1978, Korn and Nicotera, 1993, McCarty, 1996).

This initial work on interpersonal awareness revealed that there are many aspects to domestic awareness and coordination. Covering all of these in their entirety would be unmanageable and certainly outside the scope of one thesis. For this reason, I narrow the main focus of this dissertation to *Family Calendaring* (Figure 1.2, darkly shaded region). Family calendaring fits within the context of domestic awareness and coordination groupware where groups of individuals (family members) collaboratively use calendars to coordinate and stay aware of their everyday activities. I am primarily concerned with *intra-family* calendaring, which is calendaring to support collaborative activities *within* a single family unit (e.g., parents and children), as opposed to *inter-family* calendaring (e.g.,

calendar between multiple families). As we will see, family calendar moves fluidly between collocated and distributed activities. When collocated, family members may add events to the calendar or discuss its contents in order to coordinate activities. When distributed, family members may still add events or view the calendar (technology typically facilitates this) or they may discuss calendar events using technology like phones or email.

While this dissertation does discuss other family coordination tools used in addition to calendars (e.g., lists, email, instant messaging, telephones, mobile phones), emphasis is placed on family calendars, rather than these other domestic artefacts. Again, broadening the scope to include detailed analysis of *all* family coordination tools would be beyond any one thesis.

My focus of family calendar is centred on the routines of *middle class families* in Canada and the United States, though I discuss the generalization of my findings to broader middle class Western culture. Social psychology studies have shown that other cultures expend different temporal patterns (Levine, 1997); therefore, I leave the comparison of calendar routines between cultures for future work.

1.2 Research Problems

This dissertation focuses on addressing the overarching research problem that *we do not yet know how to best design digital family calendars in order to meet the coordination needs of families*. To more easily address this, I have broken this main problem into four sub-problems surrounding the design of groupware to support family calendar. The first problem addresses early questions I had about designing awareness and coordination technologies for the domestic environment. The remaining three problems narrow in on intra-family calendar research questions.

Problem 1: We do not understand the domestic awareness and coordination routines of family and friends. Specifically, this means understanding for family and friends:

- a) what awareness information is needed;
- b) for whom this awareness is needed;
- c) how this awareness is currently maintained;
- d) what problems people face when maintaining this awareness; and,
- e) what implications this has for the design of awareness groupware for the domestic realm.

Many studies of domestic culture have focused on domestic communication routines as a general concept (e.g., Ling, 2000, Hughes *et al.*, 2000, Crabtree *et al.*, 2003b, Taylor and Swan, 2005), yet they do not focus specifically on awareness and coordination. Studies that do look more specifically at domestic awareness and coordination (e.g., Grinter and Palen, 2001, Mynatt *et al.*, 2001, Tollmar and Persson, 2002, Crabtree *et al.*, 2003a, Beech *et al.*, 2004) are valuable in that they describe nuances of how awareness is used in differing domestic contexts (e.g., teenagers, distance-separated family members). These findings show that awareness needs range in the domestic realm depending on the social relationship, but they do not present a unified picture of domestic awareness that is able to illustrate why these needs differ and what the implications are for technology design. Other researchers have focused on presenting novel designs of awareness devices for family and friends, yet because of a lack of any unified model of domestic awareness needs, design decisions are often based on assumptions and not a unified understanding of this awareness (e.g., Go *et al.*, 2000, Siio *et al.*, 2002).

Problem 2: We do not have a sufficient understanding of family calendaring routines and practices. A variety of studies of workplace calendaring have been performed over the past twenty years where they describe the use of both paper and digital calendars (Kelley and Chapanis, 1982, Kincaid *et al.*, 1985, Payne, 1993, Palen, 1998, 1999). These provide a foundation for how we understand calendar use and implicitly suggest ways in which calendars may be used in the domestic realm, though they do not provide any actual details about domestic calendaring practices. Studies have also been performed more specifically on family calendaring routines (e.g., Zimmerman *et al.*, 2001, Hutchinson *et al.*, 2002, Crabtree *et al.*, 2003a, Beech *et al.*, 2004, Sellen *et al.*, 2004, Brush and Turner, 2005) to highlight the role of primary schedulers and other family members, the use of paper *vs.* digital calendars, the ubiquitous nature of family calendaring, and implications from these findings for design. These studies provide the valuable and necessary first steps in understanding family calendaring routines, yet they do not provide any overarching theory of family calendaring that formalizes: the varying types of calendars used by families, the different types of coordination routines families employ, and the event and annotation

content of family calendars. This type of formalization can offer more detailed design suggestions for digital family calendars and provide a common vocabulary to discuss family calendaring.

Problem 3: We do not know how to apply an understanding of family calendaring routines to the design of digital family calendars. While there has been some research investigating family calendaring routines, there are even fewer cases illustrating how this knowledge can be applied to the design of actual digital family calendars. The notable exceptions are family calendars by Plaisant *et al.* (2006) and Elliot and Carpendale (2005). However, Plaisant *et al.*'s (2006) calendar focuses on *inter*-family calendaring rather than the focus of this dissertation on *intra*-family calendaring. Elliot and Carpendale's (2005) calendar presents interesting and valuable family calendar design ideas, yet the design has not been evaluated to show the extent to which it supports domestic routines. Research projects have also looked at next-generation workplace calendar designs (Mackinlay *et al.*, 1994, Mueller, 2000, Mynatt and Tullio, 2001, Tullio *et al.*, 2002, Brzozowski *et al.*, 2006); however, they are focused on *workplace* calendaring routines and not domestic ones. The most prevalent form of digital family calendars comes from commercial calendaring applications designed for the web (e.g., 30Boxes, Family Scheduler, Our Family Wizard, Planzo, Trumba). These digital online calendars purport to being designed to meet the needs of individuals for personal and family activities, yet inspection of them suggests they are either modeled directly on workplace calendaring or potentially false assumptions of what family calendaring actually entails. As is the case with many companies, we do not know the actual process undertaken to design these applications or the requirements analysis that informed them.

Problem 4: We do not know how digital family calendars designed specifically to address family needs will actually be used by families as a part of their coordination routines. A further step in the comprehension of family calendaring design is to understand what effects a digital family calendar designed specifically for families will have on their overall calendaring routine, and how the calendar will be used. A variety of technologies that support maintaining an awareness of family members and friends have been deployed into everyday life to study their effects (Tollmar and Persson, 2003, Rowan and Mynatt, 2005,

O'Hara *et al.*, 2005, Sellen *et al.*, 2006b). However, for the most part, these deployments have not been specifically of family calendars. Again, the notable exception is Plaisant *et al.*'s (2006) shared family calendar which was deployed within households to understand the effects of digital family calendars on *inter*-family coordination and awareness. However, this dissertation is focused on *intra*-family calendaring. I expect that various digital calendars (e.g., commercial online family calendars, workplace calendars) are being used increasingly by individuals to coordinate family activities, though we do not know of any studies of their use in this context.

1.3 Research Objectives

My overarching objective for this dissertation is to: *provide a foundation for understanding how to best design digital family calendars to meet the coordination needs of families*. To achieve this goal, I address the aforementioned problems by linking theory, design, and evaluation through the completion of four main research objectives. These objectives build on past CSCW and domestic technology research to present original ideas and knowledge pertinent to understanding family calendaring routines and digital family calendar design. Each objective matches the corresponding problem in Section 1.2.

Objective 1: Describe the domestic awareness and coordination routines of family and friends. In collaboration with Kathryn Elliot, I conducted a series of applied ethnographic / contextual interviews (Spradley, 1979) with 29 individuals from 10 different households where the results describe a *model of interpersonal awareness* (Neustaedter, Elliot, and Greenberg, 2005, Elliot, Neustaedter, and Greenberg, 2005, Neustaedter, Elliot, and Greenberg, 2006e). This model describes how and why people have a range of needs when it comes to maintaining awareness of others in the domestic realm. This range translates into unique technological solutions to meet the varying domestic needs of families and friends.

One of these needs is technology to provide an awareness of family activities to enable coordination, or, in other words, groupware for family calendaring. This and other findings from the study caused me to narrow in and focus on family calendaring for the remainder of

this dissertation. Consequently, I investigate family calendaring by triangulating results from three research steps: theory, design, and evaluation.

Objective 2: Formalize family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems. In collaboration with A.J. Brush, I conducted a series of applied ethnographic / contextual interviews (Spradley, 1979) with a total of 60 individuals from 44 families (Neustaedter, Brush, and Greenberg, 2006c). Interviews focused on formalizing each family's calendaring routines. These interviews came iteratively from three sources:

1. Twenty of the 44 families (from Seattle, U.S.A.) were interviewed as part of participatory design sessions of a digital family calendar (Objective 3).
2. Four of the 44 families (two from Calgary, Canada and two from Seattle) were interviewed as part of field trials of a digital family calendar (Objective 4).
3. Twenty of the 44 families (from Calgary) were interviewed in a study solely looking at existing family calendaring practices.

Analysis of this data identified a typology of calendars used by families for coordination, and three family types that vary in their routines for scheduling and checking the calendar. Further content analysis of the calendars from the final twenty families identifies the types of events placed on the calendar, and the calendar annotations and augmentations families use to enhance their coordination routines. These formalizations and descriptions form the first part of the *family calendaring theory*.

I then used these formalizations to inform a set of design guidelines that suggest how digital family calendars should be designed to support families' natural calendaring practices and overcome calendaring challenges. The guidelines presented: extend existing research on family calendaring; refute particular findings from previous studies; show that family calendaring is fundamentally different than workplace calendaring requiring unique design solutions; and, illustrate that the current paradigm for designing digital family calendars for intra-family coordination does *not* meet the real needs of families. The design guidelines form the second part of the *family calendaring theory*.

Objective 3: Use the understanding of family calendar routines along with a participatory design process to design a digital family calendar. In collaboration with A.J. Brush, I designed a digital family calendar called LINC (Figure 1.3) based on the design guidelines from Objective 2 along with an iterative participatory design process involving twenty mothers (Neustaedter and Brush, 2006, Neustaedter, Brush, and Greenberg, 2006a, Neustaedter, Brush, and Greenberg, 2006b, Neustaedter, Brush, and Greenberg, 2006d, Brush and Neustaedter, 2006). The initial process involved five sequential stages:

1. The creation and iteration of paper prototypes of LINC based on knowledge of calendaring routines from existing research (Neustaedter and Brush, 2006).
2. Participatory design sessions:
 - a. Interviews with all twenty mothers, which is described as part of Objective 2.
 - b. Paper prototyping task sessions with ten mothers (Neustaedter and Brush, 2006).
3. The development of a medium-fidelity standalone digital prototype of LINC that resembled paper calendar capabilities (Neustaedter and Brush, 2006).
4. A formative evaluation of the medium-fidelity digital prototype with the remaining ten mothers (Neustaedter and Brush, 2006).
5. Based on these results, LINC was developed into a ubiquitous calendar system (Figure 1.3) capable of being deployed amongst families. This new version of LINC extended paper calendar attributes by making the calendar simultaneously accessible from multiple computers where it synchronizes through a shared LINC server (Neustaedter *et al.*, 2006a, Neustaedter *et al.*, 2006b, Neustaedter *et al.*, 2006d, Brush and Neustaedter, 2006). It also saw the development of two new clients for the LINC server: LINC Web (Figure 1.4, left) and LINC Mobile (Figure 1.4, right), which further support ubiquitous access of the family calendar from work or while mobile.

As a side note, the final twenty-four interviews described in Objective 2 were done after Step 4 in order to refine the knowledge of family calendaring routines and further aid the design process of LINC (as a part of Step 5).



Figure 1.3: The LINC digital family calendar running on a Tablet PC in a family's kitchen.

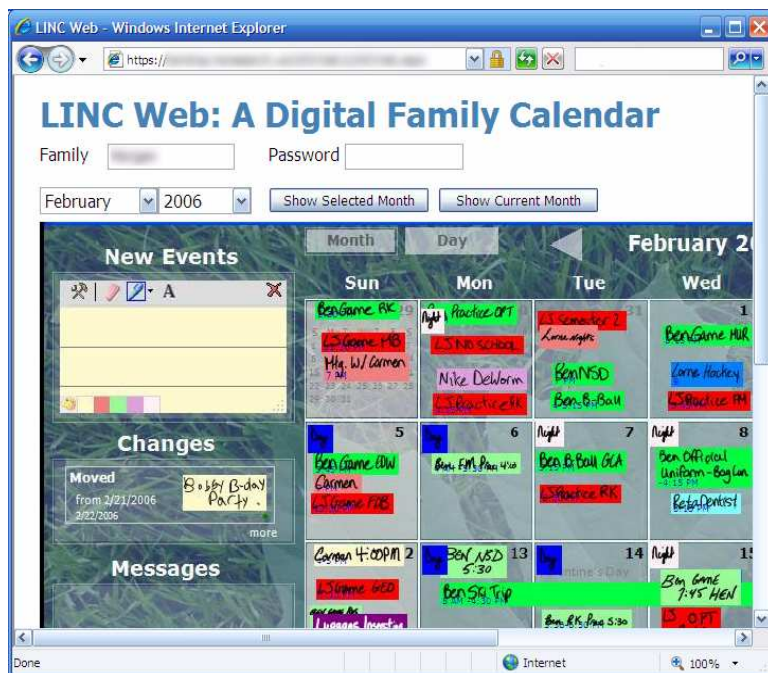


Figure 1.4: LINC Web in a web browser and LINC Mobile on a Windows Smartphone.

Objective 4: Evaluate the LINC digital family calendar in order to understand how it will actually be used by families as a part of their coordination routines. In collaboration with A.J. Brush, I performed a field evaluation of the LINC digital family calendar (Neustaedter, Brush, and Greenberg, 2006d). This study had four families, two from Seattle and two from Calgary, use LINC within their homes for four weeks. Families were interviewed initially about their existing coordination routine. LINC was then installed and left within their home where they used LINC as their primary family calendar. Families were interviewed each week about their experiences with LINC, with a final interview at the completion of the four weeks. During the study, all families had access to LINC Web. Two of the four families used LINC Mobile for two of the four weeks. As we will see, findings from the field evaluation provide validation and clarification of family calendaring routines and provide insight into how a digital family calendar will affect the behaviours of family members, e.g., how it fits within their existing coordination routine, and how these routines change to take advantage of LINC's capabilities.

1.4 Methodological Approach

This dissertation addresses design challenges by understanding how we can design technology that fits within people's existing social and physical context (Dourish, 2001). This means designing technologies that not only support the abilities that people have developed in their routines over time, but enhancing these abilities by designing technology that overcomes the challenges people still face. In order to do this, one must understand what the real processes are that people undertake and what real needs they have for technology to enhance those routines (Greenberg, 2004).

To achieve this design goal, I use findings from four different qualitative studies involving a total of 54 households comprising 89 individuals to understand the behaviours, artefacts, and shared knowledge (Spradley, 1980) that exist as a part of domestic routines. I use this understanding to develop empirically-based principles that are able to direct design (Dix *et al.*, 1998), in this case, the design of digital family calendaring systems. I chose to use primarily qualitative techniques as opposed to quantitative because I sought to understand *what* processes people employ and *why* they employ them so that we may make better design decisions as a result. Quantitative techniques are valuable for uncovering interaction effects

of various factors, but often they are unable to explain the reasoning behind the observed phenomenon (Eberts, 1994). On the other hand, qualitative techniques lend themselves naturally to helping explain *why* particular processes are undertaken (Spradley, 1979, Spradley, 1980, Maxwell, 2005). My analysis uses widely accepted techniques for analyzing qualitative data including open coding (Strauss and Corbin, 1998), affinity diagramming (Holtzblatt and Jones, 1995, Holtzblatt *et al.*, 2005), and data classification and categorization (Spradley, 1979).

I validate my qualitative findings through two primary means. First, in each study that I have performed I have taken extensive time to look for results that may threaten the conclusions that I infer (Maxwell, 2005). This involved reflecting on the findings compared to my own natural biases to ensure the results are based on the *actual* practices people employ and not my own naïve understanding. I also compared my findings to the existing research to understand how and why my findings validate, extend, or refute existing knowledge. I have also presented this research to numerous colleagues and other experts in the field as a part of research dissemination, where their critiques of the work have helped to further refine the concepts I present. Second, I have used triangulation to generate findings from a variety of studies employing a range of techniques (Maxwell, 2005). The majority of the results come from ethnographic / contextual interviews, which I have performed in three repeated stages with a range of participants. These are augmented and complemented with design studies and field evaluation methods to refine the concepts.

While much of this methodology is derived from the social sciences, it is commonly used within the field of computer science as part of the software design process. For example, in software engineering, studies of routines are often used as a basis for requirements specifications (Sommerville, 1989, Dix *et al.*, 1998). I apply this approach to the design of domestic technologies where I draw out a set of requirements for domestic awareness systems. Yet studying domestic practices requires a much more contextually-oriented approach than the workplace (Venkatesh, 1996, Edwards and Grinter, 2001, Sellen *et al.*, 2004, Taylor and Swan, 2005). This is because the home is fuelled by personal and social needs as opposed to the need to complete goal or task-centric activities (Venkatesh, 1996, Edwards and Grinter, 2001, Sellen *et al.*, 2004). For this reason, I had to probe the routines of families to understand activities that span large portions of the day, and occur in

many different contexts at varying degrees by different family members. I then use this understanding to guide the iterative design of a software system, which is akin to a typical software development cycle (Sommerville, 1989, Dix *et al.*, 1998). However, the research nature of the domestic realm meant that I had to understand how to translate rich cultural knowledge into principles that could guide the software design process. Thus, the family calendar system itself presents detailed and robust development of software interfaces and architecture to support them where cultural practices are at the core of the development. Finally, the field evaluation I perform is also indicative of a common software development practice where systems are tested to remove bugs and the interface is iterated on to improve usability (Sommerville, 1989, Dix *et al.*, 1998). However, again, I had to tailor this approach to understand both usability *and* cultural issues with the software as it was used as a part of everyday family routines. While my overall approach is centred in the core practices of human-computer interaction research and extended to meet the needs of domestic computing research, many of these practices relate strongly to approaches used more broadly in computer science.

1.5 Organizational Overview

This dissertation is divided into three main parts progressing from a broad to narrow focus as suggested by the four thesis objectives in Section 1.3.

Part I: Interpersonal Awareness Routines

The first part of this dissertation investigates the context of family calendaring by describing investigations of interpersonal awareness as a part of domestic coordination routines (Objective 1). In Chapter 2, I discuss the methodology and findings from the study of interpersonal awareness. These findings describe the *model of interpersonal awareness*. In Chapter 3, I describe how the model of interpersonal awareness can be used to guide and analyze awareness groupware designs. This leads into discussion of supporting the domestic awareness needs of families using calendars.

Part II: Family Calendaring Theory

The second part of this dissertation takes a more focused look at one aspect of awareness routines, family calendaring, to develop an empirically-based theory of family calendaring which can guide groupware design of digital family calendars (Objective 2). In Chapter 4, I present related work on calendaring. In Chapter 5, I present study findings that describe how calendars are used currently by families to maintain awareness of one another and coordinate activities. In Chapter 6, I continue the investigation of existing family calendaring routines by describing findings from a content analysis of family calendars. In Chapter 7, I synthesize the results and formalizations from Chapters 5 and 6 and present guidelines for digital family calendar designs that focus on meeting the needs and routines of families. This describes the *theory of family calendaring*.

Part III: The Design and Evaluation of a Digital Family Calendar

The third part of this dissertation further explores family calendaring through the iterative design and evaluation of a digital family calendar called LINC (Objectives 3 and 4). In Chapter 8, I describe the participatory design of LINC. In Chapter 9, I describe the field evaluation of LINC within the homes of four families.

In Chapter 10, I conclude this dissertation by describing how my research goals were completed and the research contributions that I have made. I also discuss how researchers and designers can build on my research by outlining the appropriate next steps and future work.

Part I: Interpersonal Awareness Routines

The first part of this dissertation *describes the domestic awareness and coordination routines of family and friends* (Chapter 1, Objective 1). Chapter 2 articulates the domestic routines of people as they maintain an awareness of their family and friends. It describes the individuals for whom they need to maintain awareness, what awareness information they maintain, and the techniques they use to gather this awareness. Chapter 3 illustrates how the knowledge of awareness routines can be applied to the design of awareness groupware to support the routines of family and friends. One of the needs and routines that arise is family calendaring, which requires its own technological solutions. Parts II and III of this dissertation narrow in on this focus.

Chapter 2. Interpersonal Awareness in the Domestic Realm¹

The goal of this chapter is to *describe the domestic awareness and coordination routines of family and friends* (Chapter 1, Objective 1). This description is the *model of interpersonal awareness*. Studies have shown that people naturally maintain some semblance of *awareness* of their family members and friends (Mynatt *et al.*, 2001, Tollmar and Persson, 2002, Beech *et al.*, 2004). For example, parents stay aware of their children’s extra-curricular schedules to coordinate rides. Spouses may plan dinner depending on when their partner may be home. We also know that this awareness extends beyond immediate home members to include others such as friends and the extended family (Grinter and Palen, 2001, Mynatt *et al.*, 2001). Friends may want to know about each other’s general activities in order to feel socially connected. Families may need to know the well-being or health of an elderly parent who lives elsewhere to feel comfort (Mynatt *et al.*, 2001).

We use the term *awareness* here as this is how prior work studying domestic culture has characterized the types of knowledge we have just described (Mynatt *et al.*, 2001, Tollmar and Persson, 2002, Gaver, 2002, Beech *et al.*, 2004, Markopolous *et al.*, 2004). However, awareness is a widely used (and sometimes considered overused) term that encompasses many different situations (Schmidt, 2002). We have further classified awareness in the domestic realm as *interpersonal awareness* because the existing research shows that awareness in the domestic realm is focused on existing *interpersonal* relationships between people. An extensive body of research already focuses on understanding awareness in the workplace (see Schmidt, 2002 for a summary). While we expect some of this understanding to apply in the

¹ Portions of this chapter are also published in: Neustaedter, Elliot, and Greenberg (ACM CHI Workshop 2005), Elliot, Neustaedter, and Greenberg (UbiComp 2005), Neustaedter and Greenberg (Technical Report 2005), and Neustaedter, Elliot, and Greenberg (OzCHI 2006e).

home, we also expect that the nuances of how awareness is gathered and used will differ within the personal social context of family and friends. Thus, this chapter focuses on presenting a model of interpersonal awareness that describes how awareness is acquired and used in the domestic realm.

2.1 The Study Goal

The model of interpersonal awareness presented in this chapter is based largely on our own study of the awareness routines of family and friends. The study's goal is to articulate: the spectrum of people within one's social network for whom interpersonal awareness is desired; the information that is maintained and its use across this spectrum; and, the techniques people use to maintain the awareness. To achieve this goal, we performed contextual interviews of a variety of families, analyzed the collected data, and compared this with the existing research on domestic awareness routines.

2.2 Methodology

Existing research has shown that people desire awareness for a range of individuals in their personal social network (e.g., Mynatt *et al.*, 2001, Tollmar and Persson, 2002, Rowan and Mynatt, 2005). That is, there are some individuals for whom people desire more awareness than others. For example, one may want to know more details about a close friend when compared to a distant relative. What is not clear is how one's social contacts typically fall within this range and how this affects awareness maintenance. For example, are different techniques used to maintain an awareness of a close friend when compared to a distant relative? Is different awareness information gathered for these differing social relationships? To answer questions like these, our study method analyzes awareness as a range of needs depending on one's social relationships. This allows us to compare the techniques and information desired for one's differing relationships. All materials for the study can be found in Appendix B.

2.2.1 Participants

We recruited 29 people from ten different households in total. Participants were recruited through university and department email lists, and advertising with community associations.

We sought a diverse set of participants: five were *teenagers*, sixteen were *young-mid adults* aged 20 to 39, and eight were *middle-aged adults* between 40 and 60. For pragmatic reasons (relating to ethics approval), we avoided participants under the age of thirteen. Participants had a variety of ‘work’ backgrounds, e.g., students from junior/senior high school and university/college, programmers, teachers, managers, administration, retail clerks, and retirees. Household composition also varied greatly, e.g., common-law partners, roommates, married couples with young children, couples with teenagers, couples with adult children. Participants also included a range of ethnic backgrounds.

2.2.2 Method

All stages of our contextual study took place in the participants’ own home, as this setting reminded participants of their methods and desires for gathering interpersonal awareness information of their household, family and friends. Over the course of about an hour, each study participant completed three activities: two paper-based tasks, and an interview.²

1. The Social Target: First, we asked individual participants to articulate their social network as a function of how they wanted to maintain some sense of interpersonal awareness for particular individuals. Awareness was loosely described to participants as a general sense of an individual’s whereabouts and activities. This description was deliberately vague, as we were particularly interested in how participants created their own definitions of ‘awareness,’ though our methodology does indicate to participants that there is likely a range of awareness needs for their social contacts.

Participants were given what we call a *social target*. By way of example, Figure 2.1 shows the reproduction of one participant’s completed social target (Appendix B.5 contains an empty target used in the study). The target contains several concentric rings labelled with time frequencies: daily, weekly, monthly, six months, and yearly/events. We asked participants to write and locate on the target the names of individuals or groups that they wanted to stay aware of at a matching time frequency. Thus, the location of the name within

² I designed the study method in collaboration with Kathryn Elliot.

a particular ring of the target indicates the frequency of the desired awareness. For example, in Figure 2.1 the participant wrote the names of her husband George, daughter Jill, and son John (names changed to preserve anonymity) in the centre ring, or bull's-eye, indicating that she wanted daily awareness information for each of these people.

We told participants that they could create new rings on the target if a person didn't fit nicely into one of the existing time frequencies. We also told them that if the frequency of desired awareness for a person changed from time to time, they could write the person's name on the line between regions or draw an arrow to indicate the change in frequency. For example, at the middle top of Figure 2.1 the participant used an arrow for the 'Carpools' group to indicate that the desired awareness frequency for this group changes between monthly and weekly. We also told participants that they could look up information within their home—such as their address book, email or instant messenger contact list—to remind them of particular contacts and awareness activities, but only after first attempting to fill in the social target from memory.

Following this, in a table on a separate piece of paper (Figure 2.2, the actual table is

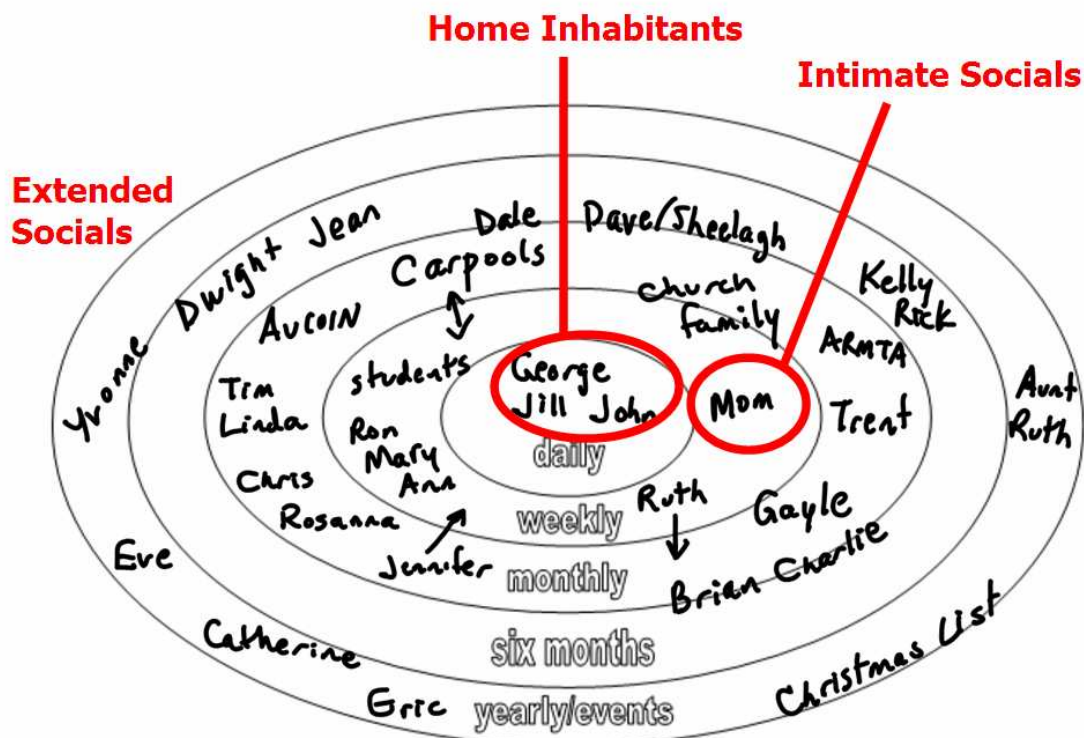


Figure 2.1: A participant's social target from our contextual study (reproduced).

Name (e.g., individuals or groups)	Relationship (e.g., friend, co-worker, spouse, brother, sister)	Location (e.g., your house, work, different city)
George	spouse	same house
John	son	same house
Jill	daughter	same house
Mom	mother	same city
Trent	friend	different city

Figure 2.2: Part of a participant's relationship table (reproduced).

found in Appendix B.7), participants wrote down the name of each person or group on their social target, the person or group's relationship to the participant, and a short description of the location of the person or group, e.g., same house, same city, different city, school, work.

We later used the social targets and tables to generate discussion points for our interviews. The goal was to understand how frequently people desired to maintain awareness in their interpersonal relationships, and to characterize the 'types' of individuals placed on the participants' graphs.

2. Interaction Frequency and Depth: In the second activity, participants were given a set of twelve graphs depicting interaction patterns. Two examples of the twelve are shown in Figure 2.3; all twelve are displayed in Appendix B.6. For each graph, the x -axis represents time and the y -axis represents interaction depth, e.g., the amount of information shared between individuals. The twelve graphs depict stylized interaction frequencies that vary (on the x -axis) from multiple times per day, to once per day, once every few days, once a week, once a month, every few months, and annually. Graphs also vary in the interaction depth (y -axis). Long vertical lines (e.g., Figure 2.3, left) portray in-depth interactions, while short vertical lines (e.g., Figure 2.3, right) portray short, non-detailed interactions. Thus, each graph shows different interaction patterns. For example, the relationships depicted in Figure 2.3 left have in-depth interactions occurring multiple times everyday, while in Figure 2.3 right we see a pattern of superficial interactions that occur weekly.

We asked participants to write the name of each contact they named on the social target next to one or more graphs that best captured their interaction patterns with that

person (two filled in examples are illustrated in Figure 2.3). If none of the given graphs were a good match for a particular person, a participant could draw a custom interaction pattern on a supplied blank graph.

We later used these graphs to generate discussion points for our interviews, this time with an understanding of the interaction behaviours of the participants.

3. Semi-Structured Contextual Interview: Following the above activities, participants took part in a semi-structured interview in their home. Appendix B.8 contains a set of sample questions used to seed the interview. In particular, we asked each participant about his/her social target and interaction frequency graphs. The discussion focused on understanding the relationships participants had with people on their social targets, what awareness information they wanted to maintain about these people, how they maintained this awareness, and how they would use this awareness information.

Following this, participants also partook in additional interviews about the locations in their home where they store, use, and leave communication media like notes, calendars, and other notices. The findings from this can be found in Elliot, Neustaedter, and Greenberg (2005). I highlight the most relevant findings from this extension in Section 2.5.4.

2.2.3 Analysis

I analyzed activities and observations using the open coding technique (Strauss and Corbin, 1998) to draw out similarities and differences between participants and households.³ That is, for each observation I assigned it a code that stylized it, and used that code to mark any recurrence of it. Observations that did not fit were given a new code. For example, when going through the interview notes looking for the types of awareness information people

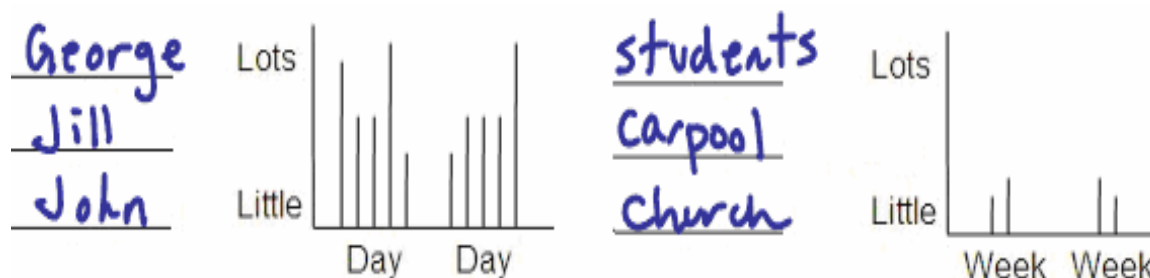


Figure 2.3: Frequency graphs showing interaction patterns for one of the participants (reproduced).

desired, I came across ‘health’ as one type of information. I created a label [H] to represent this type of information. Each time I came across another interview comment that could be characterized as ‘health,’ I flagged the data with the same code, [H]. At times, this process was iterative: I would systematically analyze data from several participants, uncover new categories, and then return to previously analyzed data for analysis using the new codes / categories. Codes generated in the analysis are found in Table 2.1. This analysis method is widely used and accepted in the social sciences; thus, the remainder of this chapter will focus on our results instead of low level details of the raw data and its analysis.

While our participant demographics and household compositions are diverse, we found many commonalities between them. Still, some differences were found between participants of different age groups; thus, I group several findings in the discussion in terms teenagers, young-mid adults, and middle-aged adults. All names appearing in the results have been anonymized.

Relationships of People for Whom Awareness is Needed:

[SP]	Spouse, significant other (girlfriend, boyfriend), fiancé, fiancée, common-law
[CF]	Close friend
[IF]	Immediate family
[W]	Work: Colleagues or supervisors
[R]	Roommate
[F]	Family, non-immediate, e.g., in-laws, not parents, not children
[FR]	Friends
[S]	Siblings
[C]	Children
[RE]	Relatives, other family

Locations of Contacts and Reasoning for Maintaining Awareness

[SH]	Same house, resides with the participant
[DCO]	Different country
[DC]	Different city
[SC]	Same city
[W]	Work
[S]	School
[EA]	Extra-curricular activity; shared interests
[F]	Family: the people have a family bond with the participant
[LR]	Long relationship: the participant has known the person for a long time
[LC]	Life changes: something has changed in the participant or contact’s life
[PE]	Personality
[B]	Change in busy-ness
[P]	Proximity: distance between people
[MC]	Most contact: they have the most contact with the participant
[COM]	Most comfortable with these people

Patterns of Awareness / Interaction Frequency and Depth:

[D]	Daily
[W]	Weekly
[MDD]	Multiple Daily, detailed
[MDN]	Multiple Daily, non-detailed
[SDD]	Single Daily, detailed
[SDN]	Single daily, non-detailed
[WD]	Weekly, detailed
[EFDN]	Every few days, non-detailed
[EFDD]	Every few days, detailed
[EFWD]	Every few weeks, detailed
[EWD]	Every week, detailed
[MOD]	Monthly, detailed
[MON]	Monthly, non-detailed

Awareness Information / Uses:

[PR]	Personal relationships
[P]	Life plans
[H]	Health, how they are feeling physically or emotionally
[LE]	Life events
[SE]	Social events
[WE]	Work/school events, activities
[S]	Availability: Schedule, free times, where the person is, when coming home
[PK]	Personal knowledge: just having an understanding of what the person is up to
[HA]	House administrative things: paying bills, cleaning up
[I]	Share ideas

Awareness Gathering Mechanisms:

[F2F]	Face-to-face conversations
[T]	Telephone, mobile phone
[SMS]	Text messaging, short message/messaging system (SMS)
[E]	Email
[IM]	Instant messengers, e.g., MSN Messenger, Yahoo, ICQ
[N]	Physical notes, e.g., sticky notes, pieces of paper
[L]	Hand written letters
[AC]	“Auto Cues” – for example, seeing if cars are home by looking in the garage

Reasoning:

[C]	People are co-located
[A]	The technology is asynchronous
[M]	Mobile: the technology allows message checking and exchanging anywhere
[PD]	Plausible deniability: the other person doesn't necessarily have to respond, not necessarily interrupting the other person
[AV]	Availability of technology or knowledge, convenience
[H]	The technology provides a history mechanism for saving interaction transcripts
[AF]	Affordability
[PE]	Personalization: the technology makes people feel close and personal
[U]	Urgency

Table 2.1: Analysis codes for social relationships, awareness / interaction patterns.

2.3 Social Groupings for Awareness

I first detail the people within one's social network for whom interpersonal awareness is desired. Figure 2.1 illustrates a very typical social target from our contextual study where we see several people in each ring of the target. Note that the target represents people's perceptions of their current social situation, i.e., the *actual* frequency with which participants maintained an awareness of others, rather than a *preferred* frequency that was not in existence. It also shows a unidirectional awareness need, where in reality there will be natural interplay between individuals to regulate the amount of achieved awareness.

The median number of entities (people and groups) participants placed on the social target was 19 with an interquartile range (IQR) of 16-25 (50% of the participants had between 16 and 25 entities on their target), and a total range of 12-42 people. The large ranges suggest that the number of entities within people's interpersonal awareness sphere is highly dependent on the individual. In our interviews with participants, we asked them to identify individuals on their social targets by the strength of their need or desire for awareness. Their responses led to two broad clusters of contacts: those for whom there existed a strong need for awareness, and those where the need was more discretionary. For some people, these clusters had subgroups within them, but in general these subgroups shared similar characteristics. After analyzing our data in terms of the types of awareness information people desired (discussed in Section 2.4), I was able to further divide and label the two large clusters into three groups of social contacts:

1. **Home Inhabitants:** the people with whom one lives, e.g., family members and/or roommates, where, in general, a strong need for awareness exists;
2. **Intimate Socials:** the people with whom one does *not* live but still maintains a close personal relationship where there is a strong need for awareness, e.g., significant others not living together, close friends, aging elderly parents; and,
3. **Extended Socials:** the people with whom one does *not* live where the relationship is more casual and the need for awareness is more discretionary, e.g., friends, extended family members or relatives.

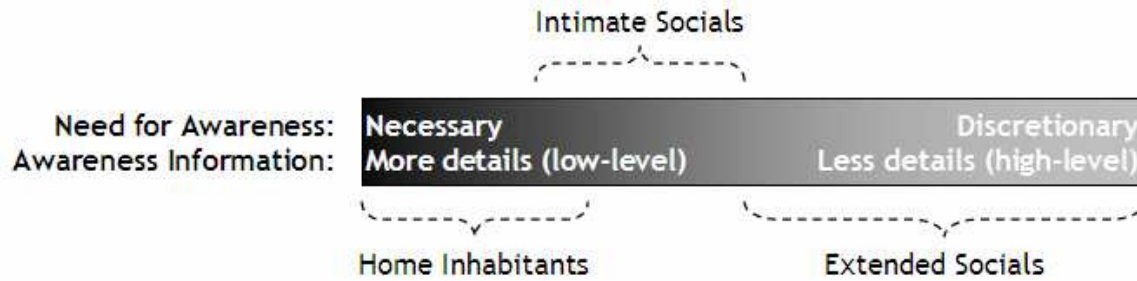


Figure 2.4: Range of awareness needs for three social clusters.

To foreshadow what is to come, these groups differ based on a combination of the level of need for awareness and the amount of awareness information desired (e.g., the level of detail), illustrated in Figure 2.4. It is these differences found throughout our interviews and analysis that allowed us to identify the groupings. Despite this, I caution that our three groups are best viewed as broad clusters defining a spectrum of relationships *vs.* strictly bounded groups.

I now describe each of these three groups in more detail. The discussion will tend to use the words *need* and *desire* interchangeably. This is because we have found that, as it relates to interpersonal awareness, one's *desires* often strongly relate to what one perceives to be *needs*.

2.3.1 Home Inhabitants

As the name suggests, *home inhabitants* contain those people with whom one lives: *significant others*, *immediate family members*, and *roommates* (Figure 2.4, left end of spectrum). The number of home inhabitants will, of course, vary depending on the household. All participants in our study said they had a strong desire to maintain an awareness of their home inhabitants. However, I caution that while our study contained several households of roommates, the roommates we saw were all close friends. We expect that individuals who do not have close relationships with their roommates will correspondingly not have as strong a need for an awareness of them.

Collectively, all of our study participants but one wanted to maintain awareness of and interactions with their home inhabitants on a daily basis. This was indicated by analyzing placements on the social target and how these placements related to the interaction frequency graphs. The sole exception was a person who only lived with his mother part of the time under shared custody; this unusual living situation explains why his desired

awareness frequency was weekly and not daily. Across all of our participants, they reported detailed interactions with over four-fifths (83%) of the 76 home inhabitants. As a typical example, Figure 2.1 illustrates how the participant placed her live-in husband, George, and teenage children, Jill and John, in the ‘daily awareness’ bull’s-eye of the social target. We also see in Figure 2.3 that she listed these family members next to the left graph, indicating that she interacts with her family members multiple times most days and that these are mostly (but not always) in-depth. Based on these findings, we conclude that *the desire for awareness as well as interaction frequencies with home inhabitants is on a daily basis, although the interaction depth can vary.*

2.3.2 Intimate Socials

The *intimate socials* group contains *those people with whom one has a close personal relationship, but does not live with, where there is a strong need for awareness* (Figure 2.4, middle of spectrum). For example, the participant from Figure 2.1 maintained a close relationship with her mother, desiring awareness on a weekly basis and maintaining detailed weekly interactions, shown in Figure 2.3. We asked our study participants to name the people (besides the home inhabitants) with whom they had a close relationship and a strong need for awareness. They reported:

- *Significant others*—included by all participants who did not live with their significant others, e.g., fiancé(e), girl/boyfriend;
- *Immediate family members*—included by all but two participants (93%), e.g., parents or siblings;
- *Close friends*—included by almost three-quarters (72%) of participants; and,
- *Work colleagues*—included by only three people (10%).

Other studies also found that people typically have a strong need for awareness of aging elderly parents (Mynatt *et al.*, 2001) along with children who have recently moved away from ‘home’ (Tollmar and Persson, 2002).

How many people comprise intimate socials? The median number of intimate socials was surprisingly small: 3 for all participants (IQR=0-6, total range=0-12). Breaking this down further, the median was 5 for teenagers (IQR=4-6), 3.5 for young-mid adults (IQR=1-6.25), and 0 for middle-aged adults (IQR=0-2.25). These numbers suggest that

teenagers typically have more close friends for whom they desire awareness than other age groups. Counter-intuitively, middle-aged adults generally have very few intimate socials. This is explained because most middle-aged adult participants had their own children, and their close contacts typically contained only immediate family members, e.g., a partner and children living with them.

Is proximity a key factor in determining who is an intimate social? Our results suggest that while proximity is important, it is not the only dominant factor. About two-thirds of our participants (66%) had intimate socials in the same city as they lived. About half (48%) had people from a different city but within the country, and about one quarter (24%) had people from a different and far-away country. Most participants said their main reason for desiring an awareness of intimate socials was because s/he was close to them as s/he was considered family. Other reasons given include shared interests in extra-curricular activities and hobbies, work, school, or similar personalities. Most teenagers' desired an awareness of friends from school because they would see them frequently. Thus, *in general people are intimate socials because they share a close personal relationship. A lack of proximity makes it more difficult for someone to be an intimate social member, but it does not prevent it.*

Does the composition of the intimate socials group ever change? Most participants felt that their intimate socials rarely changed, and when they did it was for major reasons typically involving life changes by either the participant or their intimate socials. These included moving to a different city, changing jobs or schools, retiring, graduating from school, getting married, or the death of an intimate social. Other reasons included a change in one's schedule, meeting new people, a change in one's personalities or interests, and proximity of loved ones. Several participants said they maintained more awareness and contact with certain individuals at different times of the year. For example, one participant's contacts depended on the sports season: golf in the summer, hockey in the winter. For the most part, these changes did not affect the composition of the intimate social network though. Thus, *the composition of one's intimate social network is generally only affected by life changes.*

How often is awareness desired? A strong need to maintain awareness of an intimate social does not necessarily imply a frequent need. While nearly all participants (90%) had intimate socials for whom they desire a near-daily awareness, over one-third of the participants (38%) had intimate socials for whom they desired only weekly awareness.

To break this down further across all participants, of the total 114 intimate socials, participants desired daily awareness for about 55% of them, daily to weekly awareness for about 10%, weekly awareness for about 30% of them, and about 5% for less than weekly awareness.

I emphasize that it is not the frequency of awareness that defines an intimate social, but the strength of a person's need for that awareness. For example, three participants had individuals in their daily awareness ring who were not intimate socials; while they received this information, their need for it was not particularly strong. Similarly, people may be satisfied with weekly updates of someone in their intimate circle: they have a strong need for this information, but the weekly update suffices to fulfill that need. Thus, *in general, people desire a daily to weekly awareness of most intimate socials; a frequent need for awareness by itself does not make someone an intimate social.*

How often do they interact? Most often, people interacted with their intimate socials at the same frequency for which they desired awareness: 88/114 intimate socials (77%) had the same interaction and awareness frequencies. In the cases where this differed, the differences were typically small, e.g., awareness every few days *vs.* interaction every week. Over half (54%) of the total intimate socials maintained daily interaction with participants, about 19% daily to weekly interaction, about 21% for weekly interaction, and less than 6% for interaction less frequent than weekly. The variation in interaction depth is similar. Of the 114 intimate socials, over three quarters (79%) of them had detailed interactions with the participants and about one-fifth (21%) had non-detailed interactions. Thus, *in general, most people maintain daily to weekly interaction with a large portion of their intimate socials. Moreover, the majority of all interactions with intimate socials contain detailed exchanges of information.*

2.3.3 Extended Socials

While the *extended socials* group can also contain the family and friends of interest to a particular person, *the relationship is much more casual and the need for awareness is more discretionary* (Figure 2.4, right end of spectrum). For example, in Figure 2.1 the participant noted 26 individuals and 6 groups that fit this category.

How many people comprise extended socials? The median number of extended socials for all participants was 13 (IQR=8-19, total range=3-38), teenagers was 10 (IQR=10-

10), young-mid adults 10 (IQR=7.5-14), and middle-aged adults 18.5 (IQR=16.5-27.5). A caveat is these numbers include individuals along with groups considered as single social units, yet they suffice to show that as one ages, the number of extended socials increases. This seems natural as one typically gains more family members and friends throughout a lifetime that are considered to be extended contacts and along with this comes more social responsibilities (e.g., Christmas cards, carpools). All participants had friends who were extended socials. About two-thirds (66%) had co-workers/teachers, two-fifths (41%) had siblings, and about two-thirds (66%) had other relatives. Thus, *in general, people want to maintain awareness of around ten extended socials, with most having less than forty.*

Does the composition of the extended socials group ever change? Participants reported that the composition of extended socials is relatively static over time. This was mostly the case because of an inclusion of many family relatives as extended socials. Changes to the extended socials group were normally a result of changes to the intimate socials group; if participants grew apart from any of their intimate socials, these individuals would typically become extended socials. However, changes could also occur as a result of a change in social or work activities, e.g., the end of soccer season may signal little need for an awareness of a soccer carpool. Thus, *in general, the extended social group is fairly static, but can be affected by changes to the intimate social group, or changes in social or work activities.*

How often is awareness desired and how often do they interact? The placement of extended socials varied throughout the social targets, indicating the frequency of desired awareness is highly dependent on the individual. The interaction frequency graphs also saw a wide range in frequencies, but, in general, contained non-detailed interactions. That is, people shared their more significant life changes instead of smaller details (specific instances of this are described in the next section). While nearly all participants wanted more frequent awareness of their extended socials, they found it difficult to maintain because of scheduling difficulties, distance separation, or the time required for maintaining awareness. Naturally a tradeoff exists between acquiring an awareness of more individuals and distractions, interruptions, and feelings of information overload. This tradeoff is discussed in more detail in the next chapter. Thus, *in general, the frequency of desired awareness for extended socials differs depending on the person, yet most people desire more frequent awareness for these people than they are able to maintain.*

2.4 Interpersonal Awareness Information

The second aspect of interpersonal awareness that I describe is *interpersonal awareness information*: the specific awareness information people desire to maintain for individuals within their sphere of awareness, and their uses of this information. We found that interpersonal awareness information generalizes to knowledge of one's *context* at varying levels of detail depending on the individual and her interpersonal relations. People want to know this information in order to *coordinate*, promote feelings of *connectedness* or *comfort*, or simply to have *shared personal knowledge*. This information typically falls into three interrelated categories where information in one category is often associated with information from another category.

- **Location:** where a social contact is, has been, or is planning to be, including knowledge of presence;
- **Activity:** the current, past, or upcoming social or work activities of a social contact, along with knowledge of availability; and,
- **Status:** the current or past emotions, attitudes, or well-being of a social contact, including knowledge of one's health.

These categories largely parallel existing definitions of context (Dey *et al.*, 2001), yet they contain subtleties specific to interpersonal awareness and, most important, *they differ between our three social groups*. I now discuss these subtleties where I include many examples based on findings from our contextual study and existing research.

2.4.1 Awareness of Location

Imagine asking a family member or friend the question, “*where are you going?*” or “*where were you?*” You would likely expect different answers depending on who you asked just like you would share different information based on who asked you. This is precisely what we found.

For home inhabitants, people want to know detailed location information: day-to-day or sometimes even moment-to-moment knowledge of the specific whereabouts of a cohabitant along with an understanding of where one plans to be. For example, Kayla, a working mother from our study, liked to know if her teenage son was at a friend's house after school or if he had gone straight home providing her with a feeling of *comfort*. Sometimes only a

general understanding of locations is needed: for Gwen, again a mother in our study, knowing that someone has gone out to run errands, but not necessarily knowing which errands, is enough information. This kind of knowledge helps Gwen *coordinate* household plans like dinner times. For many people, location information translates into knowing one's *presence* at a particular location (Tollmar and Persson, 2002). For example, Gary and Cathy, married with no children, both like to simply know that the other is at home because even if s/he is in another part of the home the knowledge is *comforting*.

For intimate socials, people want similar location details but at a lesser level of detail, typically daily or every few days, and often this awareness is of *past locations or upcoming ones*. For teenaged Kim, this meant knowing what her close friends had planned for the weekend so she could also *coordinate* activities with them. Adult children may desire to know whether their elderly parents are at home, have left home, or, in serious cases, are at the hospital (Mynatt *et al.*, 2001), again creating *comfort*.

For extended socials, people want to know even less details about location or may not even care about one's location except in special circumstances. Normally this involves knowing what city or area an extended social resides in or their location of work. For example, Linda told us she was often curious to know where her extended friends currently work.

2.4.2 Awareness of Activity

Now imagine asking a social contact, "*what are you going to do?*" or "*what did you do?*" Again, you'd expect a variety of answers depending on the person and their relationship to you.

For home inhabitants, people want to know about their daily activities along with their upcoming plans. This includes knowing specifics about one's schedule of work/school and social activities. Work details generally include knowing the days and times that one is working, rather than knowledge of work appointments and meetings. For example, Sandra liked to know what specific projects her husband was working on (though not the fine details of the projects) and what days he had to work. Social activities typically include knowing the activity's day/time, the type of activity (e.g., watching a movie at the theatre, visiting a friend) and the other people involved in it (e.g., which friends). As one would expect, we found parents were typically much more aware of the activities of younger children, and less so for older teenagers. Households must *coordinate* their day-to-day plans (Ling, 2000) and it is

often necessary for cohabitants to schedule their activities and events based on the activities of each other. For example, Dale and Becky, parents of children aged 14 and 16, commented that they need to know their children's schedules in order to coordinate rides to various activities. Significant others may find it *comforting* to know what the other is doing while away on a business trip, or could feel more connected if performing a similar activity while distance-separated (Gaver, 2002).

For intimate socials, people want details about past or upcoming social or work activities, rather than knowledge of current activities. For example, Kayla, a mother from our study, wanted to know what her girlfriends had been up to *last week* and if anything 'major' happened at their job simply to maintain a level of *shared personal knowledge*. Intimate socials also use activity awareness to *coordinate* but to a lesser extent than home inhabitants. For example, teenagers Carrie and Lee want to know the availability of their friends, so they can 'hang-out' with them. Detailed current knowledge of the availability of one's intimate socials was generally only desired by teenagers or significant others who did not live together, e.g., fiancés, girl/boyfriends. In the case of Paul, a graduate student living at his parents' home, awareness of his fiancée was much more like awareness of his cohabitants because of the close relationship with her.

For extended socials, people want to know activity information at an even higher level still. This typically equates to knowing major events or life changes, e.g., changing jobs, moving to a different city, getting married, having children. Awareness of activities of extended socials most often provided feelings of *connectedness* or *comfort*. For example, in the case of an aging elderly parent, knowing she is active can provide a sense of comfort that she has not fallen or is sick in bed (Mynatt *et al.*, 2001). The opposite has also been found where grandparents desire activity awareness of their children and grandchildren (Plaisant *et al.*, 2006). In our study, activity awareness was generally only used by extended socials for *coordination* at a macro level, e.g., planning visits or holidays to see these people.

2.4.3 Awareness of Status

Now imagine asking a social contact, "*How are you doing?*" The answers would again vary where we have found they will often *relate to one's location or activity* as people almost always have feelings or attitudes associated with events or situations in their lives.

For home inhabitants, status involves knowing how one feels about most aspects of their lives in addition to knowing how healthy one is and knowing about personal relationships (e.g., who is dating whom). Parents have a strong desire to make sure that things are going well for their children and, as providers, to ensure they have what they need. For Becky, she is concerned daily about how her children are feeling because she wants to provide emotional support when needed. Often this will involve knowing how they are feeling about school, such as whether a test result went well or if they are feeling overwhelmed with homework. Significant others share similar information about their lives, which can also make them feel more *connected* to one another (Gaver, 2002).

For intimate socials, the same status information is desired but typically about only a selection of activities or health information. This often equates to knowledge about a shared interest or outing, a particular relationship, or a health problem. For example, Kayla's daughter, Shannon, recently moved out of town to go to college. Kayla and Shannon talk on the phone at least once a week and often their discussions will surround Shannon's latest boyfriend. Dale and Becky are often quite concerned about the health and well-being of Dale's mother who recently suffered a stroke. They try to talk to her every few days to ensure she is still feeling fine where this knowledge is used to monitor and assist.

For extended socials, most people primarily want to know status information about health changes. Extended socials are much less intimate and feelings are not typically shared, at least not in great detail. In some cases, knowledge of status can even translate into a *lack of comfort* or worry if 'bad news' is found out about a social contact, e.g., a relative is ill.

2.5 Techniques for Maintaining Awareness

The third aspect of interpersonal awareness that I describe is *techniques for maintaining awareness*: the techniques people use to acquire and maintain interpersonal awareness as a part of their everyday routines. We found that interpersonal awareness is typically maintained using one or more of the following techniques:

- **visual cues from domestic artefacts:** by observing the presence, absence, or status of artefacts in the home, awareness information is often naturally understood without direct interaction;

- **face-to-face interaction:** when people are co-located with their social contacts they naturally converse and share awareness information; or,
- **mediated interaction:** when separated by distance, people use handwritten notes and messages or technology such as the telephone, email, or instant messenger to maintain awareness.

It is important to realize that the three techniques I present are in no means hierarchical in nature; rather, each technique offers contexts for which it is particularly well suited and each comes with its own limitations. I discuss each technique next and then illustrate how the home provides additional meta-data about awareness information through contextual locations.

2.5.1 Visual Cues from Domestic Artefacts

Households are displays where people leave imprints of their lives and activities throughout the home (Hindus *et al.*, 2001, Taylor and Swan, 2005). Here *home inhabitants receive awareness information from the presence or absence of particular domestic artefacts from routine locations*. Often these cues are noticed as background activities requiring little thought or active attention. For example, Jeremiah, a college student living at home, explained to us how when arriving home he would automatically check, without much thought, whose cars were at home as he entered the garage. This information led him to quickly understand which family members were around. His father, Mark, similarly commented that he could tell if his sons had gone out mountain biking (a common activity) by peering into the garage to see if the bicycles were gone. Other participants we interviewed used similar strategies with items like keys or wallets left in routine locations. Related research has pointed out that the *status* of domestic artefacts also provides *location* awareness. For example, the status of a light (on/off) can often indicate the presence and location of household members: if the light is on, likely someone is in that room (Tollmar and Persson, 2002). Naturally, inference errors can occur when gathering awareness through these types of visual cues, yet despite this, people still rely heavily on cues presented by domestic artefacts for maintaining awareness of home inhabitants.

2.5.2 Face-to-Face Interaction

When people are co-located with their social contacts they naturally converse and share awareness information through face-to-face interaction. People enjoy face-to-face interaction because, naturally, they like talking directly to their family and friends (Hindus *et al.*, 2001, Tollmar and Persson, 2002). *Face-to-face interactions are used heavily by home inhabitants because they are often collocated.* Here simple conversations as people go about their activities at home can provide awareness. For example, many of the mothers we interviewed talked about checking the family calendar in the evening or morning and then discussing its contents with family members to bring people ‘up-to-date’ on family activities. Significant others have even been found to streamline their conversations to develop short-hand interactions involving brief instructions, which are generally only understood by family members (Ling, 2000).

The use of face-to-face interaction declines for intimate socials as they are not collocated as often as home inhabitants. *Face-to-face interactions with intimate socials typically occur during social outings or shared activities.* While people are together, like home inhabitants, they will discuss their activities which in turn provides an awareness and shared understanding. *Extended socials often have few opportunities for awareness gathering through face-to-face interaction* because they are seen on a much less frequent basis (e.g., visits to far-away family). However, we did find that face-to-face communication allowed people to learn indirectly about extended socials. For example, children may learn about the health of a grandparent by talking with their mother after she had visited the grandparent. There are, of course, exceptions to these general cases: sometimes contacts are seen frequently, yet few details are shared because of the nature of the relationship (e.g., carpools).

2.5.3 Mediated Interaction

Mediated interaction is vital for providing social contacts with awareness information when they are not collocated. Even in the case of home inhabitants, they are not always home at the same time (e.g., someone is at work) making it impossible to gather awareness through face-to-face interaction. In this case of *time separation*, mediated interaction is crucial. Nearly all participants from our study used some form of *handwritten notes to provide awareness information for their home inhabitants*, most often because it was very simple to do. Here

individuals write a note to a cohabitant or the entire household using media like sticky notes, message pads, scraps of paper, the family calendar, or whiteboards (Elliot *et al.*, 2005). The most crucial aspect of leaving notes that we found was the *location* of the note itself, which we describe in the next section.

In addition to notes, technologies like telephones, email, and instant messaging (IM) are used by individuals to maintain an awareness of their social contacts, this time for all social groupings. Here mediated interaction is used to overcome challenges of distance separation. We found people almost always choose the technology that is both easy for them to use and likely to reach their social contacts. Telephones and mobile phones were convenient for reaching contacts at work or while mobile. Information would be exchanged much like in face-to-face situations. We found that middle-aged adults favour the telephone because new technologies seem ‘foreign’ or daunting to them. Yet many found other technologies like email very useful especially for contacts overseas when phone rates become expensive. Other non-technologies like letters (for postal mail) fulfill similar purposes yet only one person reported using these.

Heavy computer users would routinely use email or IM to exchange information. People enjoyed using email as it allowed them to share awareness information asynchronously (also found by Tollmar and Persson, 2002). For Kayla, sending an email to her son from work to home was easier than trying to catch him on the phone because he may not have arrived home yet, or he could be at a friend’s house. Our participants told us that IM provides near synchronous conversations when both parties were around, but when not, provided an easy way to leave an asynchronous message for another. Tricia and Shawn, a young common-law couple, both have an IM client running on their computers when at work. This provides a very quick and easy communication channel to make plans or update the other on their day’s activities. Brandon, like many teenagers we interviewed, likes using IM because of its near synchronous nature. He also found IM allowed him to have multiple simultaneous conversations with different people, and he could even be doing other activities at the same time like playing video games! Similar findings have been found by Grinter and Palen (2002). Smale and Greenberg (2005) found that heavy IM users often change their IM name or handle to present awareness information about themselves to their social contacts.

2.5.4 Contextual Locations

Further work led by Kathryn Elliot as a second part of this study (Elliot, Neustaedter, and Greenberg, 2005) reveals important attributes about the locations in which awareness information—through notes or other domestic artefacts—is found in the home. *Contextual locations* are “places in the home that have meaning for household members that has developed over time as a shared understanding based on knowledge of each others’ routines and pathways” (Elliot *et al.*, 2005, Elliot *et al.*, 2006a). These locations provide people with an understanding of how to easily handle the awareness information placed there. This occurs in two main ways.

First, locations can provide information about *time*, including knowledge of the urgency of information (Elliot *et al.*, 2005). For example, Kayla described a situation where she wanted her teenage son to see an important note when he arrived home from school. She stuck it on the television because she knew that watching TV was one of the first things he did when arriving home. Here the location is providing an understanding of the *urgency* of the awareness information being presented (Elliot *et al.*, 2005). Other locations may be more suitable for awareness information that is to be acquired in a more leisurely way. Knowledge of time also relates to the *relevance* of information: particular information needs to be seen at a certain time (even if it is not urgent) (Elliot *et al.*, 2005). For example, a family may place rented DVDs that need to be returned next to the door of the house. When leaving the home, a family member will see the DVDs and be reminded to return them. The act is not necessarily urgent, but it is important that the information be seen at the right time (when leaving the home).

Second, locations can provide information about *ownership*. Here family members understand *who* information is intended for based on its location. Family members will also place information in locations to reflect who it is meant to be viewed by. Four main types of locations exist relating to ownership (Elliot *et al.*, 2005):

- *Public spaces*: locations that are visible by all family members where information placed within them is intended for public family viewing, e.g., a fridge door containing a grocery list for the entire family to see;
- *Public subset spaces*: locations that are public for a subset of family members, e.g., a shared calendar placed on a shelf in a couple’s bedroom;

- *Personal spaces*: locations that are publicly visible but intended for one person, e.g., a placemat on the kitchen table where family members place mail for an individual;
- *Private spaces*: locations that are not publicly visible and intended for one person, e.g., a daytimer kept inside a family member's purse.

Knowledge of these locations by a household allows people to easily understand which information they should pay attention to (e.g., is it for them?) and also provides a convenient method for placing information. It is through these locations that awareness information found throughout the home, in the form of domestic artefacts, gains additional meaning.

2.6 Summary

This chapter *describes the domestic awareness and coordination routines of family and friends* (Chapter 1, Objective 1). This description, found throughout the chapter, creates a *model of interpersonal awareness* that is summarized in Table 2.2 and this chapter summary. It illustrates that people desire interpersonal awareness for individuals that fall into three general social clusters: *home inhabitants*, *intimate socials*, and *extended socials*. Home inhabitants are small groups of people with whom one lives; intimate socials are typically small groups of people with whom one shares a close relationship; and, extended socials are larger groups of social contacts comprised of more extended family and friends (Table 2.2, Column 1). In general, we have found that interpersonal awareness is: *a shared understanding of the location, activity, or status of one's personal contacts*. This awareness can provide people with information to enable the *coordination* of activities, or produce feelings of *connectedness* and *comfort* (Table 2.2, Column 3). Yet the need for this information varies in its frequency (Table 2.2, Column 2) and granularity (Table 2.2, Column 3) depending on whether a social contact is considered a home inhabitant, intimate social, or extended social. People typically desire detailed and frequent awareness of their home inhabitants (Table 2.2, Row 1). This equates to knowing information about past, present, and upcoming events. For intimate socials, people want somewhat less frequent yet still detailed updates focused on past or upcoming events, as opposed to information about the present like home inhabitants (Table 2.2, Row 2). People want even less frequent updates about extended socials. Here they are interested in non-detailed or high level information at even less frequent intervals.

	Social Grouping Characteristics	Frequency of Awareness	Awareness Information Maintained	Techniques for Gathering Awareness
Home Inhabitants	Household members/ families; Small groups of one to six people	Frequent updates, moment-to-moment or daily	Detailed information about activity, location, and status About the past, present, and upcoming events	Visual cues from domestic artefacts (their location shows information about <i>time</i> and <i>ownership</i>); Face-to-face and mediated interaction
Intimate Socials	Close personal contacts; Small groups of one to six people	Somewhat frequent updates, daily to weekly	Detailed information about activity, location, and status About the past and upcoming events	Face-to-face and mediated interaction
Extended Socials	Extended family and friends; Large groups of usually fewer than 20 people, but sometimes larger	Infrequent updates, weekly to monthly or even less frequent	Non-detailed information about activity, location, and status About the past and upcoming events	Fewer opportunities for face-to-face interaction; mostly mediated interaction

Table 2.2: A summary of the model of interpersonal awareness.

People use a variety of techniques for gathering awareness information of their social contacts including visual cues from domestic artefacts, face-to-face interaction, and mediated interaction. Visual cues provide home inhabitants with awareness information implicitly as they notice the presence, absence or status of artefacts in their home (Table 2.2, Row 1, Column 4). All groups benefit from face-to-face interaction where information is shared through conversation (Table 2.2, Column 4), yet when people become separated by distance or time it can be hard to gather awareness information. This is especially true for intimate and extended socials. Here technology is able to help bridge this gap. Mediated interaction is the third way that awareness can be gathered where handwritten notes and technology like email, the phone, or instant messaging provide mediums for sharing awareness.

The key finding from this chapter is that there is a range of interpersonal awareness needs in the domestic realm that *has* translated into the development of different routines for maintaining awareness of social contacts from each of the social groupings. One of these needs is the maintenance of activity awareness for home inhabitants where the information is used for household coordination. This translates into family calendaring, which becomes

the main focus for Parts II and III of this dissertation. The model of interpersonal awareness presented in this chapter also adds value for we can now begin to understand how the acquisition and maintenance of awareness in the domestic realm differs from the workplace and analyze existing awareness technologies to reveal design opportunities for awareness groupware in the home. This is the theme of the next chapter.

Chapter 3. Applying the Model of Interpersonal Awareness⁴

The goal of this chapter is to provide an understanding of how the Model of Interpersonal Awareness—described in Chapter 2—can be *applied to the design of groupware* (Chapter 1, Objective 1). This involves discussing the implications of the work in terms of the value it can provide researchers, designers, and practitioners. First, I provide a *comparison of interpersonal awareness to workplace awareness*. This involves looking at the similarities and differences between the two awareness contexts, which draw out key implications for the design of awareness technologies for the home. Second, I *analyze existing awareness technologies and artefacts* to understand where they succeed or fail at providing awareness for family and friends. This involves mapping out the interpersonal awareness design space, which shows design opportunities for groupware in domestic environments. Third, I discuss how this suggests a *narrowing of scope* from a ‘one solution fits all’ strategy to designing awareness groupware to meet the specific needs of home inhabitants, intimate socials, and extended socials. One of these needs is awareness groupware to aid coordination for home inhabitants. This led to my focus of family calendaring for home inhabitants in the remaining parts of this dissertation.

3.1 Interpersonal *vs.* Workplace Awareness

In this section, I compare informal awareness in the workplace to interpersonal awareness in the home, looking at the people for whom awareness is desired, the awareness information maintained, and the techniques used to gather this awareness. From each comparison, I

⁴ Portions of this chapter are also published in: Neustaedter, Elliot, and Greenberg (ACM CHI Workshop 2005), Elliot, Neustaedter, and Greenberg (UbiComp 2005), Neustaedter and Greenberg (Technical Report 2005), and Neustaedter, Elliot, and Greenberg (OzCHI 2006e).

draw out key implications for groupware design of interpersonal awareness technologies. Table 3.1 summarizes each aspect of the comparison.

3.1.1 Social Groupings

Existing literature on informal awareness outlines that in the workplace there exists differing needs for informal awareness of co-workers. Studies of informal workplace communication have shown that people who are situated in close physical proximity are more likely to collaborate on projects simply because they are more easily able to engage in informal conversational encounters (Kraut *et al.*, 1988). These informal encounters or casual interactions are held together by *informal awareness* which helps people decide if and when to move into interaction (Fish *et al.*, 1990, 1992, Dourish and Bly, 1992, Whittaker *et al.*, 1994). Therefore, informal awareness is strongly needed by workers who have a need and desire to frequently collaborate, often referred to as *intimate collaborators* (Greenberg, 1996) (Table 3.1,

	Workplace Awareness	Interpersonal Awareness
Social Groupings	Intimate collaborators have a strong need for awareness; Other organizational colleagues have discretionary needs for awareness that will depend on the relationship	Home inhabitants and intimate socials have a strong need for awareness; Extended socials have discretionary needs for awareness
Awareness Information Maintained	Activity and location information to understand availability	Activity and location information coupled with an emotional / status component
Uses for the Awareness	Easily move into interaction and collaboration to support goal-oriented tasks	Coordination of family activities and social outings; Personal and social needs to simply have shared knowledge
Awareness Maintenance	Typically background or sub-conscious activities (e.g., glancing in open office doorways)	Background (e.g., glancing at the presence/absence of domestic artefacts) <i>and</i> foreground activities (e.g., probing others for information)
Design Solutions	A range of software systems designed for desktop PCs: some provide detailed awareness for intimate collaborators, others provide less-detailed information for large groups	A range of software systems are needed to match the range of information needs and domestic contexts, including systems designed for non-desktop usage utilizing tangible or embodied interaction

Table 3.1: A summary of the similarities and differences between workplace and interpersonal awareness.

Row 1, Column 1). The opposite is also true: informal awareness can lead to casual interaction that helps people serendipitously form an intimate collaborator relationship. As colleagues become separated by distance, awareness decreases and so too does collaboration (Kraut *et al.*, 1988, Fish *et al.*, 1990). Thus, there exists two clusters of colleagues in the workplace with differing awareness needs (Table 3.1, Row 1, Column 1): intimate collaborators where awareness needs are high; and, other colleagues where awareness needs are more discretionary and collaboration is less frequent or even non-existent (e.g., organizational members who occasionally have to touch bases when their responsibilities overlap).

As our model of interpersonal awareness indicates, awareness in the home is also desired for a spectrum of relationships. Thus, a parallel exists between the social groups of interpersonal awareness and informal awareness. Home inhabitants and intimate socials are similar to intimate collaborators in that people desire frequent and detailed awareness of both their home inhabitants and intimate socials (especially in the case of home inhabitants) (Table 3.1, Row 1, Column 2). Breaking it down further, we can see that home inhabitants are similar to colocated collaborators where individuals in each group are primarily in the same location together. Intimate socials, on the other hand, would be more like distributed collaborators who are often separated by distance. On the other end of the spectrum, extended socials are similar to other organizational colleagues where awareness need is more discretionary and at a higher / less-detailed level (Table 3.1, Row 1, Column 2).

Clearly *both* informal awareness and interpersonal awareness revolve around a *spectrum of relationships where people have different awareness needs depending on the relationship*. In the workplace, these differing needs have brought about a spectrum of design solutions (Table 3.1, Row 5, Column 1). On one hand, tools like instant messaging systems can present awareness information for a large number of colleagues, even though the awareness information may not always be the most detailed or accurate (typically relying on a crude approximation of awareness through availability states). On the other hand, systems like media spaces (Fish *et al.*, 1990, Mantei *et al.*, 1990, Dourish and Bly, 1992) can provide a rich level of awareness detail for intimate collaborators, replicating face-to-face situations where awareness information can be deduced easily through the visual channel. There have also been a host of systems that fall somewhere in the middle, e.g., the Notification Collage

(Greenberg and Rounding, 2001), SideShow (Cadiz *et al.*, 2002), and the Community Bar (McEwan and Greenberg, 2005). These systems can support detailed awareness for intimate collaborators, often through the incorporation of an optional video link. Yet they also suffice to provide a degree of awareness for colleagues with discretionary awareness needs where features similar to instant messaging systems with availability states are provided.

Given that a range of awareness needs also exists for interpersonal awareness, like informal awareness groupware, it would be a serious mistake to design awareness groupware for the home with the mindset that one solution fits all. Instead, awareness groupware for the home should *offer a spectrum of design solutions to address the specific needs of home inhabitants, intimate socials, and extended socials* (Table 3.1, Row 5, Column 2). The model of interpersonal awareness articulates these needs and I expand on how this relates to design in Section 3.1.4. Even though the two types of awareness are superficially similar in terms of social groups, important differences exist in terms of the *types of awareness information* that are maintained and the *uses for it*. I describe these differences and the implications for design that arise from them in the next sections.

3.1.2 Awareness Information

Informal awareness in the workplace is concerned with situational cues that can provide details of a co-worker's location, activity, and availability (Fish *et al.*, 1990, 1992, Dourish and Bellotti, 1992, Dourish and Bly, 1992, Whittaker *et al.*, 1994, Greenberg, 1996). While interpersonal awareness also involves maintaining *location and activity awareness*, in the home this information is desired for much different reasons. In the workplace, informal awareness is primarily focused on knowledge of one's activity and location to support collaborative and goal-oriented tasks (Whittaker *et al.*, 1994) (Table 3.1, Row 2, Column 1). That is, the awareness is used to understand when and how to best move into interaction with others where these interactions become the key components for fostering collaboration and work activity (Kraut *et al.*, 1988, Fish *et al.*, 1992, Whittaker *et al.*, 1994) (Table 3.1, Row 3, Column 1). Contrarily, in the home the primary purpose of interpersonal awareness is *not* goal-centric. Rather, we have found that awareness in the home is centred on the everyday coordination of mundane things like family activities and social outings (Table 3.1, Row 3,

Column 2). Household activities are typically fueled by personal and social needs (Venkatesh, 1996, Edwards and Grinter, 2001, Sellen *et al.*, 2004).

In addition to location and activity awareness, we now know that interpersonal awareness often contains a *status* or *emotional component* (Table 3.1, Row 2, Column 2). People like to know how their family and friends *feel* about various aspects of life or how they are doing to *fulfill personal and social needs*. This status component is generally not found in informal awareness. This is not to say that people do not maintain status awareness of co-workers like they would friends; indeed, several people in our study did include colleagues as intimate or extended socials. The important difference is the fact that this awareness of status is much more secondary in the workplace, when compared to location and activity awareness.

While they share some similar aspects, interpersonal awareness and informal awareness are fundamentally different in terms of the awareness information that people maintain. Given this, it is clear that *awareness groupware for the workplace cannot simply migrate into the home*. Instead, designers and practitioners should design awareness technologies for the home that pay particular attention to present the awareness information that is specifically needed for domestic environments. Davis and Gutwin (2005) add to this overall argument by suggesting that awareness servers should be designed in a manner capable of broadcasting differing amounts of information depending on the recipient.

3.1.3 Awareness Maintenance

Informal awareness is primarily gathered through unconscious acts as one goes about his or her workday, for example, by looking around a shared office or by simply walking down a hallway and glancing into open office doors (Table 3.1, Row 4, Column 1) (Fish *et al.*, 1990, Dourish and Bly, 1992, Greenberg, 1996, Schmidt, 2002). The maintenance of interpersonal awareness is similar to informal awareness in that it can also be acquired through *background activities* where it is gathered almost without realization, be it through everyday conversation or by visual cues throughout the home (Table 3.1, Row 4, Column 2). Problems of distance separation arise for both informal awareness (Kraut *et al.*, 1988, Fish *et al.*, 1992) and interpersonal awareness. When people become separated by distance it becomes more difficult to gather awareness information through background activities because people are

not often in the same environment and visual cues are lost. Unlike informal awareness at work, the maintenance of interpersonal awareness frequently becomes a *foreground activity*: often people will actively probe others they are interested in for particular information, regardless of whether they are collocated or not (Table 3.1, Row 4, Column 2). Yet while people enjoy talking to their social contacts, when maintenance repeatedly becomes a foreground activity, it can become very time consuming.

In the workplace, awareness maintenance problems are typically overcome through the presentation of awareness information in technologies like instant messaging or media spaces. Given that people are most often situated in front of a computer at work, these applications are generally designed to run on a desktop PC, but can also be found on large communal displays with a PC (Whittaker *et al.*, 1994, Huang *et al.*, 2006) (Table 3.1, Row 5, Column 1). However, in the home, desktop PC-based solutions will not work for people are not often situated in front of a computer in their house (aside from those telecommuting). This has serious implications for it means that awareness groupware for the home needs to be *designed for a variety of contexts rather than assuming a system will be used on a desktop PC* (Table 3.1, Row 5, Column 2). One approach for overcoming this is to design information appliances that can be easily moved or spread throughout the home (Norman, 1998). It is also not necessarily the case that a mouse and keyboard are readily available for interaction, and likely they won't be. Instead, designers should look towards other forms of interaction such as embodied or tangible interaction, which more naturally situate interaction within the context of the user (Dourish, 2001). I stress that design solutions should not replace existing awareness-gathering techniques. Rather, technologies designed specifically to support interpersonal awareness can be used by individuals to augment existing awareness gathering techniques and to create new opportunities for awareness.

3.1.4 Designing Interpersonal Awareness Groupware

The previous sections, as well as findings from Chapter 2, show that there are cases where groupware could support the maintenance of interpersonal awareness. Taken together, these findings suggest two over-arching principles which should be applied to the design of interpersonal awareness groupware when such systems are needed:

Principle 1: Interpersonal awareness groupware should allow users to present different types of awareness information to different individuals at varying levels of detail and time frequencies.

This means that new groupware designs for home inhabitants should focus on providing detailed, daily awareness of activity and location (see Section 2.4 and 3.1.2). Groupware providing status information for home inhabitants would be less needed as this awareness is already gained very easily by home inhabitants (see Section 2.4). Designs for intimate socials should focus on presenting activity, location, and status awareness but for past and upcoming days rather than the present as this is needed less (see Section 2.4 and 3.1.2). Home inhabitants and intimate socials are generally comprised of small numbers of individuals so it is not likely that these systems need to support awareness acquisition for large groups (see Sections 2.3.1 and 2.3.2). On the other hand, one has many extended socials and new groupware designs for them should be geared to provide awareness of many individuals at a fairly high level of detail with infrequent updates (see Section 2.3.3). A direct corollary of this principle is that information presented for one social group is not necessarily appropriate for another group. Groupware designed without this knowledge could easily be ineffective if too little information is presented, or privacy-intrusive if too much information is shared.

Principle 2: Interpersonal awareness groupware should be designed to present awareness information in the locations that fit within people's existing routines.

People already have well-established routines for awareness maintenance in the domestic realm where they gather information in different locations, be it through technology or implicit environmental cues (see Section 2.5). These contextual locations naturally augment information with an understanding of its time relevance and intended recipient (ownership) (see Section 2.5.4). Interpersonal awareness groupware should exploit this location knowledge by being designed to support locations directly.

The first way this can be done is by designing technologies that can be *placed* in locations throughout the home or other locations where awareness is naturally acquired. Information appliances fit this design paradigm. Location placement will then augment the

awareness information presented there with existing socially constructed meaning. For example, if the corner of a shelf in the kitchen is implicitly designated as “Mom’s space” by the family, then an information appliance in this location would need to present information specifically for mom. Thus, the location is providing additional *ownership* meaning to the information (Elliot, Neustaedter, and Greenberg, 2005). Appliances in other locations could present different information for different family members. Similarly, information intended for the household as a whole could be placed along a routine pathway in a public home location (Elliot *et al.*, 2005). For example, calendar reminders intended for the whole family to see could appear on a device in the kitchen that all family members pass by and can easily notice. Locations can also augment digital information with an understanding of its *time* relevance or urgency (Elliot *et al.*, 2005). Urgent awareness information can appear on devices placed in locations that family members will see immediately. Information needed in a less-timely fashion can appear on devices placed in locations reflecting this aspect of time. Interaction in certain locations is difficult, especially when not at a desk. Therefore, along with this method comes a need to provide simple interaction that does not necessarily rely on a mouse and keyboard. This may require exploiting forms of embodied or tangible interaction for a location-based device.

The second way to make interpersonal awareness groupware location-based is by providing explicit cues that show the time relevance and ownership of awareness information. For example, software could explicitly state the intended recipient’s name and show a flag indicator that a note is urgent. However, this method is certainly not as natural as the first as it does not exploit people’s existing abilities and the social constructs which have developed in the home over time. For this reason, I advocate designing awareness appliances to fit within existing domestic locations (the approach previously described).

3.2 Analyzing Awareness Appliances

The model of interpersonal awareness also allows us to map out the design space of interpersonal awareness groupware for the home. Table 3.2 shows examples of how existing *awareness appliances*, found in the CSCW and HCI literature, were analyzed using our model to elicit how they provide awareness for home inhabitants, intimate socials, or extended socials. The systems in the table do *not* represent an exhaustive list of domestic

	Location Awareness	Activity Awareness	Status Awareness
Home Inhabitants	<i>Where are my cohabitants (home, work, other)?</i> ♦ RENO (Smith <i>et al.</i> , 2005) ♥ Whereabouts Clock (Sellen <i>et al.</i> , 2006a)	What are my cohabitants doing now or what is their schedule? ♦ TxtBoard (O'Hara <i>et al.</i> , 2005) ♦ AwareCo (Elliot and Carpendale, 2005) ♦ HomeNote (Sellen <i>et al.</i> , 2006b)	<i>How are my cohabitants / intimate socials feeling?</i> ♥ Feather, Scent, and Shaker (Gaver and Martin, 2000) ♥ Teddy Bear, Rattle, and Necklace (Go <i>et al.</i> , 2000) ♥ InTouch (Hindus <i>et al.</i> , 2001) ♥ mBracelet (Constas and Padadopoulos, 2001)
Intimate Socials	<i>Where are / were my intimate socials?</i> ♥ Intentional Presence Lamp (Hindus <i>et al.</i> , 2001) ♥ Lumitouch (Chang <i>et al.</i> , 2001) ♥ 6 th Sense Lamp (Tollmar and Persson, 2002)	<i>What activities have my intimate socials done or are planning to do?</i> ♥ Digital Portraits (Mynatt <i>et al.</i> , 2001) ♦ ScanBoard (Hindus <i>et al.</i> , 2001) ♦ CommuteBoard (Hindus <i>et al.</i> , 2001) ♦ Hubbub (Issacs <i>et al.</i> , 2002) ♥ InterLiving family calendar (Plaisant <i>et al.</i> , 2006) ♥ Message Probe (Hutchinson <i>et al.</i> , 2003) ♦ Expanding Ball, Spinner, IMFrame, and Chime (Guzman <i>et al.</i> , 2004) ♥ ASTRA (Markopolous <i>et al.</i> , 2004)	♥ Virtual Intimate Object (Kaye <i>et al.</i> , 2005) ♥ The Cube (Howard <i>et al.</i> , 2006)
Extended Socials	<i>Where do my extended socials work / live?</i> < we did not find any research designs >	<i>Have my extended socials had any major life events occur?</i> < we did not find any research designs >	<i>How is the health of my extended socials?</i> < we did not find any research designs >

Table 3.2: The design space of interpersonal awareness (♥ = designs for connectedness / comfort, ♦ = designs for coordination).

awareness appliances. The rows show the social groups that the designs are intended to support while the columns show the awareness information that is provided by the system. The ♥ shows which designs are intended to provide *connectedness / comfort*, while the ♦ shows designs intended for *coordination*. Each cell also contains italicized sentences which are suggested questions that awareness technologies could answer for the given group and type of awareness. Instant messaging, email, blogs, and mobile phones fit within this table and would likely cover all of the cells (and are not included in the table for this reason); however, they do have their share of problems which we discuss later.

The model of interpersonal awareness and mapping of the design space is useful for we can now revisit current designs oriented for domestic spaces. That is, we now have the knowledge to analyze existing awareness technologies to understand why designs succeed or where they fail at providing awareness for family and friends. The analysis consists of comparing the user needs in our awareness model to a system’s capabilities (Principle 1). For example, I discuss whether a particular system presents awareness information that is appropriate for the intended user group (home inhabitants, intimate socials, extended socials), and if the same information would be appropriate for other groups. I also analyze whether or not the system is designed for locations that would likely exploit people’s existing location routines (Principle 2). For example, is the system designed for a location that would augment the awareness information with relevant time and ownership meta-data. The analysis is not exhaustive; rather, I show how it is done by example. I first analyze several of the prototype systems from Table 3.2 grouped by the type of information they present: location, activity, or status awareness. In Section 3.3, I analyze instant messaging as a technology that people currently use to maintain interpersonal awareness. In Section 3.4, I analyze family calendars as a domestic artefact that family members use to maintain location and activity awareness.

3.2.1 Location Awareness

The following two systems serve as case studies analyzing appliances designed to present *location awareness*, one intended for home inhabitants, and the other for intimate socials. We did not find any awareness appliances designed to specifically to provide location awareness

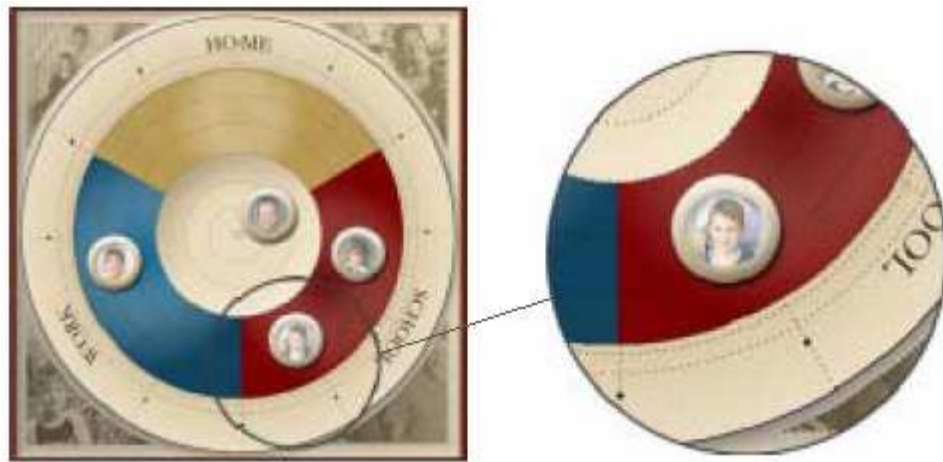


Figure 3.1: The Whereabouts Clock provides location awareness of home inhabitants (from Sellen *et al.*, 2006a).

of extended socials (Table 3.2, Row 3) though I discuss whether the designs presented here extend to this group.

Whereabouts Clock (Sellen *et al.*, 2006a): The Whereabouts Clock (Table 3.2, Home Inhabitants / Location) is modeled on a concept from a popular children’s novel, Harry Potter and The Chamber of Secrets (Rowling, 2000). Rather than telling the time, the clock displays *location* information about family members as a means to provide feelings of *comfort*. Figure 3.1 shows the prototype system, which runs on a LCD. Each family member’s real world location is tracked using GPS-location through cell phones carried by each family member. On the ‘clock,’ family members are represented with pictures inside small tokens. As family members change geographic locations so too does their mark on the clock, moving between the yellow ‘HOME’ region, the green ‘WORK’ region, and the red ‘SCHOOL’ region. Tokens in the centre of the clock show that person is currently mobile between locations.

First, I analyze the design in terms of the awareness information it presents (Principle 1). We can see this design would be successful within the home for it presents home inhabitants with desired *location* information at an appropriate level of detail (relatively specific) and frequency (moment-by-moment). This knowledge could easily support feelings of *comfort* for family members. However, while beneficial, the information presented by the Whereabouts Clock may in fact not be enough for home inhabitants. Often location

awareness is closely related to activity awareness (see Sections 2.4.1 and 2.4.2) and it may be the case that home inhabitants also desire this extra activity information. For example, while family members can see where each is located, they do not know when others plan to leave their location or what their upcoming activities are. Even though the clock is designed to provide feelings of comfort, it would be natural for home inhabitants to try to coordinate activities with its information, which could be challenging. For intimate and extended socials, the location information presented by the Whereabouts Clock could be considered overly detailed and possibly privacy-intrusive. People do not typically desire moment-by-moment location details for their intimate and extended socials.

Second, I analyze the design in terms of its ability to support contextual locations (Principle 2). Given that the Whereabouts Clock is designed as an information appliance, family members should be able to situate it in a location where they would typically be located and susceptible to wondering where family members currently are, for example, the kitchen. Thus, the location possibilities for the device are well-suited for the home. You could even imagine the appliance situated at work where parents could check the whereabouts of their children. However, the LCD form factor also restricts where it can be located. For example, it is well suited for horizontal surfaces like tables or countertops where it can simply be set down. Yet hanging the LCD on vertical surfaces like a wall (a common place for a clock) may be more challenging. Moving outside the home and work, the Whereabouts Clock would certainly need another form factor for mobile acquisition of the information such as on a cell phone or PDA.

A portion of this theoretical analysis is confirmed by empirical findings from early field trials of the Whereabouts Clock (Sellen *et al.*, 2006a). Here Sellen *et al.* deployed the system within a small group of work colleagues (to simulate a group of home inhabitants) where each had the Whereabouts Clock running in their office on a large touch-sensitive LCD. The availability of at-a-glance location awareness was seen to be beneficial, yet they found that at times group members desired to specify and know activity details coupled with location information (Sellen *et al.*, 2006a). This suggests that home inhabitants may also desire combined activity and location information, as our theoretical analysis describes. Unfortunately, the field study does not report on the participants' feelings about sharing detailed information with people who could be considered intimate or extended socials. It

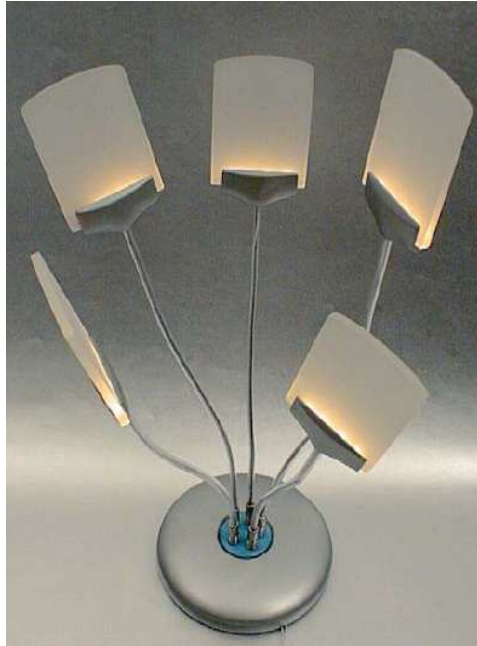


Figure 3.2: The 6th Sense Lamp shows whether or not a distant family member is at home (from Tollmar and Persson, 2002).

also does not describe any challenges in locating an ideal place for the Whereabouts Clock, likely because the field trials took place outside the context of the home.

6th Sense Lamp (Tollmar and Persson, 2002): The 6th Sense Lamp (Table 3.2, Intimate Socials / Location) allows families to gain an awareness of children who have recently moved away from home: a son's presence in his apartment causes his mother's 6th Sense lamp to turn on, shown in Figure 3.2. When he is not at his apartment, the lamp turns off. This design provides users with an awareness of the *location* of an *intimate social* where the goal of the system is to provide feelings of *comfort*. We now know that this design is successful because it presents the location information that is actually desired by intimate socials at the appropriate level of detail (Principle 1). Moreover, it presents this awareness in a manner that is natural to home inhabitants: the information is embedded within an aesthetically-pleasing domestic artefact that can be easily placed in any domestic location (Principle 2). For example, it could be placed in a publicly viewable location like a mantle where one may easily glance at it and find out if the remote family member is home.

In the everyday world, people are currently only able to maintain an awareness of cohabitants through domestic artefacts. The design of the 6th Sense lamp has extended

people's existing routines in a socially appropriate manner to provide awareness of intimate socials. The design could also extend to home inhabitants who may be distance-separated for a short time frame (e.g., at work or traveling). However, this design is not appropriate for an extended social, for the 'recipient' would see this excessive detail as a distraction, while the 'sender' could see it as a privacy intrusion. Indeed this reveals an asymmetry issue: a young adult leaving home may shift his perception of his family to extended socials in a quest for independence, while the parents adjust to seeing him as an intimate social rather than a cohabitant. While parents may want a lamp like this, the young adult may not want them to have this kind of access to his or her life.

Portions of this theoretical analysis are confirmed by field trials of the 6th Sense Lamp with two families (Tollmar and Persson, 2002). Here the lamp was found to increase feelings of connectedness between parents and their remote children (Tollmar and Persson, 2002). The study did not find any issues of asymmetrical awareness needs and this is likely the case because the 6th Sense Lamp was only tested with two families (Tollmar and Persson, 2002). I would expect that a larger evaluation would reveal that there are some situations where conflicting awareness needs arise (e.g., a child wants to reveal less information and a parent wants to know more information).

3.2.2 Activity Awareness

The following systems serve as examples of appliances designed to present *activity awareness*, one intended for home inhabitants and two for intimate socials. While we did not find any awareness appliances designed to specifically to provide activity awareness of extended socials, we discuss whether our case studies could extend to this group.

HomeNote (Sellen *et al.*, 2006b): HomeNote (Table 3.2, Home Inhabitants / Activity), shown in Figure 3.3, is a home message board that can be placed in a central home location. Family members leave messages for each other by writing on HomeNote with a stylus (handwritten messages stay on the display and are not transmitted anywhere) or sending a text message from a mobile phone to the HomeNote display. This allows family members to provide *activity* awareness through notes, which could be used to help *coordinate* events. Our model reveals that this is in fact the information that home inhabitants need to share

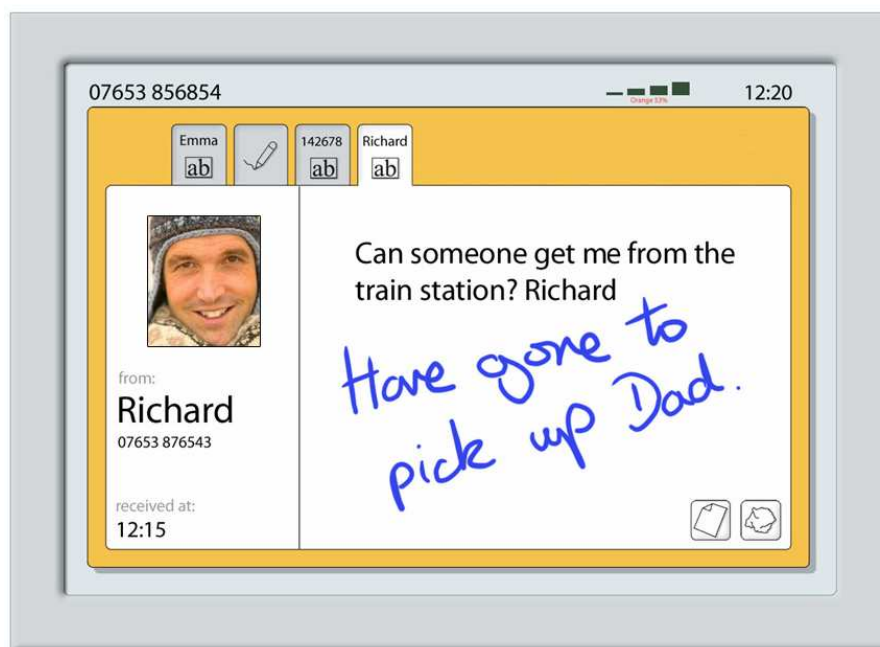


Figure 3.3: HomeNote lets family members send notes from a mobile phone to a central home location (from Sellen *et al.*, 2006b).

(see Section 2.4.2) (Principle 1). Moreover, the free form entry of HomeNote actually permits family members to provide even more than just activity awareness: they could even leave thoughtful or heart-warming messages for one another. Yet HomeNote is limited as it is designed to be used in one central location. Our model has revealed that people in fact leave messages and notes for home inhabitants in more than one location, each for different purposes and people (see Section 2.5.4). Extending HomeNote to be located in multiple-locations would further benefit home inhabitants' routines (Principle 2). In fact, this extension is one of the main features of Elliot, Neustaedter, and Greenberg's (2006b) location-based messaging system called StickySpots, which allows messages to be sent between displays spread throughout the home (Elliot *et al.*, 2006a, Elliot *et al.*, 2006b).

It is questionable if HomeNote extends to all intimate and extended socials. The concept of sending messages between locations parallels email and instant messaging, which are used by intimate and extended socials. Yet these technologies situate awareness information from these groups in a different home location—usually on a PC in a home office—where people often actively go out and seek the information (e.g., by checking their email). Given that most people have a relatively small amount of intimate socials and these

relationships are typically quite strong, having messages from intimate socials appear in HomeNote would likely be appropriate. However, messages appearing in a public home location from extended socials could easily cause undesired consequences. The information would be more noticeable as it appears and could easily become a distraction, especially with a large amount of extended contacts.

Field trials of HomeNote with five families confirm portions of our theoretical analysis (Sellen *et al.*, 2006b). Families used HomeNote to write a variety of messages for household members. For example, some family members would write messages describing their activities, as illustrated in Figure 3.3. This information was used to help coordinate family plans, as predicted in our theoretical analysis. Some family members would also write heart-warming messages to create feelings of connectedness (Sellen *et al.*, 2006b). This suggests that an appliance designed specifically to support one type of awareness may actually end up also supporting other types of awareness as people develop their own social culture around the device.

Digital Family Portraits (Mynatt *et al.*, 2001): Digital Family Portraits (Table 3.2, Intimate Socials / Activity) let adult children monitor the activity of aging parents who live elsewhere; the state of the parent is displayed as abstracted icons surrounding a static photo of the parent in a frame, shown in Figure 3.4. Using Digital Family Portraits, it is possible to know the activity level of an aging parent; inactivity may indicate health problems. Based on our model, we can see that, again, this design is appropriate for *intimate socials* because it presents the distant person with an appropriate level of *activity* awareness, where the awareness is abstracted in a manner that provides people with *comfort* without being privacy intrusive (Principle 1). Indeed, this abstracted design was motivated from interviews with families about maintaining an awareness of aging elderly parents. Digital Family Portraits also naturally support contextual locations: they can be placed in domestic locations where one may normally think about their loved ones, like a mantle or shelf with family photos (Principle 2). It could even be hung on walls in high traffic locations so the information is easily accessible.



Figure 3.4: Digital Family Portraits show the activity level of remote family members (from Mynatt *et al.*, 2001).

While appropriate for intimate socials, as confirmed by field trials (Rowan and Mynatt, 2005), this design would be inappropriate for home inhabitants as they already receive this type of activity information through their everyday interactions with household members. Extended socials may find similar technologies useful for niche relationships (e.g., a self-monitoring community of friends who voluntarily check up on each other), but it's unlikely this would generally be well received.

CommuteBoard (Hindus *et al.*, 2001): The CommuteBoard (Table 3.2, Intimate Socials / Activity) is a shared whiteboard-like application that allows people sharing a carpool ride to leave notes for one another about when they plan to leave home (Figure 3.5, bottom). The design also displays a graph showing the general noise level of the household to know if the other is awake yet (Figure 3.5, top). CommuteBoard can provide users with an awareness of the *activity* of an *intimate social* in order to *coordinate* rides. Obviously, the activity information that CommuteBoard presents is desirable for those carpooling together. This is reflected in the design's inspiration which came from the researchers' own everyday experiences.

The information presented in CommuteBoard is definitely not needed for home inhabitants for they can already gather this awareness through face-to-face means. It is also somewhat questionable for extended socials, for they would certainly find this information

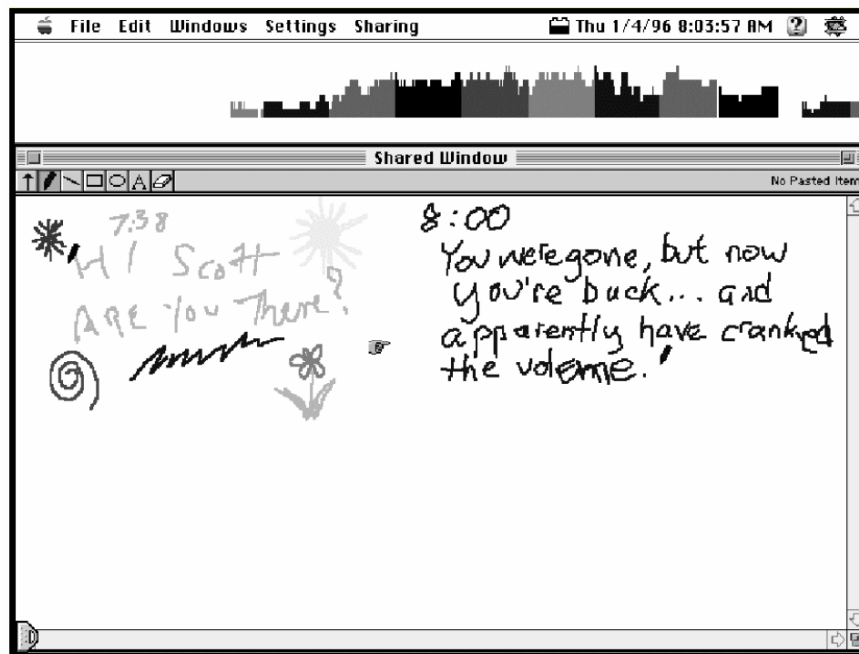


Figure 3.5: The CommuteBoard shows audio levels at remote carpooler's homes and supports sending handwritten messages (from Hindus *et al.*, 2001).

too detailed. CommuteBoard may even be problematic for some intimate socials: reporting activity through audio levels could be considered privacy intrusive. For example, high audio levels could indicate social acts that people may not want others to know about, e.g., yelling or fighting. These conflicting problems suggest that the CommuteBoard design needs revisiting: while it perhaps best matches expectations of intimate socials, it will not match expectations of the extended socials that will likely belong to carpool groups.

3.2.3 Status Awareness

All systems we found that present status awareness are fairly similar in their design idea and intended use. Here I detail one example application, designed for home inhabitants or intimate socials.

InTouch (Hindus *et al.*, 2001): InTouch (Table 3.2, Home Inhabitants and Intimate Socials / Status) is a prototype concept that consists of a small token that when touched would cause an intimate's token to glow or vibrate. This design can provide users with an awareness of the *status* of a *home inhabitant* or *intimate social*, in this case that the intimate is

thinking of the person, where the goal of the design is to provide feelings of *connectedness*. We can see this design concept would be successful for home inhabitants when they are not collocated as well as for intimate socials. Again, extended socials would likely find this awareness too detailed and unnecessary.

InTouch's reliance on the use of a small token means it could be placed virtually anywhere. This would allow users to create their own meanings for the system. For example, the token could be placed in one's pocket throughout the day, be worn as part of a ring or bracelet, or even left on a work desk. The point is that InTouch's design makes it suitable to be placed in any location where one may want to feel more connected to a loved one, whether it is left in a specific location or always with the person.

3.3 Analyzing Instant Messaging

Instant messaging (IM) is one type of mediated interaction technique that people use to gather interpersonal awareness for individuals in all social groups, albeit some more than others. While IM systems were primarily designed to support interaction, people are able to gather awareness through availability states provided in most IM clients. Availability states typically only provide a crude measure of one's activity, e.g., online, away, busy, out to lunch. Through direct conversation over IM, people can exchange any type of awareness information: location, activity, or status.

By itself, the level of awareness detail provided by availability states is not enough for home inhabitants and intimate socials. Direct conversation may fill the gaps for these groups, yet for extended socials the awareness gained from direct conversation may be too detailed or too frequent. For example, a relative whom you consider to be an extended social may attempt to chat with you on a daily basis to 'see how things are going' simply because it is now easy to do so. By doing so, they may interrupt you at work, and/or enter into conversations about detail that are not particularly interesting. In essence, IM makes it possible for extended socials to be more like one's intimates, yet this is not necessarily what people desire because awareness maintenance and resulting conversations can then become quite time consuming or interrupt other aspects of life. Even if there is somewhat of a desire, often the cost of interruptions is simply too high. Other mediated interaction technologies like the cell phone or email bring with them the same basic problem.

In Chapter 2, I mentioned that nearly all of our participants wanted more frequent awareness of their extended socials. Instant messaging, cell phones, and email are all cautionary tales about ‘getting what you wish for.’ In everyday life, physical distance, time, collocation and other factors mediate who one can actually reach. Digital medium bypasses everyday physics, meaning that people can and do have more frequent awareness of and contact with their extended socials. While this adds richness to people’s lives, it comes with interruptions, distractions, information overloading, and so on. Thus, this analysis reveals the mixed blessings of such technologies. Online technologies like blogs (including photo sharing services like Friendster) offer an interesting alternative where awareness information can be read or viewed at one’s leisure. Here people have the choice to look at the information and may choose not to if feeling overwhelmed.

3.4 Analyzing Family Calendars

Families need to maintain an awareness of the locations and activities of their cohabitants in order to schedule and coordinate events (see Section 2.4). The family calendar as a domestic artefact plays a crucial role in this respect (Zimmerman *et al.*, 2001). In fact, calendars and schedules are the second most commonly seen type of communication information found within homes, only surpassed by messages and notes left as reminders (Elliot *et al.*, 2005). This section provides a brief analysis of family calendars based on the knowledge described up to this point. Family calendars will be explored in a much greater depth in the remaining chapters of this dissertation.

Paper calendars are a popular calendar format, used by many families (Elliot *et al.*, 2005, Brush and Turner, 2005). Using the model of interpersonal awareness, we can analyze them to understand why they are successful as awareness and coordination tools and where they are limited. We can see that paper calendars provide home inhabitants with a medium to record family activities on a daily basis. Family members can also record their location relative to their activities. Our model shows this is in fact the type of awareness information that families need to maintain and the right frequency at which they need it (most calendars contain squares for each day to support daily information). Because a paper calendar can be placed in a public location within the home, family members can gain *location* and *activity* awareness simply by looking at the calendar (provided it is up-to-date). This should aid

coordination by providing family members with a shared understanding of the family's activities. Thus, we can see that a paper calendar is successful as a domestic awareness artefact because it provides home inhabitants with the awareness information they need when they are at home. However, we can also see that the availability of the awareness information on a calendar is limiting. Paper calendars really only allow family members to gain awareness when *at home*. The family calendar is not available in the many locations that family members frequent throughout a day where they may need to schedule appointments or check the family's activities. For example, one could be at work, a doctor's appointment, shopping, or even driving between different locations.

Digital calendars certainly exist and could overcome the location limitations of paper calendars. Many people use a digital calendar at work (e.g., Microsoft Outlook) (Palen, 1999), others may use a digital online calendar (e.g., Google Calendar, OurFamilyWizard, Trumba) for recording personal activities, and some may even carry a PDA with a mobile digital calendar on it. These digital calendars could certainly be used to record family activities. However, our model of interpersonal awareness suggests that these digital calendars may still not suffice to meet the needs of families because they still suffer from location limitations. That is, like paper calendars, they may not be easily accessible in the *multiple locations* that family members frequent throughout a day. For example, a work calendar may be available on a PC at work, yet not viewable from home as well. A digital online calendar may be more easily accessible from multiple locations (home, work, *and* mobile) providing that a mobile device supports web browsing. Yet it is questionable if online calendars extend beyond personal use to support family awareness needs.

Given this, a natural next step is to want to design a digital family calendar that can actually support family needs. However, this leads to two main problems. First, *we do not have a sufficient understanding of family calendaring routines and practices* (Chapter 1, Problem 2) in order to understand what needs a digital family calendar must address. For example, we do not know where family members really need to access their family calendar, what calendar information they need to record, or what specific activities family members undertake in order to schedule and coordinate with the family calendar. Second, *we do not know how to apply an understanding of family calendaring routines to the design of digital family calendars* (Chapter 1, Problem 3). That is, we do not know how to design digital family calendars to meet the

needs and practices found in family calendaring routines. The model of interpersonal awareness outlines high-level ideas to address these problems, yet it is unable to suggest specific recommendations or guidelines for digital family calendar design. This implies that additional research is needed if one wants to understand how to best design digital family calendars to support family awareness needs. This research should narrow in scope to specifically look at existing calendaring routines and digital family calendar design. The remainder of this dissertation picks up this research thread.

3.5 Opportunities for Design

While I have only analyzed a small set of example systems and tools in this chapter, it is possible to analyze other awareness artefacts or technologies in a similar manner. Of course, this type of analysis does have the caveat that there are more factors that affect a system's success or failure than the actual features of the product or artefact (e.g., the domestic routines involved in the system's use), which can often not be designed for *a priori*. Despite this, the analysis is able, at high level, to evaluate and predict a design's success in matching its expected niche. The analysis also provides a high level perspective of the interpersonal awareness design space and it is now possible to see where existing designs fit in terms of the types of relationships and awareness information they are designed to support. This makes it much easier to compare designs as it is now much clearer which designs are focused on fulfilling the same user needs.

We are now also able to see many opportunities for groupware design in the home. Most striking is the fact that in the existing literature we did not find any research designs specifically intended for extended socials (all of Table 3.2, Row 3 is empty); though, email, IM, blogs, and other online sharing sites can fulfill a portion of awareness needs for extended socials. This may be because the need for awareness of individuals from this group is more discretionary, though it does call for at least some design exploration by researchers. In addition, it appears that a large portion of the designs are aimed at providing an awareness of intimate socials (given the large number of systems that fall in Table 3.2, Row 2). However, some designs focused on providing status awareness could also extend to home inhabitants who are distance-separated for short times. Only recently have researchers and designers focused more at supporting location and activity awareness for home inhabitants.

This is evident from the small number of systems under home inhabitants (Table 3.2, Row 1, Columns 1 and 2), all recently published. This suggests that there is still a large amount of design exploration that should be done to understand how one can adequately support the location and activity needs of home inhabitants. The analysis of family calendars (Section 3.4) illustrates an example of one domestic artefact used for awareness and coordination. It also reveals that if one is to design digital calendars to support family needs, a narrowing of research scope is necessary to specifically understand family calendar routines and how this knowledge can be applied to the design of digital family calendars.

3.6 Summary

This chapter illustrates how the Model of Interpersonal Awareness—derived from the findings presented in Chapter 2—can be *applied to the design of groupware* (Chapter 1, Objective 1). First, a comparison of informal awareness in the workplace to interpersonal awareness in the domestic realm has revealed that, while similar, each has its unique characteristics. Informal awareness is centred on location and activity awareness for a range of social groups, either collocated or distributed, in the workplace. Interpersonal awareness is also desired for a range of social groups, yet in addition to location and activity awareness, people also desire status awareness for their personal social contacts. This is not generally found in the workplace and is a main differentiating factor between the two types of awareness. Both informal and interpersonal awareness can be gained through background cues in the environment; however, interpersonal awareness usually still needs to be acquired in the foreground where people actively probe for information through conversation. Challenges of distance-separation associated with gathering workplace awareness have been overcome mostly through system design for PCs. Domestic users are not often at a computer suggesting this design approach will not suffice for interpersonal awareness. Given this knowledge, it would be a mistake to simply migrate awareness groupware from the workplace into the home. Instead, design for interpersonal awareness should focus on groupware specifically designed for the range of social relationships found in the domestic realm, their specific awareness needs, and the routine locations that people already use to maintain awareness.

Second, an analysis of groupware systems already designed to support interpersonal awareness reveals that there are a large number of systems designed for intimate socials, many of which do not extend to home inhabitants or extended socials. Fewer systems are explicitly designed for home inhabitants and we did not find any designed for extended socials. This presents an under-explored niche for groupware design of domestic awareness technologies. Designs could be explored to help people overcome the challenges of maintaining a minimal level of awareness of extended socials or the detailed and frequent needs of people to know the activities and whereabouts of their home inhabitants. An analysis of family calendars reveals that the model of interpersonal awareness is limited in that it is only able to suggest design directions at a high-level. If one is to design specific awareness technologies like digital family calendars, additional research is needed that narrows in to understand the routines surrounding the specific artefact being designed.

This ends Part I of this dissertation. At this point, I have *described the domestic awareness and coordination routines of family and friends* (Chapter 1, Objective 1), which has provided a high level view of awareness needs in the domestic realm and the implications of these for the design of interpersonal awareness groupware. The next part of this dissertation builds on this understanding and takes a more focused look at one aspect of interpersonal awareness: family calendaring. Here the goal is to *formalize family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems* (Chapter 1, Objective 2). This provides depth coverage of one facet of interpersonal awareness.

Part II: Family Calendaring Theory

The first part of this dissertation *described the domestic awareness and coordination routines of family and friends* (Chapter 1, Objective 1). This uncovered the need for technology design to support home inhabitants, intimate socials, and extended socials. Yet exploring technology design in all of these areas would be outside the scope of any one thesis. For this reason, I chose to narrow my focus and investigate one particular need that was uncovered: the maintenance of activity and location awareness by family members in order to support family coordination. Many families use paper calendars as a tool to support this need. While adequate for maintaining an awareness of family activities in the home, paper calendars are limiting in that they are not easily accessible outside the home, if at all. In order to understand how to design digital family calendars to overcome this challenge, we must first gain a deeper understanding of family calendaring routines. Unfortunately, the model of interpersonal awareness presented in Part I does not provide this depth coverage of family awareness routines.

For this reason, the second part of this dissertation *formalizes family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems* (Chapter 1, Objective 2). Chapter 4 outlines existing research on workplace calendaring and family calendaring, which forms the basis for understanding the calendaring routines of families. Chapter 5 presents results from interviews with families that outline the types of calendars they use as part of their domestic routines and the ways in which they schedule activities and check the calendar in order to coordinate activities. Chapter 6 presents results describing the contents of family calendars, including the number and types of events that are placed on the calendar and the annotations and augmentations families employ to add additional meaning to the calendar. Chapter 7 shows how the understanding from Chapters 4 through 6 can be applied to the design of digital family calendars.

Chapter 4. Calendaring as We Know It

The goal of this chapter is to *present background knowledge of workplace and family calendaring*. This is the first step to *formalizing family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems* (Chapter 1, Objective 2). The chapter begins by outlining existing studies of calendaring in the workplace and then turns to the specific focus of this dissertation, family calendaring.

A variety of interview and survey studies have been performed on workplace calendars, ranging from early studies of paper calendars to more recent work on digital calendars. These studies are important for several reasons. First, they inform how calendars are used in the workplace and more generally suggest a basis for how we think about calendaring in other situations. Second, they present a foundation upon which we can later compare workplace and family calendaring to understand how the domestic realm differs from the workplace. Third, this research also encompasses a set of next-generation digital calendar designs aimed at addressing workplace calendaring challenges. This provides a general understanding of how digital calendars may be realized to better support actual workplace practice.

Research has also been performed more specifically on calendars in the domestic realm. Here we develop an initial understanding of the calendaring routines of families upon which this dissertation builds. Domestic calendaring research also encompasses a number of digital calendars designed specifically for families. These systems provide valuable discussion for understanding the current trend in digital family calendar design.

4.1 Workplace Calendaring

Interviews and surveys over the past 25 years of office workers have revealed the varying use of calendars in the workplace. Studies in the early 1980's looked at only paper calendars, yet by the mid 1980's digital calendars were beginning to enter the workplace and thus studies at this point looked at both digital and paper calendar use. In this section, I describe how

workplace calendars are used as both personal and collaborative artefacts. I also discuss illustrative examples of workplace digital calendar designs.

4.1.1 Calendars are Personal Support Artefacts

Calendars in the workplace are first and foremost personal support artefacts (Payne, 1993, Palen, 1998, 1999). Early studies of office workers by Payne (1993) showed that one of the central tasks for scheduling activities is *prospective remembering*: the act of deciding to perform an activity, periodically remembering this activity, and then actually performing it. For example, two colleagues may decide to meet to discuss their project on Thursday at 3pm. Each will then actively remember this meeting time until the point when they actually meet. Calendars restructure this task and enhance it (Payne, 1993). With a calendar, people first actively search or browse for an open time slot to perform their activity. This browsing reminds people of existing events and their dependencies (Payne, 1993). Next, the act of physically writing down the activity on a calendar further enhances its mental encoding (Payne, 1993). Of course, prospective remembering can be aided by simply writing events on regular pieces of paper, but the structured time grid of the calendar makes it much easier to understand the temporal relations of events and their dependencies on time and one another (Payne, 1993). The more events one adds to the calendar, the more times she looks at the existing events to find an open space, and the more apt she is to recall what is on the calendar. Despite this, one of the most common challenges faced in calendaring use (at least in 1993) is actually remembering to look at the calendar (Payne, 1993). Digital calendars have since helped to alleviate this problem by using automated event reminders.

Building on Payne's work, Palen (1998, 1999) studied calendar use at Microsoft, Sun Microsystems, and Lawrence Livermore National Laboratories and created a *typology of calendar work* that shows the activities that calendars support from an *individual's* perspective. People use calendars in a range of different ways depending on the nature of one's work, their experience, and their personality, yet calendars generally support activities from one or more of six categories (Palen, 1998):

- *Temporal orientation*: calendars allow people to understand how many days, weeks, or months remain until a particular event or date;

- *Schedule*: calendars permit scheduling one's activities in relation to existing activities and the activities of others;
- *Track*: information can be placed on the calendar as a record, e.g., contact information, medical history;
- *Being reminded*: calendars remind people of upcoming events like appointments, tasks, or special events (this relates to the act of prospective remembering);
- *Note record and archive*: calendars permit recording notes associated with an event, e.g., meeting notes linked to a scheduled meeting; and,
- *Retrieve and recall*: people can refer back to calendar content to see information or recall information related to calendar entries.

These tasks or activities are supported naturally by calendars because they provide a *representation of time*, typically of days, weeks, and months, in which events can be placed and related (Palen, 1998). Calendars also provide an important *information layer* that allows people to record information on them (Palen, 1998). Because of these two components, calendars are able to act as both a *temporal map* and a *workspace* for people to ease the burden of their mental map of activities and information (Palen, 1998, 1999).

4.1.2 Calendar Informational Content

Workplace calendars contain a range of informational content presented in a variety of forms (Kelly and Chapanis, 1982, Kincaid *et al.*, 1985, Payne, 1993). Prior to the introduction of digital calendars in the workplace, Kelly and Chapanis (1982) interviewed 23 paper calendar users and showed that people use a large variety of paper calendar formats to record events. Over all participants, 13 day-view, 18 week-view, and 9 month-view calendars were used (some participants had multiple calendars, described in the next section). These paper formats present a rich medium for calendar use where they contain not only events but also rich annotations like stars, brackets, lines, arrows, and additional information including phone numbers and important notes (Kelly and Chapanis, 1982). Kincaid *et al.* (1985) built on this research by interviewing thirty professional office workers shortly after the first digital calendars were being used in the office. Their study showed that calendars contain a variety of events ranging from meetings, appointments, and travel, to reminders

and tasks where nearly all interview respondents recorded both work and home activities in the same calendar (98% of 30 respondents). On average, managers had seven events per week on their calendar, yet there is unfortunately no data for other workers (Kincaid *et al.*, 1985). One would expect that the average number of events on calendars would have increased since this study given the increased digital calendar use for coordination over the past two decades; however, I did not find any more recent analyses of this.

A more formalized look at calendar events has been provided by Payne (1993). He defines two types of events, *pulses* and *steps* (Payne, 1993). *Pulses* are those events where there is a specific time associated with them. For example, a scheduled meeting for next Tuesday from 3-4pm or a report deadline of August 18th would be considered pulses. *Steps* are events that can be completed anytime or within some time window. For example, one may need to have a meeting with a collaborator sometime in the next two weeks to discuss a report deadline but it doesn't matter when the actual date of the meeting is as long as it happens in the next two weeks. Events are also often nested where a single event may be related to other calendar entries with some level of dependency (Payne, 1993). For example, events A and B may be on the calendar, both relating to the same project. Event A may need to be completed before event B can be completed, or vice versa.

4.1.3 People use Multiple Calendaring Artefacts

People use more than just a single calendar in the workplace to support their calendaring needs (Kelley and Chapanis, 1982, Kincaid *et al.*, 1985, Payne, 1993, Palen, 1998). Kelley and Chapanis (1982) found that 70% of respondents (16 of 23) used more than one calendar (with an average of two) to schedule and remember activities because people frequently need their calendar information in more than one location or in a different format. Multiple calendars were also used for different purposes (e.g., business *vs.* personal). The challenge with using multiple calendars is that careful manual synchronization must be performed between calendars in order for events to not be missed or times overbooked (Kelley and Chapanis, 1982, Kincaid *et al.*, 1985). While this is often a difficult process, the need for multiple calendars often supersedes the difficulty in synchronizing them; people will still use multiple calendars despite this challenge. More recently, Palen (1998) found that multiple calendars are still being used by workers to provide different information representations in

different locations. Here location plays a role in determining calendar access levels. For example, a calendar hanging on an office wall near the door is highly visible for co-workers entering and leaving the office. In this situation, a worker may place more public information on the calendar. In contrast, a calendar placed on one's desk facing away from the entryway is more private in nature and may contain events which are more personal.

In addition to the multiple calendars that are used for current scheduling, past calendars are often kept for archival reasons; most for short time periods like a year, while others keep them much longer, upwards of ten years (Kelley and Chapanis, 1982, Kincaid *et al.*, 1985). Despite this, referencing old calendars is an infrequent task usually associated only with checking phone numbers, birthdays, or tax-related information (Kincaid *et al.*, 1985). To-do lists also often accompany calendars as coordination artefacts, yet their use is typically restricted to recording tasks (Payne, 1993). Tasks are often kept in two separate lists, one for long term and another for short term tasks (Payne, 1993).

4.1.4 Calendars as Social and Collaborative Artefacts

Despite being personal items, workplace calendars also act as social and collaborative artefacts, though this role has evolved over time (Kincaid *et al.*, 1985, Palen, 1998). Before digital calendars were introduced to the workplace, sharing calendars was a restricted activity for only managers and secretaries (Kincaid *et al.*, 1985). Here secretaries would record a manager's appointments by hand in two calendars: the secretary's and the manager's. The need to effectively coordinate activities more broadly between co-workers saw the creation of networked digital calendars like Calendar Manager at Sun Microsystems (Palen, 1998). Since then, calendars have evolved into rich social artefacts and collaboration tools. The model most prevalent in the workplace is one where individuals each maintain their own calendar and then provide some level of sharing or access to others (Palen, 1998). This can range from showing no calendar information to others, sharing only free or busy times, sharing all calendar information including names of events and times, or even the extreme case of allowing others to modify one's calendar (Palen, 1998). Co-workers can find what seem to be appropriate meeting times by using the knowledge of what is on another's calendar. Most commercial digital calendar systems will then allow individuals to send

meeting requests to one another (often through email) which can be accepted, declined, or modified to suggest an alternative meeting time.

The amount of calendar information revealed to others presents a trade-off. When more information is supplied, people can use their own common sense to anticipate when would be a good meeting time, which can make coordination much easier (Palen, 1998). For example, if a colleague's calendar reveals that a person has no scheduled events before or after a meeting, seeing the location of that meeting can indicate if travel is required. This knowledge can then help determine if times adjacent to the meeting are free without even asking the colleague. Similarly, seeing an appointment to watch a routine weekly lecture that you know a colleague never actually attends may indicate that a visibly busy time is actually a potentially suitable time for a meeting. Yet more calendar information comes with increased risk of privacy violations. In fact, Palen's (1998) studies revealed five primary concerns for networked digital calendars at work:

- *Personal privacy of information*: one's calendar may contain appointments that you do not want others to know about;
- *Social sensitivity of information*: calendar events may have social implications (yet not be personally private), e.g., a meeting to hire a new employee for a position currently filled by a colleague;
- *Company security of information*: calendar events may be about information that only particular employees should know about, e.g., the company is considering a merger with another company;
- *Personal privacy of time allocation*: others can judge how much time one spends working or doing personal activities during the day (if personal events are placed on their work calendar); and,
- *Control of access to time*: people can see how busy your schedule is and one can easily 'lose control' over their time by being inundated with meetings.

As a result of these concerns, people have developed a variety of techniques to regulate their calendar privacy and "define personal space in a digital world." (Palen, 1988) These include changing access settings on events (e.g., setting certain events as 'private' so they are not visible), adding cryptic or context-sensitive entries so others can't necessarily understand the calendar entries, scheduling defensively by blocking out time for one's own 'work,' and

simply leaving out calendar appointments. Of course, these strategies have the natural effect of creating additional coordination challenges, but they do help regulate one's privacy.

4.1.5 Workplace Digital Calendars

The current paradigm for designing workplace digital calendars is to provide features that can aid the coordination of events with other workplace colleagues. This is a natural goal given the collaborative role of work calendars.

Microsoft Outlook is one current example of a workplace calendar in high usage (for example, as experienced through my own internships, most Microsoft employees, if not all, use Outlook for scheduling work activities). Figure 4.1 shows the interface for Outlook 2003's calendar (the current publicly released version). Here users have a *personal* calendar that they can use to schedule and view events. Outlook supports viewing the calendar in day, week, and month views (week view is shown in Figure 4.1). Users can also view the calendars of their colleagues by clicking 'Open a Shared Calendar' in the bottom left of the interface. Here they are presented with a list of all calendars that have been explicitly shared with them. Selecting a shared calendar causes it to appear beside the user's own calendar. Scheduling events is done by either clicking on a time within one's own calendar grid and typing, or by clicking 'New' in the top left corner of the interface and selecting 'Meeting' or 'Appointment.' A dialogue appears where users can add event details. Users can also invite attendees to an event by using a 'Scheduling' tab shown in Figure 4.2. Users type the names of attendees and, providing that the attendees are recognized in a shared server's address book, their free / busy times are displayed. Users can then pick a meeting time that will likely be suitable for all attendees. Next, a meeting request is generated by the system and distributed to attendees via email who can then accept, decline, or suggest an alternative meeting time. In the case of new time suggestions, the original scheduler is prompted with the request, and the scheduler can then again accept, decline, or modify the event. The types of scheduling and coordination features found in Outlook are fairly representative of most workplace digital calendar feature sets.

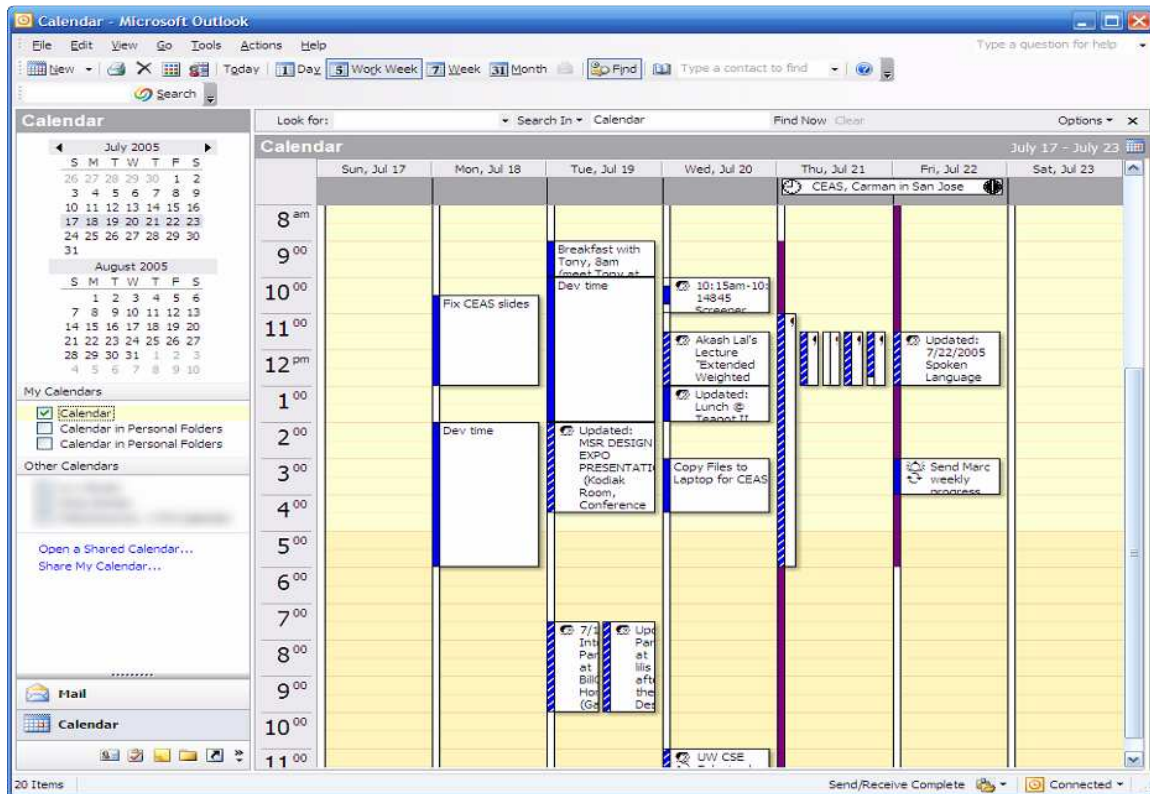


Figure 4.1: Microsoft Outlook 2003's calendar.

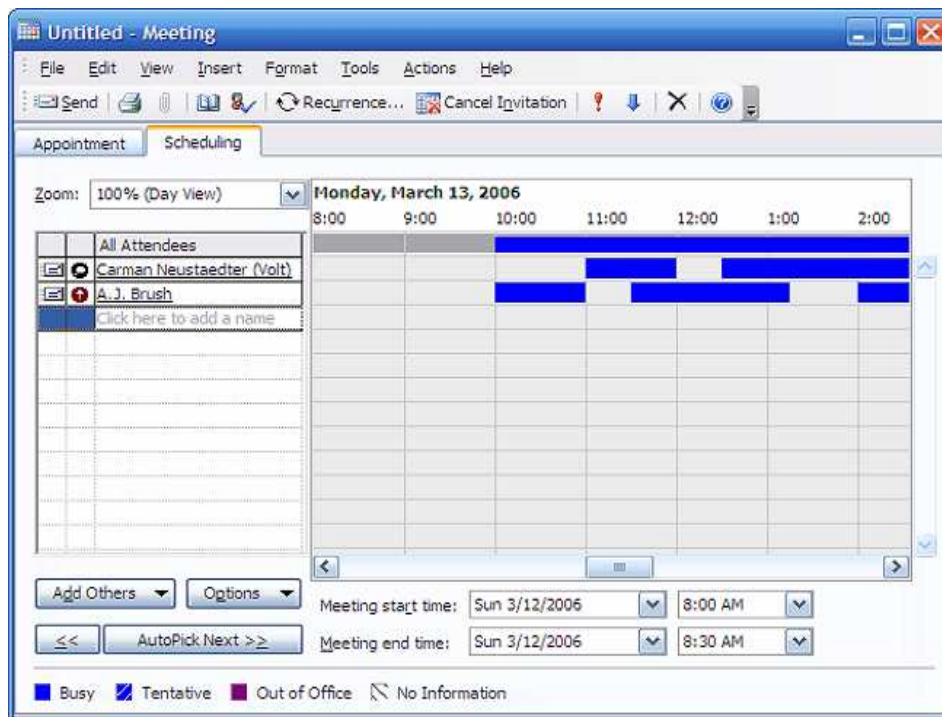


Figure 4.2: Selecting meeting attendees in Microsoft Outlook 2003.

To further enhance workplace calendaring, a variety of research projects have looked at next-generation workplace calendar designs (e.g., Mynatt and Tullio, 2001, Mueller, 2002, Tullio *et al.*, 2002, Mackinlay *et al.*, 2004, Bederson *et al.*, 2004, Brzozowski *et al.*, 2006). Here researchers focus on enhancing workplace calendaring through new scheduling and visualization features. I describe three systems as illustrative examples of the major focus of design research for workplace calendaring.

The first is a groupware calendar called Augur designed by Tullio *et al.* (2002) where the focus is to provide users with an awareness of likely colleague attendance for events and appointment sharing. Augur uses a Bayesian network to predict user attendance of activities by analyzing past attendance habits. Here Augur will determine one's likely attendance by modeling each event's priority given past activity. This information is then displayed in a web visualization shown in Figure 4.3. The left side of the interface shows one's schedule for 'today' and the right side shows schedules for the next two days. Next to each event in the calendar are several redundant visual cues representing the likelihood of colleague attendance. Icons representing each colleague with the same event are ordered from left to

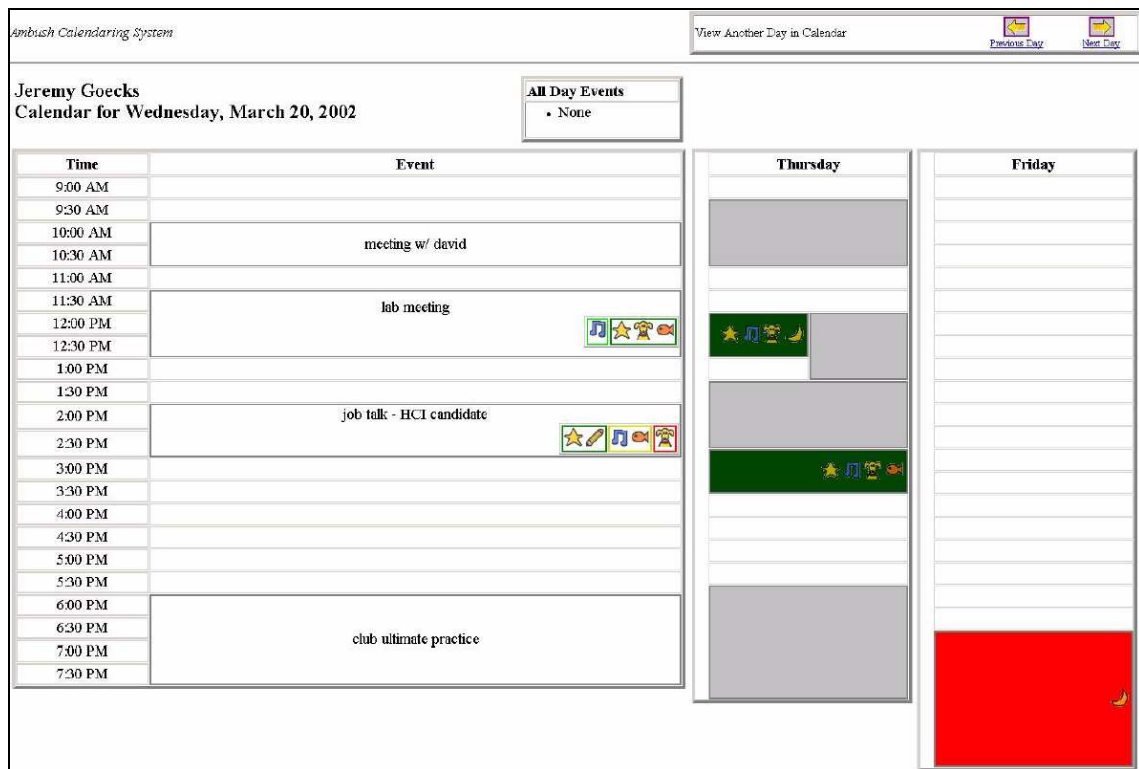


Figure 4.3: Augur provides visual cues to show likely colleague attendance at meetings (from Tullio *et al.*, 2002)

right by most likely to attend to least likely to attend. Further visual coding clarifies event attendance. Green borders around icons indicate a colleague is going to attend an event, yellow indicates they may attend, and red indicates that the person will probably not attend the event. The level of icon transparency also represents the probability of event attendance. In the two right most days of the interface, each event is colour coded as a whole to show how ‘popular’ that event is amongst colleagues. Clicking any colleague’s icon will display that colleague’s calendar.

The additional social information provided by Augur creates an understanding of meeting importance for colleagues, which co-workers can use to help determine if they should attend an event. This is especially useful when colleagues have overlapping events. Augur also provides workspace awareness so colleagues know where they expect to find each other for communication and collaboration (Whittaker *et al.*, 1994). Thus, Augur is very well suited to the workplace where people each maintain their own calendar and knowing calendar information about others can help coordinate one’s own schedule. However, as this dissertation will reveal, such a design does not match the routines of families because it is designed predominantly to support workplace and not family routines.

The second system, groupTime (Figure 4.4), is a groupware calendar designed to enhance group scheduling by allowing people to specify times of preference for meetings rather than share calendar contents between individuals (Brzozowski *et al.*, 2006). To schedule an event, users create a new meeting request that is sent via email to their co-workers; initially a meeting time is not specified by the user. Upon receipt, colleagues

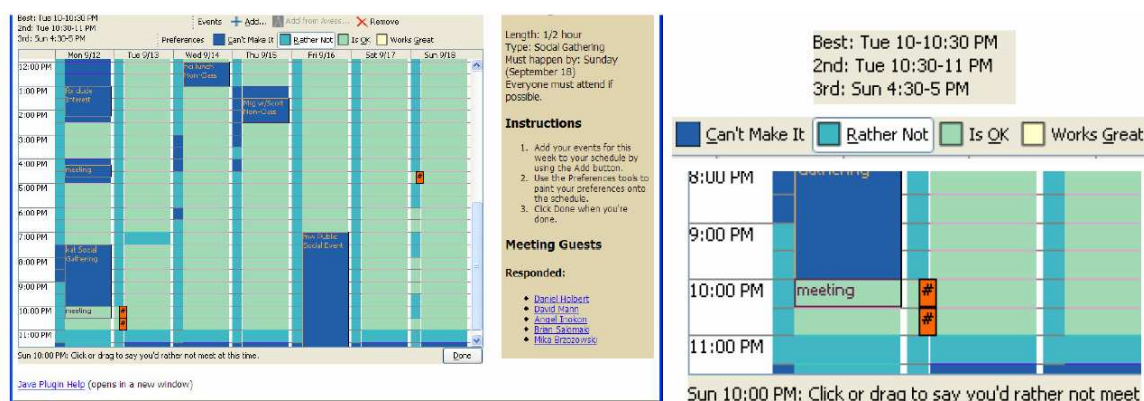


Figure 4.4: groupTime shows best event times for attendees (from Brzozowski *et al.*, 2006).

highlight regions on their calendar, shown in Figure 4.4, based on their preference: “Can’t Make It,” “Rather Not,” “Is OK,” or “Works Great.” Machine learning is then used to predict a suitable meeting time where the ‘best time’ is sent around to all attendees via email for final acceptance. Over time, the system will predict appropriate times which the user can then alter if incorrect. groupTime is highly suitable for the workplace where calendaring is individual in nature and meetings are negotiated through digital invitations. In fact, such a system would even help alleviate some of the privacy concerns brought forward by Palen (1998) as calendars no longer need to be viewed and shared amongst colleagues. Furthermore, the use of machine learning helps to eliminate at least some of the workload of selecting time preferences.

The third system, SpiraClock, uses an alternative visual metaphor to display events that contrasts the calendar grid layout most often seen in digital calendar designs (Dragicevic and Huot, 2002). Here the goal is to provide users with non-intrusive feedback of events in the near future. Figure 4.5 shows several views of SpiraClock running on a desktop PC where an analog clock shows a spiral of events. Shaded regions in the clock indicate upcoming events. For example, the view in the middle of Figure 4.5 shows that in five minutes the user has an event that will last five minutes. In 35 minutes from now, there is an upcoming event that lasts for 20 minutes. The SpiraClock can be zoomed in to show short time durations or zoomed out to show up to an entire day’s worth of events by dragging the hour and minute hands on the clock. Events can also be colour coded depending on the type of event. Extensions of SpiraClock include CalendarClock, which synchronizes with a work calendar to display calendar appointments. It is possible that visual metaphors other than

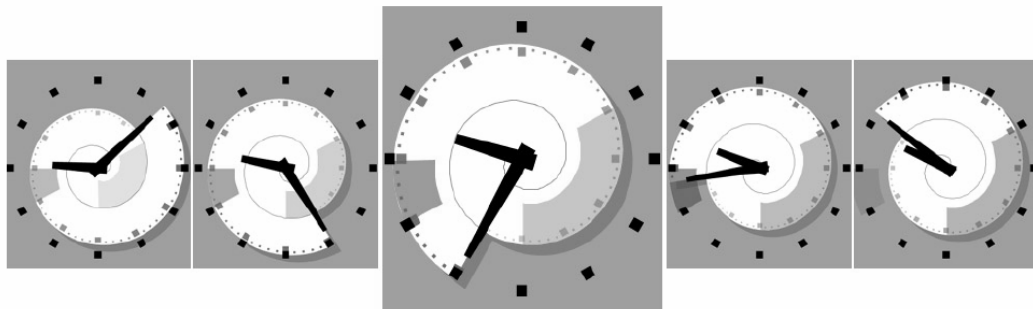


Figure 4.5: SpiraClock uses shaded regions on an analog clock to show when upcoming events occur (from Dragicevic and Huot, 2002).

calendar grids offer design potential for calendaring systems, yet initial user testing of SpiraClock did not fair so well. Users found it confusing to move forward and backward in time. The designers of SpiraClock suggest that regular calendar grid layouts are best for findings events and viewing schedules as a whole.

This concludes the review of the workplace calendaring literature. In the next section, I begin to reveal how family calendaring differs from workplace calendaring, which becomes a main theme for the remainder of this dissertation.

4.2 Family Calendaring

Through ethnographic studies of domestic routines along with interviews and surveys, researchers have found that designing digital calendar systems for the home is not simply a matter of technology transfer from the workplace (Crabtree *et al.*, 2003a). There exist social practices specific to family calendaring that suggest unique digital calendar solutions. This section begins to unravel these social practices by describing challenges with family organization and the way in which calendars are used to support domestic routines. I also describe several family calendar designs as illustrative examples of the steps already taken by researchers for digital family calendar design.

4.2.1 Challenges with Family Organization

Domestic life is about accomplishing domestic goals regardless of where one is, be it home, work, or while mobile (Sellen *et al.*, 2004). Families must continually organize activities on a daily basis and face many challenges in doing so. Sellen *et al.* (2004) describe results of a survey of 715 working parents where they assess the problems encountered in everyday home life. The most severe problems related to family organization and, thus, family calendaring were found to be:

- *Performing household chores and tasks* like going shopping and knowing what to buy, and planning and cooking meals (subsequent chapters reveal family calendars often contain household chores and tasks like these);
- *Remembering family activities* which are often written on a calendar or list, but not necessarily taken with a person when they go about their daily activities;

- *Transporting* children to various activities which have to be worked in amongst other family activities as well as resource management (e.g., the car); and,
- *Changing plans during the day* because new scheduling constraints can arise at almost any time.

Less severe, though still moderately problematic activities included:

- *Knowing a spouse's schedule* which may be contained in a personal calendar not easily accessible by all family members;
- *Balancing work and domestic activities* because often home activities encroach on work time, or vice versa; and,
- *Reminding family members of activities* because it is often the responsibility of the mother to let others know what events are upcoming.

Sellen *et al.* (2004) believe these problems stem from a variety of factors including the overhead and complexity of planning and coordinating activities, the time demand of work and home activities, a natural integration of work and home activities (especially for working mothers), and difficulties in accessing relevant information while not at home, such as a family calendar. Beech *et al.* (2004) studied the lifestyles of working parents through ethnographic interviews and observations and found similar findings. Domestic activities happen throughout the day regardless of where one is and plans change frequently requiring families to have a fairly complex organization scheme. Given this complexity, they suggest that family calendars should be designed to be accessible while mobile or at work, shared by all family members, synchronizable across devices and artefacts, and simple to use because families have little or no time to learn new technologies (Beech *et al.*, 2004).

4.2.2 Organization Systems and Artefacts

Families employ a wide range of creative or 'artful' *organization systems* to handle, deal with, and arrange information within the home (Taylor and Swan, 2005) in order to alleviate some of the challenges mentioned in the previous section. These organization systems combine many different artefacts including calendars (Zimmerman *et al.*, 2001, Taylor and Swan, 2004), to-do lists (Taylor and Swan, 2004), and paper notes (Taylor and Swan, 2005, Elliot *et al.*, 2005). In North America and the United Kingdom, fridge surfaces also play a significant role where their magnetic surface lends itself naturally to the posting of information because

of its magnetic properties (Swan and Taylor, 2005). Each family uses these artefacts in a very flexible manner that shapes the social relations of a household's members. Given this range of coordination artefacts and uses, Taylor and Swan (2005) suggest that digital organization systems for the home must allow combining heterogeneous devices, support flexible systems of organization, and integrate with established organization systems.

More detailed studies of lists by Taylor and Swan (2004) showed that paper lists are central to the organization of everyday life, especially for days when coordination is complicated. Some lists they found were linear by time, others were geographically oriented. For example, a list may contain a series of events with corresponding times such as “1pm—Pickup Kim from School, 3pm—Drop Greg off at Soccer Practice.” Lists could also contain items associated with city locations like “Grocery Store: milk, eggs, bread, cheese.” The free form nature of lists allows people to structure them in their own personalized way and to change them as needed. Lists are also highly mobile because they are most often on paper and, depending on the location in which they are placed, they can easily become shared artefacts for the household, e.g., shopping lists on the fridge. Taylor and Swan (2004) also found that it can be hard to separate work and personal life from the same list; people try to have lists for both, but often they become intertwined. Some lists even have sentimental value, and will be saved for that reason.

4.2.3 Calendars as Family Coordination Artefacts

Calendars, like lists, are also crucial to family coordination. In fact, Zimmerman *et al.* (2001) found calendars were the most prevalent household coordination artefact. Ethnographic studies of families in the United Kingdom by Crabtree *et al.* (2003a) look more closely at the role of calendars as part of family organization systems. Here they found that family calendars are collaborative objects, often situated in locations specific to this role like the kitchen. It is likely for this reason that family calendars are most often shared within households as opposed to outside of a household (as found by Plaisant *et al.*, 2006). Family calendars move from ‘dead objects’ to ‘social objects’ as people use them to produce meaning, purpose, and utility (Crabtree *et al.*, 2003a). Families not only add events to the calendar but also a rich set of annotations to provide additional meaning to calendar entries (Crabtree *et al.*, 2003a). These may include arrows, circles, or the use of colours to draw

attention to information. It is in this way Crabtree *et al.* (2003a) argue that calendars become *accountable social objects*. Shared rather than individual use of the calendar suggests that people should record their schedule on the calendar as a means to enable schedule negotiation with other family members. Like other researchers, Crabtree *et al.* (2003a) recognized the challenge of gaining calendar access outside the home and suggest digital family calendars should be accessible from a variety of locations while still maintaining the presence of an in-home collaborative family calendar. They also suggest that digital family calendars should permit the easy addition of annotations to support people's existing practices as well as providing built-in calendar facilities to negotiate schedules.

Further work by Crabtree *et al.* (2003b) looks at the location of communication information, like calendars, in the home. They found that home activity is generally concerned with communications coming into and going out of the home. More specifically they found that communication media live in one or more of three areas: ecological habitats, activity centres, and coordinate displays. *Ecological habitats* are locations where items are normally kept (e.g., a shelf may contain a stack of bills). *Activity centres* are places where items are used and transformed (e.g., the kitchen table may be used to balance one's cheque book when paying bills). *Coordinate displays* are places where items are left for others to see or for people to coordinate activities (e.g., birthday cards left for others to see on the mantle). In relation to family calendars, we can see that the location chosen to store the family calendar is an *ecological habitat*; the location where people add to the family calendar is an *activity centre*; and, the location chosen to display a family calendar for others to see is a *coordinate display*. One could also imagine that in many households these locations overlap.

4.2.4 Paper *vs.* Digital Calendars

Like the workplace, both paper and digital calendars are being used in the home for calendaring. Brush and Turner (2005) surveyed 621 Microsoft employees who used a combination of paper and digital calendars as the primary family calendar. They found that 59% of survey respondents used a digital calendar as their primary family calendar while only 31% used a paper calendar as the primary calendar. The high amount of digital calendar use is likely because the respondents all work at a technology company where *digital* work calendars are at the core of daily organization routines. Despite this, the reasoning by

respondents for using paper *vs.* digital calendars as the primary family calendar paints an interesting picture. Those choosing to use *paper calendars* did so because they are (Brush and Turner, 2005):

- *Easy to use*: adding events requires simply grabbing a pen and writing on the calendar;
- *Easily visible*: they can be hung in high traffic areas of the home;
- *Easily shared*: family members can just walk up and use the calendar;
- *Easy to archive*: one can simply store past calendars for later retrieval if needed; and,
- *Personalizable*: one can use their own handwriting, use colours, or pick calendars with certain pictures.

Despite the simplicity of paper, respondents using paper calendars still found it hard to:

- *Change events*: moving events required scratching out events and rewriting them, which could be considered messy;
- *Access the calendar remotely*: paper calendars are really only ever available in one location at one time; and,
- *Synchronize multiple calendars*: events must be manually copied between calendars.

Studies of paper use in the workplace have shown similar findings about paper in general (Sellen and Harper, 2003, Harper *et al.*, 2003). On the other hand, digital calendars were used because they are (Brush and Turner, 2005):

- *Always accessible*: digital calendars can be accessed from more than one location simultaneously if networking support is available;
- *Easy to view and edit*: providing one is at a desk with a computer, typing events is relatively simple as is changing event information (dragging events or retyping content); and,
- *Easy to synchronize with a work calendar*: many digital calendars provide features to automatically synchronize calendars.

Despite these benefits, survey respondents did note that digital calendars were at times hard to share with others. As well, synchronization with a work calendar was quite simple in many cases because the family calendar often *was* the work calendar. Hutchinson *et al.* (2002) also found that the main problems people had with their family calendar (be it paper *or* digital) were synchronization with other calendars (83% of families used more than one calendar), accessing the calendar remotely, and limitations in space to add events.

In the next section, I look more closely at family calendar usage by describing who typically maintains the family calendar, be it paper or digital.

4.2.5 Women as Primary Schedulers

Despite being a shared artefact for the entire family, studies have shown that in actual practice family calendars are in many cases maintained by one person, typically a woman, known as the *primary scheduler*. This is the person who is most responsible for recording family activities on the calendar and ensuring people know about them. In an online survey of 400 people, Hutchinson *et al.* (2002) found that family calendars were maintained by one person 44% of the time and 56% of the time by multiple maintainers, though we do not know to what extent multiple maintainers actually contributed to calendaring activities. For single maintainer families, 90% were maintained by women. Brush and Turner (2005) found similar findings: 72% of families had a single maintainer where this is more likely to be a woman. However, families using paper calendars were more likely to share the maintenance of it, likely because paper calendars are more easily situated for collaboration (e.g., they can be hung on the wall in the kitchen). Hindus *et al.* (2001) also found that women are typically the household communicators, staying in contact with friends and family more, and yet again, Beech *et al.* (2004) found that most often the woman is the household manager and responsible for scheduling activities and reminding other family members about them. Having one person in charge of the family calendar can certainly pose organization challenges, as mentioned earlier, remembering family activities and reminding other family members of them were rated by working parents as some of their most severe family organization problems (Sellen *et al.*, 2004).

Social psychological studies begin to show *why* family calendaring is dominated by women. Zimmerman *et al.* (2001) interviewed 47 heterosexual couples with children and also found that women primarily maintain the family calendar. When the couples were asked why, they explained independently that the wife assumes the role of the organizer simply because she is a *better* organizer, while the husband is more flexible and laid back. Yet further analysis revealed that this is a perception rather than the actual truth. In fact, it is not the case that women are necessarily better organizers than men in general as organizational abilities vary depending on one's personality and various other factors. It seems that the real

reason women become more responsible for family organization is their *gender* (Zimmerman *et al.*, 2001).

Wegner *et al.* (1991) argue that couples implicitly create a shared or *transactive memory* where over time each person becomes responsible for remembering particular information. Because women assume often early childcare roles, often for physiological reasons, over time family members implicitly identify this as a woman's area of expertise (Gladwell, 2000), though one could argue that cultural expectations further ingrain this idea. This assumed role as family organizer also makes women *appear* more organized than someone not in that role (Zimmerman *et al.*, 2001). Of course, certain women *are* actually more organized than some men and vice versa. Studies by Leslie *et al.* (1991) reveal that women typically assume roles of *parental responsibility*, which involves the integration of "feelings, cognitions, and behaviours" with organizational acts. Men, on the other hand, typically engage in *parental assistance* where they help perform child organizational tasks without a larger feeling of responsibility (Leslie *et al.*, 2001). Most women interviewed by Zimmerman *et al.* (2001) were satisfied with their responsibility as family organizer, which was suggested to be the case because husbands contribute in other ways within the household. There are most certainly cases in society where dissatisfaction does occur however.

In the next section, I describe existing digital family calendar designs that further illustrate family calendaring routines.

4.2.6 Prototype Family Calendar Designs

Several researchers have begun designing family calendars to support domestic coordination routines. Plaisant *et al.* (2006) designed a shared family calendar as part of the InterLiving project. Here the goal is to support *inter-family* coordination by enabling distributed extended families to view each other's family calendar. Figure 4.6 shows the main interface in the week view, where each calendar row shows a different family's calendar. In this case, the top row shows the calendar of one set of grandparents, the middle row shows the calendar of another set of grandparents, and the bottom row shows the calendar for the family of the children/grandchildren. Events can be added to the calendar by using a keyboard and mouse where users select regions of the calendar and then type event information. A second input method allows users to write on special digital paper with a

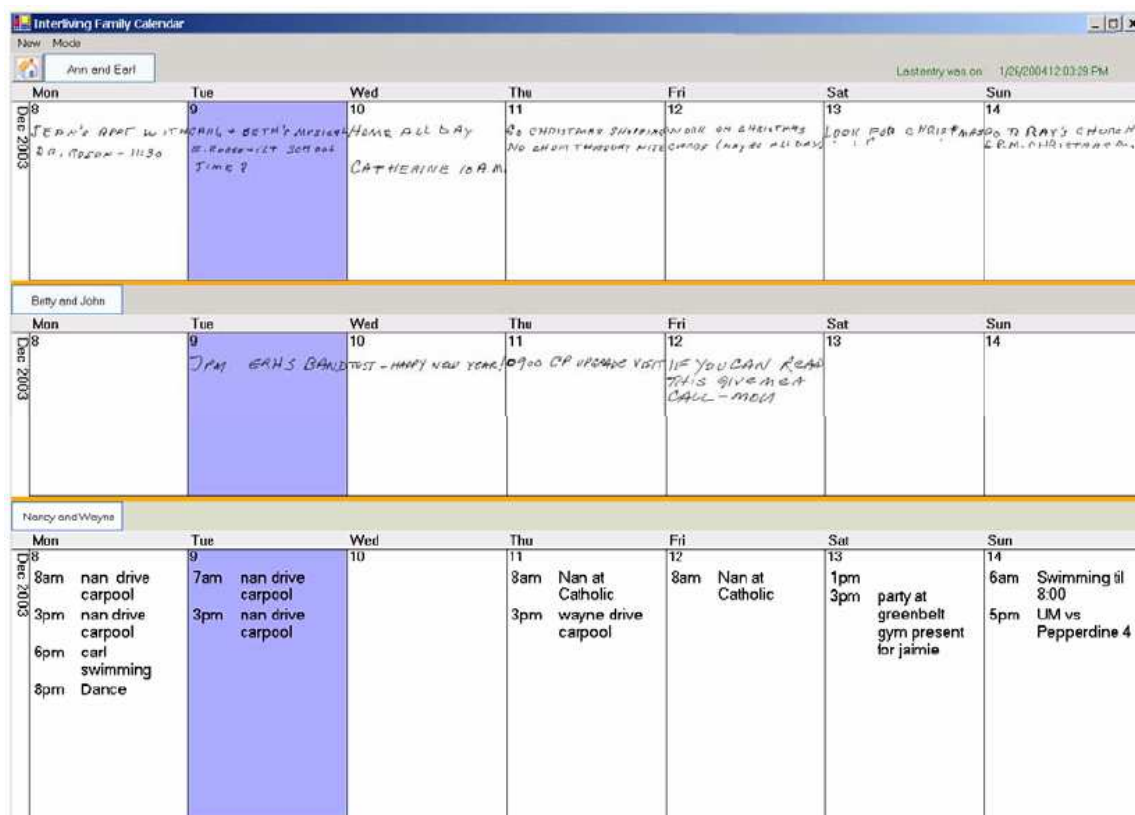


Figure 4.6: Interliving Family Calendar shows a different family's calendar in each row (from Plaisant *et al.*, 2006).

printed version of the calendar using a digital pen. When finished writing, the pen is docked in a holder attached to the PC and the written information is transferred to the calendar onscreen. Users can also view different levels of detail on the calendar using semantic zooming (Figure 4.7). Here the concepts of DateLens, originally designed for PDAs (Bederson *et al.*, 2004), were applied to desktop calendaring. For example, in Figure 4.7 portions of three months are shown at varying levels of detail. The first week (Figure 4.7, top) shows all details for the week, while all subsequent weeks are shrunk in size and show less detail.

Plaisant *et al.* (2006) evaluated their calendar with the three families whose calendars are shown in Figure 4.6. The main finding from this study was that the grandparents loved seeing the schedules of their children and grandchildren where this awareness provided additional feelings of connectedness. On the other hand, the families of the children/grandchildren provided a different story. Their schedule was much busier resulting

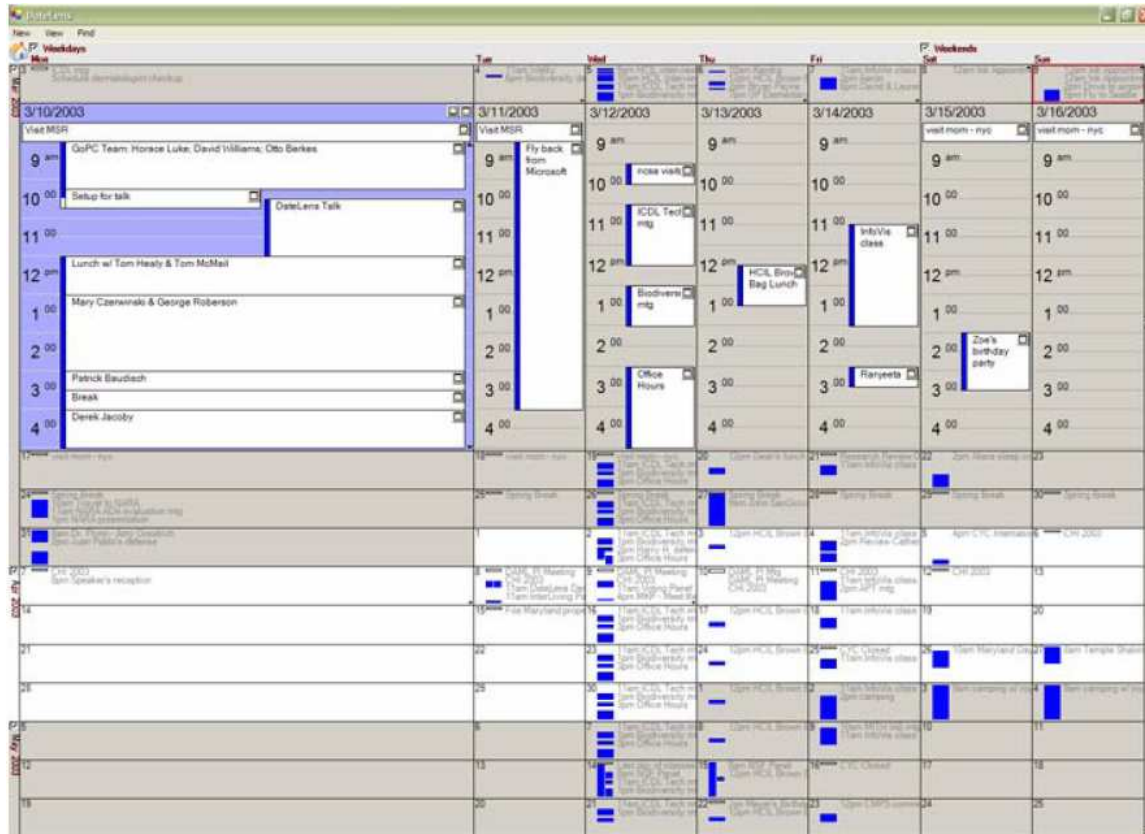


Figure 4.7: The Interliving Family Calendar uses features from DateLens to provide semantic zooming of different time periods (from Plaisant *et al.*, 2006).

in them not checking the grandparents' calendars very frequently. This type of asymmetric awareness was discussed in Chapter 3 (see Section 3.3).

The major value in Plaisant *et al.*'s (2006) work is initial attempts to design digital calendars specifically for domestic needs. For example, alternative interaction mechanisms are supplied, in this case a digital pen and paper, which are more natural to use in the home even though they are still indirect forms of interaction (writing isn't performed directly on the main calendar). We also see the model of calendaring moving from an individual calendar, which is the dominant paradigm of the workplace, to a shared family calendar design at the core.

Elliot and Carpendale (2005) have also designed a shared family calendar called AwareCo, shown in Figure 4.8. AwareCo is designed for a large public display in a home where family members can gather around to schedule, plan, and coordinate activities. Adding an event is done by clicking or tapping (if the screen is touch sensitive) on a time

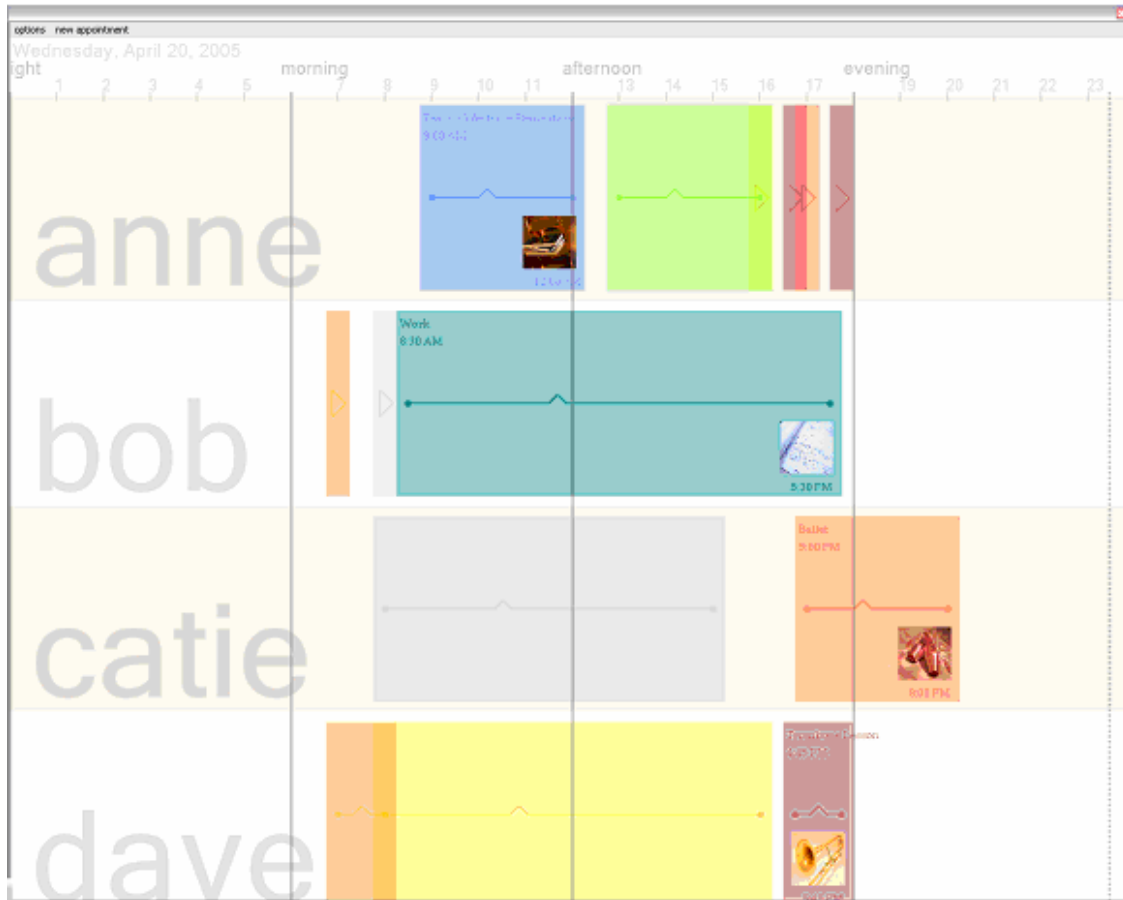


Figure 4.8: AwareCo displays each family member's events in a row across the calendar (from Elliot and Carpendale, 2005).

and then entering in appropriate details using a keyboard. Events are displayed as rectangles where users can pick colours to match any scheme they choose, for example, a colour per event type could be assigned. Family members can also assign individuals to events to show who is required for an event. For example, this could illustrate who may be driving for a child's activity. Events involving multiple family members are displayed in each family member's row. Visual cues such as triangles show which events are rides or carpools. For example, the line in the middle of the large green event in Bob's calendar row has a pulse or triangle to indicate he is driving a child to this event. AwareCo also provides several different views on the calendar that include month view, day view, and week view where users zoom in and out between views using touch gestures (if the display is touch sensitive). Gestures also allow one to scroll forwards and backwards through time.

While AwareCo has yet to be evaluated for its use with actual families, it presents several design ideas that illustrate how one may begin designing family calendars suitable for

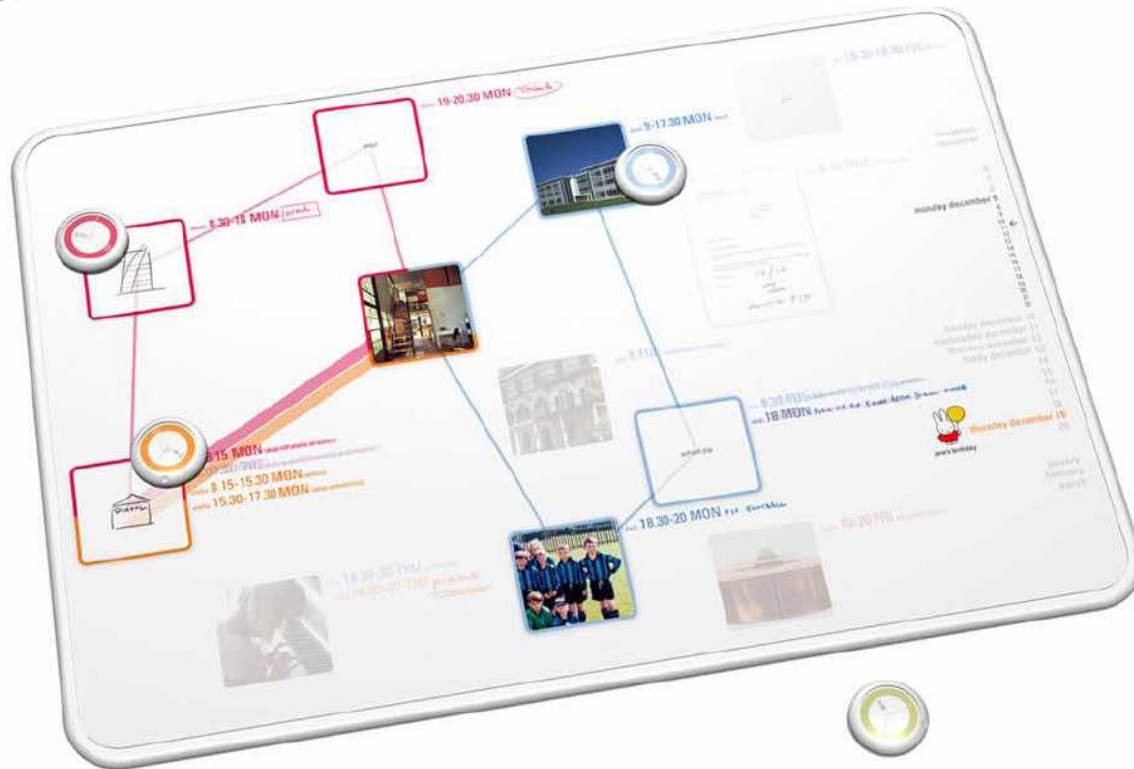


Figure 4.9: The long-term planner and coordination watches allow families to coordinate activities (from Hoefnagels *et al.*, 2004).

the home. Here the use of a large display and gesture-based interaction begins to move away from more traditional displays and interaction techniques found in the workplace to what would seem to be more natural in the home. However, the assumption that families will assign individuals to events where they can use this knowledge to coordinate and plan rides is based more on a model of workplace calendaring than family calendaring. I illustrate this in greater detail in subsequent chapters.

Hoefnagels *et al.* (2004) present an alternative conceptual calendar design that moves away from using a ‘calendar grid’ to display family activities. Figure 4.9 shows their *long-term planner*. Here the journeys of family members are shown as paths connecting images of their activities. Family members can drop in photos, drawings, appointments, and link paths between events to show interrelated activities. Thick lines show activities involving parents driving children. Each family member also has a special *coordination watch* that can be worn, which displays each family member’s current position in the day’s journey. Coordination watches are shown as small discs on top of the planner in Figure 4.9. To schedule new events, a family member simply moves her watch over the planner. Force feedback on the

watch shows how hard it is to fit something in at the current location/time. Family members can also adjust the time of a shared appointment by turning their watch dial when the appointment is visible on the watch. Again, force feedback in the watch shows how difficult it is to adjust the appointment's time based on the rest of the family members' schedules.

The long-term planner and coordination watches are still design concepts and thus not implemented as of yet. However, they still present plausible coordination methods for family members through the exploration of alternative visual layouts and interaction metaphors. Moving away from the popular calendar grid representation could be beneficial, though this is not clear. Families are very used to using a calendar grid to record and stay aware of family activities. They have also developed skills and routines over time that would need to be altered if an alternative design paradigm was to be used. This may render the long-term planner less simple to use than may be expected, at least initially. The use of coordination watches assumes a high level of involvement by family members in the scheduling routine. For example, adding an event relies on using a particular family member's coordination watch. This would benefit families where there already exists a large amount of family involvement in the coordination routine, yet it is unclear what effect this would have on families with low involvement.

4.3 Summary

This chapter *presents background knowledge of workplace and family calendaring*. This is the first step to *formalizing family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems* (Chapter 1, Objective 2).

In the workplace, calendars are in widespread use where they act as personal support artefacts providing a *temporal map* for people to ease the burden of one's mental map of activities (Payne, 1993, Palen, 1998, 1999). People use calendars in a range of different ways depending on the nature of one's work, their experience, and their personality. Typical individual calendaring tasks include orienting oneself temporally, scheduling events, tracking events for later reference, reminding oneself, recording and archiving notes, and retrieving and recall (Palen, 1998, 1999). Calendars contain a variety of events where often people will use multiple calendars to have pertinent information in different locations (Kelly and

Chapanis, 1982, Kincaid *et al.*, 1985, Payne, 1993). However, multiple calendars bring with them challenges in synchronizing events between calendars (Kelly and Chapanis, 1982, Kincaid *et al.*, 1985).

Calendars also act as social and collaborative artefacts enabling colleagues to coordinate and schedule meetings (Palen, 1998, 1999). Here colleagues maintain some level of view on to the calendars of others and use meeting requests to assign individuals to events. Naturally people must balance the reveal of calendar information to aid coordination with their own desires to maintain some degree of privacy (Palen, 1998, 1999). The design of workplace digital calendars has focused on providing ways to enhance the coordination of workplace activities while balancing the need for privacy (e.g., Mynatt and Tullio, 2001, Tullio *et al.*, 2002, Brzozowski *et al.*, 2006). Other systems (e.g., Dragicevic and Huot, 2002) have tried alternative design metaphors to the fairly ubiquitous calendar grid, yet these have shown limited success in user testing.

Taken together, the related literature has shown that in the workplace, calendars are designed to support a model where *each person has their own individual calendar and event attendance is negotiated through the calendaring system* where people get assigned as attendees. This contrasts the routines that have evolved for family calendaring.

Families face many challenges organizing everyday activities, many of which pertain to family calendaring (Sellen *et al.*, 2004). To help overcome these challenges, families use a variety of domestic artefacts, including calendars, to organize their lives (Zimmerman *et al.*, 2001, Taylor and Swan, 2004, Taylor and Swan, 2005). Table 4.1, Column 1 summarizes the existing knowledge of how families use calendars as a part of their coordination routine. Family calendars are inherently collaborative objects in the home where their location and use creates social objects (Crabtree *et al.*, 2003a). This is unlike the workplace where calendars are personal objects shared at some level with others. Families choose to use paper *vs.* digital calendars as their primary calendar for different reasons (Brush and Turner, 2005). Paper calendars are easy to use, share, and personalize, yet they are not remotely accessible (Brush and Turner, 2005). Digital calendars on the other hand are also easy to use

	Existing Research on Family Calendar Routines	Remaining Questions about Family Calendar Routines
Calendar Locations & Types	<p>Family calendars are located in public home locations (Crabtree <i>et al.</i>, 2003a)</p> <p>Families need access to their calendar outside of the home (Crabtree <i>et al.</i>, 2003a, Beech <i>et al.</i>, 2004, Sellen <i>et al.</i>, 2004)</p> <p>Families use either paper or digital calendars and receive benefits from each (Brush and Turner, 2005)</p> <p>Families refer to multiple calendars (Hutchinson <i>et al.</i>, 2002)</p>	<p>Do families have multiple locations in the home with calendars? Why?</p> <p>What calendars used outside of the home contain family calendar content? Why?</p> <p>How are the different types of calendars being used? Why?</p>
Calendar Content	<p>Space limitations restrict how much families can write on the calendar (Hutchinson <i>et al.</i>, 2002, Brush and Turner, 2005)</p> <p>Family calendars contain a rich set of annotations (Crabtree <i>et al.</i>, 2003a)</p> <p>Family calendars contain a range of events (Hutchinson <i>et al.</i>, 2002)</p>	<p>How many events are families writing on the calendars? Why?</p> <p>What types of events are recorded? Why?</p> <p>What types of annotations do families use? Why?</p> <p>Are calendars augmented with additional information relating to events? Why?</p> <p>What level of detail do families prefer viewing the calendar at? Why?</p>
Calendar Activities	<p>Families perform a batch update of the calendar with a large number of events (Zimmerman <i>et al.</i>, 2001)</p> <p>Families negotiate who will attend events using the calendar as an artifact (Crabtree <i>et al.</i> 2003a)</p> <p>Families tediously synchronize events between calendars (Brush and Turner, 2005)</p>	<p>How and when do family members add events to the calendar (in addition to ways already identified)? Why?</p> <p>How and when do family members check the calendar? Why?</p> <p>How do family members coordinate activities? Why?</p>
Family Member Roles	<p>Many families have a single maintainer, others have multiple maintainers (Brush and Turner, 2005)</p> <p>Most often a single maintainer is a woman (Zimmerman <i>et al.</i>, 2001, Beech <i>et al.</i>, 2004, Brush and Turner, 2005)</p>	<p>What activities does a single maintainer perform? Why?</p> <p>What activities do multiple maintainers perform? Why?</p>

Table 4.1: A summary of existing family calendar research and a series of unanswered research questions about family calendaring routines.

and can provide calendar access remotely, though they can be hard to share with family members (Brush and Turner, 2005). Despite being a collaborative family artefact, the family calendar is maintained in many cases by one individual who is most often a female (Hindus *et al.*, 2001, Zimmerman *et al.*, 2001, Hutchinson *et al.*, 2002, Beech *et al.*, 2004, Brush and Turner, 2005). This is because women are most often the family member responsible for organizing children's activities and care giving (Zimmerman *et al.*, 2001, Beech *et al.*, 2004). Family calendars designed specifically for family routines have started addressing the real needs of families by incorporating interaction techniques more natural to the home and designing for domestic locations (Elliot and Carpendale, 2005, Plaisant *et al.*, 2006).

The next two chapters provide findings from my own studies of family calendars to extend the material presented in this chapter and *formalize family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems* (Chapter 1, Objective 2). Table 4.1, Column 2 illustrates that there are still many unanswered questions about family calendaring routines that are not addressed by the existing literature. Answering these is crucial to truly *understand how to best design digital family calendars* (Chapter 1, overarching research problem). Chapter 5 answers questions about the types of calendars used by families, the roles of family members in calendaring routines, and the activities they perform for scheduling and coordination. Chapter 6 addresses questions about the event content placed on the calendar and the use of annotations and augmentations to provide additional meaning to calendar events. Together these findings further illustrate that *family calendaring is fundamentally different than workplace calendaring* and show why unique calendaring solutions for the domestic realm are needed.

Chapter 5. Family Calendars and their Use⁵

The goal of the next three chapters is to build on the existing material about calendaring presented in Chapter 4 to *formalize family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems* (Chapter 1, Objective 2). This work is structured as follows. The current chapter presents the interview methodology for studies of family calendaring routines and the first half of the study’s findings, which details the types of calendars used by families and the ways in which families schedule and coordinate using them. Chapter 6 details the second half of the study’s findings where it outlines the content families place on the family calendar and the ways in which they augment their calendars to provide additional meaning. Chapter 7 illustrates how the findings from Chapters 5 and 6 can be applied to the design of digital family calendars. It also situates the findings presented in this chapter within the related literature to show how it extends existing research.

Specifically, the current chapter identifies a *typology of calendars* used by families as part of their coordination routines. This includes the *primary calendar*—the main calendar used for coordinating a family’s activities—and *secondary calendars*—calendars used in addition to the primary calendar. Next, I formalize the steps families take to schedule, check the calendar, and coordinate activities, and identify three family types: *Monocentric*, *Pericentric*, and *Polycentric*. This outlines the role of the *primary scheduler*—the person most responsible for maintaining the family calendar—and other family members, called *secondary schedulers*.

5.1 Study Methodology

This chapter reports on the usage of family calendars from 44 different middle class families using semi-structured interviews that probe into the social culture and domestic routines of

⁵ Portions of this chapter are also published in: Neustaedter, Brush, and Greenberg (Technical Report 2006c).

families. While the interviews do reveal cultural knowledge and meaning, these are not interviews in the traditional ethnographic sense that occur over long periods of time and involve cultural immersion (Spradley, 1979, Spradley, 1980). Instead, the process I undertake is an applied ethnographic approach that is less intrusive, occupies a shorter time frame, and is more focused on understanding how to design new products or technologies (Sanders, 2002). This approach is similar to existing qualitative observational techniques like contextual inquiry that act as cultural probes to understand everyday routines and practices (Holtzblatt and Jones, 1995, Beyer and Holtzblatt, 1998). In this section, I describe the participants, interview method, and analysis for my study. All study materials are available in Appendix C.

5.1.1 Family Participants

The study was comprised of 60 individuals from 44 different middle class families residing either in Seattle, U.S.A., or Calgary, Canada (summarized in Table 5.1):

- a) twenty families (from Seattle) were interviewed as part of the design work detailed in Chapter 8 (Table 5.1, P21 to P40);
- b) four families (two from Seattle and two from Calgary) were interviewed as part of a field study of digital calendar use detailed in Chapter 9 (Table 5.1, P41 to P44); and,
- c) twenty families (from Calgary) were interviewed in a study looking exclusively at existing family calendar routines (Table 5.1, P1 to P20).

Interviews with the initial twenty-four participants (a and b) formed the basis of our thinking and the follow-up twenty (c) were used to narrow our focus and uncover additional detail about family coordination routines. All Seattle participants were recruited through Microsoft using a study recruitment agency which collects a database of information about people interested in user studies and contacts them to check for availability and appropriateness for a given study. All Calgary participants were recruited using a snowball sampling technique where emails were sent to colleagues and friends, which were then forwarded on to their contacts, and so on and so forth. Recruitment information is found in Appendix C.1. Participants in groups (a) and (b) were remunerated with computer software and participants in group (c) received \$20 CDN

ID	Family Member Names in the Text	Parents' Occupation(s)	# of Children by Age (yrs)			
			0-4	5-12	13-18	19+
P1	Mike	School principal and teacher		2		
P2	Brad and Jennifer	Office worker and architect			2	
P3	Linda	Administrator and admin manager			1	
P4	Jill	Student				1
P5	Jack and Sherry	Professor and graduate student		2		
P6	Sidney	Therapist and oil worker		2		
P7	Greg and Lana	Dentists	1			
P8	Muriel	Childcare provider and courier	1	2		
P9	Anita and Doug	Accountant, construction manager		1	1	
P10	Ellen and Oreste	Programmer and technical sales rep		1		
P11	Cathy	Graduate student and bank manager			2	
P12	Elaine	Homemaker and surgeon	3			
P13	Fiona and Orlando	Student and building operator		4	1	
P14	Samantha	Admin assistant and accountant		1	1	
P15	Wanda and Dale	Government clerks		1	1	
P16	Bruno and Charity	Systems administrator and teacher	1	1		
P17	Margo	Executive assistant and sales manager			1	1
P18	Lucy	Students				2
P19	Kayla	Homemaker and computer analyst		2		
P20	Mona	Teacher and self-employed		2		
P21	Yolanda and Howie	Homemaker and quality control			2	
P22	Queenie and Ian	Homemaker and general contractor			1	1
P23	Susan	Office worker and sales associate			3	
P24	Yamini	Realtor and relations manager		1	2	
P25	Quiana	Instructor and mechanical engineer		1		
P26	Brenda	Artist and engineer			2	
P27	Eileen	Accountant and teacher			1	
P28	Deanna	Homemaker and architect		1		
P29	Questa	Bookkeeper and software architect		1		
P30	Daphne	Legislative analyst		1		
P31	Ruth	Teacher and engineer		2		
P32	Michelle and Earl	Homemaker and labourer		1		
P33	Noreen and Quin	Homemaker and scientist		2		
P34	Robin	Homemaker and family physician		1	1	
P35	Carrie	Teacher and finance director		1		
P36	Nadine and Norm	Loan officer and business analyst	1	2		
P37	Catherine	Homemaker and teacher			1	1
P38	Fae	Bank vice president and service rep		2		
P39	Cadence	Engineer		1		
P40	Rebecca	Trial lawyer and general contractor	1	3	1	1
P41	Caitleen	Teachers	2			
P42	Paul	Firefighter and accountant			2	
P43	Calysta	Homemaker and delivery manager		1	1	
P44	Gloria	Tour guide and technical support		2		

Table 5.1: Participant families in the calendar studies (names are anonymized).

Demographic information was gathered through pre-study questionnaires (questionnaires for group (a) are in Appendix D.3; group (b) in Appendix F.5; group (c) in Appendix C.3). Table 5.1 summarizes the 44 households. All households were middle class families with children varying in age from three months to 20 years; the number of children ranged from one to six (median 2). Parents ranged in age from their late 20's to 50's. We had 29 dual income families and 15 single income families (the mother was a homemaker). Those working had a large variety of occupations as apparent from Table 5.1. A large majority of families, 42 of 44, consisted of heterosexual married couples. Only two of the families contained single parents (Table 5.1, P30 and P39). Despite this, we did not notice any major differences in the results between the single parents and the married couples and do not suspect the main findings of this study would differ greatly with a larger number of single parents. Even still, it is important to realize that most results are from dual-parent households where issues of coordination between divorced / separated parents residing in separate households are not investigated.

5.1.2 Interview Method

We interviewed one or more individuals from all 44 families about their existing family coordination routines.⁶ Interviews of family members varied: 31 of the 44 involved only the mother (primary scheduler), six involved both the mother and father (primary and secondary scheduler), two involved just the father (secondary scheduler), one involved an adult child living at home (secondary scheduler), and four involved all family members (excluding young children). Interviews occurred either in the participants' homes (23 of the 44 households), our research lab (20 of 44), or in a neutral location chosen by the participant (1 of 44).

Interviews were aimed at identifying routines by understanding *what people say*, *what people do*, and *what people use* (Sanders, 2002). Naturally interviews are able to draw out an understanding through *what people say* simply by listening to interviewees. Yet a critique of interviews is that people aren't able to easily describe their routines retrospectively.

⁶ I interviewed 22 of the 44 families by myself, 20 were interviewed by both A.J. Brush (my collaborator) and myself, and 2 were interviewed solely by A.J. Brush.

Knowledge of *what people do* and *what people use* can overcome this problem by validating what people say; however, this knowledge is more challenging to acquire. Learning from what people do and use typically involves some degree of actual observation. The previous chapter describes how family calendaring takes place throughout many portions of the day and in a variety of locations (Beech *et al.*, 2004). In the context of this study of family calendaring, direct observation would mean watching a family's actions inside and outside of the home over the course of several days or even weeks. Yet this type of observation could be quite privacy-intrusive. Imagine having someone observe you and your household first thing in the morning as you prepare for the day! An alternative observation approach could involve setting up cameras to video record a family's actions from the many locations they frequent during the day. However, video recording is unrealistic given the wide variety of places a family could go during a day, both as a group and individually. A third alternative would involve diary studies where participants record entries in a journal describing what they do, but it is not clear that this approach would generate the desired information or level of detail needed for a thorough analysis of family calendaring.

For these reasons, we sought an alternative means to understand *what people do* and *use*. Here we ground our interviews in real domestic coordination artefacts. That is, during the interviews we asked participants to bring, show and share with us their calendars and any other items they use to help coordinate family activities. We then asked participants to discuss these artefacts and how they were used as part of their routines. We also had a series of predetermined questions (Appendix C.6) that were used throughout this process in case certain things we were interested in did not come up naturally. This technique of situating interviews with real world artefacts is borrowed from contextual inquiry (Holtzblatt and Jones, 1995, Beyer and Holtzblatt, 1998). Interviews typically lasted about an hour. Audio was recorded for all interviews, while observations and interview responses were handwritten or typed by the interviewer during the interview. With the participants' permission, we also photographed all calendars and items used by the families for coordination purposes (a photograph consent form is in Appendix C.5). A collection of photos from participants in group (c) is available in Appendix C.8.

5.1.3 Observation and Analysis Methods

All interview notes were reviewed and if clarification was needed I returned to our audio recordings. I categorized all interview notes and observations and used open coding (Strauss and Corbin, 1998) to draw out the similarities and differences between households.⁷ This analysis process was similar to the analysis described in Chapter 2. For each unique observation I coded it with a descriptive stylized label. I then compared subsequent observations with the coded ones, where I marked recurring similar observations with the best matching code. Observations that did not fit were given a new code. The codes developed during this analysis are found in Table 5.2, 5.3, and 5.4. I then used the coding and categorizations along with affinity diagramming (Holtzblatt and Jones, 1995, Holtzblatt *et al.*, 2005) to reveal key themes within the data. The remainder of this chapter details two of these key themes: a typology of calendars used by families; and, the routines families employ for scheduling and coordinating activities with these calendars. Calendar photographs were also analyzed for content and this is described in the next chapter.

Coordination Artefacts or Methods

[APPTCARD]	Uses an appointment card when mobile to schedule appointments
[BB]	Bulletin Board
[CELL]	A mobile phone
[DAYTIMER]	A personal paper calendar that can be taken with the person
[EMAIL]	Email conversations
[F2F]	Face-to-face interaction
[IM]	Instant messenger conversations
[LISTS]	To do lists on paper
[MONTH]	Calendar with month view
[NOTEBOOK]	A paper notebook
[NOTICES]	Calendars or notices from activities like sports or band
[ONLINE]	An online calendar
[PAPER]	A paper calendar for the wall
[PDA]	A mobile personal digital assistant (NOT mobile phone)
[PHONE]	A telephone
[WEEK]	Calendar with week view

Table 5.2: Analysis codes for coordination artefacts or methods.

⁷ All analyses for this study were done solely by me.

Calendar Locations

[ALWAYSTHERE]	The scheduler is typically always close to it
[BEDROOM]	Inside a bedroom
[CHILDREACH]	Out of the reach of children
[CLOSE]	Placed close to other coordination items
[COMPUTER]	Next to the computer
[ENTRY]	Entrance way
[FRIDGE]	On the fridge door
[HOME/WORK]	Accessed from both home and work
[HOMEOFFICE]	A location in the home where business is done
[KITCHEN]	In the kitchen but on the wall, not the fridge
[MOBILE]	Mobile, stays with the person
[PRAGMATIC]	A pragmatic reason, e.g., no other good spot, already nail on the wall
[PUBLIC]	Visible or accessible for the rest of the family members, not necessarily a heavy traffic area
[ROOMDOOR]	Outside of a bedroom door
[TRAFFIC]	High traffic area

Calendar Activities

[ADDOTHER]	Add other people's events
[ADDDOWN]	Add own events
[CALLBACK]	When mobile, won't schedule but will call back to schedule
[CHECK]	Each person checks the calendar to see what is happening
[CHILDREN]	Children use it for learning or knowing what is happening
[DRIVE]	Pickup / take kids to activities
[ENDMONTH]	At the end of the month, events are transferred from handouts and other calendars (sports schedules) to the main calendar
[HEAD]	Events are remembered in head and then written down later.
[IFSAME-NONE]	If an event is at the same time each week, it won't be added
[INITIAL]	Initially an event is put on but then over time it is no longer
[MEALS]	Used to plan daily meals
[MESSAGE]	Leave messages
[OWNACTIVITIES]	Be responsible for own activities that don't involve work, e.g., a sports coach keeping track of team schedule
[REGULAR]	Events are added as they come in
[REMIND]	One person checks and reminds others about events
[SCHEDULE-CHECK]	Check the calendar when scheduling events
[SEND]	Send events to others electronically, e.g., email, voicemail
[STARTYEAR]	At the beginning of the school year, events are transferred from other schedules (e.g., band, sports)
[SYNC]	Sync own calendar with family calendar
[SYNC-OTHER]	Sync with a calendar other than the family calendar
[TODO]	Make a to do list of items that need to be done
[TOLD]	Told by someone else about calendar events

Table 5.3: Analysis codes for calendar locations and activities.

The Best / Worst Aspects of Calendaring Routines

[ABBREV]	Using abbreviations
[COLORS]	Using colours for visual distinctions and at-a-glance viewing
[COMMUNICATION]	Communicating between both parents to know what is happening
[EXTRAS]	Keeping track of the extra stuff (e.g., to do items) that don't necessarily fit on a calendar because they aren't for specific days
[FEWEVENTS]	Having a schedule that is not very busy
[FLEXIBILITY]	The current system supports changing and adapting the routine
[FOREIGN]	Can't find the type of foreign calendar that they are used to
[FORGET]	Forget to write things down
[LAYOUT]	Layout of the calendar
[LOCATION]	A convenient location for the calendar that is publicly visible
[MESSY]	The calendar is messy or the area where it is gets cluttered
[ONEPLACE]	All coordination items being in one place
[OVERLAP]	Overlapping events that happen at the same time
[PLANNING]	Being able to see long term and plans events
[PORTABILITY]	The calendar is available anywhere
[PRIMARY]	Having a single primary scheduler that stays on top of the calendar and notifies others of things they need to be aware of
[REDUCELOAD]	Reduces the memory load needed to remember activities
[REFLECTION]	Being able to look back and see what was done (e.g., work hours, tasks completed)
[REMEMBERING]	Remembering what is on the calendar when leaving home
[REMINDING]	The calendar doesn't remind the person to look at it
[ROUTINE]	Having a routine develop over time that stays consistent
[SIZE]	Size of the calendar, e.g., larger squares or more weeks
[SYNC]	Failing to synchronize multiple calendars, or the challenges of having to synchronize them
[TEMPORAL]	Keeping events in temporal order
[TIME]	Putting in a lot of time to keep the calendar up-to-date
[USAGE]	Heavy usage, entering in lots of events

Table 5.4: Analysis codes for critical incidents in calendar routines.

5.2 A Typology of Calendars Used by Families

We found families use a variety of items for coordination including to-do lists, notices or handouts, random pieces of paper, and appointment cards. However, the most prominent and central of the coordination artefacts that we saw used by families was one or more calendars.

Table 5.5 gives a broad overview, where it summarizes the number and types of calendars used by each family. Each column represents one family labelled by participant number (e.g., P1, P3 and so on) for easy comparison with other results. Families are further

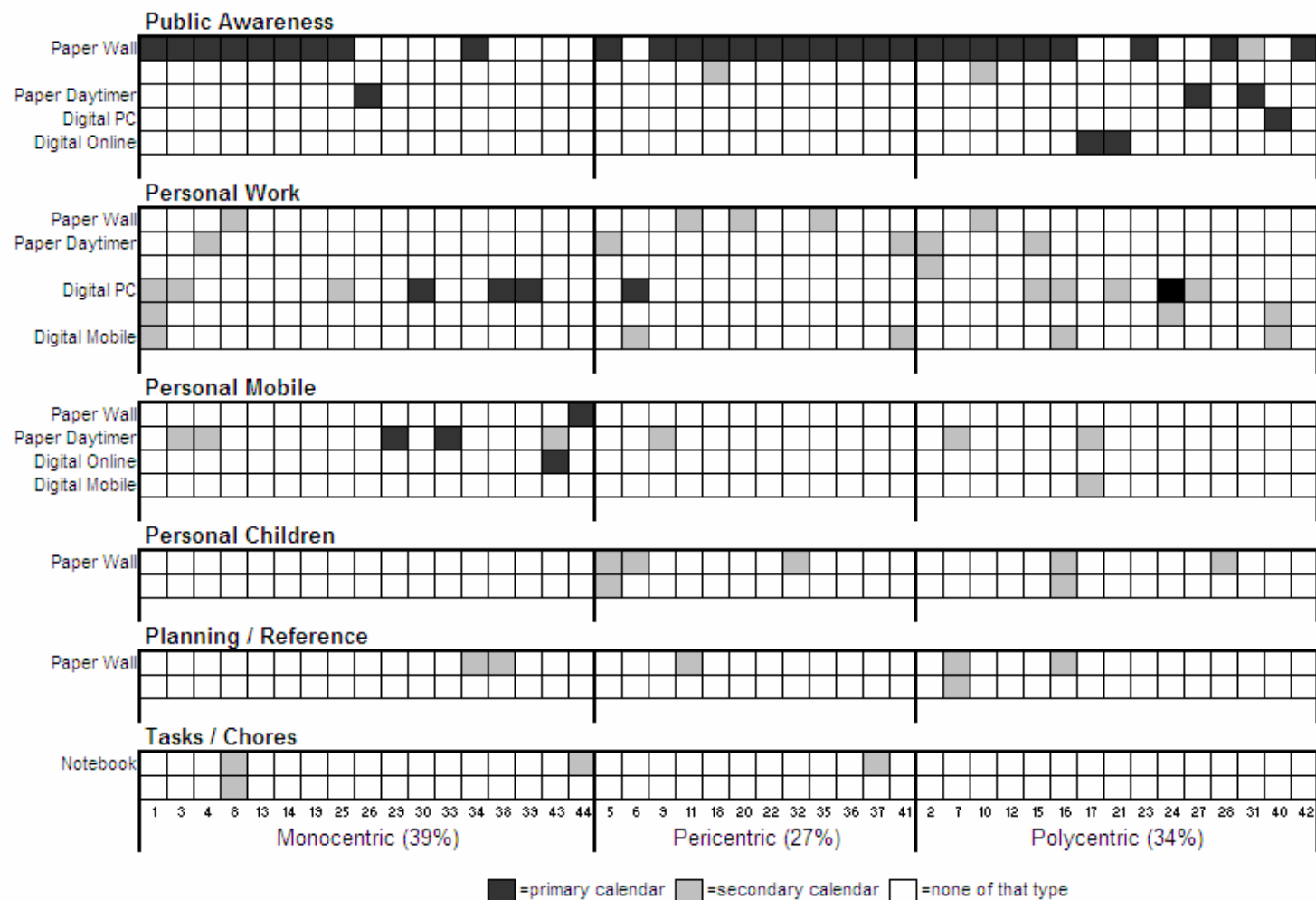


Table 5.5: Each column shows the number and style of calendars (e.g., paper wall, paper daytimer) used by a participant family (P1 through P44).

grouped across these columns by their coordination routine: *Monocentric* (first 17 columns), *Pericentric* (next 12 columns), and *Polycentric* families (final 15 columns); these groupings will be discussed in Section 5.3.1. Families are sorted by participant number within the groups, again for easy comparison with other findings. Shaded squares in each column show the styles of calendars used by families, e.g., a paper wall calendar, a digital PC calendar, and so on. Similar calendar styles were also found Hutchinson *et al.* (2002). Black squares indicate which calendar is the *primary family calendar*: the main calendar used by a family for coordination. The grey squares show *secondary calendars*: the calendars that also contain family events but are not the central calendar used by the family. White squares are calendar types not used by that family. Regardless of the type, all calendars we saw used the fairly ubiquitous Gregorian format. Rows are further grouped into six grids based on the calendar's main purpose, e.g., calendars for public awareness *vs.* calendars for personal work; I discuss these groupings momentarily. Some families had two of the same type of calendar within a grid so these types have multiple rows. For example, the top two rows both contain paper wall calendars (though only the first row is labelled as Paper Wall).

Taken together, each column can now be read as representing one family and the types of calendars they use for family events. For example, we see that the leftmost family (P1) uses four calendars: one paper wall calendar primarily for maintaining public awareness, two digital PC calendars (e.g., Microsoft Outlook) primarily for maintaining personal work, and one digital mobile calendar (e.g., a PDA) also for maintaining personal work. For this family, like many, the primary family calendar (marked in black) is the paper wall calendar. The three other calendars (marked in grey) are secondary calendars for this family.

The table illustrates many statistics. While 13 families (29.5%) used only one calendar for family coordination, a large majority of families, 31 (70.5%), used more than one calendar. The median number of calendars used for family coordination per household was two (mean 2.2 ± 1.1) with a range from one to six: 17 families (38.6%) had two, 8 (18.2%) had three, 4 (9.1%) had four, 1 (2.3%) had five and 1 (2.3%) had six. For each family, one of their calendars was considered the main calendar and often dubbed 'the family calendar.' For our 44 families, 35 (79.5%) used a paper calendar as the primary calendar while 9 (20.5%) used a digital calendar.

Over all of the calendars families used, we saw six different types of calendars emerge based on the *purpose* or *reason* for using the calendar as part of the family coordination routine (Table 5.5 has six grids that group the rows by these types). These types span both paper and digital calendars:

1. **Public Awareness calendars** (most often used as the primary family calendar) are placed in a publicly viewable location so that other family members can gather an awareness of what activities are occurring (Table 5.5, Grid 1);
2. **Personal Work calendars** are primarily used to record work activities but they also store family events that affect the work schedule, most often they are stationary though some are mobile (Table 5.5, Grid 2);
3. **Personal Mobile calendars** move with the scheduler and are used to check the calendar and schedule while not at work or home (e.g., a daytimer or PDA that is not primarily used for work) (Table 5.5, Grid 3);
4. **Personal Children's calendars** are designed for a child to become aware of his or her own activities and also how they relate to the family's activities (Table 5.5, Grid 4);
5. **Planning and Reference calendars** allow people to plan out their family activities either by recording them or checking dates, though they are not typically for public viewing (Table 5.5, Grid 5); and,
6. **Tasks and Chores calendars** are specialized for delegating or reminding family members of household tasks (Table 5.5, Grid 6).

The calendars we saw are categorized by their *purpose* as opposed to the actual *calendar style* or *its medium* (e.g., paper wall calendars, PDAs, digital calendars, digital online calendars). This is important because the *reason* people use a particular calendar in a certain way sheds light on to what features families would require in a digital family calendar. These features are described in Chapter 7. A typology based on the style of calendar would reveal little more than the fact that people use different calendar styles. Existing research also identifies that multiple calendars are used by families (Brush and Turner, 2005) and shows what styles of calendars they use (Hutchinson *et al.*, 2002). Yet it does not identify the ways in which the calendar styles are used (beyond work *vs.* home calendars) or the reasons for using them. I elaborate on these extensions in Chapter 7.

I also stress that the calendar typology presented in this chapter is specific to *family* coordination. Even though it contains some calendars geared towards work, they are included because they overlap with family coordination needs. Indeed, we left out other calendar types that people use for work activities if they were not used for family coordination. For example, a person may report using a shared workgroup calendar to plan weekly business meetings, but it is not normally used to coordinate family activities. Thus it is excluded from our typology. We also saw that some families use milestone calendars to record children's events as they grow (e.g., first steps, walking, talking). While these do contain *family* activities, they were used more for *reflection* and not *coordination* so we do not include them in our typology.

The following subsections detail each calendar within this typology and the reason for its usage.

5.2.1 Public Awareness Calendars

Families often have a calendar that acts as a *shared family information resource* where the calendar is visible for all family members (whether they check it or not). The *awareness* provided by the calendar is used by family members to coordinate activities (the details of which are described in Section 5.3.6). We call these **Public Awareness calendars** because of their role and visibility. The large volume of grey and black squares in the top grid in Table 5.5 shows that Public Awareness calendars were the most widely used type of calendar for family coordination. In fact, 80% of families (35 of 44) used a Public Awareness calendar as their primary family calendar.

Most often a *paper wall calendar* was used as a Public Awareness calendar (Table 5.5, Grid 1, Rows 1 and 2): 29 times as a primary calendar (black squares). It also appeared three times in a more secondary role (grey squares), where it complemented other public awareness calendars located elsewhere in the home. While the paper wall calendar dominated, public awareness calendars were also used as primary family calendars in the form of *paper daytimers* three times (Row 3), a *digital PC calendar* once (Microsoft Outlook) (Row 4), and a *digital online calendar* twice (Planzo and MSN) (Row 5). Despite these calendars being slightly different in form, style, and presentation, they were all used in the

same manner: all were placed in publicly accessible locations for the purpose of providing family members with awareness of their activities.

Because Public Awareness calendars are intended for public viewing by the family, they are placed in locations that family members can easily access for viewing and updating. Mona (P20) comments:

“[With a family] I found that [the calendar] needed to become more visible so that everyone had access to the information. I could carry a calendar in my briefcase but the communication wouldn’t be there for the rest of the family.” – Mona (P20), Mom and Teacher

The location of Public Awareness calendars varied slightly across families. For all but one family (37 of 38), this translated into a *frequently visited* location of the *home*. A large majority of calendars in home locations, 29 of 37 (78.3%), were hanging on the fridge or wall of the kitchen; four (10.8%) were hanging on a shelf near computers in a home office; two (5.4%) were located in drawers in the kitchen; and two (5.4%) were online calendars accessible on a PC in the living room or home office. The remaining calendar was contained in Outlook and made public by printing and distributing it to family members. Figure 5.1 shows a sample of locations used by families.

Unlike PC-based calendars, paper calendars naturally lend themselves to be placed in a variety of publicly accessible locations. One family referred to this type of location as the ‘hub of the home.’ For example, Linda’s (P3) family calendar is on the wall in the kitchen next to its entrance (Figure 5.1a):

“Can’t really miss it there...[what works best is] the fact that it’s convenient, it’s right there. I don’t have to go far to write something. I don’t have to dig it out. If it was in another room you wouldn’t check it as often. The kitchen is where I spend most of my time, especially in the morning.” – Linda (P3), Mom and Administrator

Samantha (P14) told us that while it was very important to have her paper family calendar in a public location at home, she didn’t think it was very aesthetically pleasing and it would even embarrass her if guests saw it. Similarly, Kayla (P19) says one of her least favourite things about the family calendar is how cluttered the area around it can become. Kayla’s calendar is magnetized to the fridge door (Figure 5.1b, top right) along with a variety of other items. While family calendars can certainly become a ‘mess,’ it is this mess that becomes very useful, as I elaborate in subsequent sections.



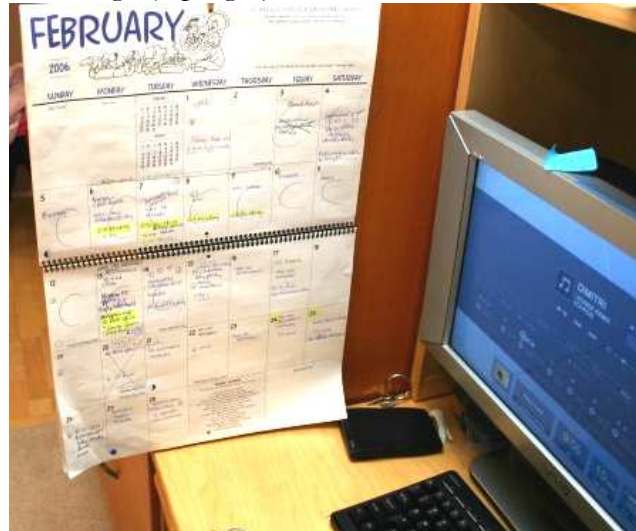
a. Linda's (P3) calendar on the wall beside the kitchen entry.



b. Kayla's (P19) calendar magnetized to the fridge (top right).



c. Anita's (P9) calendar on the kitchen wall above the phone.



d. Elaine's (P12) calendar placed near the computer.

Figure 5.1: Public Awareness calendars located in easily visible places, which are sometimes near other resources.

Some families balance the need for the calendar to be public with the ability to easily update it. For this reason, the Public Awareness calendar will not only be in a high traffic area, but it will also be situated near other important scheduling resources, like the phone or computer where a phone call or new email may trigger adding an event to the calendar. This reflects the finding from Elliot *et al.*'s (2005) study of domestic locations that shows items used for communication tend to be grouped in a particular location.

For example, Anita and Doug (P9) comment on their placement of the family calendar in the kitchen right above the phone (Figure 5.1c):

“Usually if someone is calling, you can answer questions about the calendar, whether you can do stuff on [a day], and if they’re calling about something on the calendar you can write it down.” – Anita (P9), Mom and Accountant

Somewhat similarly, Elaine (P12) keeps her family calendar by the main computer in the den (Figure 5.1d): Elaine accesses the Internet there, and considers its information an important scheduling resource. She often receives emails from neighbours about events such as birthday parties, and then copies the details from her computer onto her family’s paper calendar.

The challenge of paper-based Public Awareness calendars is that they are only accessible in one location, which means that family members have to resort to other strategies if they wish to ‘see’ the family’s activities when away from this location. One strategy involves using multiple calendars each in a different location. This is why we see many families using more than one calendar in Table 5.5. Another strategy involves using a digital calendar as a Public Awareness calendar.

Digital calendars have different affordances than paper calendars. For example, they are certainly not as amenable to flexible placement on walls and doors, and typically have too large a footprint to be placed atop a kitchen counter. Yet people develop strategies that not only work around these limitations, but take advantages of abilities not possible on paper. Typically, we saw that the contents of digital calendars is made public through online sharing or printing, where others have their own copies or can access the calendar remotely. For example, Margo (P17) is a mother of children aged 18 and 22 (the 22 year old no longer lives at home) who uses a digital online calendar as a Public Awareness calendar. She placed her calendar online so her family can view and even add events to it rendering the calendar public from a variety of locations. Margo describes how she began using the calendar:

“I kept asking my kids what do I need to do today, where am I taking you. It drove my kids nuts. They hated to keep answering me. So [my son] is actually the one that found [the online calendar]...he was getting frustrated ‘cause I would be working on something and I’d go, ‘oh I can’t get you right now or I can’t take you right now’. I said if you would write it down for me, like write down your schedule when you are working... he found it easier to just write it in once and put a repeat on it. It was really for him to make my life easier and not be so

frustrated with him. It was a way for them to let me know what their needs are for me.” – Margo (P17), Mom and Executive Assistant

Rebecca (P40) is a trial lawyer with six children (the most in our study). Her family’s primary calendar is in Microsoft Outlook on her computer and laptop. While only Rebecca can access it, she makes it publicly available by printing out copies of the calendar at the beginning of each day and distributing one to each family member (and also the nanny). If events need to be updated, family members can notify Rebecca who will update the calendar and print new copies.

Public Awareness calendars also need to be for a specific time period to provide an awareness of family activities over an appropriate time period. Families like to gain *a perspective on the entire month* (or in some cases, multiple months) so they can schedule events and check the calendar weeks ahead of time. Three participants comment:

“I have to see the entire month...because I can see at a glance. If the phone rings and someone says, ‘hi are you free,’ I can look and say, ‘yah’.” – Kayla (P19), Mom and Homemaker

“I’ve tried [a calendar with a single day] and I can’t get the big picture in my head. At work I use a day view for my job, but at home I like to look at what’s coming up tomorrow, Thursday, Friday...” – Anita (P9), Mom and Accountant

“For daytimers with a daily view, I didn’t have enough stuff to write in the pages and it seemed a waste. But I like looking at the full month to get the big picture...I sorta like just having an overall view of the next four months to get a view of what we have planned, if we have a weekend free we can try to plan something.” – Lana (P7), Mom and Dentist

5.2.2 Personal Work Calendars

Family activities and work schedules have a tendency to affect and interact with one another. For example, a parent may need to leave work early or start late because of a child’s doctor appointment. Parents may also need to know what activities are happening in the evening after work so they can mentally prepare for the evening before leaving the office. Others just like to have family activities that they are responsible for on their work calendar as a reminder or to aid coordination during the day. This is especially true if the family calendar is on paper and only accessible when at home. For these reasons, we found that 22 of 44 families (50%) also used **Personal Work calendars** in some capacity for family coordination, even though the primary purpose of these calendars was to schedule and

coordinate *work* activities (see Table 5.5, Grid 2). Fourteen families (31.8%) used one work calendar, seven (15.9%) used two (one by each parent), and one family (2.3%) even used three.

The location of Personal Work calendars varies. As expected, they are often located at work (10 of 31 work calendars, 32.2%), but in some cases they move between home and work as *paper daytimers* (6 of 31, 19.4%), or *PDA*s (5 of 31, 16.1%), or on *laptops* (3 of 31, 9.7%). For those parents who work out of their home, the Personal Work calendar is located in the home (2 of 31, 6.4%).

Five families (11.4%) used a Personal Work calendar (Microsoft Outlook) as their primary family calendar (the black squares in Table 5.5, Grid 2). Each of these families had a fairly intertwined work and family life. In these situations, all activities for the family are recorded in the work calendar, yet the challenge is that the calendar is often inaccessible for family members other than the primary scheduler. One family we interviewed had a workaround that enabled both parents to see the family calendar: Joanne (P24) sends all family events as scheduled meetings from her Outlook calendar to her husband Jason's email, which he can then 'accept' and move into *his* Outlook work calendar. While this strategy worked for Joanne and Jason, this information was inaccessible for their children. Other families who used a Personal Work calendar as their primary calendar fared even worse than Joanne and Jason, for they were unable to easily share the family calendar's events.

The remaining 26 Personal Work calendars we saw (the grey squares in Table 5.5, Grid 2) were all used as secondary calendars where they *do not typically contain all family activities*. Instead, these Personal Work calendars contain a subset of family events, usually those that affect the work schedule. Thus, these calendars were used to stay aware of certain family events when at work. For example, Ellen and Oreste (P10), parents of a 9-year old son, both write family activities in their work calendar to stay aware of family events when at work:

"If a family event that is related to my work or affects my work I will also put it on [my work calendar]. If I have a doctor's appointment and I have to leave I'll put it down. If we go to a party on Saturday it won't be on [my work calendar]." – Oreste (P10), Dad and Technical Sales Representative

“If I have to leave early from work then I will put it on my [work calendar].” – Ellen (P10), Mom and Programmer

The use of a work calendar to store family events when at work reflects an underlying challenge arising from the many paper-based primary family calendars located in the home. These calendars are inaccessible at work, which forces people to integrate portions of their family calendar into their work calendar.

5.2.3 Personal Mobile Calendars

Several families use **Personal Mobile calendars** for family coordination in order to schedule activities and see the family’s plans. These calendars are used in a manner which makes them both personal and mobile: events are recorded by one person and the calendar is accessible by that family member in multiple locations both inside and outside of the home. Ten of 44 families (23%) used Personal Mobile calendars, two of which used more than one (Table 5.5, Grid 3). The styles of calendar ranged from *daytimers* (8 of 11 personal mobile calendars) to *digital calendars* (2 of 11) and *paper wall calendars* (1 of 11). The daytimers varied between showing multiple days, a week, or even a month at a time; the digital calendars had options to view by day, week, or month; and, the wall calendar showed an entire month. I have discussed these calendar styles previously, where they were used as Public Awareness or Personal Work calendars. The difference here is that the family is using these calendars in a manner which makes them both *personal* and *mobile* where the primary purpose of them is for family activities rather than work ones.

Four families (9.1%) used a Personal Mobile calendar as the primary family calendar (the black squares in Table 5.5, Grid 3): one was a *wall calendar*, two were *daytimers* and one was a *digital online calendar* (AOL’s). Each of these calendars was used by one family member, the primary scheduler, where it was either carried with the scheduler (e.g., in their purse if it was paper) or accessed at multiple computers in the case of the digital online calendar. The challenge with having a Personal Mobile calendar as the primary family calendar is that other family members can’t see the family calendar, causing them to learn about the family’s activities in other ways (discussed in detail in Section 5.3.5).

For example, Gloria (P44), mother of two children aged 7 and 10, uses a paper wall calendar as the primary family calendar. Rather than hanging the calendar on a wall though,

it is moved throughout the home by Gloria and even taken with her most times when she goes out. Because of the changing locations of the calendar, her family typically needs to ask her what activities are occurring.

Eight families (18.1%) used a Personal Mobile calendar in a more secondary role (the grey squares in Table 5.5, Grid 3). Here most were daytimers that could be carried in the purse of the primary scheduler when out; their purpose was to have a version of the calendar handy in case something came up that they needed to schedule or check. For example, Linda (P3) carries a personal daytimer in her hand bag whenever she leaves home, and will use it to write down events when she is out. On returning home, she will sit down and transfer events from the daytimer back to her primary family calendar.

Some people don't use Personal Mobile calendars, yet they have workarounds that achieve a similar effect. We saw people carry a to-do list or piece of paper that contains a list of things that need to get done that day. Rather than have a full calendar, events are copied down from the calendar to the to-do list and augmented with additional tasks that the family member wants to accomplish. This is discussed more in Section 5.3.3

5.2.4 Personal Children's Calendars

Some families have special, dedicated **Personal Children's calendars**, where their purpose is to make children more aware of the family's activities and teach them about organization. These types of calendars were seen less frequently. Five families (11%) used Personal Children's calendars as secondary calendars (the grey squares in Table 5.5, Grid 4), where two of these families had a calendar for each of two children. All children's calendars showed the entire month and were placed either in a child's room or a public area of the home like the kitchen or living room. They are *personal* because the calendar is designed specifically for an individual, in this case, a child.

For example, Charity (P16) created a special calendar for her five year old daughter (Figure 5.2). The calendar is made of dry erase board and has a small piece of Velcro attached to each day. When a day occurs, the daughter attaches the large numbered day to that day's Velcro strip so she can learn the days of the month and her activities. Instead of writing out activities, Charity draws little symbols (discussed more in Chapter 6, Section 6.3). Once Charity's son, currently aged three, was old enough, the children would argue over

who put on the number for the current day. As a result, Charity created an almost identical calendar for her son. Each calendar now resides in a child's room.

5.2.5 Planning and Reference Calendars

Some families use certain calendars specifically for short or long term planning. We call these **Planning and Reference calendars**, and five families (11%) used them as secondary calendars (grey squares in Table 5.5, Grid 5). All showed a month or multiple months. These calendars serve one of two purposes. First, they can provide a draft space where family activities are planned out before being written on a more finalized calendar like a Public Awareness calendar. Second, they can simply be used as a reference for calendar dates, and in this situation they may not necessarily contain family events. Here the important aspect is that they can provide a long term view of the weeks and months ahead to see when holidays occur and when certain days are (e.g., what day of the week is August 18th). Of course, Public Awareness calendars could be used as Planning and Reference calendars, and we did see some families use their Public Awareness calendar in a manner



Figure 5.2: Charity's (P16) calendar made specifically for her daughter.



Figure 5.3: Cathy's (P11) calendar specifically used for long term planning.

similar to a Planning and Reference calendar. However, some families like to have separate specialized calendars for this purpose. This calendar can be even placed in a different location than the Public Awareness calendar, where the location is more conducive to the task of planning or referencing dates rather than being publicly visible.

For example, Charity (P16) maintains her own paper month calendar as a draft calendar. Charity will plan out events on this calendar, writing in a pencil to represent its draft nature. Once events are finalized, Charity will copy the events onto the more permanent family calendar that the other family members can see. Cathy (P11) prints out a Chinese calendar containing all the months of the year as well as Chinese holidays to serve as her reference calendar (Figure 5.3). This 'year at a glance' view lets her use this calendar to look ahead in the year to see if certain weeks and days are good times to plan family events like vacations. The calendar doesn't actually contain any family events, but sometimes Cathy circles certain dates because an important event occurs on it. Similarly, Greg and Lana (P7) also have a calendar specifically for looking up dates. It is located in their home office near

the phone, so they can check a date if someone calls and asks about planning an event. As with Cathy's, this calendar doesn't contain any events.

5.2.6 Tasks and Chores Calendars

Three families (6.8%) kept specialized household **Tasks and Chores calendars** (grey squares in Table 5.5, Grid 6). All were hand drawn in a paper notebook (e.g., Figure 5.4), contained either a week or multiple weeks, and were considered secondary calendars. These families either did not want to forget about these tasks or chores, or they wanted to keep a record of them. In contrast, most other families simply remembered tasks and who is responsible for them, or sometimes placed them on the primary family calendar (discussed further in Chapter 6, Section 6.2.5). Tasks and Chores calendars are usually placed in a high traffic area of the home close to the location used to plan the tasks, such as a kitchen. Thus, this calendar serves as a visual reminder about the tasks that need to be accomplished.

For example, Muriel (P8) keeps two different calendars for household chores. The first is her meal calendar, which she creates at the beginning of each month. The calendar contains each week from Monday to Friday, and Muriel uses it to plan and record what

Monday Laundry Day - Clean out Fridge	Tues Vacuuming (A.M.) Wash floors - Clean Stove Top - Microwave	Wed Dusting / Wipe Kitchen Furniture / Cabinets - Clean Bathrooms - Empty Diaper Pail	Thur Windexing Windows mirrors - TVs Tables - Fingerprints off walls & light switches	Fri Empty Garbages - Empty Diaper Pail - Organize Recycling
Monday Laundry Day - Clean out Fridge	Tues Laundry Day (For Sheets) Vacuuming (A.M.) Wash Floors - Clean Stove top	Wed Dusting / Wipe Kitchen Furniture / Cabinets - Clean Bathrooms - Empty Diaper Pail	Thur - Windexing Windows Mirrors, Tables - Fingerprints off walls & light switches	Fri Empty Garbages - Empty Diaper Pail - Organize Recycling

Figure 5.4: Muriel's (P8) biweekly household tasks and chores calendar.

meals they will have. Muriel buys all groceries for the week on the weekend, and she uses this calendar to help her so she knows that she will have the required ingredients for the planned meal. Muriel also maintains a second calendar containing a biweekly housework schedule of chores that need to be done around the house (Figure 5.4). Muriel places both the housework and meal schedule on the fridge in the kitchen because this is where she plans out the tasks and cooks meals.

5.3 Scheduling and Coordinating with the Family Calendar

Family calendars provide a place to store and retrieve family activity information, where this knowledge is used to coordinate activities. While this may appear simple on the surface, families actually follow a more complicated multi-step process that has evolved over time through trial and error, repetition, and iteration. I formalize these steps here. The first three steps involve the actual scheduling of events:

1. **Batch Updating the Calendar:** at the beginning of a certain time period (e.g., month, school year) a large group of events are scheduled in the calendar;
2. **Continuous Updating of the Calendar:** calendar events are added, updated, and removed on a daily basis as needed, either at home or while mobile; and,
3. **Synchronizing Multiple Calendars:** events are transferred between the family's calendars to ensure each calendar contains the relevant information.

The next steps involve checking the calendar or becoming aware of its contents, and then using this knowledge to coordinate the family's day-to-day activities:

4. **Awareness Acquisition:** checking the calendar directly or indirectly to see what events are scheduled; and,
5. **Coordination:** using awareness of calendar activities to coordinate responsibilities.

I present these steps as being distinct, yet in actual fact they are often intermixed and certainly not always as systematic as I describe them. What is important is that each family generally employs these techniques and steps in some form or another as part of their calendaring routine.

Another factor is *who* in the family performs these steps. As we will shortly see, almost all families have a *primary scheduler* that takes charge of many of these steps. Yet beyond that, family types vary in how *secondary schedulers* update and/or check the calendar. Some families have no secondary schedulers. Others have members who use the family calendar, albeit some use it only infrequently while others use it frequently. Existing research has also identified a batch update (Zimmerman *et al.*, 2001), the need to schedule in many locations (Crabtree *et al.*, 2003a, Beech *et al.*, 2004, Sellen *et al.*, 2004), the synchronization of multiple calendars (Brush and Turner, 2005), and the need to negotiate events (Crabtree *et al.*, 2003a). I build on this work by providing further details of how families carry out these steps and where families vary.

I begin this section by discussing three different family types, and how they vary in the mix of primary and secondary schedulers. Following this, I go through each of the five calendaring steps described above, and highlight when and how this process varies for the different family types.

5.3.1 Family Types

Primary schedulers are engaged in all family calendaring steps, yet the involvement of *secondary schedulers* varies amongst families. This is summarized in Table 5.6: each column shows which family members participate in scheduling (bottom grid), and which family members actually check the calendar (top grid). Black squares indicate frequent activity, grey indicates infrequent activity, and white indicates no activity. While almost all families have a primary scheduler, the involvement of other family members differs considerably. This range is evident in Table 5.6 by the differing number of shaded squares between families. The family in the leftmost section, P13, that does not have any schedulers (no shaded squares) does not use a family calendar; I discuss this outlier in Section 5.3.6.

To more easily compare calendaring routines, I have clustered families into one of three main types. In general, all types are centered on the primary scheduler, but vary based on the involvement in the calendaring routine by secondary schedulers.

1. **Monocentric Families:** only the primary scheduler adds to and checks the calendar, while others learn about relevant activities by having the primary scheduler tell them (Table 5.6, left section, 39% of our 44 families);

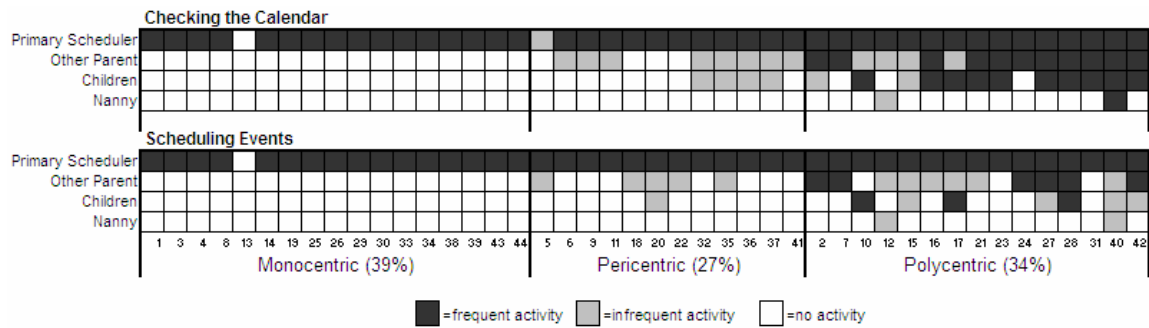


Table 5.6: Three different family types and how each family's members schedule and check the calendar.

2. **Pericentric Families:** the primary scheduler adds to and checks the calendar, and one or more secondary schedulers *infrequently* add to the calendar or ask the primary scheduler about its contents (Table 5.6, middle section, 27% of 44 families); and,
3. **Polycentric Families:** the primary scheduler adds to and checks the calendar, and one or more secondary schedulers *frequently* add and/or update its contents, or check the calendar (Table 5.6, right section, 34% of 44 families).

In 41 of our 44 families (93%), the mother was the primary family scheduler. Parents in two of the other families said they shared the role of primary scheduler (4.5%); and, in the remaining family (2.2%), the father was the primary scheduler because he was at home most often due to his shift work as a firefighter.

I caution that these are general groupings and family routines vary within each group as Table 5.6 illustrates. The groupings are at best a general means to compare and understand the differing routines that families undertake when it comes to calendaring.

In Section 5.2, I presented many types of both primary and secondary calendars used by families and it is tempting to try to correlate the type of calendar with the three types of coordination routines. Yet this correlation is at best weak. I did not find that a certain family type arises from the use of a particular calendar type. Instead, I believe that family routines are fairly idiosyncratic, where patterns emerge within families for a large number of reasons. Still, a particular mix of calendars used by a family could make high family involvement more challenging. For example, the findings show that only Monocentric families use Personal Mobile calendars as the primary family calendar (Table 5.5, Grid 3 has only black squares for Monocentric families); this makes sense, for secondary users cannot

use the calendar if it is absent. Thus, it is more likely that a family's routine somewhat influences how they select calendars, rather than the other way around.

5.3.2 Batch Updating the Calendar

The *primary scheduler* typically spends a significant portion of time placing a large amount of events on the family calendar all at once (though other household activities may occur intermittently throughout this process). The point at which this *batch update* takes place varies between families, but the existence of the batch update is fairly widespread. Batch updates do not differ based on the family type (Monocentric, Pericentric, and Polycentric); in all cases, batch updates are performed by just the primary scheduler.

Some families perform a batch update at the beginning of each month and place all known events for that month on the calendar. Two primary schedulers describe this type of process for batch calendar updates:

"Before my month begins I will write down things that generally happen...My daughter has Brownies every Monday night so I write down Brownies for every Monday night. Tuesday night I have my course from 4:45 to 6:45, so I write that down on every Tuesday...I do one hour a day practicum this term so I write that down and where I'd be...when my papers are due...I write down swimming lessons each Saturday. I used to be the main person for the kids' program at the church, so I'd write that down. And then I'd add things like dentist, things from the month before." – Kayla (P19), Mom and Homemaker

"I will collect my things for next month and then transfer them at the beginning of the month...then the calendar will build up through the month." – Anita (P9), Mom and Accountant

Rather than do monthly batch updates, Linda (P3) tries to do a batch update for certain times of the year. She comments: *"It's very time consuming but you have to do it, I guess."* In September, Linda will go through all of the school and band calendars and copy events on to the main family calendar for that year until December. The same process will occur from January until the summer, and then again when the summer activity lists are available.

Some families even do batch updates for the entire calendar year (e.g., adding all birthdays). For example, Mona (P20), mother of children aged 8 and 11, takes a longer-term approach for her batch update and updates what she can for the entire calendar year all at once. Mona is able to do this because she has a 16-month calendar that goes from September to December of the following year. In fact, this is her favourite feature of her

calendar. At the beginning of the school year when she receives the school notices for each of her two children, Mona will transfer all of the holiday events for the entire year on to the calendar from the notices. Mona will also receive newsletters once a month from her children's school with other events that she needs to add to the calendar and she will then do a batch update for the month.

For a number of families, a batch update is not as demanding as it sounds, because they specifically select and use a calendar that already pre-fills relevant information. For example, a number of our Seattle families reported that they used the local school district calendar as their primary family calendar because it already contained the school holidays.

When adding events to the calendar, most families just write events on the days in the calendar where they can find the space, while a smaller number will actually try to write the events chronologically within the date. The amount of information that is written down for an event depends on the event and the family's routine. Some will write who the event is for, its time, and its location, while others omit particular details if they are part of the family's tacit knowledge.

5.3.3 Continuous Updating of the Calendar at Home and while Mobile

Throughout the month, families must update events on the family calendar as they find out about them or plans change. One may imagine a simple process of just writing or changing the event on the calendar, but in actual practice updating the calendar is much more challenging. Family members find out about needed calendar changes throughout the day and people are not necessarily at the calendar to update it when they find out.

The bottom grid in Table 5.6 shows who adds events to the calendar for families in each family type. In Monocentric families, the primary scheduler is the only person who performs continuous updates of the calendar. For example, in Kayla's (P19) family nobody else adds events to the calendar, yet this low level of involvement in scheduling is actually desired by Kayla. In fact, she told us, *"I won't let [my husband] write on it, he's too messy."* Kayla's children are aged 8 and 10 and also don't add to the calendar. She told us that, for her, updating the calendar is a spontaneous process that happens throughout the day. She tries to keep the calendar neat but may have to add an event quickly or at any point, *"If someone*

calls me up. If I'm on the phone, I'll write it at the bottom [of the calendar] and then later add it in to the day so it's not messy."

In Pericentric families, the primary scheduler still updates the calendar regularly, yet some secondary schedulers are also engaged in adding events to it, albeit infrequently and/or in a restricted way. For example, Carrie (P35), mother of one child aged 9, told us when asked who adds to the calendar, *"Oh, no no no, I only put things on."* The calendar was *hers* for modifying, though it was still placed in a publicly viewable location for the rest of the family. Carrie *would* let her family members write on sticky notes which they could stick on the calendar for her to transcribe later. This reflects the limited or restricted way that her family adds to the calendar. Mona's family (P20) is also considered a Pericentric family. Mona is the primary scheduler and performs most of the calendar updates. Her husband also adds to the calendar though much less frequently than Mona; in a given month, he typically adds one or two events. Mona's daughter, aged 11, has also started adding some events to the calendar, but again, this is only once or twice a month.

In Polycentric families, most or all family members update the calendar frequently, although the primary scheduler performs the majority of updates. Here families are less restrictive in who updates the calendar. For example, Elaine (P12) told us that her husband would normally write something on the family calendar several times a month. Her nanny also added information, usually weekly, though it was typically to show which days she would be unable to work. In Brad and Jennifer's family (P2), all family members including both parents and their two teenage children add events to the calendar weekly. Greg and Lana's family (P7) is also a Polycentric family. They have one son aged two who naturally can't update the family calendar. Lana updates the calendar the most by adding family events and appointments for her son. Greg also frequently updates the calendar, but is more inclined to simply add his own events. This way Lana can stay aware of how Greg's activities affect the family routine.

What happens when people are mobile? Events that should be recorded sometime arise while family members are out and about. This poses a particularly challenging situation, because most family members do not actually have their primary calendar with them to update, or to check when they are free. As a result, family members either use

additional calendars, or have strategies that help them remember or record the activities while remote. Once home, they transfer these activities to the family calendar.

Like many people, Ellen and Oreste (P10) receive appointment cards for future appointments for themselves or their son during visits to the doctor. Once home they can then copy this information on to the family calendar. For other types of events that do not come ‘pre-recorded’ on a card, they will just try to remember the event and then write it on the calendar when they get home.

Kayla (P19) uses a similar ‘hit or miss’ strategy:

“I won’t know, usually I just schedule and then when I go home if I see there is a conflict I will call back and reschedule. I know this is awful. So I’d like to have a PDA so I can synchronize then I don’t have to... it would be good if I could have it incorporated into my cell because I carry my cell phone. I try not to carry any more than that.” – Kayla (P19), Mom and Homemaker

While this strategy often works, it is certainly error prone. Mona (P20), like some others, prefers not to guess when she is free. Instead of scheduling something while on the move, she will phone places back (e.g., the doctor’s office) once she checks her calendar at home.

Some families use people or technology as resources for scheduling when not near their family calendar. When Samantha (P14) needs to add something to the calendar while she is out, she phones her kids and (if they are at home) has them add things to the family calendar. Jack and Sherry (P5) email themselves with the information, where they add it to the calendar later. Paul (P42), father of two teenage sons (and coincidentally the only male primary scheduler we found in our study), phones home when he is out and leaves a message on the answering machine with event details for the family calendar. Once home, he’ll copy the details on to the calendar. If one of his sons answers the phone when he is trying to do this, he’ll tell them to hang up and not answer the phone, and then he’ll call back and leave the message.

5.3.4 The Pain of Synchronizing Multiple Calendars

Over 70% of families use multiple calendars (discussed in Section 5.2) to record family events. This comes with a need to synchronize these calendars. Good synchronization ensures each calendar has the appropriate events on it, so that double booking does not occur and events are not missed.

This process can be painful: events must be manually copied multiple times when the calendars are paper-based. Many families reported this as being one of the key challenges faced in their coordination routine. Indeed, synchronization is a challenge faced by all Monocentric, Pericentric, and Polycentric families that used multiple calendars. The only difference between these families is who is involved in the synchronization, and this depends on whose calendar needs to be synchronized.

For example, Brad and Jennifer's (P2) synchronize their calendars together after they have performed their monthly batch update of the family calendar. Here they copy events from the primary family calendar to each of their own personal mobile calendars (daytimers) that they carry with them between work and home. All three calendars—the family fridge calendar and the parents' daytimers—contain all of the same events. Jennifer comments:

"We update [the fridge calendar] and then we bring up our daytimers and we sort of triangulate them to make sure everything is there." – Jennifer (P2), Mom and Government Clerk

Wanda and Dale (P15), parents of children aged 10 and 15, both have a personal work calendar. Dale uses a paper daytimer and Wanda uses Outlook. Dale transfers events when at home from the family calendar to his work calendar if they affect his work schedule. Wanda doesn't have the luxury of being able to copy these events at home because she uses Outlook on her computer at work. As a result, once a month, Wanda takes the family calendar in to work along with any other sheets of paper containing schedule information. She then types them in to her Outlook calendar. Throughout the month, Wanda occasionally calls her work voice mail to leave a message for herself to add an event to Outlook. Dale and Wanda also email each other regularly to tell the other to add something to their work calendar.

Bruno (P16) describes how he and his wife, Charity, synchronize their calendars (one Public Awareness calendar, two Children's calendars, a Planning calendar, and two Work calendars):

"[My wife] honestly spends an entire morning doing the three dry erase calendars. While it's nice for the kids to have something to use, it's an awful lot of work...We still have the problem of she has her calendar or calendars because really they're all her calendars, and I have mine. Keeping everything in sync easily is difficult. I still try to remember, oh I have to tell [my wife] about that because if it occurs outside of my 9 to 5 thing then she needs to know."

Even if it occurs within my 9 to 5 and I'm not near my office she likes to know.” – Bruno (P16), Dad and Systems Administrator

While paper calendars are clearly hard to synchronize, we would suspect that digital calendars would alleviate this problem because synchronization can be automated (if the technology supports it). Yet we found some people still find this process to not match their needs: the detail in one person's calendar is not necessarily appropriate for the family calendar. Synchronization can also be risky, confusing or even scary. For example, Sidney (P6) finds it a challenge to synchronize personal work calendars (one of which is the primary family calendar). Both Sidney and her husband use Outlook but are fearful of trying to synchronize these calendars in order for her husband to see family events:

“[My husband and I] could probably have a shared calendar...it isn't something we've done yet. Neither one of us want our calendar screwed up. I don't want all his meetings for work in my calendar, he doesn't care who my clients are. He just cares when I have them. So there is detail on here that he doesn't want and I'm sure there are details on his calendar that I don't want. And there is also confidentiality when sharing information that you might not necessarily want shared because I'm using mine for personal use and he's going to have clients and phone numbers.” – Sidney (P6), Mom and Therapist

This concludes how calendars are updated. In the next sections, I describe how families stay aware of what is on the family calendar and use the information to coordinate everyday activities.

5.3.5 Direct or Indirect Awareness Acquisition

The family calendar provides family members with an awareness of what activities are occurring. The first way in which this knowledge can be gathered is by directly checking the calendar. Yet this will vary depending on the calendar. For example, digital calendars have automated reminder features: people can be notified of key events, but this only works if the person is at a computer. While such notifications are reasonable in a workplace for those who spend most of their time in front of the computer, this is less than ideal in the home setting where computer use tends to be much more occasional (unless one is telecommuting). Paper calendars do not have active reminders; for this reason, family members must actively monitor the family calendar and check its contents on a regular basis or when adding events. For some, this involves checking multiple calendars.

The top grid in Table 5.6 shows who checks the calendar in each family for the three different family types. Primary schedulers dominate, regardless of family type. We found that primary schedulers in all families regardless of the family type have a fairly common pattern when it comes to checking the family calendar. They check the calendar daily, in the morning or evening, in order to plan out events, and then also when they schedule events. This is evident by a solid black square appearing next to each primary scheduler in Table 5.6. The two exceptions are P3 where the family doesn't use their calendar and P5 where the primary scheduler checks the calendar infrequently because she usually remembers activities after writing them down. For all other primary schedulers, checking the calendar usually becomes a habit, or occurs simply because the calendar is in a noticeable location. Two primary schedulers comment on their calendar checking routine, with the second contrasting active looking to automated reminders:

"I check in the morning...what do I need to pack for the day, I need to have this and that, do I need dance shoes, music, do I need my ghetto blaster, music bag, do we need this, do we need that, do I have to get that soccer uniform washed. There is that whole other schedule going on in your head." – Anita (P9), Mom and Accountant

"[The wall calendar] doesn't remind me, I have to check it. That's why I like the electronic calendar at work because it sends me an email as well to remind me... I check [the family calendar] if not every day at least every other day, it's kind of a habit to glance at it every morning to make sure I'm not missing anything." – Linda (P3), Mom and Administrator

Cathy (P11), another primary scheduler, checks multiple calendars as part of her everyday routine. First she checks her primary family calendar on the wall beside the fridge. If there is nothing there, she will then check her personal daytimer and Chinese calendar to see if anything is written on them. In the evenings, Cathy checks the calendars to see what activities she has to do tomorrow, and then in the morning she will check the calendars again to reconfirm her activities. Margo (P17) uses a digital calendar online as the primary family calendar. Margo receives an email each morning from her calendar that lists her activities for the day. Margo prints this list and will take it with her when she leaves home.

The second way that people stay aware of calendar contents is through intermediaries. In Monocentric families, secondary schedulers find out what activities are occurring by having the primary scheduler *remind them* of activities pertinent to them. While some families view this as problematic, others find it beneficial. For example, Mike (P1), father of two

children aged 8 and 12, is in just this situation. Mike doesn't check the family calendar because he and his wife have a fairly clear delineation of family responsibilities. Mike's wife is in charge of ensuring the children make it to their activities, and if necessary, she will let Mike know if there are activities that he needs to be responsible for. Other Monocentric families feel their family members should check the calendar more often. For example, Linda (P3) comments "*My family members don't check [the calendar] often enough. I suppose I would tell [other family members] but again it's up to them to check the calendar.*"

In Pericentric families, secondary schedulers gather an awareness of family activities through several means: the primary scheduler reminds them about activities, they ask the primary scheduler, or they infrequently check the calendar. Unlike Monocentric families, secondary schedulers are moderately engaged in finding out what activities are occurring. For example, Anita's (P9) two teenaged sons are involved in a variety of extra curricular activities, though they check the calendar infrequently. She comments, "*[My family] usually comes to me and asks what the schedule is during the day.*" The timing of this is fairly opportunistic. Her husband, Doug, will often phone her during the day while he is at work to ask what is on the calendar for the evening. The difference between this Pericentric family and the Monocentric families is that secondary schedulers are *asking* about the calendar, rather than just being reminded.

In Polycentric families, reminding by the primary scheduler still occurs, but secondary schedulers also check the family calendar fairly frequently. For example, Charity (P16) has actively tried to involve her children in the family's calendaring process as a teaching tool by making special children's calendars (Figure 5.2). Charity's husband Bruno describes how their daughter, aged 5, checks the family calendar:

"We have a breakfast nook. [My daughter] sits at one end of the table and the calendar is at the other end of the table. She'll look at it while we're eating dinner and say, 'oh on Saturday we're doing that' so she definitely looks in at the calendar. Even erasing isn't fooling her that much anymore. We try to keep a nice regular pattern. She'll notice [when an event is removed or changed] especially if it's a regular thing, she can see that the pattern has changed. She'll question that. They'll occasionally ask for things to put on the calendar...things that didn't seem important enough for us to break out a dry/erase pen. She'll ask for us to put them on."
 – Bruno (P16), Dad and Systems Administrator

In some cases, rather than checking all events, secondary schedulers in Polycentric families are more selective in what they check. Bruno comments on his pattern for checking the family calendar:

‘I’m pretty used to our schedule so I don’t need to check it that often. As sad as it is, I work full time so a lot of activities don’t pertain to me. But Fridays change because I may be home. I may also glance at it because the activities end at regular periods. I look for the ends of things because I’ll try to make it to the last class so I can make it to at least one of their classes during that activity. And I’ll glance at it to see if anything is out of the ordinary. I get used to the pattern so if there is something that is out of the ordinary I’ll take a closer look to see what’s going on...I don’t have to do much. If I have something that is coming up, I’ll just tell [my wife] then she’ll know where I am and I’ll know.’ – Bruno (P16), Dad and Systems Administrator

The third way that family members stay aware of activities is through an archive or record of past calendars. Some families will store calendars from year to year and then return to them to look up past events. Elaine (P12) keeps all of her past calendars on a shelf near the computer, which is also near to her current family calendar. Elaine keeps the calendars mostly for tax purposes because her husband travels frequently as part of his work as a surgeon.

5.3.6 Coordinating Activities through Awareness

Once family members have some semblance of awareness of activities, they use this knowledge to coordinate who is responsible for what. Unlike workplace calendaring, the people attending the event (other than possibly the person whose event it is), are not necessarily decided at the time of scheduling the event. This is the act of *family coordination* that occurs much closer to the scheduled event. Monocentric, Pericentric, and Polycentric families are all fairly similar in this activity. In all cases, the primary scheduler coordinates with those family members involved or affected by the activity. Children are not normally involved unless they are teenagers. Coordination involves discussing activities face-to-face if all parties are at home, or using technologies like the phone, email, or instant messenger when they are not at home. Sometimes the calendar is used as a discussion artefact where it may be moved from its normal location to the place of discussion, while other times the knowledge people acquire and retain from the calendar suffices.

For example, Brad and Jennifer (P2) coordinate their family's activities (such as rides to activities for their children) each evening for the next day by talking at home. If things come up during the day, Brad and Jennifer will discuss the activities on the phone:

"In the evening we'd be checking [the calendar] to make sure we're coordinated for tomorrow. We have to coordinate for early morning ice times, we'll switch vehicles, then I'd have to get up early and drive all the boys to practice and then work. It's a coordination that way. Then the odd time I might have to pick them up." – Brad (P2) Dad and Architectural Technician

"We can't coordinate the morning of the day because I'm at work before they're even up so we have to know before....Sometimes [coordinating] is two or three conversations, figuring out maybe we can do it this way or maybe this other way...we're good at working on the fly." – Jennifer (P2), Mom and Government Clerk

Certain activities don't need to be coordinated because family members simply know who will be responsible for an event through tacit knowledge. For example, Brad and Jennifer both know when the other person is routinely finished work and in some situations there is only one person available to drive the children anyhow.

Many families try to avoid scheduling conflicts or overlapping events, but sometimes they do arise. In cases where events do overlap, plans must be rearranged. If an event needs to be cancelled, usually an implicit priority system is used. Anita and Doug (P9) check to see which event is most important. Sports games are considered more important than practices, but if the practice involves Doug as the coach, then he must attend. For Lana (P7), this involves seeing how many people the change will affect, where she tries to reduce the number. Sometimes changes will affect just her, but other times they may affect both her and her husband as well as her babysitter.

As we saw with Lana and her babysitter, resolving scheduling conflicts also involves more than just family members. For Sidney (P6), resolving conflicts often involves her friend and child share, Rebecca. Each regularly watches the other's children at least one day per week. Brad and Jennifer (P2) also find they need to sometimes rely on others to help resolve scheduling challenges. Their children will often take carpools to sports activities and, just the same, Brad and Jennifer will very often have a full vehicle of carpoolers when they drive to the activities. Coordination also sometimes involves parents splitting the activities that the family is involved in. For Mona (P20), if their children have events at the same time, her husband will take one child and she will take the other child.

I did find one family of five children who have a Public Awareness calendar yet do not really use it. Instead, Fiona and Orlando's (P13) family relies heavily on communication between family members to remember, plan, and coordinate activities. I stress that this was the only case out of 44 families where the family calendar was not crucial to the family's coordination routine. In this situation, I feel that the lack of family calendar use reflects the cultural background of the family, originally from Central America. In many regions of the world, particularly Central America, notions of time are much less structured and the tempo of life is not as fast paced as highly industrialized nations (Levine, 1997). In these regions, the importance of a calendar may be much less.

5.4 Summary

This chapter has outlined the first half of results from the study of family calendaring routines to *formalize family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems* (Chapter 1, Objective 2). It shows that families use one or more calendars to coordinate and stay aware of family activities. These calendars form a *typology of calendars* containing six different calendar types differentiated by their purpose and use within families' coordination routines. Varying styles of calendars—paper wall calendars, paper daytimers, digital PC calendars, digital online calendars—are used in each category of calendar, though certain styles lend themselves more naturally to a category.

1. **Public Awareness calendars** are placed in a publicly viewable location so that all family members can gather an awareness of what activities are occurring (regardless of whether they actually do or not). This usually means placing the calendar in a high traffic area of the house. Sometimes this also involves the calendar being near other important scheduling resources like the phone or email. When digital calendars are used as Public Awareness calendars their online sharing ability enables them to be publicly available. Because of the intended purpose of these calendars, Public Awareness calendars are the most prevalent form of primary family calendars. However, they may also be used as secondary calendars in order to have the calendar available in multiple home locations.
2. **Personal Work calendars** are primarily used to record work activities but they also store family events that affect the work schedule. Most often they are stationary and

situated on a PC at work though some are on mobile devices (e.g., PDAs), accessible via the web, or on a laptop that moves between home and work. Sometimes personal work calendars are used as a primary family calendar, but more often they are used as secondary calendars in order to have family events visible at work.

3. **Personal Mobile calendars** move with the scheduler and are used to check the calendar and schedule while not at work or home (e.g., a daytimer or PDA). They are different than Personal Work calendars because the primary use of Personal Mobile calendars is for family or personal events and not work activities. Most Personal Mobile calendars are secondary calendars used to schedule and check the calendar while out and about. Yet a small number of families use Personal Mobile calendars as their primary calendar given the convenience of always having the primary calendar with the primary scheduler.
4. **Personal Children's calendars** are designed for a child to become aware of his or her own activities and also how they relate to the family's activities. They are located in areas that children are able to view them, such as a child's bedroom. Personal children's calendars are always used as secondary calendars.
5. **Planning and Reference calendars** allow people to plan out their family activities either by recording them or checking dates. These calendars are located where people plan activities or need to check dates, like near a phone or in a home office. Events may be copied from a Planning calendar to a Public Awareness calendar once finalized for family viewing, or a Reference calendar may include annotations showing which dates have events, rather than having the actual events listed.
6. **Tasks and Chores calendars** are specialized for delegating or reminding family members of household tasks. These calendars are drawn by hand in notebooks or on paper and posted where it is relevant to see the task list. Task and Chore calendars are always used as secondary calendars.

Family calendaring involves a number of steps surrounding scheduling, checking the calendar, and coordinating.

1. **Batch Updating** the calendar involves placing a large amount of events on to the calendar at: the beginning of each month, the beginning of the calendar year, the

beginning of the school year, or when school notices or other handouts trigger an update.

2. **Continuous Updating** of the calendar occurs throughout each month. As new events arise, they are written on the calendar. Sometimes new events come up when family members are not at home and near the calendar. In these situations, they use paper to make notes about events or may phone home to leave messages about events.
3. **Synchronizing Multiple Calendars** involves transferring events between calendars to ensure that all contain the information relevant to them. This helps avoid coordination errors like double booking, yet can be tedious especially if paper calendars are used where manual transfer of events is required.
4. **Awareness Acquisition** involves checking the calendar directly to see what activities are upcoming, asking others about calendar events, or being told about calendar events. This awareness information is crucial for this knowledge is what enables the discussion and coordination of family events.
5. **Coordination** involves using the previously gained awareness of family events to actually decide who is going to or driving family members to events. This process most often involves discussing calendar events either in person or on the phone. Sometimes more than just family members are involved in coordination, e.g., babysitters, carpool members.

The *primary scheduler*—the person who is most responsible for the family calendar—participates in all of the above steps. The level of involvement by other family members, called *secondary schedulers* varies. This creates three types of families when it comes to family calendaring:

1. **Monocentric families** have the least amount of involvement by secondary schedulers where the primary scheduler is the only person to schedule activities and tells other family members of relevant events.
2. **Pericentric families** have more involvement by secondary schedulers where they begin to engage in the coordination routine by either scheduling or checking the calendar infrequently or asking about calendar contents.

3. **Polycentric families** have the most involvement by secondary schedulers where they are frequently checking or adding to the calendar.

While some primary schedulers desire more involvement by their family members in the calendaring routine, others find their routine well fitting even if it involves little family participation.

It is vital to realize that the processes and routines I present are by no means static and have evolved, in many cases, over years of trial and error, repetition, and iteration. Family routines do not simply happen; rather, they come about as a result of households trying to organize their daily activities (Hughes *et al.*, 2000).

In the next chapter, I build on these results to further *formalize family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems* (Chapter 1, Objective 2). I do this through content analysis of family calendars, which involves studying the number and type of events that families place on their calendars along with the methods they use to annotate and augment its contents. In Chapter 7, I show how the results from Chapters 5 and 6 suggest guidelines for the design of digital family calendars.

Chapter 6. Family Calendar Content⁸

The goal of this chapter is to further *formalize family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems* (Chapter 1, Objective 2) by augmenting interview results with content analysis of family calendars to show what families add to their calendar. This presents the second half of results from the study discussed in Chapter 5. Chapter 7 illustrates how the findings from this chapter can be applied to the design of digital family calendars. It also situates the findings presented in this chapter within the related literature to show how it extends existing research.

This chapter begins by describing the content analysis method I have used to analyze family calendars. Next, I show that family calendars primarily contain events that affect the family either directly or indirectly. These events fall into a range of event types from sports and drama, to school and work activities, to birthdays and anniversaries. Next, I outline how families use a rich set of annotations and augmentations to make calendar content stand out or to overcome limitations in space. These range from the use of color and other symbols to attaching extra information on or near the calendar. The findings from this chapter add value for we can now understand what informational content and interaction digital family calendars should be designed to support.

6.1 Content Analysis Method

To better understand what families are putting on their primary family calendar and how much they are adding, I performed a content analysis of one month from the primary calendars of families from our final group of 20 families, all residing in Calgary, Canada

⁸ Portions of this chapter are also published in: Neustaedter, Brush, and Greenberg (Technical Report 2006c).

(Chapter 5, Section 5.1.1, group c).⁹ The calendar photos used for this analysis are available in Appendix C.8. This analysis was divided into two stages:

1. **Event analysis:** the *events* on each family's month were counted and categorized using open coding (Strauss and Corbin, 1998). This stage involved analyzing calendars from 17 of the 20 families; three families were omitted because we did not have a satisfactory photo of a complete month: some days were covered or only partially shown. For the analyzed calendars, events already pre-printed on the calendar (e.g., by the actual printer / publisher) were not included in the analysis as we were interested in seeing what family members actually added themselves. Multi-day events were counted for each day the event transpired. I counted 562 events on all of the 17 calendar months I analyzed, which included a total of 491 calendar days. Findings from interviews with each family helped disambiguate event types and also reveal why participants included the events that they did. Interviews also revealed which types of events were *not* included in the calendar.
2. **Annotation analysis:** the *annotations* on each family's month along with any *augmentations* to the calendar were also categorized using open coding (Strauss and Corbin, 1998). This stage involved analyzing calendars from all twenty families. I was not concerned with counting the number of annotations as they were at times relatively infrequent. Yet even a small occurrence of annotations suggests significant implications for digital calendar design. Thus, photographs from all twenty families' calendars revealed enough detail to include them for annotation analysis. Some augmentations to the calendar include more than just the calendar as an artefact (e.g., some use the fridge, a purse, wall space) and in these cases, interviews and other photographs were used as part of the analysis. Interviews also helped reveal why annotations and augmentations were used by families.

The codes that were developed during the two portions of content analysis are shown in Table 6.1 and Table 6.2. The months I analyzed were either January or February,

⁹ All analyses for this study were done solely by me

Calendar Events

[ADULTS]	Events where the parent is the primary benefactor (e.g., holidays for the whole family, outings for the whole family)
[APPOINTMENTS]	Events where you are meeting someone for a specific purpose at a specific time, e.g., doctor's appointments, meetings, facial, picking someone up at the airport)
[ARTS]	Extra curricular events that teach about the arts, e.g., music lessons, voice lessons, drama performances
[BIRTHDAYS]	Birthdays, anniversaries, birth notices
[FAMILY]	Events for the family
[HOLIDAYS]	Holidays or vacation activities
[KID]	Activities for children that involve a driver
[KID-OTHER]	Activities for the children that involve someone else driving
[KIDS]	Events where the children are the primary benefactor
[MULTI]	Events spanning multiple days
[OUTINGS]	Outings or events that are social in nature, e.g., family dinner at friends, sleepovers, hockey game, movie, date night, church
[REMINDERS]	Events to trigger memory recall usually about a task to perform
[ROUTINE]	Events that happen on a consistent pattern
[SCHOOL]	Events relating to or happening at school
[SELF]	Events for just oneself, e.g., doctor
[SPORTS]	Extra curricular activities involving a sport or outdoors, includes things like wilderness training
[TIMED]	Events with an explicit time
[UNTIMED]	Events without an explicit start and end time
[VERYIMP]	Very important events
[WORK-OTHERS]	Work activities of other family members
[WORK-OTHERS-NR]	Non-routine work hours of others
[WORK-SELF]	Work activities of primary scheduler

Table 6.1: Analysis codes for calendar events.

depending on the time of the interviews, though I discuss potential month variations with them. I would have preferred to analyze more than this single month (for example, to see seasonal events), but this was impractical as many families had discarded their past calendars. Future studies run at the end of a calendar year rather than its beginning could overcome this issue. Still, the single month suffices to show strong patterns for both stages of content analysis.

All twenty families from this analysis used a Public Awareness calendar as the primary family calendar. This is not altogether surprising, since 35 of our 44 families (79.5%) used a Public Awareness calendar as their primary family calendar. However, even if other types of calendars were analyzed as the primary family calendar I would still expect to see the same types of content emerge, though the frequency of their appearance may vary. For example, a

Calendar Annotations

[?MARK]	Put a question mark next to an event
[ACTIVITY]	Uses colour for identifying activity
[ARROW]	Arrow is drawn from the old location of an event to the new location
[ASTERISK]	Puts a star on certain days to highlight an event on the day (event is not written)
[BRACKETS]	Puts a bracket beside overlapping events and will tick off who is going to an event
[CIRCLE]	Circles dates to highlight their importance
[COVER]	Markings are covered with a label or piece of paper
[CROSS]	Cross or scribble out an entry leaving a mark of the change
[ELECTRONIC]	Events are typed
[ERASE]	Erase an entry leaving no mark of the change, e.g., eraser, white out
[FELT]	Some sort of felt pen is used for writing an event
[ICONS]	Icons are used instead of writing out event descriptions
[IMPORTANT]	Uses colour to make important things stand out
[KEYWORD]	Only a keyword is written for an event (time, location, and person are not written)
[LINES]	Crosses out days that have passed with lines
[MESSAGE]	Handwritten messages are wrote on the calendar, usually in the margins
[MOVE]	Drags events to a new location on a calendar (digital)
[NUMBERS]	Numbers events to show the week # of the activity
[OVERLAP]	Will use colours if things are overlapping
[PAPER]	Additional pieces of paper attached to the calendar
[PEN]	Uses a pen to write events
[PERSON]	Uses colour to identify person
[SAME]	Events are written the same as other events
[STICKERS]	Stickers are placed on the calendar
[STICKY]	Sticky note is placed on top of the calendar
[TMARK]	Writes a T next to the event
[ACTIVITY]	The activity's name is abbreviated
[LOC]	Names of locations are abbreviated
[NAMES]	Names of people are abbreviated

Table 6.2: Analysis codes for calendar annotations.

Personal Work calendar that doubled as a primary family calendar would certainly contain more work events than a Public Awareness calendar located at home, yet the types of family-specific events on the calendar would likely be the same.

I first describe the findings from the initial stage of content analysis that outline the event information on family calendars. Next, I look at the findings from the second stage, which details the annotations and augmentations that were found.

6.2 Information Placed On and Left Off the Calendar

When you ask someone what events they write on their family calendar, a typical response is “everything under the sun.” And, to families, it most certainly feels that way. While there are certainly idiosyncrasies to specific calendar contents, this section shows that strong and consistent patterns emerge.

6.2.1 The Number of Events on the Family Calendar

I first analyzed the number of events that families place on one month of their family calendar. Of the total 491 calendar days analyzed over all 17 families, 35.6% had zero events, 31.4% had only one event, 20% had two events, 10.2% had three events, 2.2% had four events, and 0.6% had five events. Figure 6.1 shows the median number of events placed on a day for each family (P1, P2, and so on) grouped by family type (sorted within each group by the median). The circles represent the median per day; shaded rectangles (boxes) show the interquartile range (about half of the days have this many events on them); lines coming out from the rectangles (whiskers) show the overall range; and, stars show outlier days (containing an unordinary number of events). For example, the rightmost

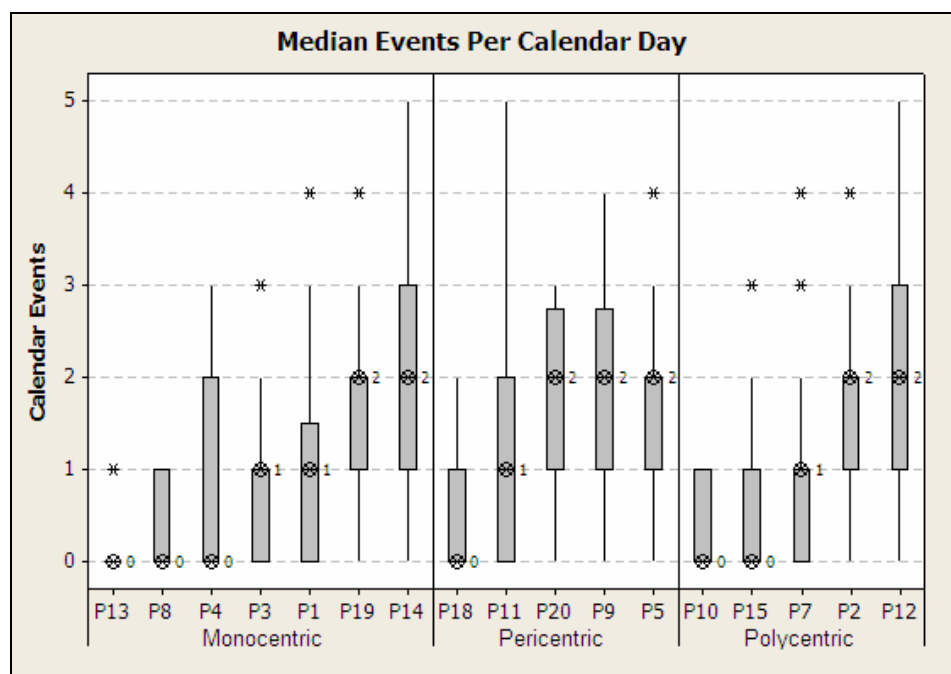


Figure 6.1: The median number of events on the primary family calendar.

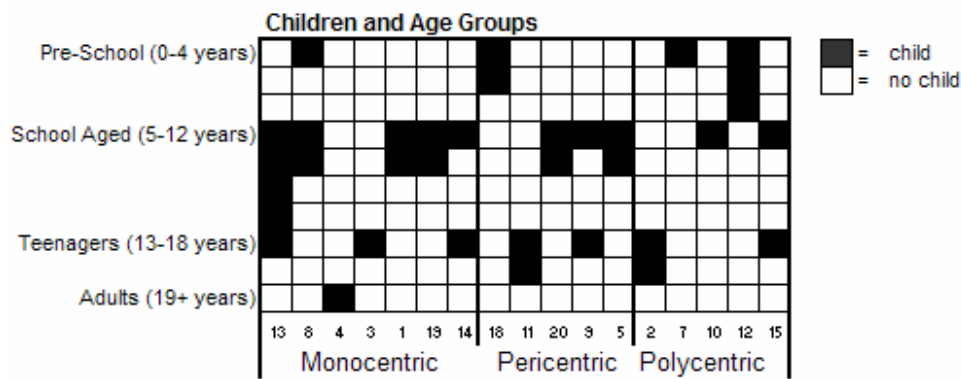


Table 6.3: The number of children in each family and their age group.

family, P12, has a median of two events per day; half of the days on their calendar month have between one and three events; the least number of events per day is zero and the most is five; and, no days are considered to be outliers.

As visible from this graph, the number of events per day has little correlation to family type. The family with the lowest median and range of events is Fiona and Orlando's (P13) who really don't use the family calendar (Figure 6.1, far left). The highest median was found to be two events for seven different families. These families varied in family type: two were Monocentric families, three were Pericentric, and two were Polycentric. The range for most families is between zero and three events per day with four families showing exceptions: P11, P9, P14, and P12. These families all had a maximum of five events on a calendar day. Again, we did not find any similarities between these families in terms of the family type: one is Monocentric, two are Pericentric, and one is Polycentric.

Table 6.3 shows the number of children in each family and how they are grouped by age. For example, P13 (Table 6.3, far left) has five children that are school-aged. Next to this family, P6 has one pre-school aged child and two school-aged children. A natural question is, what is the number of calendar events intended for adults *vs.* children on each family's calendar? Figure 6.2 shows the number of events we counted for each family during one month, split by the number of events specifically for children *vs.* adults. Family activities were included under adult. Visually we can see there is a large variation in the number of events between families and also family types. We can also see that families use the calendar differently in terms of the number of events for adults when compared to children. We did not find any correlations between the age groups of children or numbers of children with the

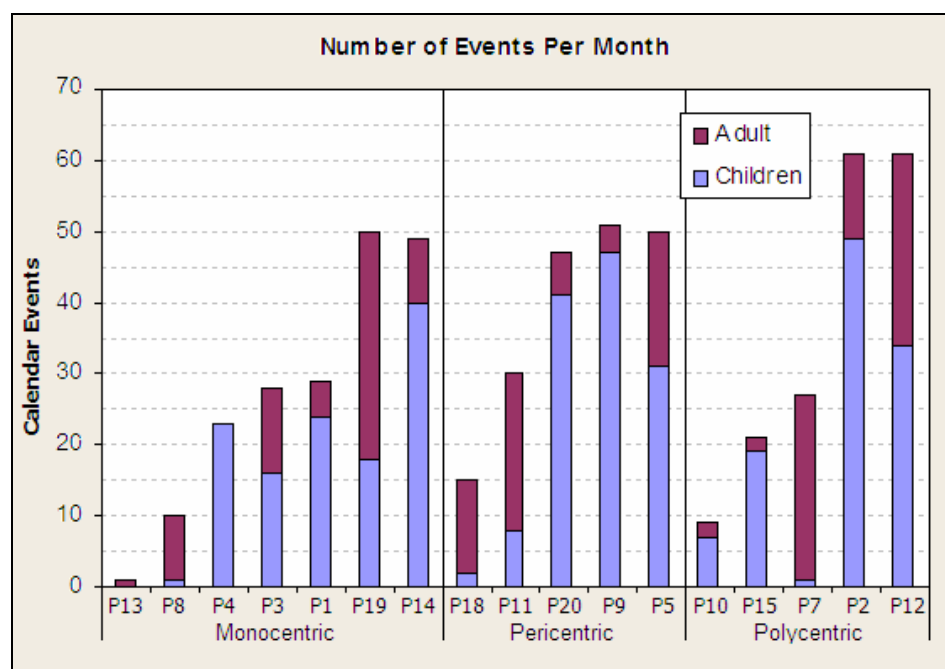


Figure 6.2: Number of children events *vs.* adult events on one month of each family's calendar.

percent of events for adults *vs.* children. For example, families with only infants, P7 and P18, had nearly all adult activities. Yet P8, who has an infant and two school-aged children, also had nearly all adult activities. On the other hand, P12, has all infants and her family calendar contains roughly an equal split between adult and children activities. This suggests, again, that families are fairly idiosyncratic in terms of the use of their calendar for children *vs.* adult events.

Taken together, the results show that there is little correlation between the number of events on the calendar, the type of family, and the number of children in a family. Rather, the number of events on the calendar is idiosyncratic to the family, their routines, and their actual need to add information to the calendar.

These results also show that the number of events placed on the family calendar per day is usually fairly small: often three or fewer, and in many cases only one event is on a calendar day. However, there are occasional times where four or five events are recorded; it would clearly be a mistake to assume that at most only three events are ever written on the calendar. In fact, our results do *not* show that families *want* to place only a few daily events on their calendar. In our interviews, many families said they find the squares for each

calendar day to be small, and they claimed they would put more information down if the calendar days were larger. In contrast, others told us that there is only so much they want to write on the calendar. Whether these perceptions by families would remain if in fact their writing space for each calendar day was much larger is hard to say.

In spite of this uncertainty, we do know that families *are* able to manage their coordination routines with the tools they are currently using and the amount of events they write down. These numbers provide a nice approximation of the level of content currently being added to family calendars.

6.2.2 Types of Events on the Family Calendar

I next analyzed the types of events found on the family calendar. Figure 6.3 shows the median number of events found on the months analyzed across all 17 families, grouped by the type of event. For example, the first column shows ‘Sports and Outdoors’ events. Here the median number of events of this type found on the calendars was 9, with an interquartile range of 0 to 19. All of the event categorizations shown in the figure were derived through open coding. I define each type as follows (the percent shows how many of that event type I found out of all 562 events counted):

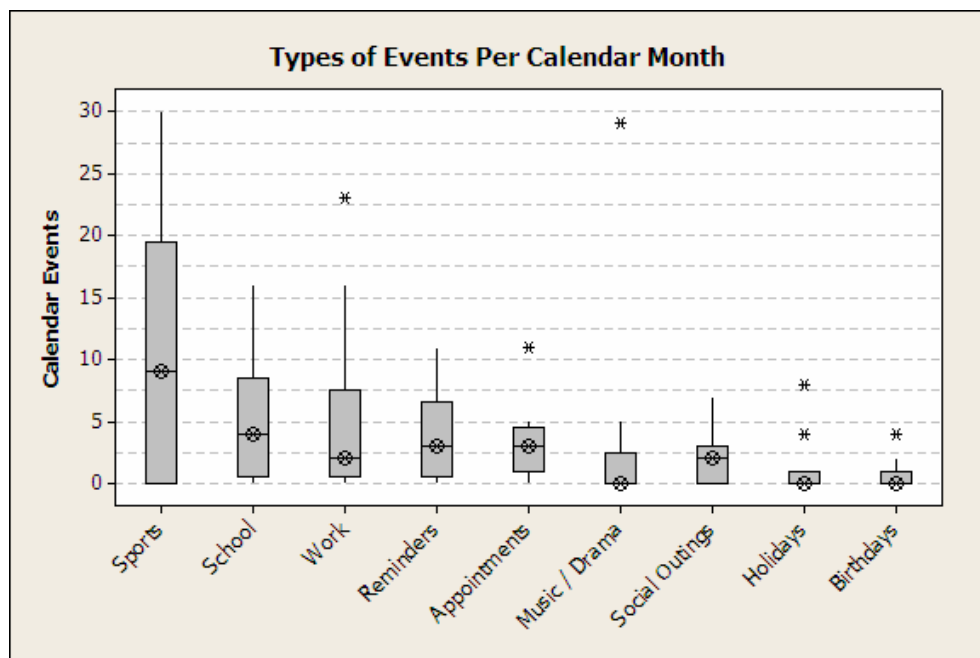


Figure 6.3: The median number of different types of events on the primary family calendar for all families.

- **Sports and Outdoors:** extra curricular activities involving a sport or the outdoors, e.g., soccer, hockey, swimming, wilderness training (30.8%).
- **School:** events relating to or happening at school (15.7%).
- **Work:** events happening at work, work schedules, or changes to work schedules (including volunteer work) (14.4%).
- **Reminders:** events to trigger memory recall usually about a task that needs to be performed (10.3%).
- **Appointments:** events where you are meeting someone for a specific purpose at a specific time, e.g., doctor's appointments, non-work meetings, picking someone up at the airport (9.1%).
- **Drama and Music:** extra curricular activities that teach about the arts, e.g., music lessons, drama performances (8.5%).
- **Social Outings:** events which are social in nature, e.g., family dinner at friends, sleepovers, going to a movie, date night, church (5.9%).
- **Holidays and Vacations:** trips not involving work (3.2%).
- **Birthdays / Anniversaries:** birth notices, birthdays, wedding anniversaries (2.1%).

Figure 6.3 shows that sports events are the most commonly occurring activity on family calendars, with the amount of events for other categories diminishing from left to right. Of all the events on the calendars, 98.5% were single day events and only 1.5% were multi-day events. Again, I did not find any major differences between family types or the number of children in a family for the types of events on the calendar. The importance of these event types is the realization that families put many different types of events on the calendar; indeed, as some of these events are quite seasonal, we would expect their frequency would fluctuate over the year (e.g., activities whose occurrence is dependant on school terms, summer vacations, courses, team membership, and so on).

To explore this further, I asked families if the month analyzed was a fairly common month in terms of the content. Sidney (P6) commented, *“March break there may be less [events]. There’s nothing at school, but we’ll go do something else like the zoo.”* Other families talked about their calendar having different cycles throughout the year. For Jack and Sherry (P5), their family calendar generally goes on a four-month cycle to coincide with university semesters (Jack is a

professor and Sherry is a graduate student). They say the number of events they have on the calendar is fairly consistent, but the type of events will change depending on the semester. Mona (P20) finds that her family calendar is less busy between mid-December and mid-January because the children are on holidays from school. She also feels that November is busier because her children are involved in practices for Christmas performances.

In summary, I believe the months analyzed are fairly typical of what one would find by looking at months throughout the year, though the content may vary slightly.

6.2.3 It Affects the Family

I next explored why particular events are placed on the family calendar and why other events are left off. In essence, the main reason why events are placed on the family calendar is because they are *activities that affect the family*. These activities fall into two main categories: those that actually *involve* more than one family member, and those that family members should *know about* because they may affect the family's routine. These events can be single day events, span multiple days, or be tentative.

The first type of event, *activities that involve more than one family member*, are usually ones where a parent is responsible for ensuring a child is at a certain place or doing an activity. Typical examples involving children's activities include sports, music, school, and appointments. Each of these generally requires a parent driving the child to or from the activity, or being at the activity to observe. These events may even involve a parent coordinating with someone else to drive the child (a friend or carpool) or may involve a parent telling the child to pack something extra when they leave for school because of the day's event. Other activities affecting the family are those where the entire family participates, such as family outings.

For example, Linda's (P3) family calendar will include band practices and performances for her daughter along with times when her daughter is taking a babysitting class because she has to drive her. Her calendar will also include multi-day family trips to a nearby tourist town, because everyone in the family usually goes.

The second type of event, *activities that others should know about*, usually includes activities that change ordinary routines. For example, non-routine work hours (e.g., irregularly scheduled shift work, or a change in hours), and work trips out of town. These are all

deviations from the normal schedule, where the calendar indicates a family member is not available for normal duties.

For Cathy (P11), like many parents, her husband watches the children at certain times during the day or on particular days. As a result, any time that her husband's work schedule will be out of the ordinary or that he is out of town needs to be on the family calendar. Similarly, Greg and Lana (P7) each watch their three year old son when the other isn't working. If both are working, they have a regular babysitter to watch him. Recently, Greg went out of town on the weekend for his friend's bachelor party; this event had to be on the calendar to remind Lana that she had to arrange alternate child care for their son.

Events that do not affect multiple family members or events that family members do not need to be aware of are *not* generally placed on the family calendar. This includes detailed school activities like class times and one's routine work schedule during the day. As well, some families won't put tentative or not fully planned events on the calendar even if they do involve other family members, although others do include them as placeholders.

6.2.4 Routine Events: Next Week, Same Time, Same Channel

I have already described that events which affect the *family* generally appear on the family calendar; however, *routine events* present an interesting special case. Routine or recurring events are those that typically appear on the same time and day each week over a series of weeks. The general trend for family calendaring is to write routine events on the calendar only during the initial weeks of their existence. When the events become ingrained as part of the family's knowledge, they no longer need to write them on the calendar. Even so, some families do prefer to note these events so they don't accidentally double book themselves.

For example, Jack and Sherry (P5) find they usually write routine events on their calendar for the first few weeks of their occurrence until the family easily remembers when and where the events are. However, Sherry still writes routine events on the children's calendars to help teach them organization skills.

Cathy (P11) also doesn't write routine activities on the family calendar once they become known. If a routine event is cancelled though, she will write this down because it is out of the ordinary. Yet sometimes the omission of routine events on the calendar causes

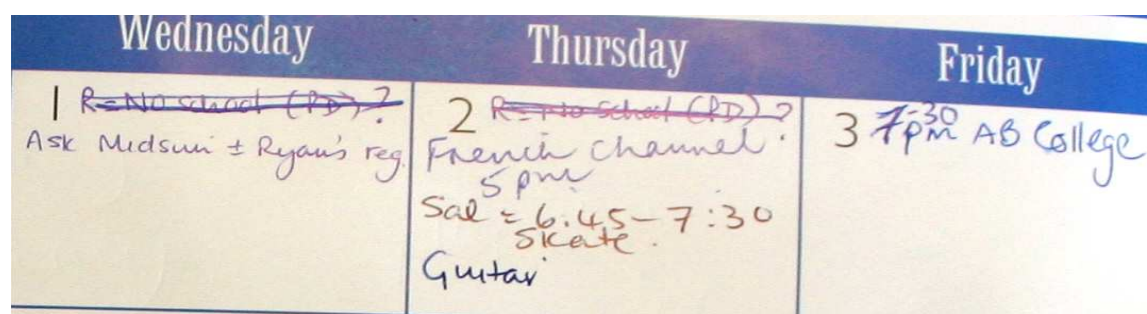


Figure 6.4: Samantha (P14) writes the word 'Guitar' for routine guitar lessons.

Cathy problems: her son's routine tennis practice is on Mondays but she often forgets about it because the family is involved in so many tennis events.

For Muriel (P8), there are certain routine events that just don't get placed on the calendar because they are easy to remember even from their onset:

"The kids used to go to [a church group] every Wednesday night. That was a routine habitual thing and I didn't write it down. I only tend to write stuff that doesn't happen all of the time. If it happens once a month then I'll write it in. If it's a weekly thing I just kinda remember."
– Muriel (P8), Mom and Day Home Organizer

In Linda's (P3) family, routine events are normally *always* written on the calendar if they affect other family members, even when they are part of the family's tacit knowledge. For her, routine events are important placeholders:

"I know that [my daughter] goes to band every Wednesday night, generally I'll put that in. I think it's just a placeholder as much as anything. I mean I know she goes to band every Wednesday and I don't need to worry about that, but it's a placeholder because sometimes it would be easy to look at that one week and think that night's free and scribble something in and not realize that it was a Wednesday night, whereas if it's in there you definitely go, oh that's a Wednesday." – Linda (P3), Mom and Administrator

Sometimes, routine events that appear on the calendar week after week will be written in a different style than other events. This reflects the fact that they comprise tacit knowledge, yet are still important as placeholders. For example, Figure 6.4 shows how Samantha (P14) just writes a keyword like 'Guitar' (on the 2nd) for a weekly guitar lesson and doesn't write the location or time. Elaine (P12) just writes a number to represent each week her children have swimming lessons, '1' for the first week, '2' for the second, etc. Figure 6.5 (left) has an event labelled '7' with a circle around it, which represents the seventh week for

swimming. This helps Elaine know how many lessons she has to pay for and when the lessons end.

6.2.5 Reminders for Household Tasks

Many families will include reminders for household tasks on their primary family calendar. Although, as mentioned in the previous chapter (see Section 5.2.6), some families use to-do lists, Tasks and Chores calendars, or simply remember the information without writing it down. When household task activities are written on the calendar, they normally differ from other events in two main ways: they may not have a date or time associated with them; and, they are usually specific to one family member.

For example, Elaine (P12) commonly places tasks on her calendar to remind herself that a certain activity needs to be done. She writes these tasks on a day when she thinks it may be appropriate to do the task. For example, Figure 6.5 (right) shows how Elaine wrote a reminder on her calendar to return library books on the 1st. Cathy (P11) will write reminders on her family calendar like paying for her children's music classes or maintenance reminders like servicing their treadmill. Lucy (P18) writes reminders like when she needs to return library books, while Linda (P3) writes down household chores like cleaning out the freezer.

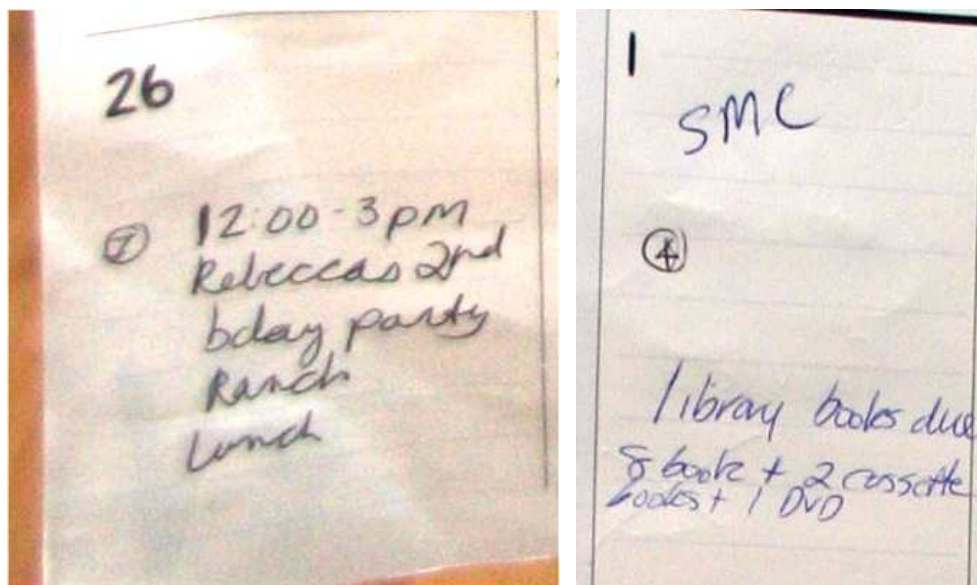


Figure 6.5: Elaine (P12) uses numbers for routines events (left) and also records tasks on her calendar like returning library books (right).

Family calendars do not come ‘out of the box’ with all the features that people need. As a result, the calendar as an artefact is appropriated as needed by families to overcome their idiosyncratic challenges. These include but are not limited to: a lack of space on calendar days, easily seeing the important information on the calendar, and seeing what has changed on the calendar.

JANUARY

2006

SCHEDULE TIME FOR IMPORTANT THINGS:
Do not miss this time! It is your chance to share your ideas and thoughts with the group.
All life is an experiment. - Ralph Waldo Emerson

Extra Information

Bearsapw
Triple - j @ bearsapw.net
Lissa Page
breadsman

Changes

Colors & Highlights

Symbols

Abbreviations

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1 10-6 CMC	2 leave Patrick 4:00 PM	3	4 Bearsapw School First Day back 1:00 AM Dr. Kobayashi	5 Leave @ 8:30 AM Hildan Peter Leave @ 11:00 AM Robt-Jenny 9:10-11:58 4:15 PM Leave @ 2:00 PM	6 Epiphany Delia 11:30-12:30 PM	7 No Baller 1-4 PM Kyle's Bday 5:00 PM Dinner @ Elaine Wongs
8 New Year's Eve	9 BP	10 9:15 Gymnastics Boris off	11 Bearsapw Library Field Trip Skating 1:30-2:00 (ML/KL)	12 William Reid Kindergarten Information Night 7-8 PM Dr. Roberts	13 HONDA 9:30-10:00 Type 2	14 MUSICA 9:00 AM Ballet OIL HUNGE Isabella's bday Colde Sea

Figure 6.6: Annotations and augmentations used by families.

these events or write words like ‘cancelled’ next to them (Table 6.4, Row 1).

For example, Kayla (P19) removes events from the family calendar by crossing them out. Changing the date of an event is done similarly by crossing it out and then writing it on a new date. Figure 6.7 shows a portion of Kayla’s family calendar: on the 16th, 17th, and 18th we see events that have been removed. Kayla finds it quick and easy to remove events this way, though she does find it to be a bit messy. Mona (P20) also normally crosses out events but sometimes she will draw an arrow between the event’s old location and its new one on the calendar, as an explicit marker to herself and others that the date has changed.

The remaining 25% of families (5 of 20) remove or move events by erasing or using white-out, where the visual indications of the change are mostly lost. Here family members must rely solely on the person making the change to notify others. Change history is also non-existent for *all* families when the change is the addition of an event, unless family members are able to recall what events used to be on the calendar compared to what is currently there.

Unlike paper calendars where editing naturally produces a change history, the editing capabilities of current digital calendars means that changes are often invisible. Although this is an apparent disadvantage, the families using a digital calendar as their primary family calendar did not find this problematic. This is likely because the responsibility of modifying the digital calendar was still mainly that of the primary scheduler, who could easily keep track of changes by memory. As well, families are fairly good about keeping each other aware of what has changed on the calendar simply by communicating.

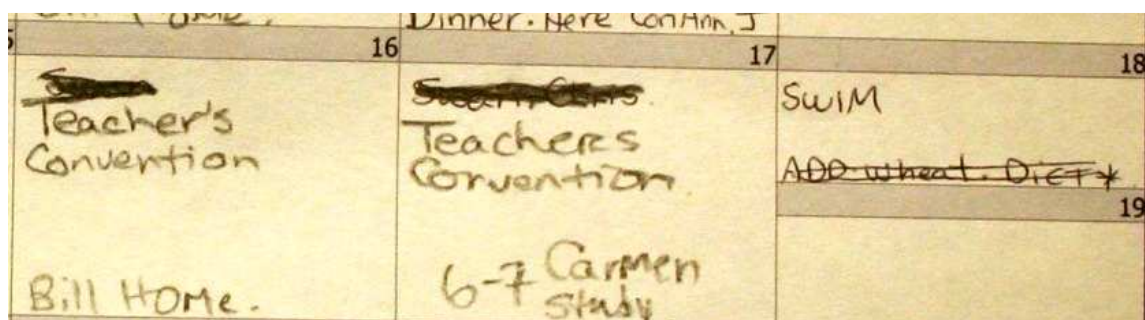


Figure 6.7: Kayla (P19) crosses out events on her calendar to remove them or change the date.

6.3.2 Abbreviations for Locations, Names, and Repetition

People often *abbreviate* information on the calendar. They do this because the space within most calendar days is limited, and because of the high effort required to write repeating events and long location names. I found 65% of families (13 of 20) abbreviate information about an event on the calendar (Table 6.4, Row 2). Not included in this count are ‘radical abbreviations,’ where the scheduler simply leaves out large portions of information (e.g., not writing down the location for an event because it is just known); nearly all families do this.

Typically, the scheduler shortens the location or the name of the person associated with the event. If understood, terse abbreviations are an economical way for people to quickly look at the calendar to acquire an at-a-glance awareness of upcoming events. Yet those individuals not as familiar with the abbreviations get only a limited understanding of the calendar’s contents.

For example, Brad and Jennifer’s (P2) family is very busy with extra curricular sports activities. Figure 6.8 shows how the family calendar contains abbreviations for the location of hockey practices and games. They do this because of the lack of space on the calendar and the long length of location names (usually schools or community arenas). On the 31st, ‘FV’ is an abbreviation for a practice’s location, while ‘FM’ abbreviates a game’s location. For the same reasons, Samantha (P14) also abbreviates locations and the names of family members; Figure 6.9 shows a portion of her calendar where events labelled with an S (for Samantha) are for her, T are for her son Timothy, and R are for her other son, Randal.

Abbreviations like arrows are also used to show that events repeat over a certain number of contiguous days. Many families, like Wanda and Dale (P15), abbreviate multi-day events by drawing an arrow to show the duration of the event, rather than writing it on each day that it occurs. Figure 6.10 shows their son’s school patrol event that occurs each day of the week from the 13th to 17th abbreviated with an arrow.

6.3.3 Colors and Highlighting to Make Events Stand Out

While people often use the closest pen at hand to write events, I found that 50% of our families (10 of 20) go out of their way to use specific colours (Table 6.4, Row 3). These families said they use colours to make particular events stand out, be it for the type of activity or the person involved in it. The benefit is that colours make the calendar more

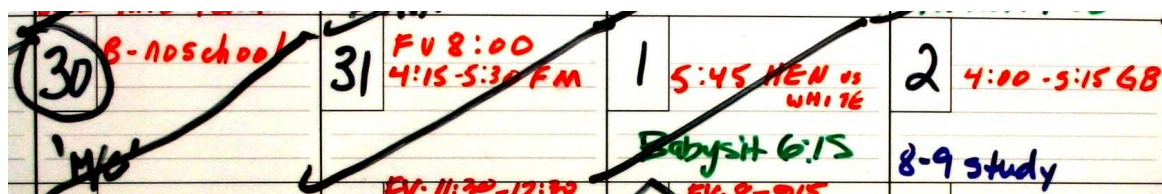


Figure 6.8: Brad and Jennifer (P2) use abbreviations for locations and a colour for each family member.

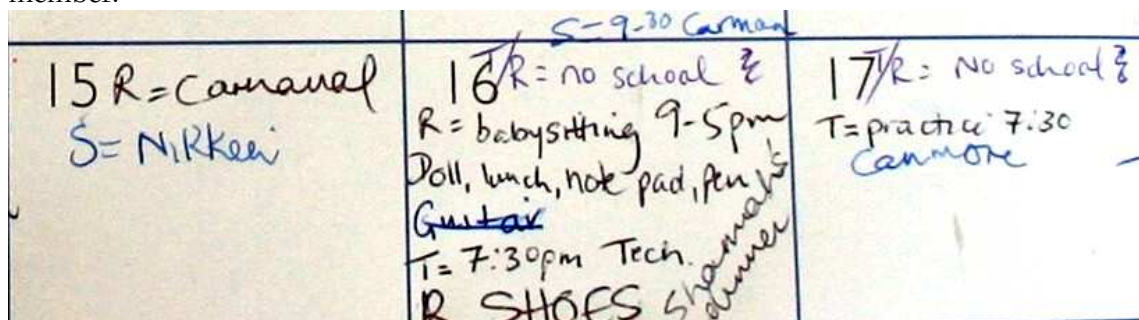


Figure 6.9: Samantha (P14) abbreviates who an event is for on her calendar with initials.

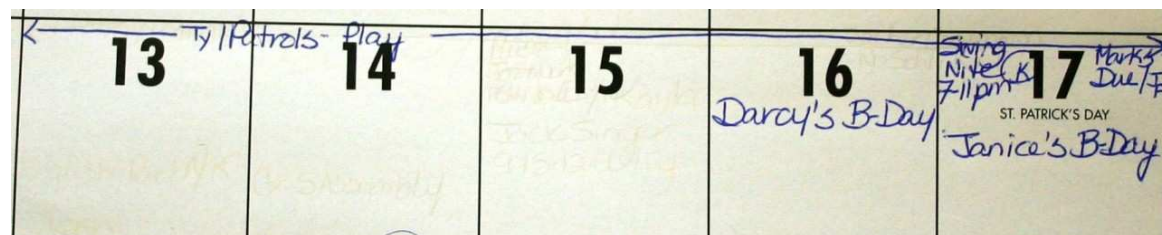


Figure 6.10: Wanda and Dale (P15) draw an arrow to avoid writing a multi-day event on several days.

readable, where family members can quickly look at the calendar to gain an at-a-glance awareness of the family's events.

For example, Brad and Jennifer (P2) use different coloured dry erase pens on their family calendar where each person's events are written in a specific color (Figure 6.8). The red event labelled 'FV 8:00' is for their son, the green event labelled 'Babysit 6:15' is for their daughter, the blue event labelled '8-9 study' is for Jennifer, and the black event labelled 'M/C' on the 30th is for Brad. They explain that these colours let them easily see at a glance who has activities on a given day: they don't have to *read* the calendar entries for the day to know which children have events. Both parents find the colours to be one of the best things about their family calendar:

"I like the colour coding. It's a quick at-a-glance [our son] has something." – Jennifer (P2), Mom and Government Clerk

“When [our daughter] had soccer and [our son] had hockey you knew which one of the two of them you had to worry about. And one of the better things about that is you knew what time of day depending on which [child]... The colour is the best part, that’s why we do the colour.”
 – Brad (P2), Dad and Architectural Technician

Mona (P2), a teacher, uses colours to highlight the types of activities on her calendar rather than who has activities. Pink events are birthdays and births, blue is for education and teaching, and bright blue is for school holidays. Figure 6.11 shows Greg and Lana’s (P7) calendar where important events are highlighted like the appointment in green on the 11th labelled ‘Grace Maternal Child’ and the ‘Hockey Game’ in orange and green on the 12th (two colors were used to make it ‘really’ stand out). Figure 6.12 shows Paul’s (P42) family calendar where sometimes colour and nothing else is used to show that an event is taking place. On days when Paul is working (shift work as a firefighter), the number of the day is highlighted in blue. The family also highlights important events in yellow.

Despite really enjoying the use of colours, families who do colour events often end up stopping after time. I interviewed several people who used to use colours but who did not currently. This is not to say people don’t continue to use colours, but many who do use colours at some point end up finding it to be cumbersome. Coloured pens can be easy to lose or hard to find and it is often much easier just to grab whatever pen is available. For example, Anita (P9) used to use colour on her calendar: a colour per person and a highlighter



Figure 6.11: Greg and Lana (P14) use highlighters to make important events stand out on their calendar.

Family calendaring is about more than just the actual events written on the calendar. There is often an abundance of other information that must be kept along with the events, or information that is not necessarily associated with a particular calendar day like additional schedules, maps, phone numbers, and tasks. This information is important but people often struggle with where to put it because it often doesn't nicely fit on the calendar. Sometimes it even needs to travel with people because it describes the details of how to use the event on the calendar, for example, how to get to a particular location. I found that 50% of families (10 of 20) either write this information in the margins of the calendar, augment the calendar by attaching information directly to it, or locate the information near the calendar (Table 6.4,



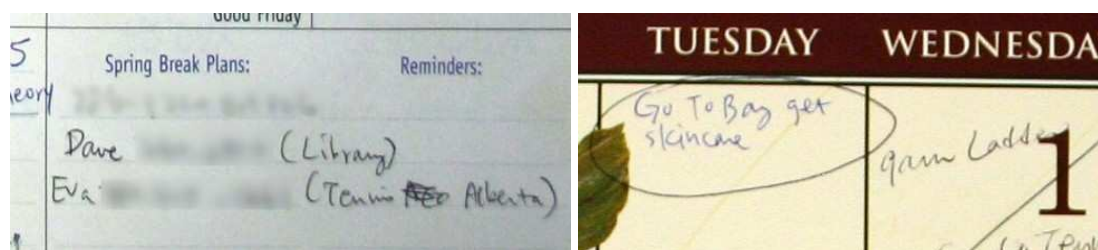


Figure 6.13: Cathy (P11) writes extra information about events in the margins of her calendar.

Row 4). This keeps the information close at hand to the calendar, and provides quick access to it.

For example, Cathy (P11) finds she uses the corners and margins of her calendar to write extra information about events for the current month, or to jot down events that are happening next month. Figure 6.13 shows samples from her calendar (portions blurred for confidentiality). On the left, Cathy's old calendar had a space in the bottom right corner to add the extra information. On the right, Cathy's new calendar does not have extra space for this type of information so she is forced to write it in the extra space before the 1st of the month. Cathy usually finds she writes down messages, reminders, or things that don't generally fit into a day but need to be done this month. If she ever runs out of space, Cathy will place sticky notes on top of her calendar with the same type of information. Cathy's old calendar, like many others, also has space at the back to write information like emergency numbers and medical card numbers, which she does.

Anita's (P9) calendar is an example of one where the extra information is attached to the calendar. She slides the paper handouts from various extracurricular activities between the pages of her calendar (Figure 6.14) for easy storage. When mobile, she will then take the extra information that is needed and place it in her purse. Anita describes the challenges of the 'extra information':

"The only thing that is missing is all the other details that I have like how do you get to this place, where is that, all the extra stuff. It'd be nice with all the extra stuff if you had it in one place then I wouldn't need my purse file. I used to have extra things stuck to the fridge, now they're stuck in the calendar. We used to have their soccer schedules on the fridge. I think it's trying to get it all in one place." – Anita (P9), Mom and Accountant

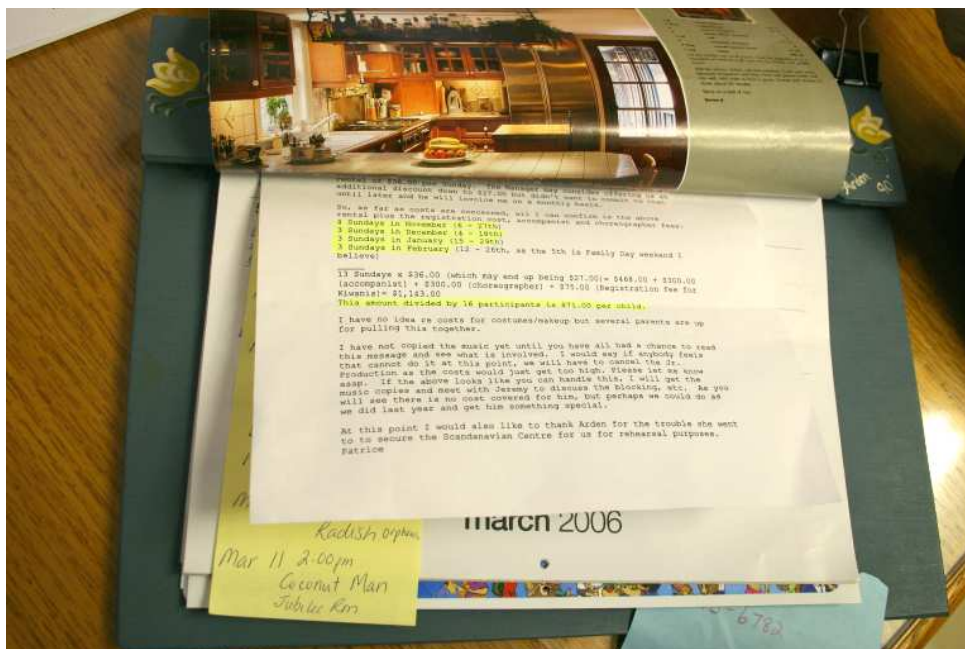


Figure 6.14: Handouts, notices, and other pieces of extra information are slid into Anita's (P9) family calendar.

Samantha (P14), mother of two children aged 12 and 14, has specifically selected her calendar to help with the problem of storing the extra calendar information. Samantha orders a Block Parent calendar every year over the phone for the simple reason that there is a *pocket* behind each month (Figure 6.15) that she uses to place the extra stuff that goes with her family's calendar events.

Sometimes families will specifically place this extra information in a location nearby the calendar so it is ready-at-hand when needed. For example, Brad and Jennifer's family (Figure 6.16) ends up with this information stuck on the fridge next to the calendar; thus, the fridge becomes an ecology containing both scheduling and associated information. This relates to the idea of having 'coordinate displays' or 'ecological habitants' where communication information can be placed for others to see or use (Crabtree *et al.*, 2003b). This location is usually 'public' so that all family members can gain access to the information placed there (Elliot *et al.*, 2005). Susan's (P23) family has developed yet another strategy for handling this extra event information. The 'Book of Life' is a binder that contains all of the school notices, maps, phone number lists, etc. that the family needs to reference often when going about their everyday activities (Figure 6.17). The Book of Life resides in the kitchen in a drawer near the calendar and any family member can pull it out to check the information.



Figure 6.15: The pocket in Samantha's (P14) family calendar holds extra information.



Figure 6.16: Brad and Jennifer's (P2) calendar on the fridge along with information relating to it.

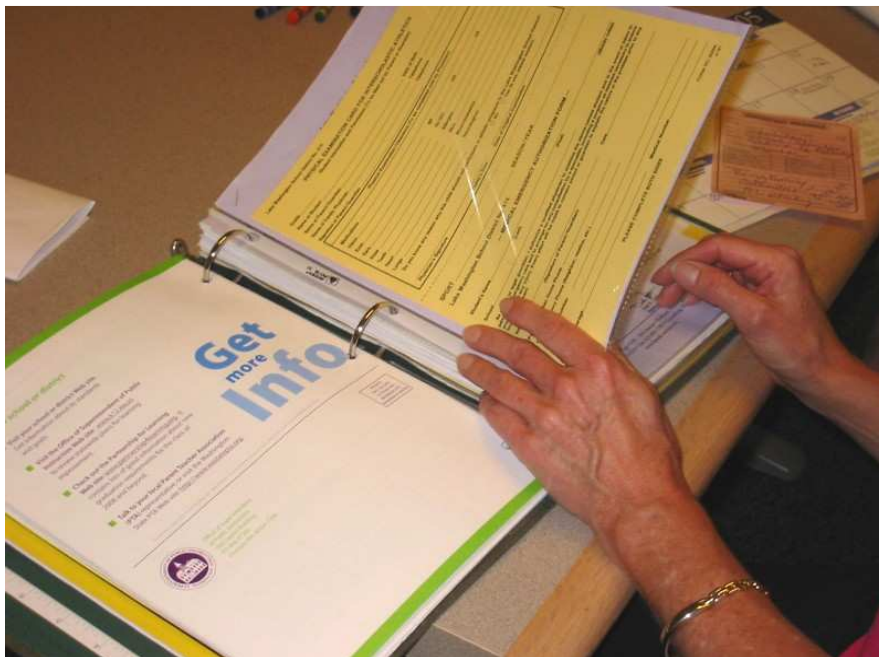


Figure 6.17: Susan's (P23) family's 'Book of Life' contains all of the extra information associated with events.

6.3.5 Symbols: Stickmen, Stickers, Etc.

Some families also place symbols on their calendars, like drawings or stickers, to serve as abbreviations, to highlight activities, to indicate the status of an event, and even to make calendaring more fun. Here the symbol either replaces text or augments it. I found 35% of families (7 of 20) used symbols on their calendar (Table 6.4, Row 5), where these visual representations benefit families by again providing an at-a-glance view of what activities are on the calendar.

For example, Charity (P16) has developed a very rich symbol system for her family's calendar so that her children, aged 3 and 5, can learn and understand what activities are on it. Figure 6.18 shows a portion of her family's calendar. The upside-down stickmen (on the 23rd and 2nd) represent gymnastics for her daughter, the books mean school, the dog means dogsitting, the smiling house (27th) means her son is going to grandma's house, the treble clef (27th) is for her son's music lessons, M is for a special lunch at Montana's restaurant, and the 'Mom' balloon (1st) represents Mom's birthday. Even though the symbols were originally intended for the children, Charity's husband, Bruno, says they also provide him with an at-a-glance view of what activities the family is doing.



Figure 6.18: Charity (P16) uses symbols on her calendar for her children who can't read yet.

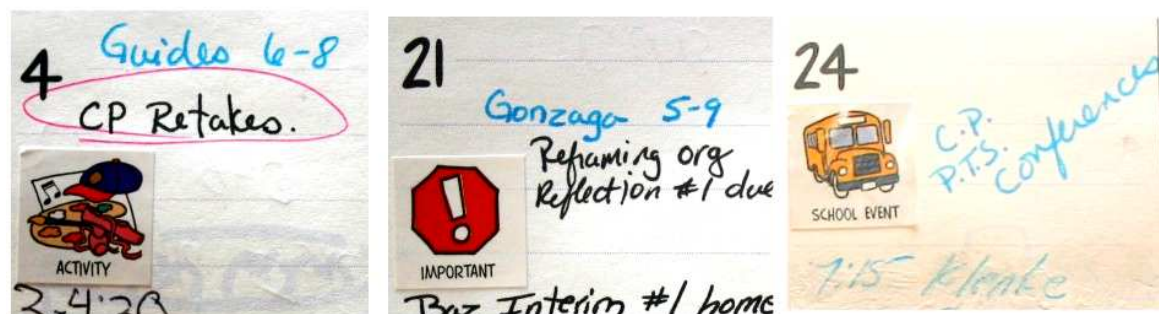


Figure 6.19: Mona (P20) uses stickers on the family calendar to highlight events for her children.

Mona (P20), like some other primary schedulers, tries to achieve a similar effect through the use of stickers. Mona's calendar comes with a set of generic stickers like 'Important,' 'Birthday,' and 'Activity.' Figure 6.19 shows stickers on a few days from her calendars. However, Mona finds the set of stickers to be quite limiting, both in terms of the quantity of stickers given with the calendar and the small range of types. She says that the idea of adding stickers to the calendar makes things a little more fun for her kids who like to place the stickers next to events.

Elaine (P12) has devised various symbols to show at-a-glance when people in her family have activities. In her case, colours were not enough to provide awareness at-a-glance. For example, Elaine has devised a 'tick system' to help her understand who is involved in overlapping events. Figure 6.20 shows portions of a week from Elaine's calendar. A bracket is drawn beside activities that are overlapping. No tick on a bracket means the event is for just Elaine. Each time a child has to be at an event a tick is added.

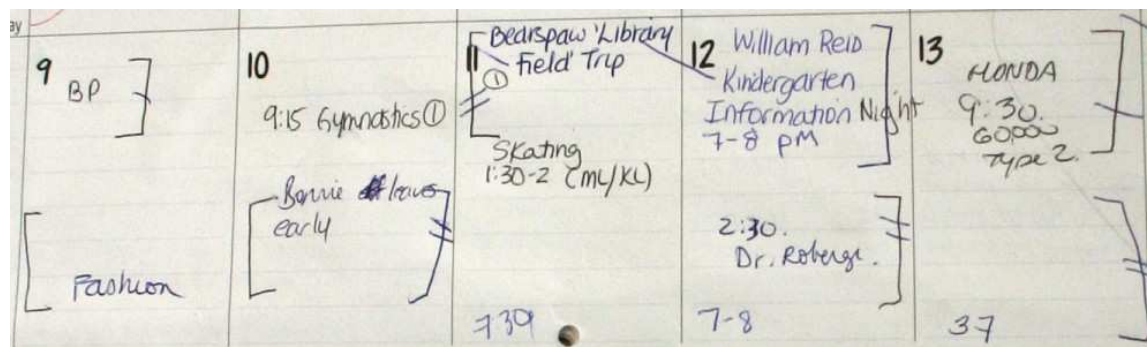


Figure 6.20: Elaine's (P12) 'tick system' helps her know who has activities at-a-glance.

For example, the 'Information Night' on the 12th is just for Elaine because there are no ticks on the bracket. The doctor's appointment below it (12th) is for both Elaine and her children. Elaine comments on her 'tick system' and the role it plays:

"Most of the time I have two things going on at once. We have preschool in the afternoons so there are two kids at preschool, but at the same time I have to go to a doctor's appointment so they're happening at the same time. So that's why I kinda need this tick system cause I need to know if I have to drive a kid or if I have to leave a kid. Same thing over here [points to spot on calendar], one kid was at preschool but I had to go for a doctor's appointment so they're at the same time. I write [the ticks] right on the bracket so I know that I am away and one kid is at preschool." – Elaine (P12), Mom and Homemaker

Some families also use symbols like '?' marks to reflect the fact that some events are tentative, or they will put a large 'X' or line through days as they pass in order to easily see what day today is. Elaine (P12) also uses symbols to show which days have passed, but has found the use of an 'X' caused her confusion. As a result, she writes a large 'C' on days that have 'completed':

"C just means [the day] is done. I used to X them out but I used X's to mean there is no school...because I have to know what day the kids don't have school...it was kinda confusing, holidays were a highlighted X, but then I got lazy and didn't want to use the highlighter. I used to cross out the days with a squiggle but then I couldn't read what was under if I wanted to look back. I like to cross out the dates because then I know what day it is." – Elaine (P12), Mom and Homemaker

6.4 Summary

This chapter has further *formalized family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems* (Chapter 1, Objective 2). Specifically, I have performed content analysis, in addition to interviews, to investigate what information is being placed on the family calendar and what information is left off. Findings from this analysis have shown that family calendars typically contain a small number of events per day usually ranging from zero to three events. It is rare that days have more than three events, but some families did have up to five events on a day. Despite this small number of events, some families want to add more to their calendar and say the space is too limiting. Whether they would actually add more if they had more space is unclear. Other families commented that there is only so much they need to add to their calendar because a lot of activity information comprises tacit knowledge that does not need to be written down. I did not find differences between the three family types (mono/peri/polycentric) in terms of the number of events on the calendar.

Events on the calendar vary whether they are for children or adults, and in terms of the type of activity. In order from most prevalent to least prevalent (across all families combined), activity types were: sports and outdoors, school, work, reminders, appointments, drama and music, social outings, holidays and vacations, and birthdays and anniversaries. Again, I did not find any differences between families in terms of the number of events on the calendar from each type.

Interview findings explained why families placed certain events on the calendar and left other events off. Events were primarily added to the family calendar because they affected the family either directly by being for multiple family members, or indirectly by altering the family's routine as a whole. Routine events are one special type of event that sees a range of strategies for including them *vs.* not including them on the calendar. The most popular strategy is to initially write them down until they become tacit knowledge at which point they are no longer written down. However, some families continue to add routine events to the calendar to act as placeholders so times are not double booked. Family calendars also sometimes contain reminders for household tasks and chores. Here the reminder is usually for one family member as opposed to the entire family.

Calendars, like many tools in life, do not always get used as may originally be intended by designers. I found five different ways in which family calendars are extended through *annotations* and *augmentations* in order to overcome challenges in a lack of space on the calendar and to make certain information stand out and visible at-a-glance. I did not find any differences between family types when it comes to annotating the family calendar. The annotations and augmentations I saw include:

1. **Changes** are markings left on paper calendars when a family member moves or removes events. These visual indications help the primary scheduler and other family members (if they check the calendar) understand what has changed on the calendar. Most families tell others what has changed verbally, but these visual cues aid this process. Digital calendars typically do not provide any visual cues of calendar changes.
2. **Abbreviations** are event details that have been shortened because of limited space on the calendar and the time needed to write a large amount of information (e.g., locations of events can sometimes be long school or community names). They can also aid at-a-glance awareness of calendar content. Typical abbreviations are names, locations, and activity descriptions. Events spanning multiple days are sometimes abbreviated with an arrow to show the event's duration rather than writing it multiple times.
3. **Colors and Highlights** are visual indications on the calendar that help draw attention to particular events or show who has an event. Events may be written in a different colour, highlighted with a colour, or a coloured shape may be used instead of writing event details. These help family members gain an awareness of events by glancing at the calendar where they don't necessarily have to read event details.
4. **Extra Information** is additional information about calendar events that needs to accompany the calendar. The unassigned space on the calendar (outside of the month's days) is used to write this additional information, or the information is just attached to the calendar or areas near its location (e.g., a fridge door). This aids family members by overcoming space limitations on the calendar and makes the extra information ready-at-hand when needed.
5. **Symbols** are visual representations on the calendar like drawings or stickers that are used in place of words to provide more detail or to represent an event. These again aid family

members by providing an at-a-glance awareness of calendar content and can also help children better understand the calendar by making calendaring fun.

The findings from this chapter *formalize family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems* (Chapter 1, Objective 2) by illustrating what content families place on the calendar and how calendars are extended for everyday use. In the next chapter, I discuss how these results and the results from Chapter 5 can suggest guidelines for the design of digital family calendars.

Chapter 7. Family Calendaring Synthesis¹⁰

The goal of this chapter is to complete the *formalization of family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems* (Chapter 1, Objective 2). Specifically, I synthesize the family calendaring results and present implications for the design of digital family calendars. This involves understanding family calendaring within the context of Chapters 2 and 3, where I integrate the related work about family calendaring from Chapter 4 with the findings presented about family calendaring routines from Chapters 5 and 6. Thus, the current chapter describes a unified *theory of family calendaring*. As social science, this knowledge can be used by researchers to better understand the routines families employ to coordinate their activities. For designers and practitioners, this presents an understanding of the culture in which digital family calendars will reside. As human-computer interaction research, this knowledge contributes even more for it bridges the gap between theory and design by suggesting empirically-based guidelines for the design of digital family calendars, which I articulate. I first describe the cultural knowledge that has been uncovered and situate it in the related literature. This illustrates how family calendaring differs from workplace calendaring. Then I show how this informs a set of design guidelines for digital family calendars. Following this, I analyze digital online calendars—currently the most prevalent form of digital calendar designed for families—to see how they fair in relation to the design guidelines.

7.1 Family Calendaring Theory

Through the past three chapters, a large amount of detail has been presented that describes the calendaring routines of families. This section synthesizes this material to describe a

¹⁰ Portions of this chapter are also published in: Neustaedter, Brush, and Greenberg (Technical Report 2006c).

unified and empirically-informed *theory of family calendaring*. This theory is broken into five interrelated parts: a typology of calendars; family types; scheduling and awareness routines; information on the calendar; and, annotations and augmentations.

7.1.1 A Typology of Calendars

Families use calendars as domestic artefacts central to their coordination routine (see Chapter 1, and Zimmermann *et al.*, 2001). Family calendaring occurs inside the home, outside the home at locations like work, and even while mobile between locations (see Section 5.2 and Section 5.3.3, Crabtree *et al.*, 2003a, Beech *et al.*, 2004, Sellen *et al.*, 2004). Multiple calendars are used (Hutchinson *et al.*, 2002) to provide family calendaring information and access in these locations (see Section 5.2). This is similar to workplace calendaring where multiple calendars are used to have calendar information in different work locations or for different purposes (Kelley and Chapanis, 1982, Kincaid *et al.*, 1985, Payne, 1993, Palen, 1998). Yet, family calendaring and workplace calendaring will each involve using a different set of calendars, though these sets may overlap. For example, someone's primary work calendar may contain some family events, though a calendar for an entire work group would likely not. Similarly, some calendars used at home may contain some work events, but likely not a complete work schedule. Other home calendars may not contain any work content, e.g., a children's calendar.

Table 7.1 summarizes a typology of calendars used by families for coordination. Families often have a calendar that is used as a *Public Awareness calendar* in their home (see Section 5.2.1). These are calendars that are made public for the entire family by either being placed in high traffic locations in the home (see Section 5.2.1, Crabtree *et al.*, 2003a) or made virtually public through online sharing of a digital calendar (see Section 5.2.1). All family members are able to see the calendar's contents and add to it. Because of this role and visibility, a Public Awareness calendar is often the *primary family calendar*: the main calendar used by a family for coordination (see Section 5.2.1). Most families want to see a month at a time in their Public Awareness calendar in order to adequately plan and check the calendar. Public Awareness calendars in the domestic realm parallel workplace calendars that are used as collaborative artefacts (Palen, 1998). They are both used for providing others with an awareness of activities that can aid coordination (see Section 5.2.1, Palen, 1998). Yet in the

Type of Calendar Used for Family Coordination	Description of the Calendar Type's Use and Location
Public Awareness calendar	Calendars placed in publicly viewable locations in the home so that family members can all gather an awareness of family activities. Primary calendars are often used in this manner.
Personal Work calendar	Calendars used for work scheduling where some family events are also recorded because they affect the work schedule. They are located at work, but may move between home and work if in a portable form factor.
Personal Mobile calendar	Calendars that move with a single family member to provide mobile calendar access while out and about. Their primary use is for family activities, not work ones.
Personal Children's calendar	Calendars designed to teach children about scheduling, organization, and the family's activities. They are located in areas where children can easily view them.
Planning and Reference calendar	Calendars used to plan out family activities or provide a reference for dates. They are located in areas conducive to planning.
Tasks and Chores calendar	Calendars used to record family tasks or chores only. They are located in areas conducive to planning or visual reminding.

Table 7.1: Family Calendaring Theory: a typology of calendars used by families as a part of their coordination routine.

home the calendar is by its very nature for the *entire family* (see Section 5.2.1) rather than an *individual* with varying access rights for others (the model used for workplace calendaring) (Palen, 1998).

Some families also use other *secondary calendars* within the home to provide coordination information in more than just one home location (see Section 5.2). *Secondary calendars* also contain family events but are not the central calendar used by a family for coordination. These may include another Public Awareness calendar, *Personal Children's calendars*, *Planning and Reference calendars*, or *Tasks and Chores calendars*. *Personal Children's calendars* contain family activities relevant to a child in an effort to teach them organization skills (see Section 5.2.4). They are often placed in home locations where the child will naturally see the calendar like his or her bedroom and people generally use calendars that display an entire month. *Planning and Reference calendars* allow families to plan over a long term by gaining an understanding of when particular dates occur or drafting out events (see Section 5.2.5). They are often placed in home locations where one may need to refer to dates or where

planning occurs, such as a home office, and most often display an entire month or several months. While they may be publicly visible, in the culture of the home, these calendars are known by family members to be less public in nature than Public Awareness calendars. *Tasks and Chores calendars* provide families with space to list tasks that are associated with particular days (see Section 5.2.6). They are often placed in home locations relevant to the planning of tasks like the kitchen and display a week or multiple weeks. Some families do not use Tasks and Chores calendars because they store the same information on their primary family calendar or on other coordination artefacts like paper lists.

Many families also use one or more *Personal Work calendars* for family calendaring (see Section 5.2.2). The primary purpose of these calendars is for work; however, family activities often affect one's work schedule. Thus, families will either use a work calendar as a primary family calendar or they may use one (or more) in a secondary role where it contains family activities that are relevant to one's work schedule (see Section 5.2.2, Kelley and Chapanis, 1982, Brush and Turner, 2005). Most work calendars are situated on a PC at work, but they are sometimes found on mobile devices like PDAs or laptops. The amount of days shown on a work calendar will vary based on an individual's needs. For work activities, these calendars can act as collaborative artefacts when they support networking (Palen, 1998). Yet when it comes to family calendaring, these calendars are fundamentally personal in nature with most often no access to the calendar for family members (they are, after all, usually at one's work where family members do not frequent). This can create family calendaring challenges if a Personal Work calendar is used as a primary family calendar (see Section 5.2.2).

Many families also use one or more *Personal Mobile calendars* for family calendaring to overcome challenges of adding to and viewing the family's events while mobile (see Section 5.2.3). These calendars are personal in nature because they usually stay with an individual as they go outside the home to various locations. They display anywhere from a single day, to multiple days, or even an entire month at a time. Most often Personal Mobile calendars are used in a secondary role, yet some families do use them as a primary family calendar. Because they are personal in nature, use as a primary family calendar inhibits other family members from participating in the family calendaring process. Some families don't use Personal Mobile calendars and will instead use other strategies for family calendaring while

mobile. This can include simply using one's memory, creating paper lists, or phoning home if someone is available to check or add to the in-home family calendar (see Section 5.2.3 and Section 5.3.3, Taylor and Swan, 2004, 2005).

The important realization stemming from these findings is that family calendaring spans many locations both inside and outside the home (see Section 5.2 and Section 5.3, Crabtree *et al.*, 2003a, Beech *et al.*, 2004, Sellen *et al.*, 2004) and this has translated into people using multiple calendars to provide ubiquitous calendar access (see Section 5.2). Even though multiple calendars are beneficial, they bring on their own challenges of synchronization (see Section 5.3.4, Kelley and Chapanis, 1982, Kincaid *et al.*, 1985, Hutchinson *et al.*, 2002, Brush and Turner, 2005) regardless of if they are paper or digital calendars (see Section 5.3.4). The typology of calendars illustrates the types of location needs that a digital family calendar should support.

7.1.2 Monocentric, Pericentric, and Polycentric Families

The family calendar is nearly always maintained by a *primary scheduler*: the family member most responsible for recording family activities on the calendar and ensuring people know about them (see Section 5.3.1). Most often the primary scheduler is a woman (see Section 5.3.1, Zimmermann *et al.*, 2001, Beech *et al.*, 2004, Brush and Turner, 2005) because women are typically the household communicators (Hindus *et al.*, 2001) and often assume roles of parental responsibility (Leslie *et al.*, 1991) because of their gender (Zimmerman *et al.*, 2001). There are cases where parents share the role of primary scheduler or a man may be the primary scheduler because of work activities, though this is rare (see Section 5.3.1). Other family members, labelled as *secondary schedulers*, also participate in the family's calendaring routine (see Section 5.3.1, Hutchinson *et al.*, 2002, Brush and Turner, 2005) though their level of involvement varies (see Section 5.3.1). In the workplace, multiple calendar maintainers are not common as people maintain their own individual calendars (Kincaid *et al.*, 1985, Payne, 1993, Palen, 1998). Exceptions would include administrative assistants and executives (Kincaid *et al.*, 1985, Payne, 1993, Palen, 1998).

Families vary in the roles of primary and secondary schedulers in their calendaring routine. This variability identifies three different types of families: *Monocentric*, *Pericentric*, and *Polycentric* families (see Section 5.3.1), summarized in Table 7.2. All family types see the

Family Type	Description of the Family Type	Family Members' Activities
Monocentric	Families whose calendaring routine is centred on one person, the primary scheduler, with no direct involvement by other family members.	Only the primary scheduler adds to and checks the calendar, while others learn about relevant activities by having the primary scheduler tell them.
Pericentric	Families whose calendaring routine is centred on one person, the primary scheduler, where others participate in calendar activities infrequently.	The primary scheduler updates and checks the calendar frequently; secondary schedulers update or check the calendar infrequently.
Polycentric	Families whose calendaring routine is centred on one person, the primary scheduler, where other family members are also actively-engaged in the routine.	All family members check or update the calendar frequently.

Table 7.2: Family Calendaring Theory: the three family types where each varies in the level of family involvement in the calendaring routine.

family calendar maintained by the primary scheduler, yet differ based on the activities of the secondary schedulers. *Monocentric families* have low involvement from secondary schedulers where the primary scheduler is responsible for adding to the calendar, checking it, and then telling or reminding family members about activities involving them (Table 7.2, Row 1). *Pericentric families* see more involvement from secondary schedulers. Here secondary schedulers now either add to or check the calendar infrequently, or query the primary scheduler for relevant calendar information (Table 7.2, Row 2). The level of engagement by secondary schedulers has risen from that of Monocentric families. *Polycentric families* have the highest level of involvement from secondary schedulers in the calendaring routine (Table 7.2, Row 3). They add to or check the calendar frequently and there is less reliance on the primary scheduler to remind people of activities, though the primary scheduler still does have to remind others occasionally.

Families will vary within each family type (see Section 5.3.1), yet the three family types provide a suitable and valuable means for comparing and contrasting calendaring routines, which is discussed more in the next section. The family types also serve an important role in highlighting the varying routines of families that digital family calendaring designs will need to support.

7.1.3 Scheduling and Awareness Routines

Like workplace calendaring (as described by Palen, 1998), families also use calendars to orient themselves temporally (see Section 5.2.1 and Section 5.2.5), schedule activities (see Section 5.3.2 and Section 5.3.3), track information (see Section 5.3.5), record and archive notes (see Section 5.3.5), be reminded of events (see Section 5.3.5), and refer back to activity information (see Section 5.3.6). Family calendaring involves five activities that I have formalized for scheduling, checking the calendar, and coordinating activities, where the level of involvement in each activity varies depending on the family type. Table 7.3 summarizes the five activities. These activities are often similar to processes undertaken as a part of workplace calendaring, though I highlight the main differences.

1. **Batch Update** involves placing a relatively large amount of events (as opposed to only one or two events) on the calendar at one time (see Section 5.3.2, Zimmermann *et al.*, 2001) (Table 7.3, Row 1). The primary scheduler is generally the only person involved in this scheduling stage regardless of family type. Batch updates may occur on a specific pattern like monthly, seasonally, or annually, or more opportunistically if a large amount of events arise (like a sports schedule is brought home). Events may come from notices or past calendars and usually involve school activities, sports activities, or a set of

Scheduling and Awareness Activities	Description of the Activity
Batch Update	The primary scheduler places a large portion of events on the family calendar. This activity is triggered by changing time periods (month, year, season) or the arrival of school or extra-curricular activity notices.
Continuous Updates	Family members update the calendar as needed throughout the month. This activity occurs in various locations, including the home, work, or while out and about.
Synchronizing Multiple Calendars	Family members copy events between multiple calendars to ensure each calendar contains relevant family events.
Awareness Acquisition	Family members check the calendar or get told about its contents in order to understand what family activities are occurring.
Coordination	Family members use their awareness of family activities to discuss who will be responsible for events or who will attend them. Sometimes explicit coordination is not needed as activity responsibility comprises tacit knowledge.

Table 7.3: Family Calendaring Theory: the scheduling and awareness activities of families.

birthdays and anniversaries. Some calendars already contain pre-filled content (e.g., holidays) that alleviates some of the batch update process.

2. **Continuous Updates** see events added to and updated on the calendar as needed throughout the month (see Section 5.3.3) (Table 7.3, Row 2). These updates typically arise opportunistically. For example, someone may phone about an activity, or an email may arrive. Continuous updates also arise throughout the day when one is not at home and, instead, at work or mobile between locations (see Section 5.3.3, Beech *et al.*, 2004). For this reason, people use multiple calendars or other strategies to facilitate continuous updates like using one's memory, creating paper lists, or phoning home if someone is available to check or add to the in-home family calendar (see Section 5.2 and Section 7.1.1, Taylor and Swan, 2004, 2005). Continuous updates differ from batch updates because they involve only adding one or two events to the calendar at a time. In Monocentric families, only the primary scheduler performs continuous updates. In Pericentric families, the primary scheduler performs continuous updates frequently and secondary schedulers perform them infrequently. In Polycentric families, both primary and secondary schedulers are performing updates. A similar process of continuous calendar updates also occurs at work (Kelley and Chapanis, 1982, Kincaid *et al.*, 1985, Payne, 1993, Palen, 1998) though the difference is that most often people are situated in one location at work, which is near their calendar. This is not the case for family calendaring.

3. **Synchronizing Multiple Calendars** involves copying events between different calendars to ensure each has the appropriate events (see Section 5.3.4, Kelley and Chapanis, 1982, Kincaid *et al.*, 1985, Plaisant *et al.*, 2006) (Table 7.3, Row 3). Calendars can be of different types and reside in different locations where only certain events are relevant (see Section 5.2). Thus, synchronization does not necessarily mean having the *same* events on all calendars (see Section 5.2, Brush and Turner, 2005). For example, on a Personal Work calendar, only family events that affect one's work schedule may be desired. It is important to realize that the events desired in any one location will vary between families and their needs. Calendar synchronization is similar with all family

- types where the people who participate in the synchronization process and to what extent will depend on whose calendars need to be synchronized.
4. **Awareness Acquisition** involves using one or more calendars to find out what family activities are upcoming or occurring (see Section 5.3.5) (Table 7.3, Row 4). This can involve checking the calendar directly or having a primary scheduler tell or remind others about activities. In Monocentric families, only the primary scheduler checks the calendar. Secondary schedulers learn about calendar content by being told. In Pericentric families, secondary schedulers are told about the calendar's contents by the primary scheduler, they may ask the primary scheduler about it, or they may infrequently check themselves. In Polycentric families, primary and secondary schedulers usually check the calendar frequently to understand its contents. In the workplace, awareness acquisition of the schedules of others differs. Instead of checking a central artefact like the primary family calendar, when scheduling a meeting, people will check the individual calendars of others to see who can participate and when (Palen, 1998).
 5. **Coordination** involves using the awareness of family calendar content (obtained from the previous step, 'Awareness Acquisition') to discuss and decide who is attending or driving family members to which activities (see Section 5.3.6) (Table 7.3, Row 5). In workplace calendaring, the norm is to explicitly list and invite meeting attendees ahead of time, usually at the time of creating the meeting in the organizer's calendar (Palen, 1998, 1999). This is not how coordination is done in family calendaring: none of our participant families kept records of who was needed to attend a family event. Instead, it is crucial that family members have some semblance of awareness of activities so they can coordinate through discussions in person, or using technologies like the phone, mobile phone, email, or instant messenger (see Section 5.3.6). All families coordinate in this manner regardless of the family type, though the means for actually discussing activities and who is involved will vary depending on the family, the activities needing coordinating, and the time at which coordination is done. Crabtree *et al.* (2003a) also point out that families must negotiate events through discussion where the calendar provides shared knowledge.

These five steps occur intermittently throughout everyday life (see Section 5.3, Beech *et al.*, 2004) and are not often as structured as they may appear on paper. Yet all families employ them in some shape or form in order to effectively manage family calendar information and coordinate activities (see Section 5.3). It is these processes that digital family calendar designs must support.

7.1.4 Information on the Family Calendar

Families place a variety of information on the family calendar including extra curricular activities like sports or music lessons, school activities, work activities, social outings, holidays, and birthdays or anniversaries (see Section 6.2.2, Hutchinson *et al.*, 2002). All families regardless of the type will record events of these types, though some will have more than others. Most families typically have fewer than five events per day on their calendar, with most days containing only one or two events (see Section 6.2.1). This is not to say that families only wish to place that many activities on the calendar; space often becomes a factor. The information written down for an event will vary, but typically it includes one or more of: a description of the event, the name of who the event is for, a time, and a location.

What is common about all of the events placed on the family calendar is that they affect the *family* in some way (see Section 6.2.3). First, activities can directly affect the family where *more than one family member is involved* in the activity. For example, a family outing for dinner would include more than just one family member just as driving someone to an activity would. Second, activities can affect the family more indirectly by being *activities that others should know about*. This could involve activities that affect ordinary routines, such as a change in work hours. If activities affecting the family are *routine events* that occur the same time and day each week, families may or may not continue writing them on the calendar after an initial time period (see Section 6.2.4). This depends on the idiosyncratic routine of each family. Families also sometimes place household tasks and chores on their primary calendar; though, these are more specific to one individual family member (see Section 6.2.5).

Given the widespread nature of the informational content on the calendar, it is no wonder that the actual information written down for a calendar entry varies quite broadly. It is also these entries / events that a digital family calendar must be designed to support.

Type of Annotation or Augmentation	Description of the Annotation or Augmentation
Changes	Markings left on a calendar after changes are made (e.g., crossed out writing). These implicitly provide change awareness.
Abbreviations	Portions of event descriptions are abbreviated to overcome space limitations on the calendar and reduce the need to write long descriptions. These implicitly provide at-a-glance awareness of calendar content.
Colors and Highlights	Events are highlighted or wrote in different colors to make calendar information stand out or be discernable at-a-glance.
Extra Information	The unassigned space on calendars (outside the date range) is used to add additional information related to events, or the information is attached to or placed near the calendar.
Symbols	Visual representations like drawings or stickers are used in place of words to provide more detail or to represent an event so that information is discernable at-a-glance.

Table 7.4: Family Calendaring Theory: the annotations and augmentations found on family calendars.

7.1.5 Annotations and Augmentations

Families provide additional meaning to their calendar and its contents through annotations and augmentations. This is especially true for paper calendars. These annotations and augmentations fall into five categories that I have formalized where the goal of the annotations is to overcome space limitations on the family calendar and provide awareness of events at-a-glance. Table 7.4 summarizes the five categories.

1. **Changes** are markings on the calendar left after an event has been moved or removed (see Section 6.3.1), which provides a change history (Tam and Greenberg, 2006) (Table 7.4, Row 1). They are often in the form of scratches or cross-outs where the goal is to remove information rather than provide additional information, which it inadvertently does. Change markings for ‘new events’ are not visible unless family members remember what events were previously on the calendar. Change markings help family members know if anything has changed on the family calendar. Despite most family members telling others about changes, visual change awareness is still important for it can augment this knowledge and help spawn its discussion. Digital calendars do not

support change awareness very well because change information is not normally presented.

2. **Abbreviations** are shortened event descriptions to reduce the amount of information that must be written on the calendar, to overcome limitations in the amount of space available for writing, and provide awareness of events at-a-glance (see Section 6.3.2) (Table 7.4, Row 2). Many families abbreviate names, event locations, or multi-day events on their calendars. Though it is not discussed in the workplace calendaring literature, abbreviations are most certainly used at work. The need for them may be less however as digital workplace calendars offer functionality to easily replicate calendar information rather than manually entering it multiple times (like on paper calendars).

3. **Colors and Highlights** are visual indications on the family calendar used to draw attention to particular events or details about them (see Section 6.3.3, Crabtree *et al.*, 2003a) (Table 7.4, Row 3). Their main purpose is to provide awareness of calendar contents at-a-glance. Colors may be used for writing different types of events or events for different people. Event details or days can be highlighted to draw attention to an event or particular day. Though again not discussed in the workplace calendaring literature, colours are most certainly used on digital work calendars. However, here they are typically used for categorizing *types* of events (e.g., meeting, out of office, personal), rather than events for certain people (if one looks at the default color options available in workplace calendar user interfaces).

4. **Extra Information** comprises additional information related to calendar events that is not necessarily written with an event on the calendar (see Section 6.3.4) (Table 7.4, Row 4). This could include phone numbers, notices, or driving directions. This extra information is written in the margins of the calendar, attached to the calendar with extra pieces of paper, or placed in locations close to the calendar (e.g., a fridge door). These locations all store the relevant information so it is ready-at-hand when needed. Workplace calendaring also involves this extra information (Kelly and Chapanis, 1982).

If the information is digital, it can often be easily stored inside a digital calendar with the actual event, or a pointer to the information can be added (e.g., a web or email link).

5. **Symbols** are visual representations on the calendar that take the place of words to provide information about an event (see Section 6.3.5, Crabtree *et al.*, 2003a) (Table 7.4, Row 5). These can include stickers or drawings on the calendar. Symbols also provide awareness of activities at-a-glance without the need to explicitly read calendar content, which benefits young children. Workplace calendars that are paper also have been found to contain rich symbols like stars, brackets, lines, and arrows (Kelly and Chapanis, 1982), yet the ability to add such symbols with digital work calendars is not normally supported.

These annotation and augmentations were found to be used by families regardless of their family type. Their importance is recognition that calendars do not always get used as one expects. This also highlights ways in which calendars do not currently support people's everyday needs directly and suggests ways in which calendars can be better designed to support what people want or need to do.

In the next section, I illustrate how the theory synthesized in Section 7.1 can be used to guide the design of digital family calendars.

7.2 Design Guidelines for Digital Family Calendars

The synthesized theory presented in this chapter suggests a series of interrelated guidelines for the design of digital family calendars. As we have seen, families have developed their own routines within a family type (Mono/Peri/Polycentric). Rather than force people to change their routines or the nature of their family types, our goal is to enhance what they currently do. This means designing to support the activities that people currently do which *already* benefit their calendaring routine. It also means providing a means through technology to overcome the challenges families face in their exiting routines.

Researchers have already suggested related family calendar guidelines, such as: allowing synchronization between multiple devices (Beech *et al.*, 2004) that are likely to be heterogeneous (Taylor and Swan, 2005) providing remote calendar accessibility (Crabtree *et al.*, 2003a, Beech *et al.*, 2004, Brush and Turner, 2005), and creating protocols for negotiating

events (Crabtree *et al.*, 2003a). I use my results to build on these ideas, where I show what calendar devices are likely to need synchronizing, what locations are necessary for remote access, and how we can aid coordination by leveraging the techniques people already employ. The main premise of the design guidelines is to *support family coordination by enhancing both scheduling and awareness acquisition through the use of calendaring devices in multiple locations*. I now list and discuss each guideline.

7.2.1 Provide an Always-on and Public Client for the Home

Families already benefit from having a Public Awareness calendar as a primary family calendar. The first guideline addresses this:

1. **Always-on and Public:** A digital family calendar should have a publicly available client for placement in high traffic areas of the home that is always-on and accessible.

To provide an always-on and public digital family calendar, the form factor of the design must allow the placement of the calendar in a variety of locations that families would normally want to place Public Awareness calendars. Moreover, much like paper wall calendars, the calendar should be accessible with minimal interaction so one can simply glance at the calendar to check it. Digital calendars designed for placement on a conventional computer would be less than optimal because of problems locating the calendar and because the computer would be used for multi-tasking (the calendar would not always be visible). Information appliances where the device is dedicated to a specific task like calendaring would be more appropriate in this regard. Several (unprompted) participant quotes discussing digital family calendars allude to the points I make:

"I think a digital calendar is a good idea but you have to be sitting at the computer. If you're in the kitchen, you don't have the time to boot up the computer to see what time your meeting's at. If a digital calendar was on my wall attached to my computer now wouldn't that be easy!"
- Linda (P3), Mom and Administrator

"I don't have to pull something up and kick the kids off the computer...if you designed something that looked like [my paper calendar] and was inexpensive and there it was on the fridge and you had one of these pencil things [a stylus], then there you go...If [a digital calendar] was on the fridge and like [my paper calendar], it'd be an easy transition...it would

have to be a small size because you don't have that much space [on the fridge]. And turning on the computer [sighs], a computer is way too slow." – Kayla (P19), Mom and Homemaker

Beech *et al.* (2004) suggest a large wall-mounted display for digital family calendars, though reflections on paper calendars suggest this type of digital calendar may be cumbersome to use. People routinely take paper wall calendars down to write on them, and sometimes move them to various locations in the home for discussion or planning. Alternative form factors like Tablet PCs (i.e., pen based, light, but of course much cheaper if they are to be considered for this dedicated use) may be more appropriate as they have affordances that more closely match people's existing behaviours. These location needs also mean that traditional interaction through a mouse and keyboard may not be easy. Imagine trying to use a keyboard and mouse on your kitchen counter amidst a variety of other forms of clutter or in another area not conducive to sitting down. Instead, *digital family calendars should use pen-based interaction*, as pens are better suited for locations away from a desk like the kitchen wall or counter. This type of interaction takes advantage of the actual physical and social context of which the user is present (Fishkin *et al.*, 1998 and Fishkin *et al.*, 2000, Dourish, 2001).

Crabtree *et al.* (2003a) suggest that digital family calendars should incorporate access rights for extended family or friends (outside the home) to view the family calendar. Yet none of the 44 families I interviewed suggested this feature. In fact several families felt their calendar was not appropriate for public viewing outside the home because it was messy. While one could extract event information and provide it 'out of context' for others, nobody from our family calendaring study suggested this. That being said, our studies of interpersonal awareness and calendar studies by others (e.g., Plaisant *et al.*, 2006) did show that families wish to share activity information with intimate and extended socials at some level. What may be the case is that people don't tie this desire to their calendars. Other lightweight technologies besides digital calendars may be more appropriate vehicles for displaying this information.

7.2.2 Provide At-a-glance Awareness of Calendar Content

Families coordinate by first gaining an awareness of activities and then discussing these activities. Our second guideline shows how to support this for digital family calendar designs:

2. **At-a-glance Awareness:** A digital family calendar should provide at-a-glance awareness of calendar content for easy awareness acquisition.

Families already employ specific social techniques with their family calendar to provide awareness at-a-glance by making *information within the calendar discernable quickly*. This involves using various annotation techniques on family calendars. For example, people use colour and highlights to indicate which events are important, or who has events on a particular day. They also use abbreviations in a similar respect, so less information must be read and processed to understand what activities are occurring. They may even use symbols or stickers to achieve awareness without having to read calendar entries. Paper calendars also often contain a visual history of what has changed, usually shown with pen markings. These types of *visual annotations should be supported in a digital family calendar* and would most certainly help individuals quickly understand what is on the calendar and what has changed. Supporting rich annotations like these is also suggested by Crabtree *et al.* (2003a), though I have identified the specific kinds of annotations designers should expect to support.

What about the case where the calendar is not being checked enough? This happens for secondary schedulers in Monocentric families, and could also happen to family members from other family types when they neglect to check the calendar. In these cases, providing visual features within the calendar to make information stand out will not help. Instead, automated reminders may be appropriate, where the reminder is sent to a family member. I emphasize that reminders cannot simply appear on the calendar or they will still be missed; instead, they need to be sent to contextual locations (see Section 3.1.4, Beech *et al.*, 2004; Elliot *et al.*, 2005), where family members will actually see them. This is a situation where location-based message systems could augment a digital family calendar. For example, reminders or the calendar events themselves could be sent to an appropriate location, like an exit leaving the home, the fridge door, or a mobile phone of a family member (Kim *et al.*, 2004, Sellen *et al.*, 2006b, Elliot *et al.*, 2006a, Ludford *et al.*, 2006). This could even be done

in an opportunistic fashion when people are present in locations and performing other tasks (Hsieh *et al.*, 2006).

We also need to recognize that primary schedulers are involved in most events directly or indirectly by having to remind others about them. This is especially true for Monocentric and Pericentric families. Thus, most events could also have reminders sent to the primary scheduler so he or she can inform others, although some balancing would be needed to avoid interruptions. Sending automated reminders to other family members is likely problematic, as people don't assign family members to events ahead of time. Thus, it would not be clear which events are relevant to which family members. While software could attempt to infer this information, it would be subject to errors. Alternatively, location-based reminder systems could provide features to allow the primary scheduler to forward appropriate reminders to family members as needed. Such features could lessen the reminding burden on primary schedulers, especially in the case of Monocentric families.

What about negotiation protocols that let family members assign people to events and negotiate schedules? This is the model used in workplace calendaring (Palen, 1998) and negotiation protocols are even suggested by Crabtree *et al.* (2003a) for family calendaring. Yet we now know that this is not how families coordinate their activities. This has serious implications for it suggests that we can not simply import explicit features that show who is supposed to attend an event from workplace calendars into digital family calendars to support coordination. Secondary schedulers in Monocentric and Pericentric families do not check the calendar frequently (if at all), rendering any form of negotiation protocol mostly useless. Plans are also changed too frequently in some families and, if used, negotiation protocols would simply increase the workload needed for coordination. One may be tempted to include such features in a digital family calendar design just in case a family may wish to use them, and, this is certainly plausible and may work for Polycentric families. However, this functionality could easily 'get in the way' of the simple tasks families need to do and force them into writing down tacit knowledge, which could again increase their workload. Even worse, event negotiation features could force a family into thinking this is how they *should* approach family calendaring regardless of whether it works for their routine or not. For this reason, I advocate *not* designing to support negotiation protocols, which are based on workplace calendaring routines and not family ones.

At-a-glance awareness of calendar activities can also be supported in another way through the display of the family calendar in *multiple locations*. I return to this idea in subsequent guidelines by illustrating where and how it should be presented.

7.2.3 Support Appropriate Event Information and Levels of Detail

Families place a variety of types of events on the family calendar and need to view this information at varying levels of detail in order to gain awareness and plan activities. Our third guideline addresses this need:

- 3. Appropriate Information:** A digital family calendar should support adding and viewing appropriate event information at different levels of detail.

Families place information relevant to the *family* on their calendar. Thus, digital family calendars should act as *a shared calendar for the entire family*. The type of information and number of events placed on the calendar does not differ per family type. For this reason, family calendar design for event content does not need to be tailored to particular family types. While the types of items recorded on the calendar varies, so does what people actually write down for calendar entries. Families are idiosyncratic in the patterns they follow. Thus, I suggest that *digital family calendars support free form event creation*, where the scheduler is able to choose what information is added for calendar entries to create their own meaning for calendar events. This type of flexibility is described by Taylor and Swan (2005), though not in the context of calendar entry.

The limited size of days on most calendars causes people to abbreviate information on the calendar, be it the name of the person, event, or its location. Particular events may not even be written because of a lack of space. Digital family calendars should be designed to *provide more space for calendar entries*. Additional space to add more events or display event information could come from the use of visualization techniques like semantic zooming as suggested by Bederson *et al.* (2003). However, other calendar visualization techniques designed for work calendars (Mackinlay *et al.*, 1994) appear to limit the ability to gain an awareness at-a-glance, though this would require evaluation.

Calendar events also have a variety of ‘extra information’ like paper notices that are associated with them where people are forced to write in the margins of their calendars,

augment the calendar, or place this information in cluttered locations near the calendar. Thus, digital family calendars should *support the easy incorporation of ‘extra information’ associated with events*. Augmenting a digital family calendar with systems that allow the creation of lists (Elliot *et al.*, 2006a, Elliot *et al.*, 2006b, Ludford *et al.*, 2006, Sellen *et al.*, 2006b) could help support the incorporation of ‘extra information’ for events more naturally. Events could also be linkable to emails and web URLs that may contain relevant information, like sports schedules or maps to locations. Of course, a problem is what to do with current paper-based information, for it is more difficult to link this to a digital calendar unless the information is scanned in. The alternative is to simply wait until this information too becomes digital and accessible online as many sports and school schedules are now beginning to become.

Subsequent guidelines call for family calendar access from multiple locations inside and outside the home. For this reason, supporting appropriate event information also means presenting events in a manner that suites their location. This means designs should *present the events appropriate for a location at the right amount of detail for that location*. I discuss this more in the context of each calendar location described in the remaining guidelines: work, mobile, and multiple home locations.

7.2.4 Provide Family Calendar Access at Work

Families also use Personal Work calendars to store either all or some of the family’s events, as this helps them stay aware of family activities and coordinate when at work. They may also think of events they need to add to the family calendar while at work. Our fourth guideline addresses this need:

- 4. Work Access:** A digital family calendar should be accessible for viewing and editing family events while at work.

Digital family calendars should allow access to add and view family events either by offering a client that runs on a work PC where family calendar content synchronizes between work and home clients, or by having family events available within the context of one’s work calendar. For example, family events could be displayed within Microsoft Outlook, or whichever digital calendar one uses at work. Some work-specific events also

affect the family schedule or family members may even think of events to add to the work calendar when at home. Thus, family calendar designs should *offer access to certain work events from within the context of the home, and vice versa*. Beech *et al.* (2004) argue for seeing work and home activities together, yet the relevance of such events will come and go when at work or home. For this reason, we suggest that *information should be selectable for display at work and home*—also argued for by Brush and Turner (2005)—rather than simply displaying all events. We also know that calendar interaction for work environments is well suited to a mouse and keyboard where PCs are situated on desks; therefore, *family calendar clients for the office should also permit mouse and keyboard interaction*. Digital work calendars offer a range of views to view calendar content (e.g., day view, week view, month view) and naturally family events displayed in a work calendar should be able to be presented at these varying levels of detail.

7.2.5 Provide Family Calendar Access while Mobile

Families also need to be able to schedule and check the calendar while out and about. This was also found by other researchers, though design suggestions for a mobile calendar interface were out of the scope of their work (Crabtree *et al.*, 2003a, Beech *et al.*, 2004, Brush and Turner, 2005). Our fifth guideline addresses this need:

- 5. Mobile Access:** A digital family calendar should provide a mobile interface for viewing and editing family events while not at home or work.

While mobile scheduling and calendar checking is clearly an important task, we did not find it to be a frequently occurring task. Nearly a quarter of families (23%) used a Personal Mobile calendar to support it. Those who did not have a Personal Mobile calendar had fairly practical workarounds while mobile like using appointment cards, one's memory, or phoning others at home. Of course, these strategies have their drawbacks, but more importantly they suggest the way in which a mobile family calendar interface should be designed. That is, they suggest families do not need their entire family calendar when mobile. Instead, they may need to query for particular time periods to see if they are available to schedule something, they may need to leave a message to add something to the calendar, or they may need to just find out the location of an event. Thus, many families would benefit from *lightweight mobile technologies that permit querying or leaving a message with the family calendar*. This

suggests that small devices can serve an important role. Technologies that send lists of task information to mobile phones (Ludford *et al.*, 2006) could also be augmented to send relevant calendar information when needed. Conversational input proposed by Lyons *et al.* (2005) would also be suitable. For example, one could imagine ‘phoning’ the family calendar and adding an event via voice input.

There will certainly be families who want full calendar access while mobile, and in this situation it would also be necessary to have a mobile version of a family calendar that synchronizes with an in-home client. Space limitations on mobile devices naturally call for information visualization techniques like semantic zooming (Bederson *et al.*, 2003). We saw families use a variety of Personal Mobile calendars ranging in the amount of detail shown from only a day, to a week, or even a month. This range of detail would certainly be desirable in any mobile digital family calendar. Regardless of the type of mobile device, care must be taken so the device is simple to use, or like other current mobile devices, people may simply abandon them because of their complexity and return to the simplicity of paper or memory (Starner *et al.*, 2004).

7.2.6 Provide Family Calendar Access from Multiple Home Locations

Families also place calendars in multiple locations in the home either as a second Public Awareness calendar, or more specialized calendars in the form of Children’s, Reference and Planning, or Tasks and Chores calendars.

6. Multiple Home Locations: A digital family calendar should be accessible from multiple locations within the home where the information displayed may vary.

While less than half of families had calendars in multiple home locations, this still outlines an important family need. In fact, I suspect that other families don’t have multiple calendars in the home because synchronizing them would currently be tedious. Yet synchronization is easy with digital calendars (if a design adequately supports this feature in a useable fashion). This suggests the need to have multiple family calendar clients present within the home. Not all locations would need to display the same information however; *in-home calendar clients would need events to be selectable for information display*. For example, a

Children's calendar displayed in a child's room could show only events relevant to the child. Events on a Planning calendar could be displayed on a Public Awareness calendar once they are finalized, or a Reference calendar could show a high level view of the entire year highlighting days with large amounts of activity. Reminders for tasks already appear on many Public Awareness calendars and again could easily move between dedicated Tasks and Chores calendars and a Public Awareness calendar.

The calendars we saw in the home also ranged in the level of detail at which they presented calendar information. People wanted to see an entire month on a Public Awareness calendar in order to adequately plan. Children's calendars always displayed an entire month as well. Planning and Reference calendars showed a month or multiple months. Tasks and Chores calendars showed a week or multiple weeks. Thus, digital family calendar designs for these home locations should *reflect the level of detail that people naturally pick for these types of calendars and the locations in which they are placed.*

7.3 Digital Online Calendars

Currently digital family calendar design is dominated by online calendars ostensibly designed for family or personal use (e.g., 30Boxes, AirSet, Family Scheduler, Google Calendar, Our Family Wizard, Planzo, Schedule Us, Trumba). Yet after analyzing a sample of these calendars, it is clear that *current digital online calendars offer a largely impoverished experience for families that does not match their natural routines.*

Digital online calendars are disadvantaged when it comes to providing a publicly available, always-on or accessible family calendar (Guideline 1). For example, explicitly going to the PC in a home office or spare room, launching a web browser, and logging in to an online family calendar is certainly not as easy as passing by the paper calendar hanging on the wall in the kitchen and glancing at its contents. This inaccessibility would likely make a family more like the Monocentric families, where only one family member checks the calendar. Families could, of course, locate a PC in a high traffic home area, use one login account for all members, and leave its web page always-on. Yet interaction would still be a challenge, as these locations don't lend themselves naturally to mouse and keyboard interaction. While a Tablet PC form factor does promote stylus interaction, existing web page interactions often make stylus use more, rather than less, cumbersome. Finally, while

some families do have dedicated PCs in their kitchen or living room, they often use them in a task-switching ‘work’ mode that would compromise the ‘always on, always visible’ requirement of a domestic calendar.

Digital online calendars also do not always match the needs of families to gather awareness at-a-glance in order to coordinate (Guideline 2). Instead, many provide explicit event negotiation where individuals are invited and assigned to events (e.g., Family Scheduler, Our Family Wizard, Google Calendar, Trumba). I stress again that while this is reasonable for work scheduling, this is not how families coordinate. On the positive side, many digital online calendars do provide a means to acquire awareness at-a-glance by explicitly assigning colours to events (e.g., 30Boxes, Family Scheduler, Google Calendar), though some do not (e.g., Our Family Wizard, Planzo, Trumba). Yet all of the online calendars I looked at restrict the information that people are able to add for an event. For example, they restrict people to typing; people cannot draw pictures, symbols, or include a visual image like a sticker to represent events. This detracts from a calendar’s ability to provide at-a-glance awareness. Digital online calendars’ use of automated reminders also does not match the needs of families. While many permit sending reminders to email or a mobile phone (e.g., 30Boxes, Family Scheduler, Google Calendar, Trumba) at a designated time, they are restricted to just one email address or mobile device, rather than a plethora of devices that would be needed for proper family-oriented location-based messaging.

Current digital online calendars do not allow appropriate event information to be stored (Guideline 3). While they do support adding any type of event, they restrict the actual information that one can enter by only allowing typed text. Some even automatically parse this information and extract out potentially relevant description details erroneously (e.g., 30Boxes, Google Calendar). Online calendars are also most often designed specifically for individuals (Family Scheduler is a notable exception): the underlying assumption is that each person will have their own online calendar, while still being able to view the calendars of others overlaid on one’s own. This idea is obviously imported from work calendars and this would create unnecessary authentication and sharing issues if one is to try and view all activities relevant to the family from a number of different calendar accounts. It also assumes that each family member will actively maintain a calendar, yet we have seen that this is not always the case.

When it comes to ubiquitous calendar access from work (Guideline 4), while mobile (Guideline 5), or from multiple home locations (Guideline 6), digital online calendars are mixed. On one hand, they are well suited to provide access to family calendar events while at work; they are, after all, designed for traditional desktop PCs. Another nice feature is that no special software is needed because these calendars run in standard web browsers; this could alleviate potential security constraints that disallow installation of personal software at work. On the other hand, digital online calendars typically do not provide mobile family members with a good calendar access experience. While one could navigate to a web page on a mobile device, these web pages are designed for a standard PC display *vs.* a small screen. Finally, and as previously mentioned, these calendars are designed to run on a standard mouse-based PC, which compromises how they can be positioned in multiple home locations.

7.4 Summary

This chapter has synthesized the findings from related work about family calendaring presented in Chapter 4 with the family calendar study results presented in Chapters 5 and 6. This completes the *formalization of family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems* (Chapter 1, Objective 2). This empirically-informed theory shows that families use multiple calendars from a typology of calendars in order to add events to the family calendars and view these events from a variety of locations. When paper calendars are used, this process can be painful as manual synchronization between calendars is required. Workplace calendaring also involves the use of multiple calendars, though these are not always the same ones that are used for family calendaring.

Family calendaring involves one or more family members updating and checking the calendar. This differs depending on the family type—Monocentric, Pericentric, and Polycentric; a spectrum ranging from low involvement by secondary schedulers to high involvement by all family members. In the workplace, multiple calendar maintainers are not common as people maintain their own individual calendars (unless one has a dedicated administrative assistant). Other people's calendars may be viewed at some level of detail if meetings are being scheduled however.

When it comes to calendar content, both family calendars and work calendars contain a range of types of events. For family calendars, these are primarily events that: affect more than one family member, or that family members should know about because they affect the family's routine. In the workplace, events are primarily about work activities, though sometimes family events are placed on a work calendar. Family calendars also contain rich amounts of annotations and augmentations for providing additional information and meaning. Because workplace calendars are now most commonly digital, the ability to add such richness is limited. However, digital calendars do excel at allowing one to link appropriate digital information to calendar events.

The theory presented in this chapter provides additional value for it suggests empirically-based guidelines for the design of digital family calendars. These aim at providing appropriate calendar information in the locations and form that family members need it:

1. **Always-on and Public:** A digital family calendar should have a publicly available client in high traffic areas of the home that is always-on and accessible. This includes providing interaction with the calendar that takes advantage of the physical and social context in which family members are present.
2. **At-a-glance Awareness:** A digital family calendar should provide at-a-glance awareness of calendar content for easy awareness acquisition. This means allowing information to be easily discernible at a glance by supporting rich calendar annotations, and utilizing location-based messaging for awareness acquisition when not at the calendar.
3. **Appropriate Information:** A digital family calendar should support adding and viewing appropriate event information at different levels of detail. This means supporting a variety of types of events, adding and viewing of extra event information, and providing more calendar space for adding events.
4. **Work Access:** A digital family calendar should be accessible for viewing and editing family events while at work. This means allowing certain family events to be viewed and edited either within the context of the work calendar or in a separate family calendar client running at work. It also means having some events from one's work calendar accessible for viewing and editing from the context of the home.

5. **Mobile Access:** A digital family calendar should provide a mobile interface for viewing and editing family events while not at home or work. This means using lightweight technologies to query the family calendar to acquire particular information or to store events while remote. For some families, this also means providing full calendar access while remote.
6. **Multiple Home Locations:** A digital family calendar should be accessible from multiple locations within the home where the information displayed may vary. This means allowing family members to select which information is relevant for display in which home locations.

This ends Part II of this dissertation. At this point, we now have a rich understanding of family calendaring routines and practices, and a set of guidelines that can inform the design of digital family calendars. In Part III, I use the theory and guidelines presented in Part II to guide the design and evaluation of a digital family calendar called LINC. The design of LINC provides further understanding of family calendaring routines, as well as an articulation of how one can apply the family calendaring theory to the actual design of a digital family calendar.

Part III: The Design and Evaluation of a Digital Family Calendar

The second part of this dissertation *formalized family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems* (Chapter 1, Objective 2). This included the articulation of family calendar routines and the presentation of design guidelines based on this that suggest ways in which a digital family calendar should be designed. This offers a significant contribution to research in itself. Yet it does not illustrate how one could apply this empirically-based theory to the actual design of a digital family calendar.

For this reason, the third part of this dissertation further investigates family calendaring through the design and evaluation of a digital family calendar called LINC. This completes the final two objectives of this dissertation. First, this part *uses the understanding of family calendar routines along with a participatory design process to design a digital family calendar* (Chapter 1, Objective 3). Chapter 8 describes the participatory design approach of the LINC client for in-home family calendaring. It also outlines the extensions made to LINC that make calendar content ubiquitously accessible from inside and outside the home. Second, this part *evaluates the LINC digital family calendar in order to understand how it will actually be used by families as a part of their coordination routines* (Chapter 1, Objective 4). Chapter 9 details the evaluation of LINC through field trials that further uncover design lessons for digital family calendars.

Chapter 8. The Design of LINC¹¹

The goal of this chapter is to *use the understanding of family calendar routines along with a participatory design process to design a digital family calendar* (Chapter 1, Objective 3) called LINC. The design process of LINC further refines the theory of family calendaring presented in previous chapters through the actual *design* of a digital family calendar. We took an iterative design approach that involved people representative of the actual end users of digital family calendars, in this case, the primary schedulers of twenty different families. I outline this approach and describe the progression from low-fidelity paper prototypes of LINC and associated design sessions, to a medium-fidelity digital prototype and its evaluation, and then to a refined high-fidelity prototype suitable for deployment and use by real families.

The theory from Part II of this dissertation was partly investigated in parallel with this design process: the first twenty interviews occurred as LINC was being designed, while the remaining interviews occurred later. For this reason, the initial design of LINC was inspired by the interpersonal awareness research from Chapters 2 and 3 as well as previous research on family calendaring articulated in Chapter 4. Further design ideas arose as a result of participatory design activities and the arising, but not yet completed, theory from Chapter 7. At the end of this chapter, I discuss LINC's design in relation to the guidelines set out in Chapter 7.

8.1 Design Approach

LINC's design evolved via an iterative approach, where it was progressively refined alongside theory development, as ideas were generated, and as problems were found and

¹¹ Portions of this chapter are also published in: Neustaedter and Brush (ACM CHI 2006), Neustaedter, Brush, and Greenberg (ACM CSCW Video 2006a), Neustaedter, Brush, and Greenberg (ACM CSCW Demo 2006b), Brush and Neustaedter (UbiComp Demo 2006).

addressed (Nielsen, 1993, Dix *et al.*, 1998). Our goal was to address not only usability problems, but also high level questions involving understanding *how* a digital family calendar could best be designed to support families' everyday practices. To help achieve this goal, we used a participatory design approach where we had twenty primary schedulers participate in two main stages of the design process (Nielsen, 1993, Dix *et al.*, 1998). Materials for our participatory design sessions can be found in Appendix D. These include the study descriptions read to participants, pre and post-study questionnaires, task descriptions, and paper prototypes.¹²

8.1.1 Participants

We recruited twenty mothers with at least one child over three years of age to participate in our design process. These twenty mothers also formed the first twenty interview respondents described in Chapter 5 (Section 5.1.1). Participants were all recruited using a participant recruitment agency from Microsoft.

We chose *women with children* to be involved in the design process of LINC for two main reasons. First, prior research has shown that women are the primary schedulers for most households (Zimmermann *et al.*, 2001, Beech *et al.*, 2004, Brush and Turner, 2005). By selecting women, we were likely to get a high number of primary schedulers who would be able to provide us with the best overall picture of the family's coordination processes. The caveat, of course, is that this user selection does not include secondary schedulers who may still use the family calendar and be affected by it. For this reason, we were careful to include a portion of secondary schedulers in the other calendaring studies presented in Chapters 5, 6, and 9. Second, women *with* children are representative of actual end users of a digital family calendar. That is, they have a real need for maintaining a family calendar given that they have children who most likely participate in a range of activities. This need could certainly translate into the future use of a digital family calendar for family organization.

Otherwise, we sought a diverse group that varied in age, family composition and employment. Summaries of these families are found in Chapter 5, Table 5.1 (P21 to P40).

¹² I designed and conducted the study in collaboration with A.J. Brush.

As it turned out, all but one of our participants said they were the primary scheduler within their family while the remaining participant shared the role with her husband. Eleven participants were aged 31-45 and the remaining nine were aged 46-60. All but two participants were currently married. Our participants were fairly diverse in the number and age of their children. Six participants did not currently work outside of the home and the remaining fourteen had a variety of jobs (e.g., realty, law, art, teaching), working a range of hours from less than 20 to over 40 per week. Participants were remunerated for their participation with a choice of one piece of Microsoft software.

8.1.2 Method

We chose a participatory design approach for LINC to better inform our design ideas. Participatory design involves integrating users into the design process at one or more stages (Nielsen, 1993, Dix *et al.*, 1998, Sanders, 1999). Typically, users act as *aids to designers* where they generate design ideas through workshops or meetings (Nielsen, 1993, Sanders, 1999). For example, the PICTIVE (Plastic Interface for Collaborative Technology Initiatives through Video Exploration) method involves giving users pieces of paper or plastic that can be drawn on or pre-printed with interface components (Muller, 1991). Users create designs out of these materials where the activity is video recorded for later analysis. In this situation, the goal is to understand people and their processes through what they *make* (Sanders, 1999). One critique of participatory design is that users may not have formal design training or understand the technological possibilities for a product (Nielsen, 1993). Yet this is not typically a problem if the designs created by participants are used in a generative fashion where they can spawn further ideas by the actual product designers and are used to understand a product's context of use.

At the onset of LINC's design, we already had an initial understanding of principles upon which a digital family calendar should be based, which were gathered from the related literature (Chapters 2 through 4). Because end users do not have this type of knowledge, we thought it would be most beneficial in our situation to have users work with pre-existing design ideas generated by ourselves, the researchers. This design process took place over three main stages, two of which actively involved our participants. An initial stage of the study, already described in the context of Chapter 5, involved interviewing each participant

about their own family calendaring routine and calendar. A pre-study questionnaire also gathered background information about each participant (Appendix D.3). We then progressed through three design stages: low-fidelity prototyping, medium-fidelity prototyping, and high-fidelity prototyping.

Low-fidelity prototyping focused on generating the design of an in-home family calendar client for LINC. Design ideas were formulated based on our initial understanding of family calendaring largely garnered from existing research and our own studies of awareness technologies (see Chapters 2 through 4). We iterated on our ideas by creating several paper prototypes using sketches and PICTIVE methods, where we overlaid multiple pieces of paper to create potential interface designs (Muller, 1991, Snyder, 1993).

Once we came up with a design that we felt best reflected our initial design ideas, we had ten participants work with the paper prototype through a series of calendaring tasks. The actual task descriptions are found in Appendix D.4 and all paper prototype screens are in Appendix D.6 (upcoming figures contain only a subset of the actual prototype screens). Tasks included locating a particular family member, adding events to the calendar, moving events, and looking for conflicts. The calendar was preloaded with a sample family's events and the participant was described a family scenario where she played the role of the mother. I acted as the computer by updating screens as needed (e.g., by showing the user particular screens, attaching additional pieces of paper to the screens, or writing on the screen to display output). The goal for participants was to describe to us how the design could or could not be used for their current calendaring practices (Greenberg, 2004) and suggest design changes through discussion or actual illustration on paper or our prototype. We also asked participants to explain to us any cases where our tasks did not reflect the actual processes that their family would undertake for calendaring. Each session was videotaped and notes were taken to record suggested interface changes and other observations. The session concluded with a discussion of the prototype and any recommended changes along with a post-study questionnaire to record participant reactions to the overall prototype design (Appendix D.5).

Medium-fidelity prototyping involved using the knowledge we had acquired from the first ten participants to iterate on our design and create a digital medium-fidelity prototype of LINC. This digital version was prototyped on a Motion Computing Tablet PC (12" display) in landscape mode. We then brought in ten *different* participants in an attempt to generate even more design ideas and further see how our design could or could not meet existing practices (Nielsen, 1993). These participants participated in a *formative evaluation* of the medium-fidelity prototype of LINC. The goal of a formative evaluation is to help improve an interface (e.g., find problems); this contrasts with a *summative evaluation* that assesses overall quality of an interface (e.g., comparing two interfaces) (Nielsen, 1993). This study used the same methodology as in the low-fidelity prototyping stage, where participants again worked through tasks (Appendix D.4) but this time with the digital prototype. To simulate the calendar hanging on a wall, we placed the Tablet PC on a shelf approximately 52 inches (132 cm) from the floor and had users do half of the tasks standing (~10-15 minutes). Participants were given the option of sitting down, but none did. The other half of the tasks were done with the tablet on a table in the room. None of the participants had experience with Tablet PCs, but were given a minimal description of it. While performing the tasks, participants suggested design changes through discussion or illustration. Because they couldn't directly alter this *digital* prototype, we provided paper and other tools (e.g., pencil, coloured pens, glue) for participants to express their ideas. A post-study questionnaire recorded their reactions to the overall prototype design (Appendix D.5).

High-fidelity prototyping involved using the findings from the first two design stages to iterate on our design by removing usability problems and by making our design better match the needs of families. We then continued the implementation of LINC to generate a high fidelity prototype of a system that could be deployable and actually used by real families as their primary family calendar within the home. We also extended LINC to be ubiquitous, e.g., where it could be accessed from multiple locations inside and outside the home. This included making the LINC client run on multiple PCs, where each would synchronize calendar data through a shared server. It also saw the creation of two new clients for LINC, which could act as design probes to further understand ubiquitous calendar access. LINC

Web provides calendar access from any web browser, while LINC Mobile provides calendar access from a mobile phone.

The next sections describe the LINC digital family calendar by outlining each of these three design stages in detail.

8.2 Low-Fidelity Paper Prototyping

Our first design stage involved using low-fidelity prototyping to generate a suitable design basis for an in-home family calendar client for LINC. This involved the creation of sketches and PICTIVE-style interfaces along with paper prototype sessions with ten mothers.

8.2.1 Initial Design Ideas

Our initial ideas surrounding family calendar designs were largely influenced by design implications from our previous studies of interpersonal awareness (Chapters 2 and 3) and findings in the related literature (Chapter 4). We present these here and in subsequent sections show how our design of LINC supports and extends them.

1. **Simple to use (like a paper calendar):** A digital family calendar certainly needs to have simple interaction like paper calendars or it will not likely be adopted by families. One way to overcome complexity is to design *information appliances*: devices designed to perform a specific task or function (Norman, 1998, see also Chapter 3, Section 3.1.3). For these reasons, our first idea was to design LINC as an information appliance where it would be *just a calendar*. We also wanted to ensure interaction was as simple to use as a paper calendar and that the visual layout would be easy to understand.
2. **Flexible to support varying routines:** Families use a range of tools to coordinate activities and these tools are used in a range of creative or ‘artful’ ways, where families develop their own meaning and use for the tools (Taylor and Swan, 2004, 2005). This suggests that digital systems for the home should support flexible systems of organization and integrate with established organization systems (Taylor and Swan, 2005, see also Chapter 3, Section 3.1.3). For these reasons, our second idea was to design LINC in a manner that would enable people to employ their own coordination routines and use LINC in a manner that made sense to them.

3. **Provide coordination tools:** Family members use a daily awareness of their cohabitants' activities to coordinate schedules, where often they rely on technology to facilitate awareness acquisition (see Chapter 2, Section 2.4.2). Family coordination is also about negotiating schedules and making others aware of who is going to be at an event (Crabtree *et al.*, 2003a). For these reasons, our third design idea was to present family members with an at-a-glance awareness of activities and tools built into the calendar for family members to negotiate event attendance (the latter feature was shown to be unnecessary in Chapter 7, though during LINC's initial design we did not yet know this).
4. **Support contextual locations:** People already have well-established routines for awareness maintenance in the home where they gather information in varying locations (see Section 2.5.4 and Section 3.1.4). Family calendars are typically placed in high traffic areas of the home like hallways and kitchens reflecting this (Crabtree *et al.*, 2003a). For these reasons, our fourth idea was to design LINC to be placed in a variety of home locations (as an information appliance), rather than be designed for a desktop PC situated in a home office.

We explored these design ideas by creating sketches and PICTIVE interfaces of LINC. Our brainstorming included looking at varying display sizes from large wall displays to small portable displays and a variety of visual layouts. We also discussed interaction techniques for adding calendar events, including indirect and direct interaction. Our ideas eventually converged on a paper prototype design that we felt was suitable to have participants work with and iterate on. This is presented in the next section.

8.2.2 Paper Prototype for Design Sessions

Our paper prototype of LINC was designed to be an inkable family calendar where each event is written on a sticky note and placed on the calendar. In this section, we outline how LINC supports each of our initial design ideas.

Simple to use (like a paper calendar): We designed LINC as an inkable awareness appliance with the intention that LINC would be always-on. We created three simple calendar views—Month (Figure 8.1), Day (Figure 8.2), and Week (Figure 8.3)—which purposely look similar to many existing paper calendar designs. This type of calendar layout

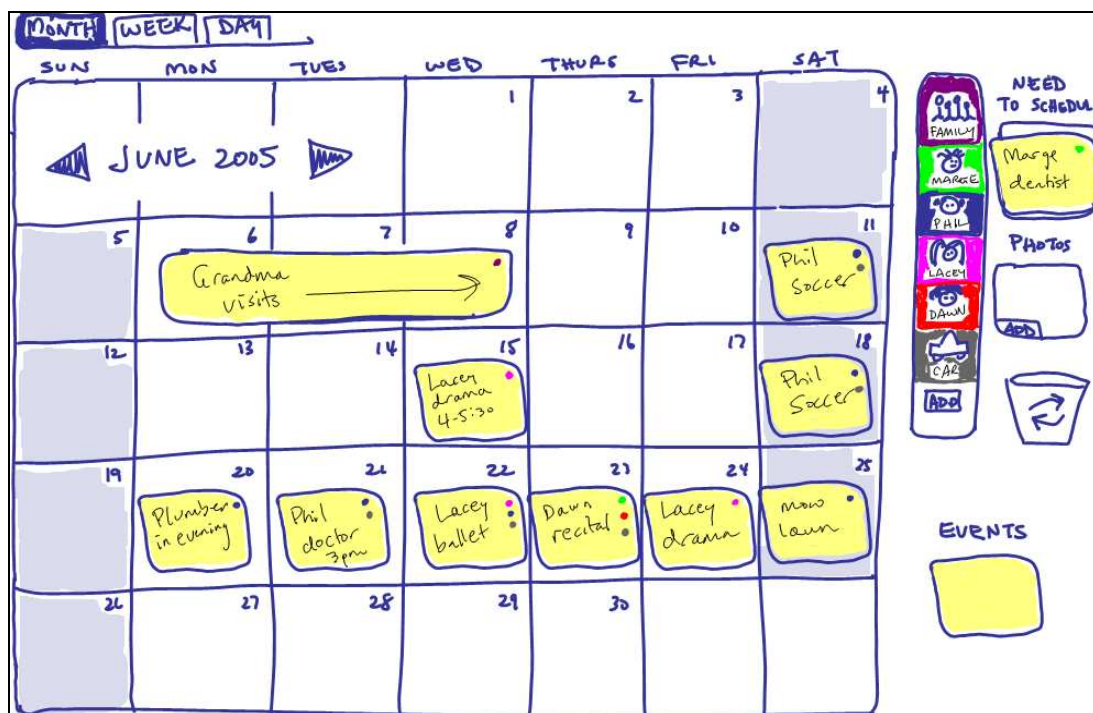


Figure 8.1: Viewing the month in LINC's paper prototype.

is a natural choice as it is already at the core of everyday family coordination—every single one of our participants had a calendar with a view similar to LINC. Studies of workplace calendaring have shown that the structured nature of the calendar grid helps people understand temporal dependencies (Payne, 1993). Yet other design paradigms certainly exist that could have been used for LINC as an alternative to a ‘calendar grid.’ For example, Hoefnagels *et al.*’s (2004) conceptual long term planner (see Chapter 4, Section 4.2.6), Sellen *et al.*’s (2006a) Whereabouts Clock (see Chapter 3, Section 3.2.1), or Dragicevic and Huot’s (2002) SpiraClock (see Chapter 4, Section 4.1.5) all present possibilities. We certainly thought about alternative design metaphors and explored them through our brainstorming. The problem is these design alternatives are less familiar to people and do not necessarily allow them to exploit their existing calendaring practices. For these reasons, we used a simple and familiar ‘calendar grid’ metaphor for LINC.

We wanted to make the creation of events in LINC as simple as on paper (e.g., writing directly on the calendar). Naturally, our first design idea had users simply write directly on the calendar. We could then group handwriting into a single event internally within the system using cues like the time between ink strokes (ink strokes made within a few seconds

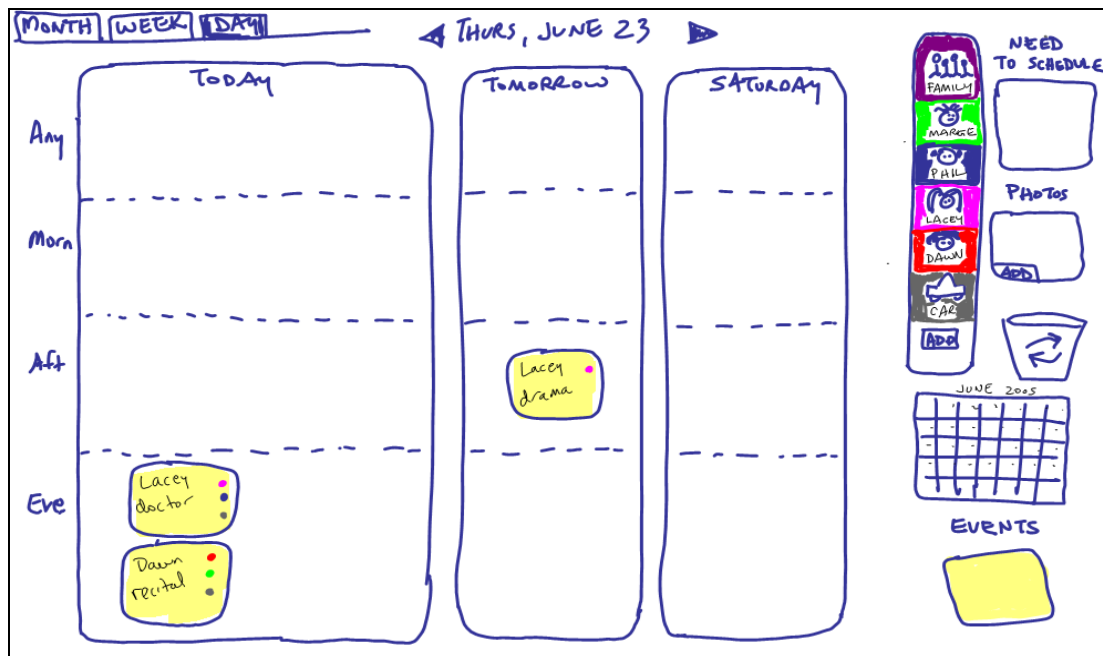


Figure 8.2: The day view of LINC's paper prototype.

likely all belong to the same event) or the distance between ink strokes (ink strokes close to one another likely belong to the same event). Even though this idea reflected what people *actually* do with paper calendars, we chose not to use it because users would then be confined to only writing new events in the empty space on each day (e.g., events could not overlap on a day).

To increase space on the calendar, our alternative idea was to use 'sticky notes,' where notes could stack or pile up on a day (if needed because of space limitations). With this idea, users can add events to any of LINC's views by either starting to write on the calendar, which creates a sticky note underneath the handwritten event, or by writing on an existing sticky note under the label 'Events' (Figure 8.1, 8.2, and 8.3, bottom right). Notes can then be dragged on to the appropriate date/time. Sticky notes help increase the amount of space available for events because they can be piled on top of one another and then easily moved to see what is underneath. The notes would also make identifying which ink belonged to which event trivial.

Double clicking an event in the paper prototype opens an Options dialog (Figure 8.4). In the bottom left of the dialog, users can set an event as recurring: clicking a day in the calendar toggles it on/off in the recurrence. We decided to experiment with a simple time

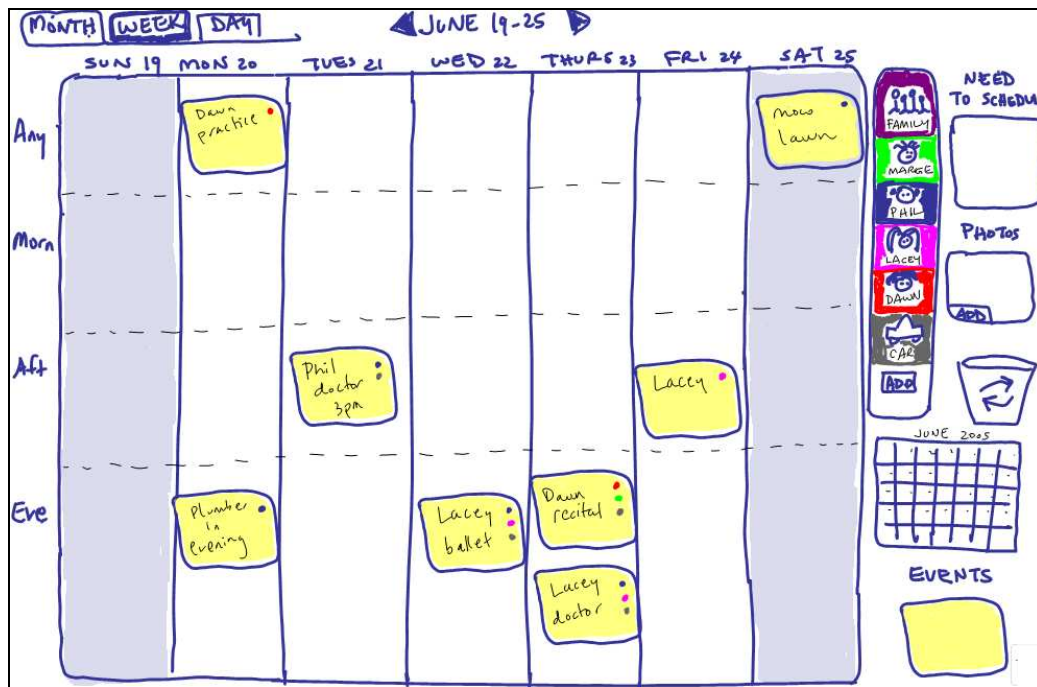


Figure 8.3: The week view of LINC's paper prototype.

metaphor for Day and Week views. Instead of containing rigid times as is often found in work calendars, these views include 'time buckets' for: Any Time, Morning, Afternoon, and Evening (Figure 8.2 and 8.3, left). For those who desire more rigid times, we left the ability to add specific times in the Options dialog (Figure 8.4, top left).

Flexible to support varying routines: We supported flexibility in LINC's design by letting users write free form within a note using their own handwriting. This would allow them to record a range of information for an event, depending on their style. They could also even provide rich annotations like drawing pictures. We added the ability for users to drag items into a 'Need to Schedule' box (Figure 8.1, 8.2 and 8.3, right) that acts just like a bulletin board or 'To Do' list. Similarly, users could add images to the 'Photos' box (Figure 8.1, 8.2, and 8.3, right) which can then be dragged on to any date or event for personalization.

Provide coordination tools: In addition to gathering an awareness of activities simply by looking at the calendar, we provided support for family members to coordinate schedules through the calendar's Option dialog (Figure 8.4). In the top left corner of the dialog, users can mark an event as 'tentative,' which creates a jagged border around the

Figure 8.4: The options dialog for events in LINC's paper prototype.

event, set specific start and end times, or add driving time to an event. In the top right corner, users can add people or resources (e.g., car) to an event under the 'Needed' label. Checking off a given resource like a family member will assign that person to an event. The note on the calendar will then have a coloured dot for each assigned resource. A legend for colours appears on the right of each view (Figures 8.1, 8.2, and 8.3, right). For example, the event labelled 'Dawn Recital' on June 23rd (Figures 8.1, 8.2, and 8.3) contains a red dot for 'Dawn,' a green dot for 'Marge,' the mom, and a grey dot for 'the family car.' These are the three 'resources' that were added for that event.

Automated calendar reminders also present tools for coordination. In the bottom right corner of the Options dialog (Figure 8.4), users can create multiple reminders by checking off a reminder box and leaving a handwritten note, which will appear on top of the calendar at the appropriate time interval, either 15 minutes before, one day before, or one week before the event.

Support contextual locations: We designed LINC specifically to be located in a high traffic area of the home such as a kitchen or hallway. The design was intended to run on a small display like a Tablet PC that could either be situated in this home location or moved around to permit easier adding of events. We chose to use a stylus as the only interaction tool as keyboards and mice tend not to permit location flexibility, e.g., without a desk or

table present they are awkward to use. Using a Tablet as the display device does constrain design possibilities, however, a larger display would limit the mobility of the calendar and smaller displays would restrict the already small space typically allocated to calendar days.

8.2.3 Participatory Design Sessions

I now detail the key findings from our design sessions with the first ten mothers. Here they worked through a series of tasks with our paper prototype. During the design sessions we showed participants a Tablet PC and asked them to imagine the prototype was running on it. Despite having supplies available for modifying our paper prototype ‘on the fly,’ feedback typically came as verbal explanations.

Simple to use: We saw a reasonable acceptance of our first design idea of creating a family calendar that was as simple to use as a paper calendar. Participants enjoyed being able to create events in a very free form way, e.g., just by writing on a sticky note or on the calendar (which caused a sticky note to appear). In fact, some commented that the creation of events was almost as simple as their paper calendars. We had hoped this would arise as clearly it was our intention. However, there did seem to be a learning curve for participants to realize that this type of very direct event creation was even possible. Many would look around the interface for a ‘New Event’ button (which did not exist), reflecting existing experience with digital calendars. When it came to adding event information, we found that most participants simply wrote an event’s time right on its sticky note and thus didn’t need to set a specific time through the interface. This suggested our notion of simple ‘time buckets’ was reasonable. Together, these findings validate Guideline 1 from Chapter 7 that suggests digital family calendars should allow pen-based interaction (see Section 7.2.1), and Guideline 3, which calls for free-form event creation (see Section 7.2.3).

Flexibility: We found that our prototype lacked flexibility when it came to event information. Participants commented that the size of the notes were too small and could not contain a lot of the extra information that participants wanted to add directly to an event’s note (e.g., location, phone numbers). Some suggested that the interface should allow larger notes for events so that extra details could easily extend the basic event information. Naturally, participants preferred to write this information on the actual event itself although details like an event’s location was sometimes simply remembered rather than having it

written down. This highlights the fact that a great deal of tacit knowledge already exists around family calendaring activities and requiring people to explicitly add such knowledge to the calendar introduces redundancy and is unnecessary. On the other hand, people do want to add extra detail as needed. Together, these findings also validate Guideline 3 from Chapter 7 that suggests it should be possible to incorporate extra information with calendar events (see Section 7.2.3). Clearly our initial prototype of LINC is still lacking in this respect.

We also saw that many participants expected events to automatically appear in chronological order within the time buckets. This somewhat contradicted our underlying idea of allowing the user to organize calendar events in their own way, where some people may make events chronological and others may not. This presents a cautionary tale of designing a technology that replicates paper systems but still appears as a digital system.

Tools for Coordination: Our most compelling findings were in terms of coordination tools. In the workplace, coordination is very much done *through* the calendar: people can send meeting requests and then accept or decline incoming requests (Palen, 1998). However, in the home, we found that assigning people or resources to events was not something that participants found particularly useful. People did not use the ‘resource’ bar that we had included and most said they generally wouldn’t use such a feature. Instead, they told us that they would use the calendar as a tool for gathering an awareness of activities and then, using this knowledge, they would coordinate using face-to-face or phone conversations. For them, *the calendar was merely an awareness tool in the process*. In fact, one participant even commented that she would not trust a calendar that let you assign people to events, noting that it still would not be clear if someone would *actually* do what they were assigned to and the extra overhead of entering this information into the calendar didn’t make it worth the effort. This validates Guideline 2 from Chapter 7 that suggests that negotiation protocols are not necessarily needed for family coordination and at-a-glance awareness of activities is more crucial (see Section 7.2.2).

While our paper prototype used a single colour for ink and sticky notes, we discussed the use of coloured sticky notes or coloured pens with participants as additional tools for coordination and awareness. We received mixed reactions from those who thought it would be helpful, to those who said that they already know who is scheduled for a particular event

and would not need a coloured note to more easily see at a glance. Again, this highlights the tacit knowledge that family members naturally maintain surrounding family activities.

We learned from our participants that reminders are somewhat different when it comes to family scheduling than work scheduling. At work the default reminder (at least for Microsoft Outlook) is ‘15 minutes before an event,’ yet we found most participants say this late of a reminder was absolutely useless in the home. In fact, reminders to leave for an event were really not needed. Most participants would have checked their calendar at the beginning of the day or the previous evening and would already have a good idea of where they needed to be or what they needed to get done that day either through memory or a handwritten list. When used, reminders were instead seen as ways to leave a note as a reminder to bring something specific to an event. This further clarifies Guideline 2 from Chapter 7 that describes the use of location-based reminders (see Section 7.2.2): we now have a better understanding of how these reminders may be used by families.

Contextual Locations: Our main finding regarding contextual locations was also about reminders. When it came to the placement of reminders, it was quite evident that pop-up reminders on top of the calendar would simply not do the trick as most participants said they were not often at their calendar. Instead, participants desired reminders to be delivered to cell phones, placed in locations where people actually were, or were audible when the person was in the home. This validates Guideline 2 from Chapter 7 that calls for the use of location-based reminders (see Section 7.2.2).

8.3 Digital Medium-Fidelity Prototype

Our next design stage involved iterating our design to create a standalone digital version of our calendar which could be evaluated by another group of ten mothers. I describe our digital medium-fidelity prototype and the findings from its evaluation.

8.3.1 Medium-Fidelity Digital Prototype Design

We iterated on our low-fidelity prototype of LINC to create a medium-fidelity digital prototype design. The prototype was designed to run on a Tablet PC with a 12” display in landscape mode (Figure 8.5). I outline its design again in terms of our initial design ideas.



Figure 8.5: The medium-fidelity design of LINC prototyped using a Tablet PC.

Simple to use: The general layout of our digital prototype design (using a calendar grid) remained fairly consistent between the low and medium-fidelity prototypes as we saw no indication that a change was needed. Figure 8.6 shows the Month view and Figure 8.7 shows the Multi-Day view for the medium-fidelity version of LINC. The multi-day view acted as a combined day and week view (there was no single day view or a view of the complete week). Like the paper prototype, users can add events to any of the views by writing on a sticky note and then dragging the note to the appropriate date using a control point in the leftmost corner of the Note Toolbar (Figure 8.6, top left). This toolbar is only shown on a note when the stylus is hovering over it. We did not permit users to write on the calendar to create events (e.g., where a sticky note would appear underneath the writing) as we did in the paper prototype because this would interfere with other functionality, e.g., writing on a day is interpreted as a tap/click that opens Multi-Day view. We also stayed with the notion of ‘time buckets’ and relied on the user to spatially position events in a day. Users could open the Options dialog (Figure 8.8) for a note by clicking an icon in the Note Toolbar (Figure 8.6, Note Toolbar, second icon from left).

During implementation, we realized that recurring events required a fairly complicated cognitive model to understand if event changes would affect the entire series or just a single event. To simplify this aspect, we allowed users to create ‘copies’ of events instead of recurring events. This is done by tapping on days in the calendar at the bottom of the Options dialog (Figure 8.8) or choosing a pattern similar to Outlook’s method. Of course, the downside of this model is that copies of an event are not linked together and changes

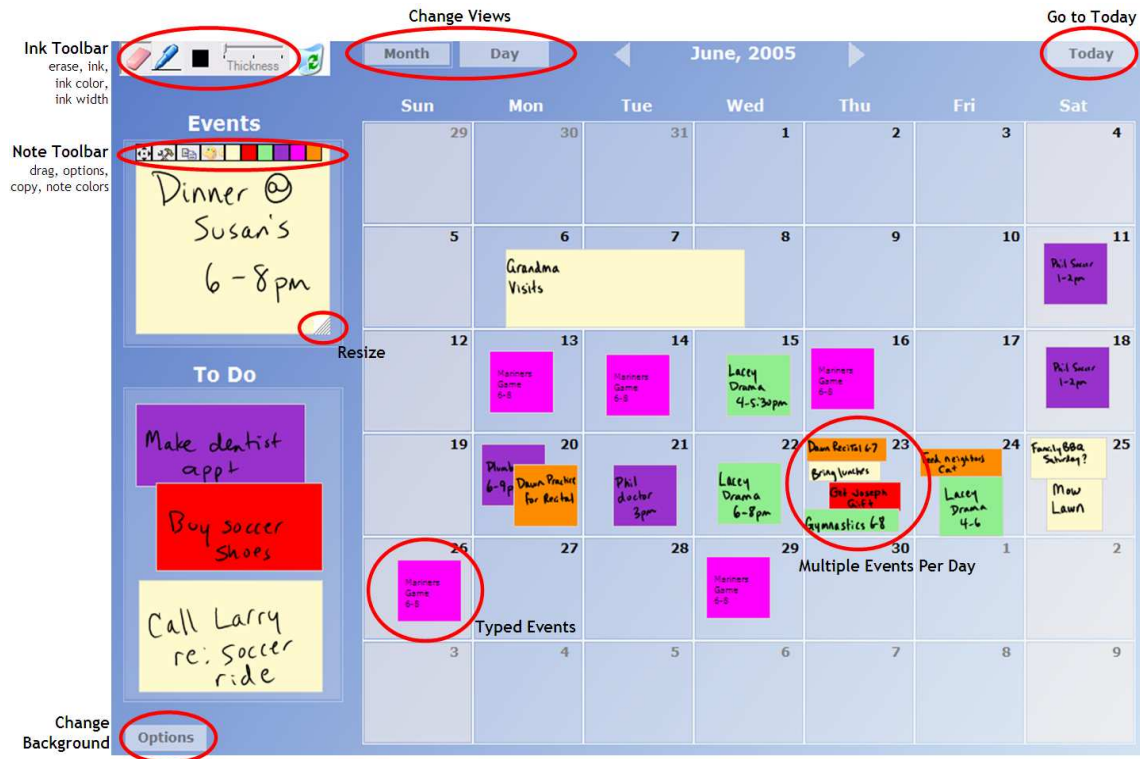


Figure 8.6: The month view of LINC's medium-fidelity digital prototype.

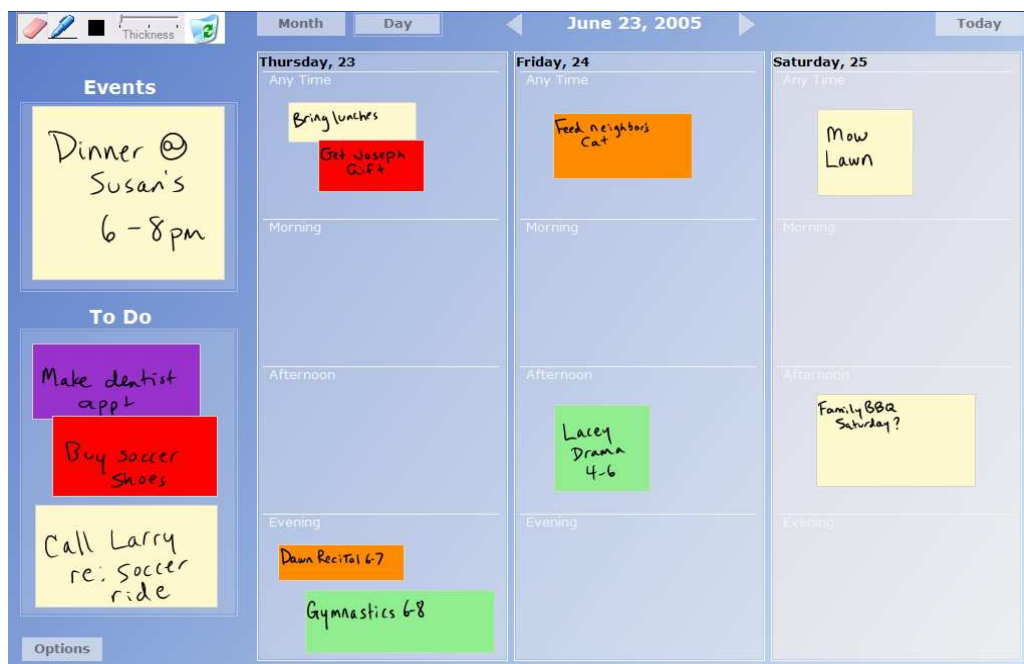


Figure 8.7: The multi-day view of LINC's medium-fidelity digital prototype.

Figure 8.8: Options dialog of LINC's medium-fidelity prototype.

must be made to each event individually. Despite this, we were interested in seeing how this input style would work for family calendaring.

Flexibility: We increased flexibility in our digital prototype by providing more writing space for notes: resizing a note could be done by dragging the icon in the bottom right corner of each note (Figure 8.6, Resize). In order to increase space on calendar days, we implemented a zooming feature. Notes appear in full size on the left of the calendar and when dragged on to the calendar they shrink in size to a thumbnail view. Dragging off the calendar causes notes to grow to their full size. The calendar can provide at-a-glance awareness of three or four events per day (Figure 8.6, Multiple Events Per Day) if they are sized accordingly; yet more events on a day will cause overlap. This is a limitation of our design, but it is mitigated by letting a person bring a note forward in a stack of notes by clicking on a buried note. Next I discuss how we added flexibility in terms of coordination.

Tools for Coordination: Instead of explicitly providing resource management in the Options dialog and coloured dots on notes, we chose to provide users with tools that they could use in their own creative way for coordination. To this end, users can change the colour of each note in the respective Note Toolbar (Figure 8.6, Note Toolbar, rightmost

icons) and pen colour and thickness were available in the Ink Toolbar (Figure 8.6, top left corner). While we did feel that some people might use explicit resource functionality (e.g., assigning people / car to events), we wanted to see if participants would ask for such a feature to be added. We preloaded the calendar with the same events as the paper prototype and coloured notes according to who the event was primarily for (e.g., each family member had their own note colour). We described our note colour scheme to participants and also explained that the notes containing typed events (Figure 8.6, Typed Events) were baseball games that had been downloaded from the web (this functionality didn't exist, but is a future consideration). We included multiple reminders, but removed the tentative flag and driving times due to limited use in the previous study. Reminder times included "the morning of the day," "the day before," "a week before," and "two weeks before."

Contextual Locations: As previously mentioned, LINC was prototyped using a Tablet PC with 12" display (Figure 8.5). This allows LINC to be easily placed in a variety of home locations. One caveat, of course, is that Tablet PCs are currently prohibitively expensive to dedicate to calendaring, yet we anticipate that our design could potentially lead to the manufacturing of a dedicated cheap information appliance. As our study of LINC was still in a lab environment, we did not implement any location-based or mobile reminders; this is explored in future efforts detailed later in this chapter.

8.3.2 Formative Evaluation

I now describe findings from our formative evaluation, focusing on the significant aspects and shortfalls of LINC's design.

Simple Awareness Appliance: Participants found the digital version of LINC to be generally appealing and our model for handling recurring events as 'multiple copies' was well received. Our findings relating to the first design idea were mostly usability issues typically stemming from a lack of user familiarity with pen interfaces. For example, participants experienced problems with stylus modes for dragging notes, inking, and erasing. Users easily understood 'erase' mode, but had problems differentiating between drag and ink modes. We would often see them try to drag a note by simply touching the note with the stylus and dragging it. However, rather than dragging, this drew a line on the note. Increasing the drag region in the note's toolbar did not help the situation: participants still had problems finding

the drag region *and* remembering to use it. Yang *et al.* (2005) discuss ways to overcome these types of mode errors with pen interfaces as does early work on modes in general by Sellen *et al.* (1990, 1992).

Flexibility & Tools for Coordination: In the digital prototype we had not included a specific mechanism to assign resources to an event; rather, we focused on providing flexibility by allowing coloured notes and ink as tools for coordination. This turned out to be quite successful as our presentation of coloured notes was the most popular feature within the system. Participants loved the idea of being able to assign colours to individuals or types of activities. In relation, one person asked for either a tentative flag or a pre-specified colour for tentative events. Only one participant desired to actually assign people to events and have detailed conflict resolution. This participant had five children and was a heavy user of Microsoft Outlook. For the remaining participants, either using one's memory or a user-defined colour scheme worked fine. This further validates Guideline 2 from Chapter 7 that calls for at-a-glance awareness to support family coordination rather than negotiation protocols (see Section 7.2.2).

We found participants were easily able to discern an awareness of the whereabouts and availability of their family members with the digital calendar by looking at the events placed on it, yet participants desired an awareness of calendar changes. Given that most calendars are maintained primarily by one person, our expectation was that a family calendar interface wouldn't need visual cues to show changes. Instead, we found the opposite to be true: the common fear was that someone would change something on the calendar and the primary scheduler would not know about it. With paper calendars, people have fairly strict social protocols in place to guard against this (e.g., the family knew they would get in trouble if they added something to the calendar without telling Mom first). Yet for a digital calendar, participants desired some level of access control, such as a simple list of calendar changes. Together, these findings validate Guideline 2 from Chapter 7 that calls for visual representation of calendar changes (see Section 7.2.2).

Contextual Locations: Many participants liked the fact that LINC was not intentionally designed for a home office; they liked that LINC could be placed in the kitchen and could be easily written on despite not being familiar with using a stylus. We asked them how they would like to access LINC from work and most really liked the thought of having

a web version of LINC. Most participants found it equally easy to use the calendar from both the standing and sitting positions although a couple of participants desired a lower height for LINC on the wall. The size of the display was also fairly well received; only one participant commented that she would like a smaller display and nobody suggested a larger one. This validates our design of LINC as an information appliance for placement in high traffic home locations, outlined in Guideline 1 from Chapter 7 (see Section 7.2.1), though our use of location in this study is still somewhat contrived. Our design of reminders was also well received and participant feedback pointed to the need for reminders to go to places such as a mobile device or an email account. This again validates Guideline 2 from Chapter 7 (see Section 7.2.2) that calls for location-based reminders.

In the next section, I discuss the final high fidelity version of LINC, which includes the addition of multiple LINC clients to make family calendar access ubiquitous.

8.4 High Fidelity Prototype

Our next design stage involved iterating on our medium-fidelity prototype of LINC to create a high-fidelity design that could be deployed and tested in the homes of real families. While this involved fixing a number of usability issues and other bugs, the focus here is on presenting the high level changes that we made to better meet the needs of families. I also highlight how LINC's design meets the design guidelines presented in Chapter 7. Technical challenges associated with digital family calendar design are discussed in Appendix E.

8.4.1 The LINC Awareness Appliance

The main LINC client remains as an awareness appliance running on a Tablet PC shown in Figure 8.9; thus, LINC can be placed in any home location and moved, if needed, when updating the calendar (e.g., writing on it at a table). This reflects Guideline 1 from Chapter 7 that calls for an always-on publicly displayed digital family calendar (see Section 7.2.1). Figure 8.10 shows the month view of LINC and Figure 8.11 shows the multi-day view. Both views remain similar to the medium-fidelity prototype with a noticeable exception of the background. Families can now personalize their calendar by placing any photo as the calendar's background. Figure 8.10 shows a nature photo though other family photos could



Figure 8.9: The LINC awareness appliance.

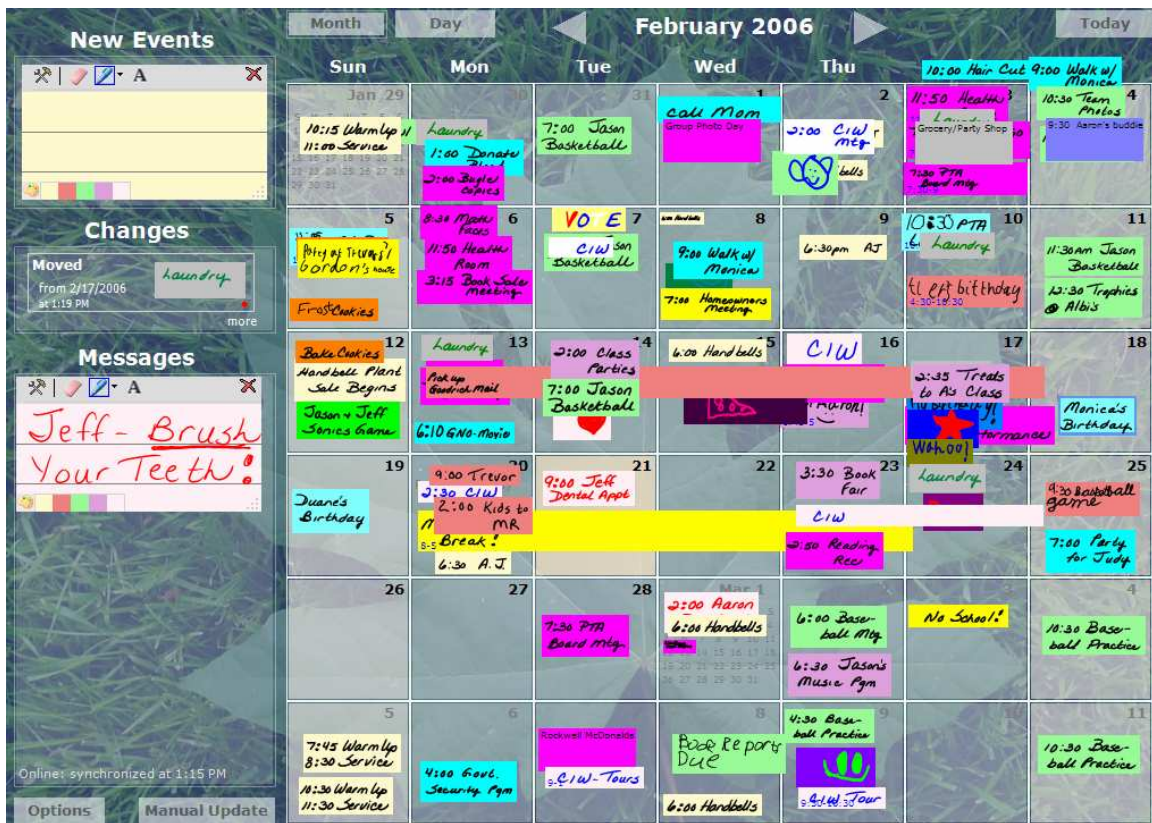


Figure 8.10: The high-fidelity version of the LINC awareness appliance in month view.



Figure 8.11: The high-fidelity version of the LINC awareness appliance in multi-day view.

be used. This extends LINC to also be a public display of family photos, which can help personalize the family's calendar experience.

Updates to LINC are still done using pen-based interaction to support Guideline 1 (see Section 7.2.1), though the visual design of notes was updated to be more stylized. For example, each large note now has its own toolbars containing colour and ink options (Figure 8.10, left) rather than a global toolbar (Figure 8.7, top left). To add events, users write on a new note in the top left corner of LINC under 'New Events' (Figure 8.10 and Figure 8.11, top left). LINC permits free form entry of an event's description to support Guideline 3 (see Section 7.2.3). Notes can also be resized to contain any amount of ink, which helps support the addition of extra event information, also called for in Guideline 3 (see Section 7.2.3); however, there is not yet a way to link in other documents like URLs or emails that may contain other relevant event information. This could be done through a drag n' drop metaphor that places icons on notes to link to the additional information. The colour of each note in LINC is still selectable as is the ink colour using the toolbars on the notes.

These features help support an at-a-glance awareness of calendar content where colour and highlights can be used to make particular events stand out, thus, supporting Guideline 2 (see Section 7.2.2).

Once written, new events are placed on the calendar by dragging the note's grey title bar (Figure 8.10, top left under 'New Events'). Dropping a note on a day causes it to resize where the ink scales appropriately. We have continued to leave the spatial organization of notes to the user in order to create their own relevant meaning for note location. A new addition includes a 'snap-to-size' feature where the coloured background of a note automatically shrinks to the size of the ink when dropped on the calendar. This helps reduce overlapping notes, though it does not completely solve the problem (as visible on several days in Figure 8.10, for example, see February 20th). Despite this, calendar days can comfortably fit three events, which easily supports the majority of days on families' calendars (as shown in Chapter 6, see Section 6.2.1). Of course, it would be better to support the addition of more events. Clearly with a lack of screen real estate this involves utilizing additional information visualization techniques. However, we have left this for future work as our first priority for LINC was exploring calendar ubiquity (discussed in the next section). As shown in Chapters 5 and 7, families have a strong need for remote calendar access (see Section 5.2 and 7.2).

We also added the ability to create events that span multiple days. Dragging the bottom right corner of a note to stretch over multiple days sets the event's start and end dates accordingly. For example, in Figure 8.10, the event "Pick up Goodrich Mail" spans February 13th to 18th. Double clicking a note opens the Options dialog shown in Figure 8.12. Here users can also select start and end dates where LINC will then set the width of the event to span multiple days. If an event is set to span multiple *weeks*, an event will be created for the appropriate days in each week it spans.

We added change awareness features to LINC in order to reveal what has changed on the calendar to family members; this further supports Guideline 2 (see Section 7.2.2). The last calendar change is visible on the left of LINC under the label 'Changes' (Figure 8.10, left). A zoomed version is shown in Figure 8.13a. The type of change is displayed in the top left corner of the item and can be: 'New Event' (a new event was created), 'Moved' (the date of the event was changed), 'Edit' (the event description was changed), or 'Delete' (the event

Figure 8.12: The options dialog for an event in the high-fidelity version of LINC.

was removed). Each change also shows the time of the change in the bottom left corner and an image of the note prior to the change on the right. A coloured circle in the bottom right corner indicates whether the change has been synchronized with a LINC server (red means no, green means yes), which is discussed later. Clicking on the change item highlights the change on the calendar with a blue border, shown in Figure 8.13b for ‘Monica’s Birthday.’ Clicking the ‘more’ label at the bottom of Figure 8.13a opens a dialog showing the previous 100 changes to the calendar with the most recent at the top, shown in Figure 8.13c. We would have liked to have recorded and displayed *who* performed each change on the calendar, though currently this is not supported. This can be difficult to ascertain given that LINC is designed to be publicly viewable *without* a need to login. However, embedded RFID tags within family members’ clothes or jewellery and an RFID reader on the LINC appliance would be one way to facilitate user identification when family members update the calendar. In practice, the handwriting on the note likely suffices as an indicator of who made the change.

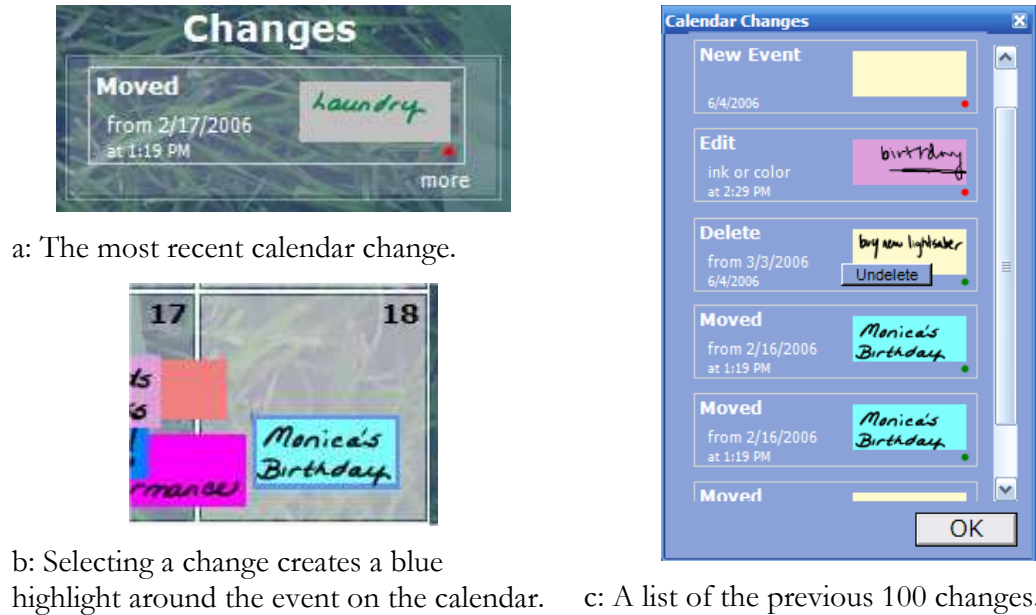


Figure 8.13: Change awareness features to show what has been updated on the calendar.

8.4.2 Multiple LINC Clients

The initial version of LINC was a standalone client and for this reason, we extended LINC to create a ubiquitous family calendar experience. LINC now synchronizes events and calendar changes between multiple LINC clients using a server (Appendix E describes the technical challenges faced in developing this). Each client runs normally in offline mode and maintains a local database of calendar events and any changes to the calendar. At designated time intervals (default is 20 minutes and this is settable in an option dialog), each client will update any changes with a remote server database (and thus other LINC clients). This ensures that, even with a potentially faulty home wireless network, the calendar will still function if connectivity is interrupted. A message in the bottom left corner of LINC shows the status of the synchronization and tapping/clicking a 'Manual Update' button causes an

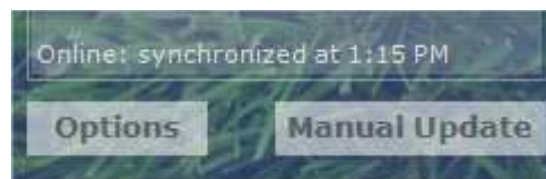


Figure 8.14: A status message (in the bottom left corner of LINC) shows the last synchronization time.



Figure 8.15: LINC supports keyboard input on a standard PC by clicking the 'A' icon on the top of notes.

immediate synchronization (Figure 8.14 shows a zoomed version of the bottom left corner of LINC). We use a simple scheme to synchronize event changes where the most recent change is always used. LINC's synchronization feature enables multiple LINC clients to run autonomously from any location while maintaining updated calendar information (provided that an Internet connection is available during synchronization). We anticipate this will enable clients to run from multiple locations within the home as well as at work, making awareness information and event reminders ubiquitous to any PC / location running LINC. This makes LINC support Guidelines 4 and 6 that call for family calendar access while at work and in multiple home locations (see Sections 7.2.4 and 7.2.6); however, LINC does not yet support selectable event viewing. Currently all calendar events are shown in each location.

We recognize that LINC may not always be on a computer dedicated for just the calendar. For this reason, we created a simple screensaver for LINC that displays an image of the family's calendar at approximately one-third the size of the calendar. This enables any display to become a visible location for the family calendar. PCs running LINC may also not have support for stylus interaction. To alleviate this, we enabled keyboard and mouse interaction. Events can be dragged with a mouse just like they can with a stylus. Clicking the 'A' icon on a note's toolbar (Figure 8.15, left) switches the note to take keyboard input as opposed to ink. Typed text appears on the event as shown on the 27th in Figure 8.15.

8.4.3 LINC Web

Family members may also be in locations where they are unable to install the LINC client. For example, a work location may restrict computer access by disallowing the installation of third-party software. In these situations, web access to the calendar would be beneficial in

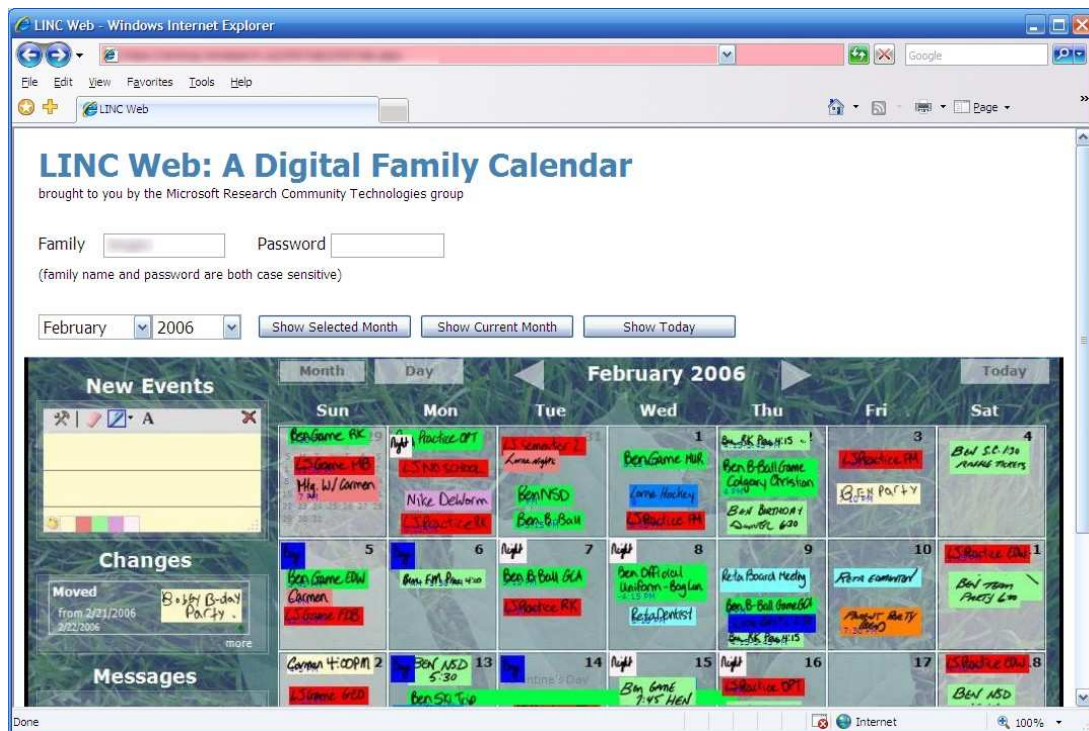


Figure 8.16: LINC Web provides calendar viewing in a web browser from any remote location with a PC.

order to see what family activities are upcoming. We have designed LINC Web to satisfy this need. The main interface is shown in Figure 8.16 and can run in a web browser. Users browse to the URL of LINC Web, enter a family name and password, then select the calendar information they wish to view. This includes selecting a given month, showing the current month, or showing ‘today’ in multi-day view. An image of the calendar for the desired time period is queried from the LINC server database and rendered in the web page. At this point, LINC Web does not support calendar interactivity, just browsing. This is because we were not yet sure how valuable a web client would be given that LINC could already run on any PC, which could provide calendar access from work in many situations. For this reason, LINC Web was created to act as a design probe to further understand the remote calendar access needs of families.

8.4.4 LINC Mobile

Mobility is an important factor in calendar use as Guideline 5 points out (see Section 7.2.5). The Tablet PC offers some mobility within the home, but is less than perfect outside of it

due to wireless network range, form factor issues, and device availability. To facilitate this need and support Guideline 5, we designed LINC Mobile to run on a Windows Smartphone (Figure 8.17). Users initially enter a family name and password using the Smartphone's keypad and then request the calendar month they wish to view. The image loads, as shown in Figure 8.17. Users can then pan around the calendar to different days (Figure 8.17, left and middle images) using the left-right-up-down toggle switch on the phone. They can also zoom in to view actual calendar events on a given day by pressing '2' (Figure 8.17, right) or zoom out by pressing '8.' At a zoomed out view, events are no longer legible but coloured events can provide an overview of who has events and what days are free (Figure 8.17, left and middle). Users can also press '4' to move to the previous month and '6' to move to the next month. Like LINC Web, LINC Mobile also only allows calendar browsing. This is again a caveat; however, it does fulfill the goal of further exploring mobile calendar access where LINC Mobile acts as a design probe.

8.4.5 Implementation

The main LINC client was implemented as a Windows Application with C# using Microsoft Visual Studio .NET 2003. All graphics and controls are rendered using GDI+. The Microsoft Tablet PC SDK was used to extract ink information and render it within notes. Each LINC client maintains its own local Access database that stores events and calendar changes (used for synchronization) for a family. Clients send and receive data with the server using a set of secure ASP .NET web services that I created specifically for LINC. The web services are accessible via an external Microsoft Research server that also maintains a SQL Server database of all calendar entries for all families using LINC. When a family's calendar needs to synchronize with a server, data is passed to the SQL Server database using the web services. Thus, the SQL Server is the central database for each family. The actual structure of the database is proprietary to Microsoft Research.

LINC Web was implemented as an ASP .NET Web Application also using C# and Microsoft Visual Studio .NET 2003. LINC Web uses the same web service methods as the LINC clients to request data from the server's SQL Server database. LINC Mobile was implemented using C# and Microsoft Visual Studio 2005 along with the Microsoft



Figure 8.17: LINC Mobile runs on a Windows Smartphone and allows users to pan around and zoom in on the family calendar.

Smartphone SDK.¹³ Again, the same set of web service methods are used by LINC Mobile to acquire calendar data for display.

8.5 Summary

This chapter has *used the understanding of family calendar routines along with a participatory design process to design a digital family calendar* (Chapter 1, Objective 3). The design of the LINC digital family calendar involved an iterative design process that took place over three stages. The first design stage involved the creation of low-fidelity paper prototypes of LINC. These were based on four main design ideas:

1. **Simplicity:** LINC should be as simple to use as a paper calendar, including interaction and visual layout.

¹³ The implementation of LINC Mobile was done by A.J. Brush. My work involved implementing the necessary backend components for LINC Mobile.

2. **Flexibility:** LINC should be flexible to meet the varying coordination routines of families.
3. **Coordination Tools:** LINC should include tools within it that could enable coordination.
4. **Contextual Locations:** LINC should be designed to be placed in high traffic areas of the home.

These design ideas were expressed and discussed using a series of sketches and PICTIVE interfaces of LINC. Eventually, design ideas converged on a paper prototype design that was shown to ten mothers who worked through a series of tasks with it and described alternative design ideas. The paper prototype of LINC was designed to be ink-based involving writing on sticky notes which could be placed on the calendar. Users could also assign ‘resources’ like family members or the car to events depending on who would be attending a particular event. The paper prototype sessions with participants showed that:

- users enjoyed being able to write on the calendar in a manner similar to paper calendars;
- the prototype lacked flexibility when it came to adding event information as users could only write a short description for each event; and,
- families often do not plan ahead of time who will be attending events and negotiation features built into the calendar would not be used by families.

These validated several findings from Chapters 5 through 7.

The second design stage involved iterating LINC’s design to create a medium-fidelity digital design prototyped using a Tablet PC. Again, pen-based interaction was used where users wrote on notes and dragged them on to the calendar. Instead of providing explicit negotiation tools in LINC, we provided flexible colour options. Users could assign colours for notes and ink. We then used the digital medium-fidelity prototype in a formative evaluation to uncover further design problems with LINC. Here another ten mothers used LINC for a series of tasks and again suggested design changes. The main findings from this study showed that participants:

- liked the idea that LINC was designed as an information appliance rather than software for a PC in a home office;
- enjoyed the flexible colour options for providing easy awareness of calendar events; and,

- also desired awareness of calendar changes, in the case that other family members may update the calendar.

The third design stage involved iterating LINC's design, yet again, to create a high-fidelity digital prototype that would be stable and suitable for use by real families in their homes. This included:

- creating a further-refined LINC client that contained stylized notes, personalized background photos, and 'snap-to-size' sticky notes to reduce overlapping notes;
- creating a server component for LINC and extending the LINC client to synchronize with the remote server so that multiple LINC clients could be running autonomously from multiple locations;
- adding support for keyboard input to LINC as well as a LINC screensaver so that LINC would be able to run on any PC including one at work; and,
- creating two new clients, LINC Web and LINC Mobile, that could further provide ubiquitous calendar access and act as design probes.

In the next chapter, I discuss the evaluation of the high-fidelity LINC client where it is deployed into four families' homes over the course of four weeks. This study brings further validation and clarification to the design guidelines presented in Chapter 7.

Chapter 9. Field Trials of LINC¹⁴

The goal of this chapter is to *evaluate the LINC digital family calendar in order to understand how it will actually be used by families as a part of their coordination routines* (Chapter 1, Objective 4). LINC was evaluated through field trials involving four families representative of the actual end users of the technology. These field trials reveal how a digital calendar designed based on the existing calendaring routines of families will actually be adopted and used for family coordination. This further refines the model of family calendaring by validating and extending the digital family calendar design guidelines presented in Chapter 7. I begin by describing the field methodology that was employed for LINC's evaluation and our study families. Following this, I describe and discuss the key findings from the field trials.

9.1 Field Study Method

We deployed the refined high-fidelity version of LINC to four households over a period of four weeks; two families were from Seattle, U.S.A., and two were from Calgary, Canada.¹⁵ All materials for this study can be found in Appendix F, including study descriptions, questionnaires, and sample interview questions. Our goal for the field study was to understand how LINC affected family calendaring routines: 1) did it fit within people's existing routines, and 2) did it extend routines in an appropriate way to overcome existing calendaring challenges.

We based the length of our field study on pilot studies with our own families. These showed that it took about two weeks to get into the habit of using LINC. Thus, a four week field trial would capture the initial adoption of LINC, plus an additional two weeks of

¹⁴ Portions of this chapter are also published in: Neustaedter, Brush, and Greenberg (Technical Report 2006d).

¹⁵ I designed and conducted the study in collaboration with A.J. Brush. The Calgary families were administered during the study by me, while A.J. administered the Seattle families.

regular use that could show how routines further developed around LINC. We chose four families to participate in the field trials in order to see the effects of LINC on several different styles of coordination routine: two families were classified as Monocentric families (P43, P44), one as a Pericentric family (P41), and one as a Polycentric family (P42). Next, I outline the reasoning for choosing a field study and the actual study steps undertaken. The study families are described in detail in Section 9.2.

9.1.1 Why a Field Study?

Studying the real-world usage of digital family calendars is critical to our understanding of how to design family coordination systems that meet families' needs. I believe that a field trial methodology provides the necessary real usage of such a calendar, where families use their *own* calendar information within their *own* domestic routine. This *real usage* allows us to understand the *actual* real world challenges of adopting and using a technology on an everyday basis. While lab studies offer complimentary findings, they cannot draw out this kind of contextual information. Of course, there are tradeoffs. Lab studies can economically evaluate a large number of participants to draw out significant findings (Dix *et al.*, 1998). In contrast, field trials often involve in-depth study of a small number of participants, where a vast amount of data is collected about longitudinal and ongoing usage of the technology (Dix *et al.*, 1998). I opted for the latter approach given that the main focus of this research phase was to understand real world digital family calendar usage.

9.1.2 Interviews and Deployment

We began the field study by having families fill out an initial survey (found in Appendix F.5) about their family's composition and technology use. Next, we interviewed them to understand their existing family calendaring routine. Sample questions can be found in Appendix F.6. The interviews typically lasted about an hour and we kept written notes and audio recordings. Children were interviewed only if it seemed appropriate after discussing the family's calendar routine with the parents, e.g., if the child actually did anything with the calendar or would check it. To ground the interview questions, we asked participants to describe and show us what artefacts (e.g., calendars, notices) they used for coordinating

family activities (as described in Chapter 5). Findings from the interviews are detailed in Chapter 5 and summarized in Section 9.2.

At the conclusion of the interviews, we spent up to an additional hour with each family introducing them to LINC and setting it up in their home. Families were each given a Motion Computing Tablet PC to use for LINC for the duration of the study. We also setup a wireless network in one home to provide mobile Internet access for the Tablet PC (P42); the other three already had an existing wireless network. Setup also included family members picking a location to place the LINC awareness appliance and the researcher going through a short hands-on tutorial of how LINC works (a tutorial checklist is found in Appendix F.9). Participants were also given instructions and a CD with LINC on it so they could install it at work if they desired and we pointed them to the URL for LINC Web and showed them how it worked. Windows Smartphones with LINC Mobile were given to the two Seattle families for the last two weeks of the study to see how the addition of mobile calendar access would affect the family's routine. Due to the pragmatics of international mobile phone plans (particular mobile phones and plans were needed and costs for this were exorbitantly high in Canada), the Calgary families were not given Smartphones. While a limitation, this allowed us to compare families with LINC Mobile to those without in terms of the need for mobile calendar access.

9.1.3 The Four Week Study Period

Each family then used LINC as their primary family calendar for four weeks. We gave each family a journal for which they were asked to report any findings and thoughts that came up throughout the week. To remind family members to create entries, the journal was initially placed next to the Tablet PC LINC location. At the end of each week, a researcher visited the family's home to discuss how they used LINC over the week. To ground discussions, we used descriptions from the family's journal and events recorded in LINC as conversation pieces. Sample weekly interview questions are found in Appendix F.7. During deployment, we fixed minor interface bugs that appeared in LINC, but did not perform any major changes. The field study concluded with an exit interview with each family at the end of the four weeks. Sample post-study interview questions are found in Appendix F.8

9.1.4 Data Analysis

During the study, we gathered over thirty hours of interview data describing the adoption and use of LINC based on more than 120 total days of usage by all families. At the study's conclusion, we reviewed the journals' contents, all of our interview notes, and returned to our audio recordings for clarifications. Using affinity diagramming (Holtzblatt and Jones, 1995, Holtzblatt *et al.*, 2005), I categorized findings across all families based on the type of challenge or success that was reported with LINC's use.¹⁶ That is, each finding was written out and placed spatially near other related findings one at a time. As findings were added, new clusters of related findings emerged and existing ones were refined. This categorization revealed several key themes which are the focus of our results. The next section describes the existing routines of the study families; this forms a basis for comparing the results.

9.2 The Study Families

Four of the 44 families described in Chapter 5 participated in our field trials of LINC. Table 9.1 summarizes the families' compositions and their calendaring routines *before* LINC. While our families are fairly similar in composition, they differ in a crucial way: *each family has a different coordination routine*. These routines are also highly representative of family calendaring routines as evident from Chapters 5 and 6. Here I highlight each family's existing calendaring routine as a means for comparison to our field trial findings.

9.2.1 The "Leonard" Family

The "Leonard" family (P43) (Table 9.1, Row 1) lives in Seattle and is comprised of Mom who is a homemaker and avid investor, and Dad who works as a manager for a delivery company. Both parents are very busy with work and meetings. The Leonards have two children aged 13 and 10. Dad carries a Blackberry and the other family members all have mobile phones (only the youngest child's does not have Internet access). All family members are on the computer a large amount of time during the week.

¹⁶ I performed the primary analysis and received feedback from A.J. Brush.

	Family Composition	Routine <i>before</i> LINC	Existing Primary Calendar	Stated Successes	Stated Challenges
Leonard (Seattle)	Homemaker & Manager; Children: 10 & 13	<i>Monocentric:</i> Mom's primary scheduler and reminds others	AOL Online Calendar; Mom has access to the calendar from any computer	Mom 'owns' the calendar	Getting others to check the calendar because it is digital
Isaacs (Seattle)	Tour guide & Tech support; Children: 7 & 10	<i>Monocentric:</i> Mom's primary scheduler and reminds others	School district paper calendar and notebook stay with Mom	One person in charge; One location with all events	Getting others to check the calendar; Synchronizing the calendar and notebook
Newman (Calgary)	Accountant & Firefighter; Children: 15 & 17	<i>Polycentric:</i> Dad's primary scheduler; All check the calendar	Paper calendar in kitchen on door by exit to garage	Publicly viewable calendar location for all family members	Scheduling remotely
Chambers (Calgary)	Two teachers; Children: 3 & 3 months	<i>Pericentric:</i> Mom's primary scheduler and reminds others; Dad also checks	Large paper calendar on the fridge near the phone	One person in charge; Public calendar location for entire family	Synchronizing calendars; Scheduling remotely

Table 9.1: Calendaring routines of the four families before LINC.

The Leonards have already adopted a digital calendar as their primary family calendar: they currently use AOL's online calendar (Figure 9.1). It acts as a Personal Mobile calendar. The Leonard Mom accesses the calendar from one of their five computers (two desktop PCs, three laptops) though routinely she is at the computer at the top of the stairs. Mom likes being able to access her calendar in a variety of places and even checks it while waiting for her car to get serviced at the local car dealer.

The family's calendaring activities are fairly typical of Monocentric families. Leonard Mom is the primary family scheduler and having her 'own' the schedule works well for the family: she records most everything on the family calendar, checks it several times per day, and will remind family members of upcoming activities. Despite this, Leonard Mom still



Figure 9.1: The Leonard's AOL online calendar running on their main computer.

wishes her husband had access to the calendar and would check it from time to time. The Leonard Mom also uses a small pocket calendar showing the days in a month view (which was coincidentally lost just before the onset of the study). She likes this small paper calendar because it has places she is able to write notes in during her investment meetings. It is also handy for scheduling appointments while 'out and about.' Both children also have school calendars in which they record school homework.

9.2.2 The "Isaacs" Family

The "Isaacs" family (P44) (Table 9.1, Row 2) also lives in Seattle. Mom is a part-time technology tour guide and Dad is a technical support technician at a local company. They have two children aged 7 and 10; the youngest is only involved in school activities, while the eldest plays on the school basketball team and is also active in the school music program.

The Isaacs family uses the calendar provided by the local school district as their primary family calendar because it already has the school schedule on it (Figure 9.2). It acts as a Personal Mobile calendar where it generally moves around with Mom who is the primary scheduler. She takes it out of the house and to work with her, especially if she knows in advance that she will need to schedule something. She likes the fact that there is a central location for her family's activities. Isaacs Mom makes rich annotations on the family



Figure 9.2: The Isaacs' family calendar moves around with Mom throughout the day.

calendar: she highlights vacations and when company is coming, she circles important items to call attention to them, and she has recently found stickers which she uses for different types of events like doctor's appointments. Mom tries to keep the calendar neat and organized and will even use 'white-out' when events change. The Isaacs family's calendaring activities exhibit characteristics of Monocentric families. Family members typically come and ask Mom what's on the calendar. Dad rarely adds to the calendar and when he does it is to note his 'days off' from work. Both parents wish that they could more easily share the calendar's information so Dad could more easily see it and become more active in their calendaring routine.

Mom also uses a notebook as a Tasks and Chores calendar where she records additional information about events on the calendar and other tasks—each day is listed in the notebook along with event times and to-do items. Every Sunday night she sits down and creates a list for the week. The notebook is just Mom's and other family members don't have access to it. The notebook also travels with Mom when she leaves the house and she'll check it periodically throughout the day. Naturally, Mom wishes she could have one place



Figure 9.3: The Newman's paper calendar on the pantry door near the exit to the garage.

to record all of her information instead of trying to manage two separate items (the calendar and the notebook), but finds that the calendar doesn't have enough space for this.

9.2.3 The "Newman" Family

The "Newman" family (P42) (Table 9.1, Row 3) lives in Calgary and is comprised of two parents and two sons aged 15 and 17. Dad is a firefighter who works alternating day and night shifts (four days on each) and Mom is a full-time accountant. The children and Dad all play hockey with several practices each week along with games. The youngest son also plays school basketball at least twice a week, and neither son works yet. Mom does not have much extra time for additional activities as her job requires many evening meetings and she volunteers time to do bookkeeping for a friend's company.

The family calendar is a paper calendar, acting as a Public Awareness calendar, that the Newmans keep on the inside door of the pantry in their kitchen (Figure 9.3). This location is easily visible as they enter or leave the home through the pantry into the garage. The Newmans are a Polycentric family with a large amount of family involvement in the calendaring routine. Dad is the primary scheduler because he is the one that is most often at home during the day. He and Mom both add events to the calendar frequently. Any event

that affects other family members will make it on to calendar. All family members check the calendar during the day, e.g., before school, after school, when someone phones.

The family feels the best thing about their coordination routine is that the calendar is accessible to everyone when they are at home. They have also used the same routine for the last 18 years so it is very well established in the home. Adding events to the calendar while not at home is challenging: either the parents will phone home and ask the kids to write the event on the calendar or Dad will phone home and leave a message on the answering machine for himself when he gets home. The family recently bought a family mobile phone plan and are finding it very convenient for negotiating activities and rides. The family calendar is very important to the Newmans, in fact during our first visit Dad told us "*[The calendar] is our life line, [LINC] better work.*"

9.2.4 The “Chambers” Family

The “Chambers” family (P41) (Table 9.1, Row 4) also lives in Calgary and has the youngest family in our field trials, comprised of two parents with young children aged 3 and 3 months. Both parents are computer teachers at local schools, though during the field study Mom was at home on maternity leave. She commented that as a result, their calendar was not as busy as it usually is. The parents routinely participate in community sports teams and the eldest child goes to pre-school as well as a special playschool during the week.

The family calendar is a paper calendar, acting as a Public Awareness calendar, magnetized to the fridge door in the kitchen (Figure 9.4). They find this location valuable because both parents can easily see the calendar everyday. Before having children, the Chambers didn’t use a fridge calendar but once they had children they found a need to have a calendar that both parents could see. The Chambers’ calendaring activities are typical of Pericentric families, showing a modest level of family involvement. Mom is the primary scheduler because she is the one who is responsible for making all of the children’s appointments. She maintains the family calendar along with a paper notebook calendar (Personal Mobile) that she takes everywhere with her—both calendars show a month view. Mom adds events to the family calendar using a pencil because she doesn’t like it to look messy. Sometimes Dad will tell Mom about an activity that needs to go on the family calendar and she will add it. Mom checks the calendar daily; in the morning to see what is



Figure 9.4: The Chambers' paper calendar on the fridge door.

happening that day and in the evening to see what is happening tomorrow. Dad checks the calendar every once in a while and will sometimes record family events in his work calendar, which runs on his new PDA (an iPAQ).

The Chambers like having multiple calendars each with its own purpose and type of events; they think that a single calendar with all work and family information would not be useful because there would be too many activities. They find the best thing about their current routine is that Mom is in control of it. They feel 'on top of things' because one person takes charge and keeps the other informed. The Chambers find it difficult to record events when not at home and it is hard to manually synchronize their various calendars.

In the next section, I describe how the four families adopted and used LINC as a part of their family calendar routines. For certain families, LINC fit within existing routines, and for others, it altered the routines I have just described.

9.3 Factors Affecting Adoption and Use

All four study families adopted LINC during the course of the field trials and even wanted to continue using LINC after the study finished. The benefits and drawbacks of LINC for each family are summarized in Table 9.2; the details are described throughout this section.

Because LINC was designed to be used in ways similar to paper calendars, the Chambers and Newman families were able to *adapt LINC into their existing routine* with only small routine adjustments. The Chambers Mom recorded 17 events on LINC during the first week of the study (including events transferred from the paper calendar) and 4 events in the remaining weeks (Figure 9.5) (compared to 13 on their paper calendar the previous month). Mom checked the calendar as per her usual routine and Dad checked it more because he was excited that LINC was a technology (as opposed to the *paper* family calendar). The Newmans recorded 72 events on LINC in the first week and 14 during the rest of the month (Figure 9.6) (102 on their paper calendar last month) with a large number added by both Mom and Dad and several by their children (who were also excited because LINC was a technology). All family members checked LINC as per their usual routine.

The Leonard and Isaacs families also adopted LINC, yet saw *changes in their calendaring routine* as a result. For these families, LINC caused *increased family involvement* in the routine as a result of its paper calendar qualities *and* digital extensions. In both families, *more than just the Mom was checking the LINC calendar*. Despite this change, both families maintained their existing success of having calendar updates dominated by Mom. The Leonards recorded 31 events in the first week and 41 the remaining weeks (Figure 9.7) (57 on their AOL calendar last month). The Isaacs recorded 75 events in the first week and 12 in the remaining weeks (Figure 9.8) (89 on their paper calendar last month). In both cases, most events were added by Mom with infrequent updates by other family members.

	Main Benefits with LINC	Main Drawbacks with LINC
Leonard (Seattle)	Public and <i>multiple</i> home locations allowed others to check the calendar	Didn't always need mobile calendar access
Isaacs (Seattle)	Public location allowed others to check the calendar; Access at work for Dad	Mobile device not the right form factor
Newman (Calgary)	Paper-like attributes allowed it to fit within their routine (with only minor changes); Access at work for Mom	Didn't have overview plus daily detail; Needed ability to add events while mobile
Chambers (Calgary)	Paper-like attributes allowed it to fit within their routine (with only minor changes); Access at work for Dad	Not integrated with Dad's work calendar; Dad couldn't add events from work

Table 9.2: The main benefits and drawbacks with LINC for each family.

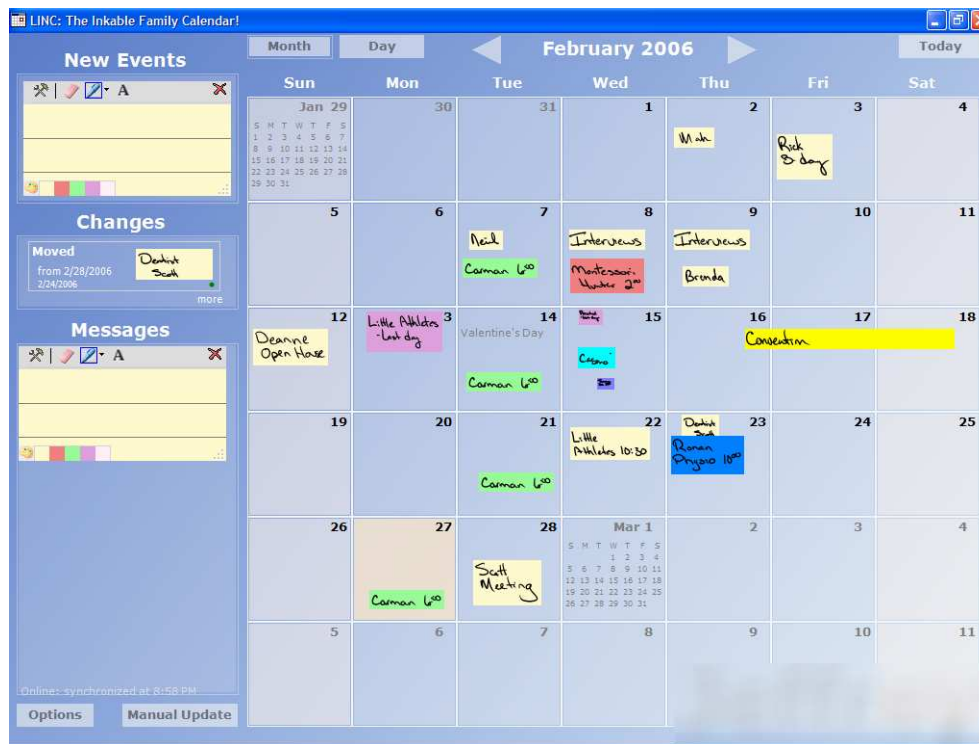


Figure 9.5: The Chambers' LINC calendar at the completion of the study.

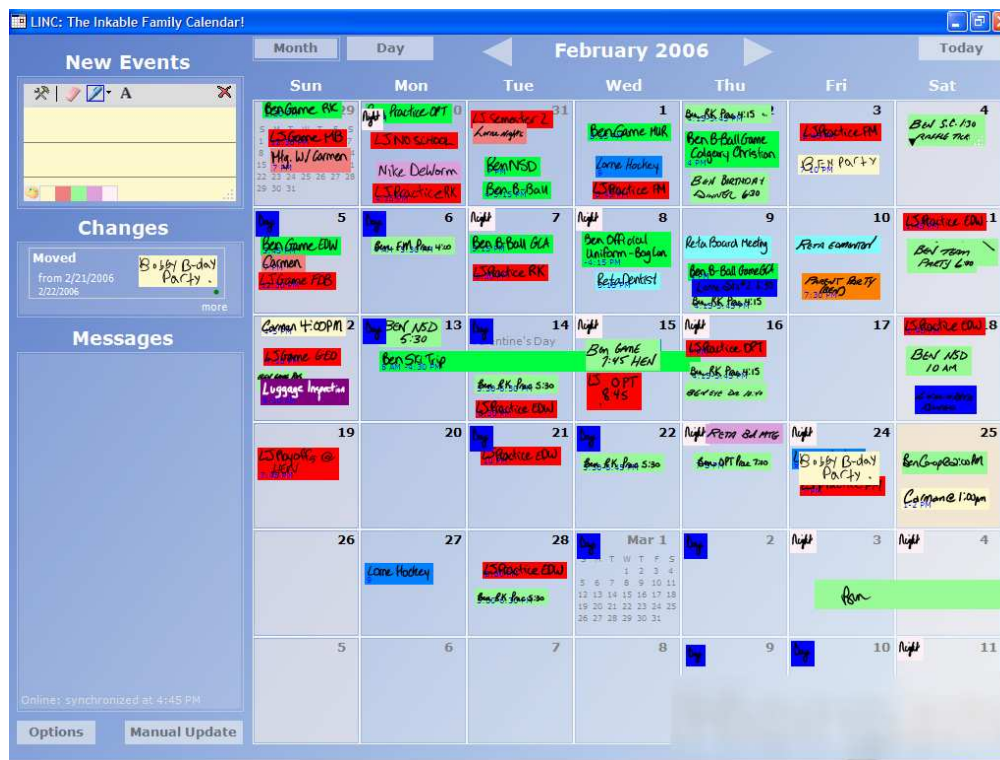


Figure 9.6: The Newmans' LINC calendar at the completion of the study.

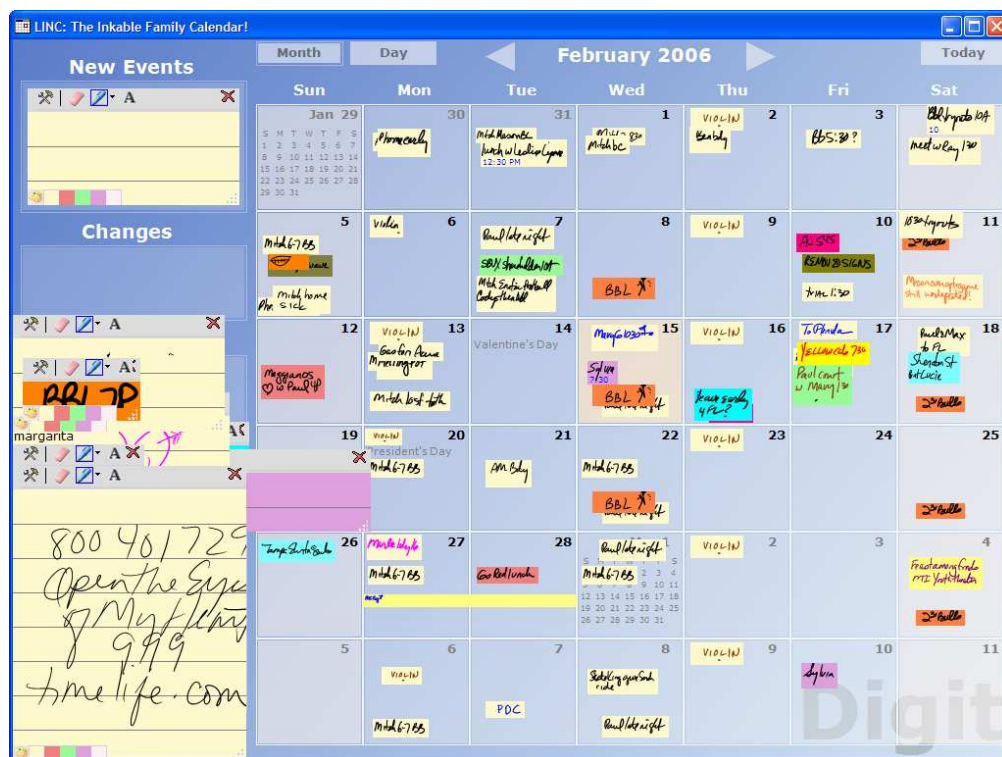


Figure 9.7: The Leonards' LINC calendar at the completion of the study.

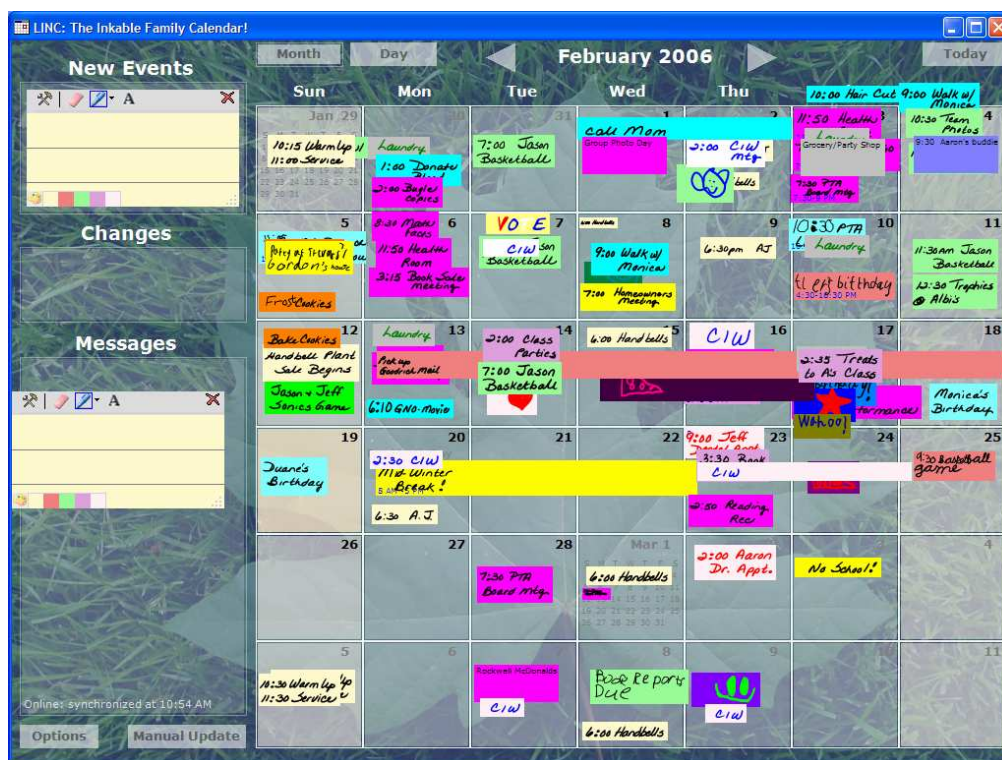


Figure 9.8: The Isaacs' LINC calendar at the completion of the study.

I now illustrate the key factors that helped the families adopt and use LINC and also those which hindered its use. I also show how these findings validate and extend guidelines for digital family calendar design. A summary of this is found in Table 9.3.

9.3.1 Flexible and Public Primary Location

We allowed each family to choose the initial location for the LINC awareness appliance (the Tablet PC). The Leonards did not previously have a public location for their paper calendar. As a result, at the onset of the study, the Leonard family faced challenges in choosing a location for LINC. At our first weekly visit we found LINC sitting on their kitchen table, off, and facing the wall. We suspect that their lack of location choice and having the

	Original Design Guideline	Extensions to Design Guideline
1: Public and Always-On	Provide a publicly available client for placement in high traffic areas of the home that is always-on and accessible.	Designs should support <i>location flexibility</i> and <i>calendar mobility</i> within the home. Designs should relax the always-on calendar requirement and <i>permit access to calendar-related applications</i> .
2: At-a-glance Awareness	Provide at-a-glance awareness of calendar content for easy awareness acquisition.	For some families, automated reminders of content are not needed. Support existing social conventions for handling changes.
3: Appropriate Information	Support adding and viewing appropriate event information at different levels of detail.	Designs for public awareness should show an entire month or week <i>combined</i> with a day view.
4: Work Access	Support calendar access for viewing and editing family events while at work.	For some families, the web offers a viable medium for family calendar access when at work.
5: Mobile Access	Provide a mobile interface for viewing and editing family events while not at home or work.	Families need flexibility when choosing a mobile form factor.
6: Multiple Home Locations	Provide access from multiple locations within the home where the information displayed may vary.	For some families, a single fixed location in the home is ample.

Table 9.3: Extensions to the design guidelines for digital family calendars.



Figure 9.9: LINC in the Leonard family's kitchen near the stove.

computer turned off simply reflected their existing calendar routine, i.e., they were accustomed to Mom managing the current AOL calendar from her own computer. This family had no *a priori* notion of a ‘public’ calendar location. After the initial week, LINC moved throughout the home with the Leonard Mom. She used it while watching TV in the living room, in the bedroom when sick one day, and even outside of the home at several evening meetings. Yet by the end of the study, the Leonard Mom proudly showed us how she had decided to place LINC on the kitchen counter next to the stove, shown in Figure 9.9, *“It landed up in the kitchen which is where I think it should have always been.”* The flexible form factor of the tablet allowed the Leonard Mom to experiment with many different locations before settling on one that fit her life while maintaining the family benefit of public visibility.

As a result of LINC’s public location, the Leonard family saw increased family involvement in the calendaring routine. Family members would now check the calendar, or Mom would tell them to go and look at it instead of asking her, because it was now in a public location for them to view: *“Its kind of fun though referring my family to [LINC] instead of asking me to know everything...and really that’s quite a feature in itself. Before [LINC], calling me was the answer.”*

Leonard Dad enjoyed the fact that LINC was more publicly visible, as it allowed him to get an idea of what family activities were occurring:

‘It makes me more interested in paying attention to the home calendar...I never really accessed the AOL calendar much. [LINC] was something I could access easily without spending a whole bunch of time looking for it...it was very much more visible... The fact that it was easily accessible and I could look at it on Sunday night or Monday morning and look at what’s going on and be prepared for it...made it a little bit easier for me.’ – Leonard Dad (P43), Delivery Manager

The Isaacs also did not have a set location for their calendar prior to the study. They chose to place LINC on a bookcase next to the kitchen table (Figure 9.10). LINC remained there and they found having the family calendar in a publicly viewable location was one of the main benefits of LINC. Isaacs Dad pointed out that the digital version is basically an electronic ‘replica’ of the calendar that Mom used so it was very easy for LINC to integrate into their existing scheduling routine. Isaacs Mom felt that family involvement with the calendar increased as a result of having LINC in a central location. She found the kids were now infrequently adding things to the calendar by drawing pictures (though not all were distinguishable by Mom) and would even routinely ask her to make sure that a certain activity was on the calendar (previously this was not done).

The Newmans and Chambers already had highly visible locations for their paper calendar that had evolved through their calendar’s use over time. For them, it was critical that LINC be placed in locations that allowed them to maintain their existing routines.



Figure 9.10: LINC on a bookcase next to the kitchen table in the Isaacs home



Figure 9.11: LINC on a desk in the Newman family's kitchen.

However, LINC's form factor posed some pragmatic challenges for these two families. Instead of hanging LINC on their pantry door, like their paper calendar, the Newmans placed LINC on a kitchen counter next to a desk that contained one of the family's desktop PCs (Figure 9.11); this location was across the room from the pantry door. Despite a less than ideal location, the Newman Dad reported being able to adapt his routine during the first week of the study, so he would walk by LINC on the counter during his exit out of the house. At the end of the study, Newman Dad made some final thoughts on LINC's location:

"At least for me, I can't think of a better place. It's next to the computer, if you're looking at some emails and you go, 'oh yah, I need to add that' then it's right there, you can add it on...we couldn't have had a better location for us. It's very visible." – Newman Dad (P42), Firefighter

The Chambers family was similar to the Newmans as they too were unable to place LINC in their most preferred location: on the fridge where their paper calendar was located. Instead, the Chambers placed LINC on a counter in the corner of the kitchen, a good ten feet from the fridge and adjacent phone. Unlike the Newmans, this new location proved awkward (although they still modified their routine to use it). As Chambers Mom says, location is critical for convenience and easy calendar access:

“It’s obviously not a good location. For me, I’d like to have a little bit more options of where I can put it. Here because we are doing [the study]...I make a conscious effort to go over and use it, but it’s not my first initial place to look because I’m used to looking at the fridge...[the fridge] is just like second nature.” – Chambers Mom (P41), Teacher

In one situation, Chambers Mom reverted back to using her paper calendar when on the phone simply because the calendar on the fridge was in a more convenient location. She also commented on how location depends on each person’s individual routine,

“I tell my students to use a calendar to keep themselves organized and I say put it somewhere you look everyday like your light switch, your fridge, because it’s something you look at everyday.” – Chambers Mom (P41), Teacher

Taken together, these findings show that *having a digital family calendar in a public location is in fact important for calendar adoption*. This validates Design Guideline 1 from Chapter 7 (see Section 7.2.1). The findings also extend this by illustrating that in real world use *designs must support even greater location flexibility* than LINC was able to support (Table 9.3, Row 1). The pragmatic challenges of the physical world need to be considered with calendar placement.

9.3.2 Mobility Around the House

While it is certainly advantageous for families to be able to place a digital family calendar in a single public location, we saw that family members also wanted to move the calendar around the home as they went about their everyday activities. The importance of mobility is brought to life by the Chambers. Initially, Chambers Mom disliked LINC on the tablet because she felt her handwriting (*vs.* typing) was messy. Yet, by the end of the study, she began to realize (and so did Chambers Dad) that the mobility of the LINC more than offset concerns over ‘messy’ text.

“Honestly if I didn’t have the tablet I know I wouldn’t use it because it’d be on my computer in the other room and why would I go in there. For me this is how I’d use it, it doesn’t make any sense to use it any other way then to have the tablet...I’m not going to go in [to the other room] to check it because I have kids in here. I’m not going to go and type it in because my phone is in here, I’m not going to drag my phone around and type it in, that’s why I keep my [paper calendar] in here. Mobility is very important, that’s why I like the wireless and the tablet...let’s say the boys are playing in the other room, I can take it in to that room and do the things I need to do sitting beside my kids.” – Chambers Mom (P41), Teacher

On a smaller scale, mobility also enabled families to more easily plan and add things to the family calendar. The Newmans and Chambers preferred to add items to the calendar on a flat surface, where they would routinely unplug LINC and move it to the surface of the kitchen island. The Isaacs and Leonard Mom acted similarly, often moving LINC to a table to schedule events.

A downside to mobility is power management issues. All families found the battery life on the Tablet PC to be less than ideal. Each faced a situation where they had unplugged LINC, brought it to another location in the home, and had forgotten to plug it back in when finished. On the flip side, the power requirements were an incentive to return LINC back to the ‘standard’ location allowing other people to easily find it.

These findings extend Design Guideline 1 (see Section 7.2.1): while a single public calendar location is important, *families should also be able to move their digital calendars around the home* (Table 9.3, Row 1).

9.3.3 Always-On or Easily Accessible

Families don’t want to ‘boot up’ the family calendar to add events to it or check it. As with paper calendars, they simply want to walk up and use it. The strongest illustration of this arose as a consequence of a design flaw. In the Newman household, the parents’ bedroom is positioned such that lights in the kitchen can be seen from it. Because we designed LINC to be always-on, LINC produced a glow that could be easily seen by the parents as they tried to sleep. We remedied this using a built-in power feature that turns the display off after 15 minutes of non-use. Thus, in order to see the calendar (regardless of the time of day), one has to tap the screen and wait several seconds for the display to turn-on. This interaction and wait overhead proved excessive for the Newman Dad. As a result, he would opt not to use LINC when leaving the house, and instead checked the paper calendar (which still had the family’s events on it). That is, even minimal overhead to viewing the calendar had drastic consequences for its use.

Leonard Mom also found that having LINC always running was critical for her use of it and she simply wouldn’t use it if not available without ‘booting the computer’:

‘It was really helpful to be able to have access. That’s been the issue with the way I do my calendar...I like the way this can just be on all the time. Sometimes you’ll be running out the

door and somebody will call and say hey will you be able to go to <pause>, and oh no, I don't want to run back upstairs and turn the computer back on.” – Leonard Mom (P43), Homemaker

In contrast, the Newman Mom felt that having LINC running on the Tablet PC as an always-on display was beneficial but not necessarily crucial. She told us that *easily accessible* (i.e., some interaction and a short wait) instead of *always accessible* was enough for her to use a digital family calendar. Newman Mom suggested LINC could work as an application on a PC in ways similar to other easily accessible but not always visible applications (e.g., MSN Messenger, which is automatically invoked on system startup): *“The kids right now have their MSN automatically on boot up, it comes up and signs them in. I would do the exact same thing so [LINC] would be there all the time.”*

An interesting development during the study was that the families reported trying out the Tablet PC for other activities like checking email and web pages. This was found to be valuable as other digital information often relates to calendar activities.

These findings validate Design Guideline 1 that calls for an always-on digital family calendar (see Section 7.2.1) and extends it by showing that *an easily accessible family calendar may be enough for some families* (Table 9.3, Row 1).

9.3.4 Detail plus Context Views for At-a-glance Awareness

Families want to be able to quickly glance at the calendar and see what is happening. However, we found that the views we presented for LINC were not necessarily the best at conveying information at-a-glance. Reading ink in Month view was difficult for some because LINC shrinks the ink to create space for more events. Notes in Multi-Day view were larger and more readable, yet this view did not provide the context of the entire week or month. Newman Dad comments,

“We never have it on a month because it's too tiny. For us we just have so much stuff going on in a day that month view is too small...if it had a month view and day view [combined]...I could see where very seldom we would ever change it. The new events, changes, and messages are something you could just drop down if you needed it.” – Newman Dad (P42), Firefighter

For similar reasons, our screensaver showing the monthly calendar did not work in practice. Newman Dad suggested, *“If the screensaver defaulted to the current day that would be huge. We're looking for the current day. You could walk by and you wouldn't have to touch it.”* Isaacs Dad

also suggested the same thing saying that coordination is about ‘Today’ and not today plus a couple of days.

We received several suggestions on repurposing the screen real estate to meet the families’ needs. Both the Newmans and Chambers suggested a combined Day and Month view, where ‘Today’ would be visible on the side of the calendar next to the month view. They felt this would provide the detailed information they needed for ‘Today’ along with longer term planning information from the month. We were encouraged that despite the problems with LINC’s views, Leonard Mom still felt she could squeeze more events into LINC than her previous AOL calendar (which shows at most 3 events per day).

These findings validate Design Guideline 2 that calls for at-a-glance awareness of calendar activities (see Section 7.2.2). We also extend this idea and Design Guideline 3 as we now know that in practice the calendar should *show an entire month or week combined with a day view* to facilitate at-a-glance awareness (Table 9.3, Row 3). When looking at information visualization techniques to increase space on the calendar, it is important that content still be readable at-a-glance.

9.3.5 Staying Aware of Calendar Contents and Changes

Families highly valued the ability to use color and other annotations in LINC. In fact, colored notes were one of the most popular features. The Leonards calendar contained 9 different note colors, the Isaacs used 15, the Newmans used 11, and the Chambers used 7. On the Isaacs calendar, Mom used pink for school events, green for her son’s sports activities, red for doctor appointments, light blue for her own events, and grey for laundry (because she said it wasn’t fun). Color coding like this aided all families in quickly knowing *who* had activities on a particular day or if *important* activities were upcoming. Chambers Mom said, “*I do like the idea of the colors. I can look at [LINC] and I know, all the green is [my husband’s events].*” Similarly, Chambers Dad said, “*I just come down in the morning, I look, if there’s no colors on there I don’t worry about the day. If there’s a color on there I know.*”

Family members found the default set of colors not very distinct and would often choose the brightest colors available to help events stand out more. Newman Dad comments on how everyone in the family has adopted the family color scheme,

"I think people got in the habit of using colors. Before I'd grab a couple of different colors to fill things in [on the paper calendar] but then you'd just use whatever color after that...I think we're actually getting more into colors now...[Son 1's] color is green. I see [Son 2] has some colors here...I find I only use [the default colors]....[Son 2] did this darker green color but it's not one of the default colors. If your colors in the [tray] were more distinct colors that would be better." – Newman Dad (P42), Firefighter

While colors were important, Leonard Mom also asked for additional ways to visually annotate the calendar,

"You know what would be really nice, if there was little symbols. That's something I've kinda enjoyed with the AOL one. I've got little stickers with the calendar they gave me...see look at the little birthday, it also helps you get into it...unfortunately they don't have many symbols, they could provide more." – Leonard Mom (P43), Homemaker

She soon found she could simply draw pictures on LINC and added a heart for Valentine's Day, *"I liked the colors...I liked how you could draw...it really does look a lot more fun."* Drawing on events was also a popular feature for the Isaac children and made them feel much more a part of the family calendar activities.

Another aspect of being aware of the calendar's contents is receiving reminders for events. Automated reminders were found to be one of the favourite features for workplace digital calendars (Payne, 1993, Palen, 1998). Yet none of our four families found much use for automated reminders in LINC. Because the family calendar is habitually checked daily, family members said they already have a good sense of what activities are upcoming. Checking the calendar is a reminder enough. Newman Dad explains, *"Because we look at the calendar so many times a day, for me a reminder isn't a big deal."* Similarly, Chambers Mom says, *"We almost don't need reminders. If I were to use reminders it would be to remind [my husband], but then I would just phone him. I'd look at the calendar and say 'do you remember you have this today?'"*

While these findings suggest reminders are not needed in a digital family calendar design, Chambers Mom did say that if their schedule was busier they may need them.

LINC's change awareness panel also saw very limited use. This was somewhat surprising, for any family member—parent or child—could easily add or change calendar events without others knowing. Yet families reported their existing practices for alerting others of changes worked well. Newman Dad comments on this,

“It would be no different than our paper calendar...I look at it and if it has been scratched out then it obviously isn’t happening. I can’t honestly say that we would normally add something on the paper and not notice it. We’d usually go, hey, did you notice that. Sometimes we talk about things before we add them.” – Newman Dad (P42), Firefighter

On the other hand, Chambers Dad felt it was important to be able to see changes that happened *during the day* while away from home and at work:

“We get so busy from day-to-day so if something changes I look at it first thing in the morning. If something changes during the day, we’re lost anyhow. That would be helpful if it was online if something changed during the day.” – Chambers Dad (P41), Teacher

These findings validate Design Guideline 2 that calls for flexible interaction to aid at-a-glance awareness of calendar contents (see Section 7.2.2). We extend this by showing that *for some families, automated reminders are not needed* (Table 9.3, Row 2). For these families, at-a-glance awareness of content on the calendar is all the more crucial. For other families, being able to send reminders from the primary scheduler to family members to aid coordination may still be valuable, as outlined in Design Guideline 2. We also saw that social conventions for handling calendar changes continue to work well and explicit change awareness features may not be used by all families. However, the need for them may increase with ubiquitous calendar access. Thus, *designs should support existing social conventions* (Table 9.3, Row 2) while still providing enhanced change awareness features in the case that routines may change with increased ubiquitous access.

9.3.6 Calendar Access from Work

All of the families really liked the concept of accessing the family calendar from outside the home. Both the Isaacs Dad and Newman Mom would check the calendar from work to stay more aware of what activities were upcoming and what was being scheduled (both were not the primary family scheduler). Isaacs Dad found one of the best features of LINC to be its accessibility from work, *“I think what works well is that I can pull it up on my work computer. That was definitely a nice thing.”* In response, Isaacs Mom said, *“It pulled you into being a part of it more.”* Still, Newman Mom did find that it was difficult to remember that she *could* view her family calendar while at work, *“It is very beneficial. I guess again it’s like anything else...it’s remembering it’s available. Over time you’d remember.”*

A crucial feature we had *not* yet developed into LINC Web was the ability to add events. Chambers Dad found the thing he wanted to do most while at work was add things he had thought of to the family calendar. The lack of being able to add events on the web page hindered this process: *“I also had something I wanted to put on [the family calendar] but I didn’t remember at home until four days later.”*

Chambers Dad also wanted to be able to view his family calendar on his iPaq, which he normally synchronized with his work Outlook calendar. Having the family calendar accessible at work feeds people’s desire to easily integrate and synchronize events across the work and family calendar. The Chambers family wanted certain events from the family calendar viewable in Outlook (the work calendar), and vice versa, so when at home Mom could see what activities Dad was up to. However, they commented that only some events should migrate between the work and home calendars: of these they wanted to easily discriminate through visual cues between home and work events.

These findings validate Design Guideline 4 that calls for calendar access from work (see Section 7.2.4). They show that, for some families, *the web is a viable medium for accessing the family calendar while at work* (Table 9.3, Row 4). For others, as outlined in Design Guideline 4, *integration with existing work calendars is needed*. We also now know that updating the family calendar from work via a web interface is definitely a ‘must’ for future designs.

9.3.7 Calendar Access while on the Move

The Seattle families had the opportunity to use LINC Mobile for the second half of the study, yet they didn’t find it that beneficial. Isaacs Mom found the display on the mobile phone to be too small, which made it difficult to see calendar events, even though the phone could show a complete day. Isaacs Mom did not normally carry a mobile phone and suggested a larger form factor for LINC Mobile,

“I’m going to need something bigger [when outside the home]...I’ve seen those PDAs, but I’m not sure about the size. I’m used to carrying binders...but thinking about the grocery store I’m not sure I’d want to carry [a tablet]...if I have a PTA meeting I’d take it so [the tablet size] for me and my eyes, it’s probably that weening from paper to something similar in size.” – Isaacs Mom (P44), Tour Guide

Isaacs Mom wanted to take a multi-purpose device like the Tablet to certain activities, as the above quote shows, yet she told us other times she didn’t need a calendar with her

while mobile. Leonard Mom faced a similar situation: when she knew she was going to be out and needed to view or add something to her calendar, she would bring a printout of it instead. This shows that families typically have great foresight into when they will need to view or add to the calendar before they leave the home.

In our discussions with the Newman family about how they would visualize their preferred mobile experience of LINC, Newman Dad suggested being able to phone the home calendar and leave a voice event. This was similar to how he currently leaves messages on the answering machine to remind himself to update the family calendar. This reflects a desire to have access to the family calendar at particular moments while out and about (e.g., to add a single event), as opposed to always carrying a calendar. Chambers Dad similarly commented that having the calendar on a device that is always with him is not necessary; he'd prefer to leave the device behind if he didn't see a need for it on an outing. The Chambers also thought that a mobile phone's display would be too small, and recommended a PDA version instead.

These findings validate Design Guideline 5: mobile calendar access is indeed important for families (see Section 7.2.5). We have also validated that, for some families, *it is more of a secondary need*. Mobile calendar use is influenced by the form factor of the device and the convenience of using it, which will vary for families. Thus, *families need flexibility when choosing a mobile calendar device* (Table 9.3, Row 5).

9.3.8 Multiple Home Locations

In addition to physically moving the Tablet PC around the home, another way to have the family calendar available throughout the house is to install LINC on multiple computers. For the Isaacs family, we installed LINC on the desktop computer upstairs, and on Dad's laptop which traveled between work and home. Isaacs Mom pointed out to us that people are not always in the same location within the home. She describes how it was beneficial to have LINC in multiple places:

"Having [LINC] upstairs also was terrific because if things came in email I could modify them right away...I think if anything [multiple locations] helped enhance [our routine] because I am in different locations...I didn't have to scramble and go and find that paper calendar which may not always be in the place I thought." – Isaacs Mom (P44), Tour Guide

Despite the Isaacs Mom being the primary scheduler, Isaacs Dad felt his involvement in the family calendar increased because the calendar was now accessible for him on his laptop in the locations he needed it “[*Mom*] is the master scheduler, but it did pull me in a little more having it.” For the Leonards, LINC was installed on the den PC and another laptop. Mom most often used the tablet to create events (because of the ink), yet appreciated that LINC was available on her laptop and looked at it there occasionally. Multiple locations were important for the two Seattle families, yet it is certainly not necessary for everyone. The Newmans had another computer in a home office where they could access LINC Web, but they never found the need to view the calendar from this location or install the full version of LINC; the publicly visible calendar in the kitchen was enough for them.

These findings validate Design Guideline 6 (see Section 7.2.6): for some families, *calendar access from multiple fixed home locations will be valuable*. For other families, *a single location in the home is ample* (Table 9.3, Row 6).

9.4 Discussion

Our field trials aimed at improving our understanding of digital family calendar design by seeing how a digital family calendar like LINC would affect family routines. This has revealed interesting findings about designing based on the attributes and use of paper calendars, digital extensions to realize calendar ubiquity, and the benefits and drawbacks of changes to calendaring routines as a result. I discuss each of these in turn.

9.4.1 Designing Based on Paper Calendars

LINC was designed based on several attributes of paper calendars: publicly visible, always-on, simple and flexible interaction, and at-a-glance awareness. Table 9.3 (Rows 1 through 3) summarizes these as a part of the design guidelines from Chapter 7. These *paper-like features were enjoyed by families* and, for the Calgary families, *this allowed them to fit a digital calendar within their existing routines* (with only minor adjustments). However, at times, LINC’s design did not meet the flexibility of paper. For example, it was not as flexible as paper when it came to being able to place it in home locations and family routines had to adjust slightly to accommodate.

We have also learned that sometimes it is beneficial to move beyond the abilities of paper. For example, we learned that at times it would be beneficial to relax the always-on calendar model and allow families to use the calendar device for other tasks (Table 9.3, Row 1). That is, a device should primarily function as an always-on calendar, but it could also allow people to access other programs like email or the web (which often relate to scheduling activities) when needed. After a certain amount of inactivity, the device could revert to the always available calendar display. This is similar to paper in that it is multi-purpose, yet paper clearly does not offer digital information access. Studies by McClard and Somers (2000) have also revealed the value in being able to perform a variety of tasks in the home on a mobile device like a Tablet PC. While Tablet PCs are still prohibitively expensive to fulfill these needs in practice, we anticipate cheaper dedicated devices could be built for this. Taken together, the field trials have revealed that *a digital family calendar design should balance how it exploits the properties of paper while also overcoming its shortfalls.*

9.4.2 LINC's Digital Extensions

LINC was also designed with digital extensions to overcome some of the challenges of paper calendars. In particular, it enabled ubiquitous calendar access, as summarized in Table 9.3 (Rows 4 through 6). We found that digital extensions to a family calendar can actually *change* family routines in beneficial ways. Ubiquitous calendar access helped *increase family involvement in checking the calendar* for the Seattle families (reported as a previous challenge for them). We initially thought that access to the calendar outside the home would be crucial for adoption of a digital family calendar. We were surprised by the value the Seattle families received from having access to the calendar within the home in multiple fixed locations. Of course, remote access is still important. Even though LINC offered an imperfect remote experience, families still benefited from calendar access at work and, in some situations, while mobile. These findings validate that designing for ubiquity is an appropriate step for digital family calendar design. However, further exploration still needs to be done. This should involve studying the integration of the family calendar with work calendars and also other mobile form factors. Alternative lightweight mobile access capabilities discussed in Chapter 7 are also appropriate design avenues to further explore.

The fact that LINC *was* a novel technology caused some members of the Calgary families to pay more attention to the family calendar. Of course, one could argue that this novelty would wear off. However, our future calendar users—our children—are increasingly exposed to computers in schools; we anticipate they will be more comfortable with family calendars that are a part of the digital realm in the future. The fact that a digital family calendar like LINC *is* able to meet family calendaring needs shows promise for digital calendar design in the domestic realm.

9.4.3 The Benefits and Drawbacks of Change

Family routines changed as a result of using LINC (at least for the Seattle families). The main change saw an increase in family involvement in the calendaring process. Yet is increased family involvement in the calendar routine beneficial? This certainly depends. Our study was predominantly positive. We saw family involvement increase, and families welcomed and appreciated the changes. This is because routines changed to overcome previous challenges without inhibiting existing successes. In most cases, this meant that responsibility for the family calendar was still left up to the primary scheduler even though others would routinely check it. Family calendaring also remained a task predominately centralized in the home.

Of course, improved ubiquitous access and extended use of a digital family calendar could introduce adverse changes. Perhaps improved access from work and while mobile will, over time, increase remote checks and updates of the family calendar by other family members to a point that hinders the value of the primary scheduler. Still, we expect that—much like other domestic activities—one person would generally ‘take charge’ of the family calendar with others assisting. This assistance would benefit the primary scheduler, perhaps by having some change awareness let them maintain an overview of others’ calendar activity. Of course, there is the chance that increased family involvement through ubiquitous access could cause increased distraction, conflict, or power struggles. This is hard to predict and should certainly be explored in further field studies of digital family calendaring.

9.5 Summary

This chapter has presented the field trials of LINC where I evaluated the design guidelines derived from family calendaring theory and tested them in actual real-world practice. This involved deploying the high-fidelity version of LINC into the homes of four families for a period of four weeks, where LINC was used as their primary family calendar.

Through the field trials, we have gained a deeper understanding of digital family calendar design and use. The idea of providing an always-on and public digital family calendar benefited families because they could use the calendar in a way that fit within their existing routine. Yet we also learned that, in addition, relaxing this always-on model could be valuable in order to let families utilize the calendar device for other calendar-related tasks like checking email or browsing the web. The ability to glance at the calendar and acquire awareness information through rich annotations was also valuable. In fact, this superseded the need to use automated reminders to remember calendar activities for coordination. Digital extensions to LINC that permitted ubiquitous calendar access caused changes to the routines of some families. In this case, more family members began checking the calendar. This increase in family involvement helped overcome existing challenges in calendaring routines without imposing on the success of having one person in charge of the family calendar. Ubiquitous calendar access was not without its pitfalls though. Mobile calendar access requires a greater range of device form factors than was available and work access requires a design that is better integrated with existing workplace calendars.

The findings are limited in that they are derived from the specific use and reactions of four families to LINC. However, we took care to choose a diverse set of families in terms of their coordination routines. These routines prove highly representative of middle class Canadian and American family calendaring routines in general, as evident from Chapters 5 and 6. Thus, a key strength of the study design was our choice of families. Given this, it is reasonable to expect that designing digital family calendars based on paper attributes and extending them to be ubiquitously accessible will in fact work for the majority of families from this demographic. Naturally, some families will still vary based on geographic region, culture, and lifestyle, and designs will still need to be flexible to meet a range of idiosyncratic needs. This is good, for it shows the potential of further digital family calendar development.

In the next chapter, I conclude this dissertation by placing the findings from this chapter and others in the context of my original research objectives. I also reflect on the research contributions I have made to family calendaring and domestic computing.

Chapter 10. Conclusions

This dissertation has explored the design of groupware to support family calendaring routines. The goal of this final chapter is to conclude the dissertation by summarizing the research problems I addressed and describing the completed objectives that form my research contributions. I then discuss how my results generalize culturally and what implications exist for the studies of calendaring in general, as well as the design of home technologies. Following this, I describe the next steps of family calendaring and domestic awareness research that can build on this dissertation's work.

10.1 Research Problems

This dissertation focuses on addressing the overarching research question: *how can we best design digital family calendars to support the everyday calendaring routines of families?* This question was divided into four sub-problems in Chapter 1 that looked at the design of groupware for family calendaring from a broad to narrow perspective. I summarize each problem here to lead into a discussion of my research contributions.

Problem 1: We do not understand the domestic awareness and coordination routines of family and friends.

Problem 2: We do not have a sufficient understanding of family calendaring routines and practices.

Problem 3: We do not know how to apply an understanding of family calendaring routines to the design of digital family calendars.

Problem 4: We do not know how digital family calendars designed specifically to address family needs will actually be used by families as a part of their coordination routines.

10.2 Research Contributions

The main objective of this dissertation was to: *provide a foundation for understanding how to best design digital family calendars to meet the coordination needs of families*. I completed this objective by addressing each of the previously mentioned research problems with the completion of four sub-objectives. These present a number of significant research contributions to the fields of HCI, CSCW, Ubiquitous Computing, and, more specifically, domestic technology design. I outline the four objectives, the steps I took to complete them, and the research contributions they present.

10.2.1 Domestic Awareness Routines

Objective 1: Describe the domestic awareness and coordination routines of family and friends.

I have completed this objective by: conducting ethnographic / contextual interviews with 29 individuals from 10 households, analyzing the findings using open coding, and synthesizing the findings with the related literature. The completion of Objective 1 presents several major research contributions:

—*Model of Interpersonal Awareness*: This model identifies the domestic relationships for which people need to maintain awareness, the specific awareness information people need and the uses for it, and the techniques people employ as a part of their everyday routines to maintain an awareness of others (Chapter 2). This reveals that people have a range of needs when it comes to maintaining awareness of others in the domestic realm. The model of interpersonal awareness adds significant value for it situates family calendaring within a larger sphere of domestic awareness needs (Chapter 3).

—*Design Guidelines for Interpersonal Awareness Groupware*: The above model also draws out general guidelines for the design of domestic awareness technologies. The range of interpersonal awareness needs translates into unique technological solutions to meet the varying needs of families and friends. One of these needs is technology to support activity awareness of family members; this is groupware for family calendaring. Other needs exist as well, including technology specifically to support the maintenance of awareness of intimate

and extended socials. We also now know that interpersonal awareness groupware should be designed to fit within the contextual locations that people naturally use within the domestic environment. This means designing technology that is not necessarily situated on a desktop PC. (Chapter 3)

The completion of Objective 1 also presents lesser, yet still important, contributions:

—*Comparison to Workplace Awareness*: The model allows us to compare interpersonal awareness needs to workplace awareness needs, which helps us understand the relationship between the home and work contexts. This reveals that awareness groupware for the workplace cannot simply migrate into the home. A range of awareness needs exist in both contexts, yet the practices people undertake to maintain awareness are different. (Chapter 3)

—*Analyze Existing Awareness Technologies*: The model allows us to analyze existing interpersonal awareness technologies to understand where they succeed or fail at providing family and friends with awareness information. This has revealed that a large number of technologies are able to support intimate socials, with fewer supporting the needs of home inhabitants. We also did not find any technologies that can adequately address the awareness maintenance needs of extended socials. (Chapter 3)

—*Method for Investigating Awareness in the Domestic Realm*: The completion of this objective has also presented a novel approach for investigating awareness in the home. This includes using ethnographic / contextual interviews in an applied setting and augmenting them with paper activities to further understand a social phenomenon. This technique could similarly be applied to workplace investigations of awareness by augmenting direct observational techniques with paper exercises appropriate for the context. (Chapter 2)

10.2.2 Family Calendaring Theory

Objective 2: Formalize family calendaring routines and practices into a theory that can inform the design of groupware calendaring systems.

I have completed this objective by conducting applied ethnographic / contextual interviews with 44 families, analyzing the findings using open coding and other qualitative analysis methods, and synthesizing the findings with the related literature. The completion of Objective 2 presents several major research contributions:

—*Family Calendaring Theory*: This theory provides further understanding of the context in which paper and digital calendars are being used by families. It reveals a typology of family calendars that are used by families along with three family types that differ in their level of family involvement in the calendaring process. It also formalizes the steps families undertake for scheduling, maintaining activity awareness with calendars, and coordinating activities with this knowledge. Moreover, it illustrates how families add additional meaning to their calendar and its contents through annotations and augmentations. And, finally, through synthesis, it situates this knowledge in relation to related calendaring literature. This theory as a whole provides researchers and designers with a shared understanding of the context of family calendaring and a common vocabulary to discuss both paper and digital calendar designs, which in itself is a contribution (Dourish, 2006). (Chapters 4 through 7)

—*Guidelines for Family Calendaring Design*: The theory described above also provides implications for design through a set of empirically-based design guidelines for digital family calendars drawn from real domestic calendaring practices. These guidelines can guide the design of digital family calendars and also analyze the benefits and limitations of existing family calendar designs. Previous CSCW research on domestic culture has produced an understanding of family calendaring practices and several guidelines to support them. The theory of family calendaring presented in this dissertation extends this understanding in several regards. Moreover, it questions several design suggestions coming from past research of domestic culture and shows that the design direction of current commercial digital family calendars is fundamentally wrong and likely to produce impoverished family calendaring routines. This is because many digital calendars designed for personal or family use are based on a model of workplace calendaring activities, which are *not* family calendaring routines. (Chapter 7)

The completion of Objective 2 also presents a lesser, yet still important, contribution:

—*Method for Investigating Family Calendaring*: Observing domestic practice is challenging. Direct observation can be intrusive and time consuming because domestic activities span large portions of time over one or more days. The approach I used overcame these challenges by grounding applied ethnographic / contextual interviews with everyday domestic artefacts to reveal how they are used and why. This involved combining

approaches from ethnographic interviews (Spradley, 1979) with methods from contextual inquiry (Holtzblatt and Jones, 1995, Holtzblatt *et al.*, 2005). This technique could be similarly used for studying other domestic phenomenon in addition to family calendars. (Chapters 5 and 6)

10.2.3 The Design of the LINC Digital Family Calendar

Objective 3: Use the understanding of family calendar routines along with a participatory design process to design a digital family calendar.

I have completed this objective by designing a digital family calendar called LINC through an iterative participatory design process that took place over three stages—low-fidelity, medium-fidelity, and high-fidelity prototyping—and involved twenty primary schedulers. The completion of Objective 3 presents several major research contributions:

—*A Proof-of-Concept Digital Family Calendar:* LINC is a proof-of-concept digital family calendar that illustrates how an understanding of family calendaring routines can be applied to the user interface of a digital family calendar. This contributes to the field of CSCW as further illustration of how existing practice can inform design. While only a portion of the family calendaring theory was available during LINC’s design (the initial twenty interviews were being conducted during its participatory design and the remaining 24 were conducted after its design), it still embodies many of the principles that come out of the family calendar analysis in Objective 2. LINC’s design also shows that digital family calendars *can* be designed specifically to fit within a general understanding of family calendaring routines, even though family routines vary in actual practice. (Chapter 8)

LINC is a fully working application capable of being used by real families as a part of their everyday routines. It has full network capabilities to support calendar access from multiple locations in the home and locations outside the home where it can be installed on a PC or work as an information appliance. In fact, during its design, LINC was used within my own home over the course of one month and it continues to be used in the home of my collaborator, A.J. Brush. LINC is also available internally for download within Microsoft where others have tried LINC as a part of their own family calendaring routine. However, findings from this usage are beyond the scope of this dissertation.

—*Validation of Family Calendaring Theory*: LINC’s design process has also uncovered findings about family calendaring routines. This includes showing that a digital family calendar designed to fit within existing routines is desired by families, coordination tools to negotiate who will attend events is not needed, and awareness of calendar content is crucial for coordination. These validate and extend the theory articulated as a part of Objective 2. (Chapter 8)

The completion of Objective 3 also presents lesser, yet still important, contributions:

—*LINC Web and LINC Mobile*: These two additional clients for LINC illustrate how a digital family calendar can be designed for ubiquitous calendar browsing outside the home when a full LINC client cannot be installed (LINC Web) or a family member is away from a PC (LINC Mobile). At current state, LINC Web and Mobile are best suited as design probes for further investigation into family calendaring routines. That is, they are capable of being used for field trials of a digital family calendar to understand what mobile needs exist for families. (Chapter 8)

—*Method for Designing a Digital Family Calendar*: LINC’s design used an iterative participatory design approach where users participated as aids to designers and researchers. Participatory design is already in widespread use for the development of many technologies. The contribution in this dissertation is to show how participatory design can be applied in the context of family calendar design. This includes the stages in which participants were included, the stages participants were not included in, and, the reasons for their inclusion at each point. This approach can certainly be applied to the design of other home technologies in a similar manner and would involve understanding where it would be most beneficial to include participants given the research context. (Chapter 8)

10.2.4 Field Trials of the LINC Digital Family Calendar

Objective 4: Evaluate the LINC digital family calendar in order to understand how it will actually be used by families as a part of their coordination routines.

I have completed this objective by deploying the LINC in the homes of four families over a period of four weeks and understanding their use of LINC through contextual interviews. The completion of Objective 4 presents several major research contributions:

—*Real World Usage of a Digital Family Calendar*: The field trials of LINC showed how families will adopt and use a digital family calendar as their primary family calendar. This illustrated that digital family calendars *are* able to support existing routines where they do not disrupt the successful social practices of family calendaring. It also showed that a digital family calendar, if designed appropriately, is able to extend family calendaring routines in ways that enhance coordination routines through the power of technology (e.g., digital input, remote access, automated synchronization). (Chapter 9)

—*Validation of Family Calendaring Theory*: LINC's field trials also uncovered findings about family calendaring routines. This includes showing that a digital family calendar should be always-on or easily accessible in a public location, provide at-a-glance awareness of calendar content through rich annotations, and support ubiquitous access from multiple locations within the home as well as while mobile and at work. These further validate and extend the theory articulated as a part of Objective 2. (Chapter 9)

The completion of Objective 4 also presents a lesser, yet still important, contribution:

—*Field Trial Method*: The field trials of LINC used an approach similar to the field deployment of other home technologies (e.g., Tollmar and Persson, 2002, Rowan and Mynatt, 2005, Sellen *et al.*, 2006b, Plaisant *et al.*, 2006). Thus, the field trial method I have detailed illustrates yet another application of field deployment methods. In this respect, I have shown how field trials can be applied to the study of family calendaring. A similar method could be used for further studies of calendaring in domestic environments, just as it could be applied to the evaluation of other domestic technologies. (Chapter 9)

10.3 Generalizing the Results

I have studied the domestic routines of middle class Canadian and American families, though my findings generalize more broadly to middle class Western culture. My findings also provide, at a high level, ideas for designing domestic technology in general. I discuss each of these here.

10.3.1 Generalizing to Other People and Cultures

The research presented here looks specifically at the domestic routines of middle class families in Canada and the United States. I saw many commonalities between families despite the diversity of the households chosen. Moreover, I also saw my results coincide and extend existing calendaring and awareness research. Given this, I hypothesize that more detailed studies over a broader and larger pool of households would uncover the same results. Thus, my findings certainly exhibit *face generalizability* as there is no obvious reason to believe that the results would not generalize from the families I have studied to the larger population of middle class families in Canada and the United States (Maxwell, 2005).

I also expect that the results I have presented generalize to the broader middle class Western culture at a high level. Many of the awareness systems I analyzed in Chapter 3 were developed in other regions around the world outside of Canada and the United States. Yet these systems still fit within the theory I presented. Given this, it is likely that people in the broader Western culture exhibit a range of needs for maintaining interpersonal awareness of family and friends. However, the actual range may differ between regions and sub-cultures as would the mechanisms people employ for maintaining awareness. This is evident given the high proliferation of mobile phone usage in Europe, which far exceeds North America.

In terms of calendaring, there is a large body of social psychology studies that look at the tempo, rhythm, and use of time in various cultures around the world (Levine, 1997 summarizes a large sample of studies). These studies have shown that most industrialized nations exhibiting strong economies have fairly similar tempos and notions of time (Levine, 1997). However, there will naturally be exceptions based on one's location (e.g., rural vs. urban), personality (e.g., Type A vs. B personalities) (Levine, 1997) and context (e.g., living alone, or dysfunctional families). Thus, I would expect that most industrialized nations would exhibit similar properties for family calendaring that I have presented. That is, there is still likely to be a typology of calendars used by families in broader Western culture, along with a range of family involvement in calendaring, and general themes when it comes to calendar content and annotations. What will likely differ are the specifics of each of these as they are customized based on the lifestyles people lead in each sub-culture. Of course, these assumptions should be verified with future cross-cultural comparison studies.

Do my findings generalize beyond middle class Western culture? This is not likely. The same social psychology studies show that time is a very flexible notion in some cultures (Levine, 1997). For example, cultures in Mexico and Central American exhibit a tempo of life that is much less than Canada and the United States (Levine, 1997). Meeting someone at 1pm for an appointment could easily mean meeting at any point in the day (Levine, 1997). Given this, I would question that calendars are in fact as crucial to other cultures as they would be to middle class Western culture. It may even be the case that calendars are used very little in cultures where time is much more flexible. Here coordination may be a near non-existent practice. Again, these assumptions should be verified with future cultural studies.

10.3.2 Generalizing to Domestic Computing

Even though I have focused on family calendaring, the findings I have presented are applicable more broadly to domestic computing. My findings reveal that a range of calendars are used by families in multiple locations. People augment these calendars as needed to create their own meaning for them and their content. At a high level, it is natural that these findings would extend to other domestic technologies. For example, it is likely that other home technologies would also present the same location needs for design. That is, designs should be able to be situated in specific locations that are used as a part of everyday domestic routines (Elliot, Neustaedter, and Greenberg, 2005). This would also mean that, like family calendars, appropriate information should be presented in these locations. All domestic technologies will also likely need to be customized by families to mold into the specific needs of families. Thus, the design theory I have presented about family calendaring is but one example of how we should, at a high level, design technology for the domestic realm.

10.4 Future Research

This dissertation answers many questions, yet also generates many more. Other researchers and designers should use the work presented in this dissertation as a building block for these future explorations.

10.4.1 Interpersonal Awareness

I have provided breadth coverage of interpersonal awareness that provides high level guidelines for awareness design rather than specific and intricate details. The next steps for domestic awareness research involve building on the model of interpersonal awareness by conducting ethnographic and design studies to draw out the specific subtleties of awareness acquisition and maintenance that the breadth coverage is unable to provide. I have already investigated one of these specific areas—activity awareness for home inhabitants *or* family calendaring—though further research is needed for other aspects. For example, future studies could look further into the maintenance of location awareness for home inhabitants to outline more detailed ways in which technology can support this facet of awareness. Similarly, research could uncover detailed design guidelines for maintaining awareness of extended socials, which could lead to design explorations. As our findings revealed, we did not find any research explorations of technology designed specifically for awareness of extended socials. The research I have presented lays the foundation for these future steps. It provides a vocabulary to talk about this awareness in the domestic realm and outlines the different contexts in which interpersonal awareness research should continue.

10.4.2 Calendaring Routines

I have looked specifically at intra-family calendaring routines, rather than extending my work to include inter-family calendaring: coordination between families using calendars. Future studies should build on the theory I have presented to understand which findings are applicable to calendaring between families. This relates to studies of interpersonal awareness. Further work should articulate what family calendaring information is best presented to other families who may consist of intimate or extended socials. This work also entails understanding how this calendaring information is best presented. For example, should it be presented in the context of a family's existing calendar, in another calendar, or in another device altogether. The theory I have presented can be used as a basis for this work where the new knowledge obtained extends my findings to incorporate inter-family calendaring. This work will also lead to designs. Here it may be appropriate to build on the design ideas presented in LINC. Plaisant *et al.* (2006) have already begun this research track, where they have designed and deployed a shared inter-family calendar to draw out initial

findings of how families will use such a calendar. I suggest researchers continue on this track to further formalize inter-family calendaring design.

As discussed in Section 10.3, I have investigated the calendaring routines of middle class families in Canada and the United States. These findings likely generalize to middle classes in other industrialized nations in Western culture; however, this should be verified with future studies. These studies should first seek to understand what types of calendars (or coordination artefacts) are used by other subcultures within Western culture, how these calendars are used for coordination, and how people provide additional meaning to them. These findings can then be compared and contrasted with the theory I have presented. Calendaring designs could build on the ideas presented in LINC to create and evaluate a calendar prototype specific to the needs of the subculture. This could be a completely new calendar design or one that extends LINC.

It is clear that other cultures beyond Western culture exhibit different notions of time (Levine, 1997), which translates into different coordination needs. Future studies should further investigate these routines to understand how technology can benefit these cultures, if at all. These findings can again be compared with the theory and design ideas I have presented to produce a larger understanding of family coordination. The methods I used to generate my theory can also be applicable for studying other cultures providing they do in fact have artefacts that are used for coordination. This assumption would need to be first verified.

10.4.3 Coordination Tools

This dissertation is most certainly about design, though many design explorations are still to come by other researchers. In terms of my own work, LINC presents further potential explorations in itself. LINC was designed based on a paradigm similar to paper calendars where it uses a calendar grid metaphor and pen-based interaction. Though I saw no reason to deviate from this type of design, it is certainly possible that other visualization and interaction paradigms exist that may be better suited for families than the ones they are already familiar with. Future work should explore other design avenues by building on the design guidelines I have presented and further refining them. For example, we now know what information people need to record in their calendars, how they want to represent it,

and what level of detail they need to see when checking the calendar. This knowledge is all a necessary precursor to the further exploration of design paradigms for a digital family calendar that fits people's needs. This design work can involve iterating on LINC's design or using it as a basis for a new design of a digital family calendar.

LINC's ubiquity also presents future design opportunities. LINC is capable of presenting calendar information in multiple locations, yet currently the same information is presented in all locations. The design guidelines presented in Chapter 7 call for selectable information in locations and suggest what types of calendar content is likely to be needed in each. LINC should be extended to support such functionality. This includes looking further at the integration of work and family calendars. Even though they were valuable as design probes for exploring calendar routines, LINC Web and LINC Mobile are imperfect design solutions that also require further design iteration. Both naturally need to be extended to provide more than just calendar browsing. The interaction and visual display for adding and updating events needs to be explored and tested in each. For LINC Web, studies should investigate how best to design a web interface for a family calendar. Many digital online family calendars are in existence and can benefit from design iteration based on the design guidelines presented in this dissertation. For LINC Mobile, studies should investigate lightweight presentation of calendar details specific to the needs of family members while out and about. This may include list-based techniques for presenting calendar details relevant to the current time period. It may also involve studying other interaction techniques like voice input or query. In addition to this design work, future research should also perform longer term field trials of these calendaring technologies to understand larger cultural changes that may arise.

At the onset of this dissertation, I explained that even though calendars are perhaps the most crucial of domestic coordination artefacts, there are certainly others that are in need of exploration. For example, notes and lists have been shown to be commonly used by families for coordination especially when one's schedule is busy (Swan and Taylor, 2005). Chapter 2 also revealed other technologies that are used by family and friends for maintaining awareness, some of which are used for coordination. Future studies should continue explorations of these coordination artefacts in an effort to understand how we can design integrated coordination systems. This is an idea proposed by Taylor and Swan

(2005). LINC is but one coordination tool amidst a plethora of other tools and technologies that people can use to coordinate everyday life. Researchers need to first study these tools piecemeal, but after this is complete there needs to be further research to understand how these tools can be integrated into one complete system. This is certainly a challenging endeavour and not one that should be approached as a whole. Researchers should attempt to integrate coordination tools one at a time. A natural first step may be to try to understand how to link a family calendar like LINC to a workplace calendar so that relevant information may smoothly move between the two coordination tools. This is suggested as a design guideline in Chapter 7. Alternatively, one could seek to understand how to best integrate family calendaring systems like LINC with list-making technology.

10.5 Final Words

This dissertation has investigated the design and evaluation of groupware to support family calendaring through rigorous scientific method. It has identified the context of family calendaring as interpersonal awareness information that is exchanged and maintained between family and friends. It has also uncovered and formalized the domestic calendaring routines of families to show how digital family calendars should be designed. These findings have validated, extended, and, at times, refuted prior research on family calendaring. They have also illustrated that family calendaring is fundamentally different than workplace calendaring and requires unique technological solutions to address calendaring needs. This theory has led to the design of a digital family calendar called LINC that fits within and extends the natural routines of families. LINC's design and evaluation have helped validate and further refine family calendaring theory. Yet despite advancing domestic coordination research in this dissertation, there still exists many unanswered research questions. Future research should use the material presented in this dissertation as a building block for further theory and design exploration.

In closing, the findings presented may appear to illustrate what is obvious in nature to some. This is what I would hope for as I have articulated and verified the everyday activities that people are familiar with. That being said, sometimes the obvious isn't so obvious until one is told, for our everyday domestic routines are often tacit and may easily go unnoticed.

Appendix A. References

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Appendix B. Interpersonal Awareness Study Materials

This appendix presents materials used for the study on Interpersonal Awareness.

B.1 Study Recruitment

Investigators: Carman Neustaedter and Kathryn Elliott
Supervisor: Saul Greenberg

Experiment Purpose: The purpose of this research is to understand interpersonal communication between home inhabitants and their family and close friends. We would like to understand the social culture of this group and the mechanisms they currently use to stay in contact and coordinate activities with each other.

Procedure: You will be asked interview questions about your social relationships, e.g., family and friends, the communication mechanisms you use to maintain contact with others, and the areas of communication in your home. The interviews will take place in your own home where you can show the investigators the areas of communication in your home, e.g., your fridge door, the area around the phone, your answering machine. Photographs/videos will be taken of these areas with your permission.

Objective: The research objective is to design an electronic message centre for homes with the goal of supporting interpersonal communication. To achieve this, we need to first understand the social culture of domestic environments and the mechanisms currently used by home inhabitants for interpersonal communication. With this understanding we can design communication technologies for future “smart homes” which are socially appropriate and useful.

Committment: Your participation in the study will take one to two hours and you will be compensated for your time with a payment equivalent to approximately \$50 per family. For you to participate, we ask that all members of your household participate, with the exception of those under 12 years of age. The study will involve both group and individual activities. Parents will be required to provide consent for minors and be present for all interviews with minors.

To Participate or For More Information:

Send email to: carman@cpsc.ucalgary.ca, elliottk@cpsc.ucalgary.ca

B.2 Description

The following description should be read to each participant at the beginning of the study to inform participants of the procedures prior to giving consent. Italicized text are instructions to the investigator.

Introduce yourself.

My name is _____, and I will be giving you instructions on what to do and will answer your questions.

We're researching interpersonal communication between home inhabitants and their family and close friends. We would like to understand the social culture of this group and the mechanisms they currently use to stay in contact and coordinate activities with each other.

Tell them about the experiment.

The study will involve an in-depth interview about the social relationships of you and your family, the communication mechanisms you use to maintain contact with others, and the areas of communication in your home. Throughout the study we will be taking notes and would like to take photographs/videos of communication areas in your home, given your permission.

Tell the participant that it's OK to quit at any time.

If you feel uncomfortable, you are free to quit at any time. Do you have any questions at this point?

Give them the consent form to sign. If it is not signed, do not proceed.

Proceed with an initial demographic interview.

B.3 Demographics

The following demographics will be gathered about each household participating in the study. There will be no formal questionnaire – household members will simply be asked for this information at the beginning of the interview or during the recruitment process.

Full-Time Members are people who live permanently at this address, with only short-term exceptions.

Number of Full-Time Members: _____

Part-Time Members are people who may only live at this address part of the time – i.e. children living under shared custody agreements, etc. They should be significant, permanent members of the household.

Number of Part-Time Members: _____

Ages of Household Members:

Scholastic Grade/Year and/or Occupations of Household Members:

Relationships between Household members (e.g., spouse, child):

B.4 Consent Form

Research Project Title: Interpersonal Communication in the Home

Investigators: Carman Neustaedter and Kathryn Elliot

This consent form, a copy of which has been given to you, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Purpose: The purpose of this research is to understand interpersonal communication between home inhabitants and their family and close friends. We would like to understand the social culture of this group and the mechanisms they currently use to stay in contact and coordinate activities with each other.

Participant Recruitment and Selection:

To be recruited for this study, we ask that you allow us to use and analyze your results from the study.

Procedure:

The study should require one to two hours of your time. You will be asked interview questions about:

1. your social relationships, e.g., family and friends,
2. the communication mechanisms you use to maintain contact with others, e.g., phone, email, instant messenger, notes, mail, and
3. the areas of communication in your home, e.g., the area around your phone, your fridge door, a bulletin board, a whiteboard, the front door, your computer.

The interview will require that you show the researchers specific areas and artefacts in your home that you use to communicate with others.

Confidentiality:

Your anonymity will be strictly maintained. Reports and presentations will refer only to a participant identification number and will be in a secure filing cabinet or on a secure computer. Confidential information will be hidden from photos and videos prior to the publication of results from this study.

Risks:

There are no known risks, however, if you feel uncomfortable you are free to quit at any time. All information collected from a person that withdraws will be destroyed.

Investigators:

Carman Neustaedter is a PhD student and Kathryn Elliot is a MSc student, both in the

Department of Computer Science at the University of Calgary. Their supervisor is Dr. Saul Greenberg, Professor in the Department of Computer Science.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. If you have further questions concerning matters related to this research, please contact:

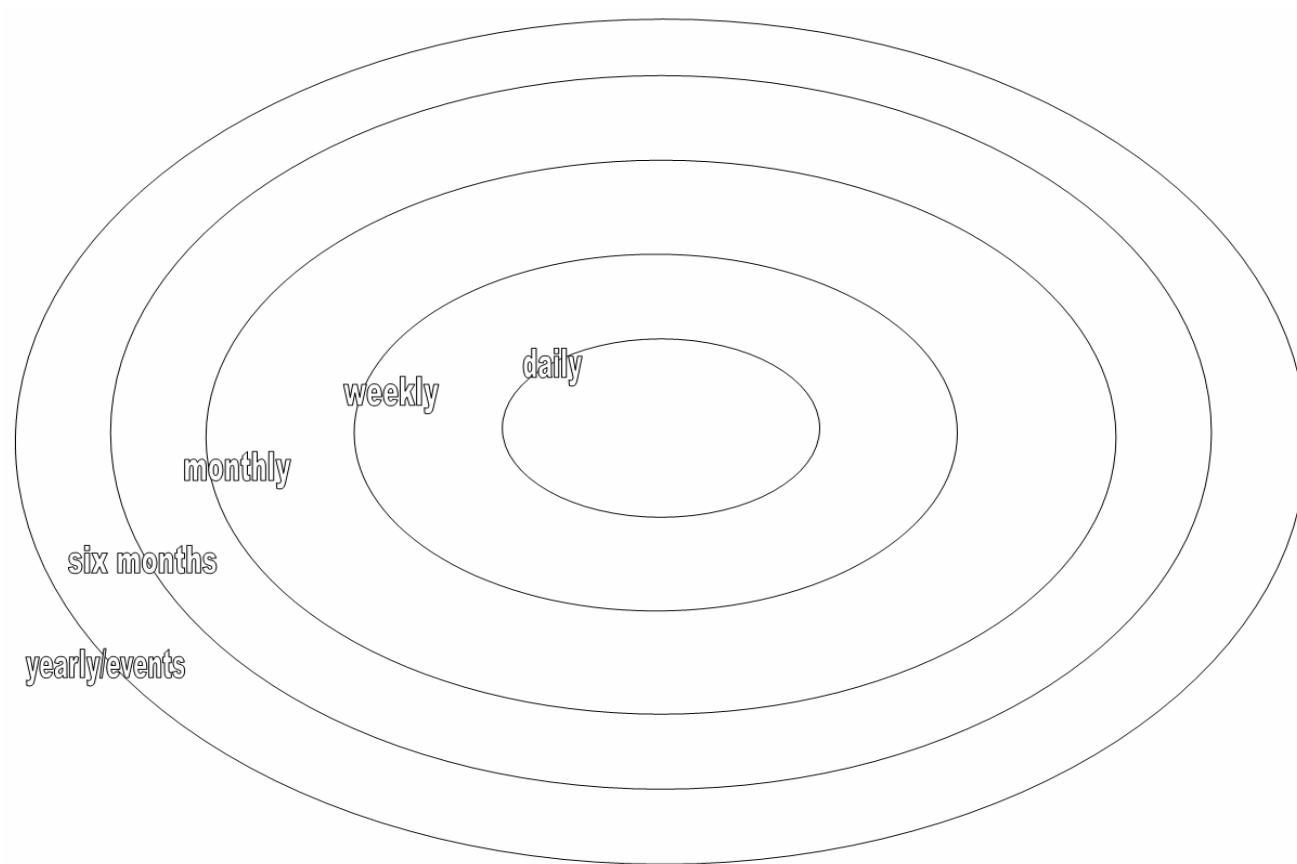
Carman Neustaedter (carman@cpsc.ucalgary.ca), Kathryn Elliot (elliottk@cpsc.ucalgary.ca), or Dr. Saul Greenberg (saul@cpsc.ucalgary.ca)

If you have any questions or issues concerning this project that are not related to the specifics of the research, you may also contact the Research Services Office at 220-3782 and ask for Mrs. Patricia Evans.

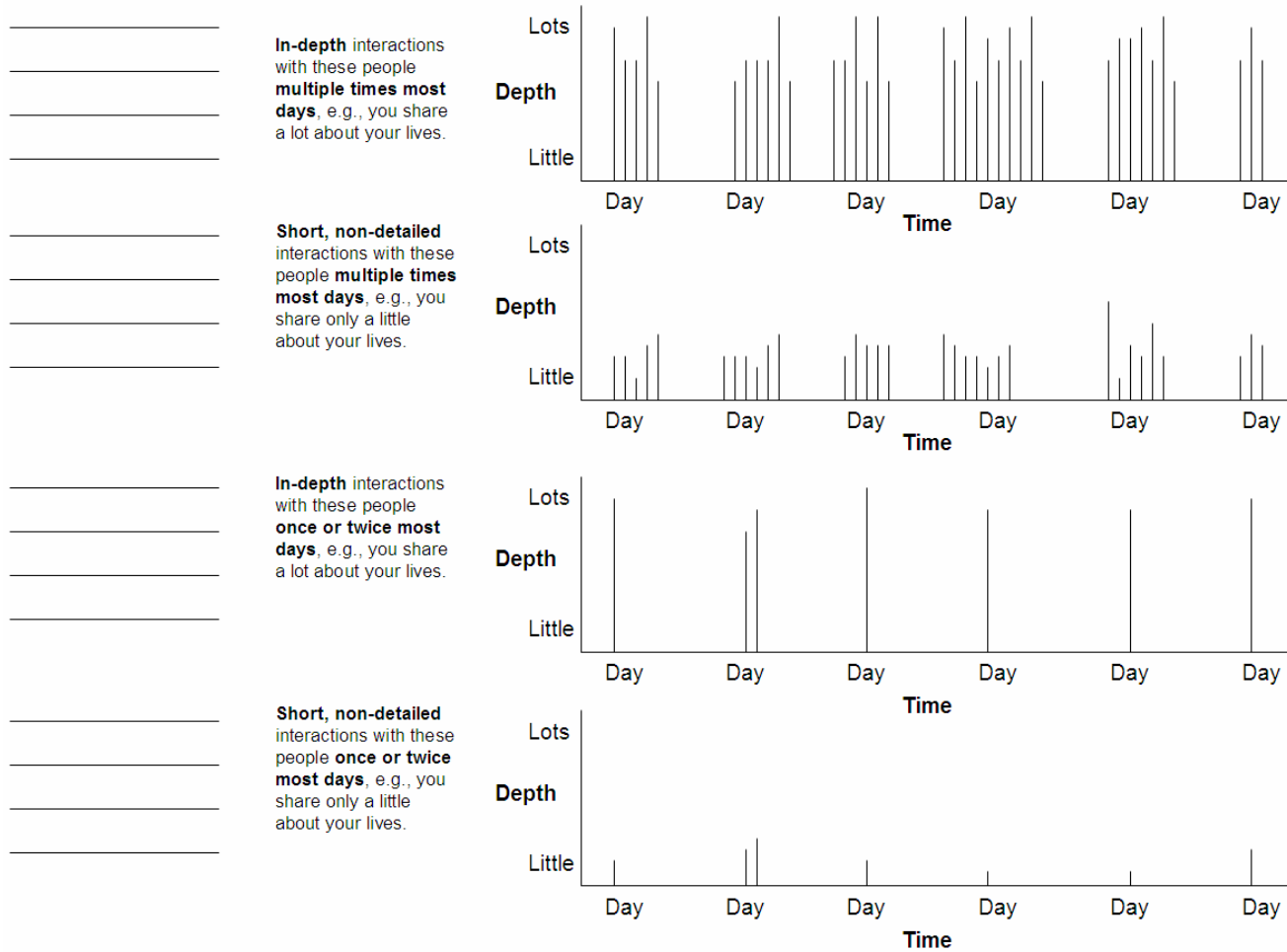
<hr/>	
Participant's Name	Date
<hr/>	
Participant's Signature or Signature of Parent/Guardian	Date
<hr/>	
Investigator's/Witness's Signature	Date

A copy of this consent form has been given to you to keep for your records and reference.

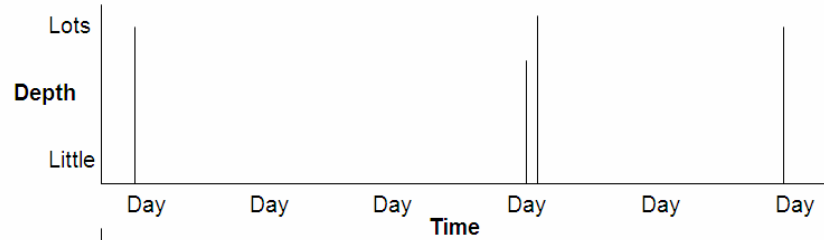
B.5 Social Target



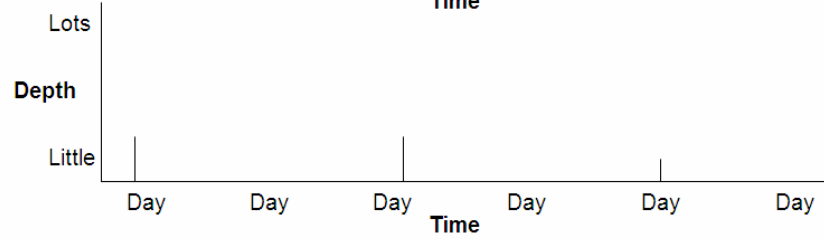
B.6 Interaction Frequency Graphs



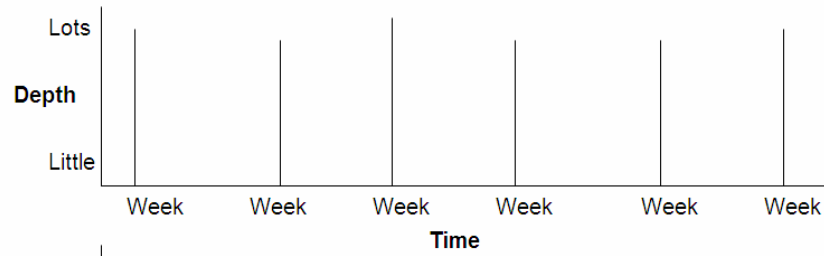
In-depth interactions with these people **every few days**, e.g., you share a lot about your lives.



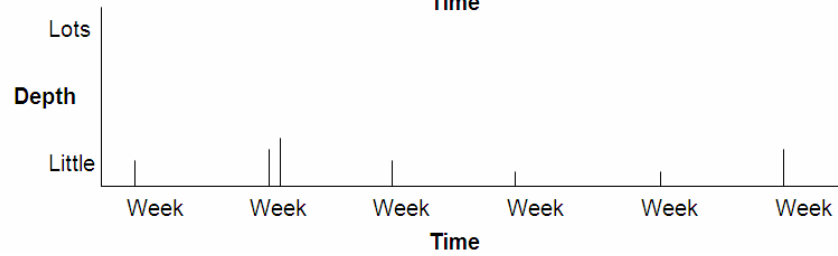
Short, non-detailed interactions with these people **every few days**, e.g., you share only a little about your lives.



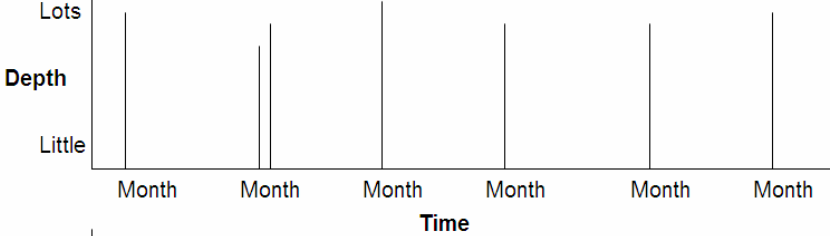
In-depth interactions with these people **most weeks**, e.g., you share a lot about your lives.



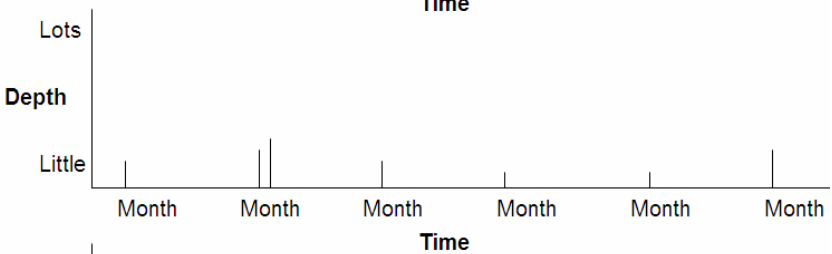
Short, non-detailed interactions with these people **most weeks**, e.g., you share only a little about your lives.



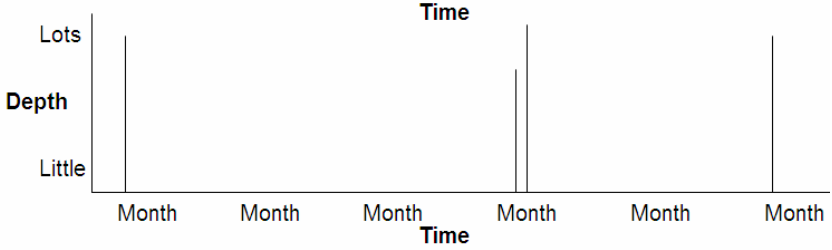
In-depth interactions with these people **most months**, e.g., you share a lot about your lives.



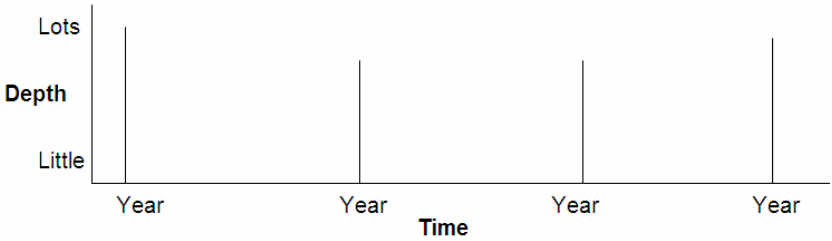
Short, non-detailed interactions with these people **most months**, e.g., you share only a little about your lives.

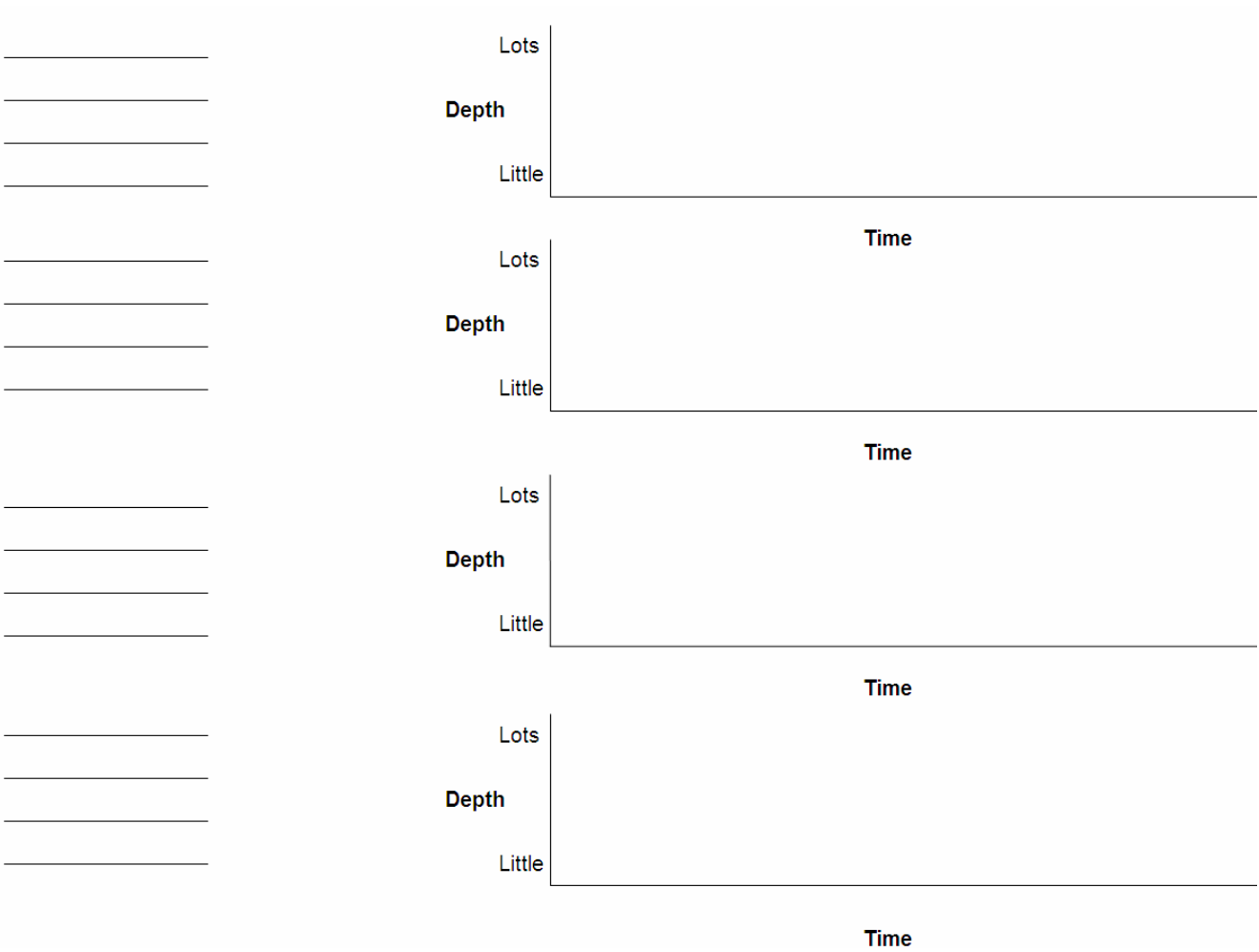


In-depth interactions with these people **every few months**, e.g., you share a lot about your lives.



In-depth interactions with these people **most years**, e.g., you share a lot about your lives.





B.8 Potential Semi-Structured Interview Questions

These questions will not be asked of every participating household. They are intended only as potential questions that may be asked to encourage participants to explain their social relationships and how they communicate with family and close friends. Other questions will be asked based on responses and on the artefacts and locations within the home.

Possible Stage 1 Questions about Interpersonal Awareness

Is there a certain group of people that you are always interested in?

Why are you interested in them?

What makes people close to you (part of this group)? e.g., proximity, interaction, awareness.

Do the individuals in this group change? Why/why not?

How many people are in this group? Does this change?

When does your group change?

What information do you want to know about this social group? About individuals in this group?

What do you expect from these people?

How important is it that you know where they are and what they are doing?

Are there other individuals you want to maintain awareness of? How do they differ?

Possible Stage 2 Questions about Domestic Locations

How do you decide where to leave information for someone else?

What information do you leave for others?

Where do you receive information from others?

Where do you prefer to receive information from others?

What information do you receive from others?

How do you know who is home or who is around?

B.9 Ethics Approval



UNIVERSITY OF
CALGARY

MEMO

CONJOINT FACULTIES RESEARCH ETHICS BOARD

c/o Research Services
Room 602 Earth Science
Telephone: (403) 220-3782
Fax: (403) 289 0693
Email: plevans@ucalgary.ca
Tuesday, March 23, 2004

To: Carman Neustaedter
Computer Science

From: Dr. Janice P. Dickin, Chair
Conjoint Faculties Research Ethics Board (CFREB)

Re: Certification of Institutional Ethics Review: Interpersonal Communication in the Home

The above named research protocol has been granted ethical approval by the Conjoint Faculties Research Ethics Board for the University of Calgary.

Enclosed are the original, and one copy, of a signed **Certification of Institutional Ethics Review**. Please make note of the conditions stated on the Certification. A copy has been sent to your supervisor as well as to the Chair of your Department/Faculty Research Ethics Committee. In the event the research is funded, you should notify the sponsor of the research and provide them with a copy for their records. The Conjoint Faculties Research Ethics Board will retain a copy of the clearance on your file.

Please note, an annual/progress/final report must be filed with the CFREB twelve months from the date on your ethics clearance. A form for this purpose has been created, and may be found on the "Ethics" website, <http://www.ucalgary.ca/UofC/research/html/ethics/reports.html>

In closing let me take this opportunity to wish you the best of luck in your research endeavor.

Sincerely,

Patricia Evans
Executive Secretary for:
Janice Dickin, Ph.D., LLB., Faculty of Communication and Culture and
Chair, Conjoint Faculties Research Ethics Board

Enclosures(2)

cc: Chair, Department/Faculty Research Ethics Committee
Supervisor: Saul Greenberg
Co-investigator: K. Elliot, Computer Science

CERTIFICATION OF INSTITUTIONAL ETHICS REVIEW

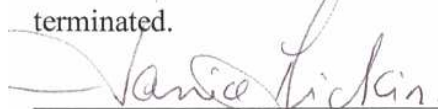
This is to certify that the Conjoint Faculties Research Ethics Board at the University of Calgary has examined the following research proposal and found the proposed research involving human subjects to be in accordance with University of Calgary Guidelines and the Tri-Council Policy Statement on *"Ethical Conduct in Research Using Human Subjects"*. This form and accompanying letter constitute the Certification of Institutional Ethics Review.

File no: **CE101-3914**
 Applicant(s): **Carman Neustaedter**
 Kathryn Kylie Elliot
 Department: **Computer Science**
 Project Title: **Interpersonal Communication in the Home**
 Sponsor (if
 applicable):

Restrictions:

This Certification is subject to the following conditions:

1. Approval is granted only for the project and purposes described in the application.
2. Any modifications to the authorized protocol must be submitted to the Chair, Conjoint Faculties Research Ethics Board for approval.
3. A progress report must be submitted 12 months from the date of this Certification, and should provide the expected completion date for the project.
4. Written notification must be sent to the Board when the project is complete or terminated.



Janice Dickin, Ph.D, LLB,
Chair
Conjoint Faculties Research Ethics Board

March 18, 2004

Date:

Distribution: (1) Applicant, (2) Supervisor (if applicable), (3) Chair, Department/Faculty Research Ethics Committee, (4) Sponsor, (5) Conjoint Faculties Research Ethics Board (6) Research Services.

Appendix C. Family Calendars Study Materials

This appendix presents materials used for the study solely looking at family calendaring routines.

C.1 Study Recruitment

Investigators: Carman Neustaedter, Kathryn Elliot, and Saul Greenberg

Interview Purpose: The purpose of this research is to understand the domestic coordination and awareness routines of families. In particular, we will focus on understanding how the family calendar is used as a tool for coordination and awareness.

Procedure: The study can be done at your home or at the university. You will be asked to show us any items you use for coordinating and planning family activities, e.g., family calendar, daytimer, notepads, electronic devices. Photographs will be taken of these items with your permission. We will then interview you about these items, discussing how they are used amongst you and your family for coordination.

Committment: Your participation in the study will take up to one hour and you will be compensated for your time with a payment of \$20.

C.2 Description

The following description should be read to each participant at the beginning of the study to inform participants of the procedures prior to giving consent. Italicized text is instructions to the investigator.

Introduce yourself.

My name is _____, and I will be giving you instructions on what to do and will answer your questions.

We're researching family coordination routines and family calendaring in an effort to understand how to design a digital family calendar for the home.

Tell them about the experiment.

The study will involve an in-depth interview about the coordination routines of you and your family. Throughout the study we will be taking notes and, if it is fine with you, would like to take photographs of your family calendar and any other items you have brought with you that you use for coordinating family activities.

Tell the participant that it's OK to quit at any time.

If you feel uncomfortable, you are free to quit at any time. Do you have any questions at this point?

Give them the consent form to sign. If it is not signed, do not proceed.

Proceed with a pre-study questionnaire.

Proceed with interview.

Ask participants if it is okay to photograph their calendar and other coordination items.

C.3 Pre-Study Questionnaire

In this survey we define household to mean any children and adults you live with. For example, a spouse, partner, roommates, kids, parents, or au pair. Please include children even if custody is shared. If you are uncomfortable answering any of the questions please skip them.

Please fill in the following table to describe each of your family members:

	Relationship to You	Age	Gender	Occupation or School grade	Work hours per week
You	<self>				
Adult 1					
Adult 2					
Child 1					
Child 2					
Child 3					

1. Do you have a car for each member of your household that can drive?
 - a. Yes
 - b. No

2. Would you say that you are the primary calendar scheduler in your home for family activities?
 - c. Yes
 - d. No

3. What is your household approximate combined annual income?
 - e. < \$20,000
 - f. \$20,000 – 35,000
 - g. \$35,001 – 50,000
 - h. \$50,001 – 70,000
 - i. \$70,000 – 100,000
 - j. \$100,000

C.4 Consent Form

Research Project Title: Understanding Domestic Coordination Routines

Investigators: Carman Neustaedter, Kathryn Elliot, and Saul Greenberg

The University of Calgary Conjoint Faculties Research Ethics Board has approved this research study.

This consent form, a copy of which has been given to you, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Purpose: The purpose of this research is to understand the domestic coordination and awareness routines of families. In particular, we will focus on understanding how the family calendar is used as a tool for coordination and awareness.

Participant Recruitment and Selection:

To be a recruited for this study, we ask that you allow us to use and analyze your results from the study.

Procedure:

The study should require up to one hour of your time. You will be asked interview questions about:

- the domestic artefacts you use for family coordination, e.g., family calendar, daytimer, notes
- the routines you and your family have surrounding the coordination of activities and events

The interview will require that you show the researchers the artefacts in your home that you use to coordinate and plan family activities. We also would like to take a picture of your coordination artefacts.

Confidentiality:

Your anonymity will be strictly maintained. Reports and presentations will refer only to a participant identification number and will be in a secure filing cabinet or on a secure computer. Confidential information will be hidden from photos and videos prior to the publication of results from this study, unless prior consent is given.

Risks:

There are no known risks, however, if you feel uncomfortable you are free to quit at any time. All information collected from a person that withdraws will be destroyed.

Investigators:

Carman Neustaedter is a PhD student and Kathryn Elliot is a MSc student, both in the Department of Computer Science at the University of Calgary. Their supervisor is Dr. Saul Greenberg, Professor in the Department of Computer Science.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. If you have further questions concerning matters related to this research, please contact:

Carman Neustaedter (carman@cpsc.ucalgary.ca) or Dr. Saul Greenberg (saul@cpsc.ucalgary.ca)

If you have any concerns about the way you've been treated as a participant, please contact Bonnie Scherrer in the Research Services Office, University of Calgary at (403) 220-3782; email bonnie.scherrer@ucalgary.ca

Participant's Name	Date
Participant's Signature or Signature of Parent/Guardian	Date
Investigator's/Witness's Signature	Date

A copy of this consent form has been given to you to keep for your records and reference.

C.5 Photograph Consent Form

Investigators:

Carman Neustaedter, Kathryn Elliot, and Saul Greenberg, University of Calgary

This consent form authorizes the investigators to use the photographs taken during the study without modification for illustrative purposes in the dissemination of the study's results, including but not limited to, presentations and publication of papers and/or theses.

Participant's Name	Date
Participant's Signature or Signature of Parent/Guardian	Date
Investigator's/Witness's Signature	Date

A copy of this consent form has been given to you to keep for your records and reference.

C.6 Potential Semi-Structured Interview Questions

These questions will not be asked of every participating household. They are intended only as potential questions that may be asked to encourage participants to explain their social relationships and how they communicate with family and close friends. Other questions will be asked based on responses and on the artefacts and locations within the home.

General Item Questions

- a) What items do you use to plan and coordinate family activities?
e.g., calendar, note pad, daytimer, electronic organizer, other software
- b) Why do you use these items for coordination?
- c) Where are these items located? Why are they located there?
- d) What type of calendar do you primarily use? Why that kind?
- e) Do you use the item for anything besides calendaring?
- f) How important is this item to your coordination and scheduling routine?
- g) What are the main problems you face in your coordination routine, if any?
- h) Can you recall any 'critical incidents' in which your coordination routine fails?

Adding Calendar Events

- a) Who in the family adds things to this calendar? Why?
- b) What gets added? What doesn't get added?
- c) What determines what gets added?
- d) What writing utensil do people use to add or change things on the calendar?
- e) When do people add to the calendar? Why that time?
- f) What do you do if you need to schedule something when away from the home? (e.g., dentist office)
- g) How many events do you typically put on a single day in your calendar?
Does it vary during the seasons? Does it vary during the weeks?
- h) How do you change events on your calendar?
- i) How do you remove events from your calendar?
- j) How do you handle tentative events on the calendar?
- k) How do you deal with regular or routine events?
- l) Do you use colour in any particular way on your calendar?
- m) What do you NOT put on the calendar?

Gathering an Awareness of Activities

- a) Who looks at the calendar? Why? When? (pattern for reading calendar)
- b) What time span is looked at?
- c) How do you know where other family members are or what activities they are doing?

C.7 Ethics Approval



UNIVERSITY OF
CALGARY

MEMO

CONJOINT FACULTIES RESEARCH ETHICS BOARD
c/o Research Services
Main Floor, Energy Resources Research Building
3512 - 33 Street N.W., Calgary, Alberta T2L 1Y7
Telephone: (403) 220-3782
Fax: (403) 289 0693
Email: bonnie.scherrer@ucalgary.ca
Friday, January 27, 2006

To: Carman Neustaedter
Computer Science

From: Dr. Janice P. Dickin, Chair
Conjoint Faculties Research Ethics Board (CFREB)

Re: Certification of Institutional Ethics Review: Understanding Domestic Coordination Routines

The above named research protocol has been granted ethical approval by the Conjoint Faculties Research Ethics Board for the University of Calgary.

Enclosed are the original, and one copy, of a signed **Certification of Institutional Ethics Review**. Please make note of the conditions stated on the Certification. A copy has been sent to your supervisor as well as to the Chair of your Department/Faculty Research Ethics Committee. In the event the research is funded, you should notify the sponsor of the research and provide them with a copy for their records. The Conjoint Faculties Research Ethics Board will retain a copy of the clearance on your file.

Please note, an annual/progress/final report must be filed with the CFREB twelve months from the date on your ethics clearance. A form for this purpose has been created, and may be found on the "Ethics" website, <http://www.ucalgary.ca/UofC/research/html/ethics/reports.html>

In closing let me take this opportunity to wish you the best of luck in your research endeavor.

Sincerely,

Bonnie Scherrer

For:

Janice Dickin, Ph.D., LLB., Faculty of Communication and Culture and
Chair, Conjoint Faculties Research Ethics Board

Enclosures(2)

cc: Chair, Department/Faculty Research Ethics Committee
Supervisor: Saul Greenberg

CERTIFICATION OF INSTITUTIONAL ETHICS REVIEW

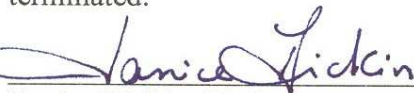
This is to certify that the Conjoint Faculties Research Ethics Board at the University of Calgary has examined the following research proposal and found the proposed research involving human subjects to be in accordance with University of Calgary Guidelines and the Tri-Council Policy Statement on *"Ethical Conduct in Research Using Human Subjects"*. This form and accompanying letter constitute the Certification of Institutional Ethics Review.

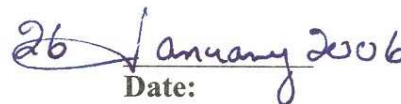
File no: **4644**
 Applicant(s): **Carman Neustaedter**
 Kathryn K. Elliot
 Department: **Computer Science**
 Project Title: **Understanding Domestic Coordination Routines**
 Sponsor (if applicable): **NSERC**

Restrictions:

This Certification is subject to the following conditions:

1. Approval is granted only for the project and purposes described in the application.
2. Any modifications to the authorized protocol must be submitted to the Chair, Conjoint Faculties Research Ethics Board for approval.
3. A progress report must be submitted 12 months from the date of this Certification, and should provide the expected completion date for the project.
4. Written notification must be sent to the Board when the project is complete or terminated.


 Janice Dickin, Ph.D, LLB,
 Chair
 Conjoint Faculties Research Ethics Board

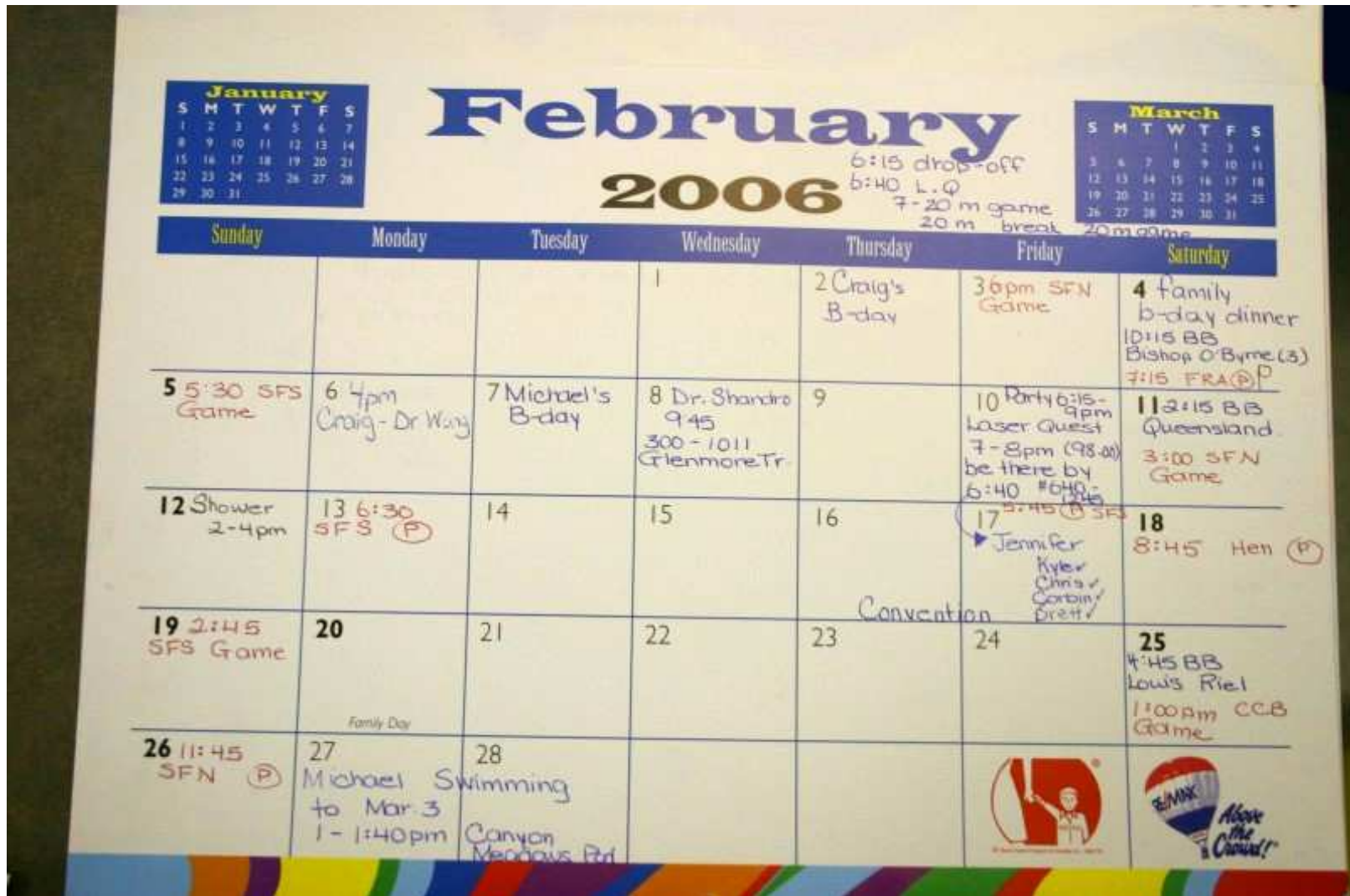

 Date: 26 January 2006

Distribution: (1) Applicant, (2) Supervisor (if applicable), (3) Chair, Department/Faculty Research Ethics Committee, (4) Sponsor, (5) Conjoint Faculties Research Ethics Board

C.8 Family Calendar Photographs

This is a collection of photos of calendars and other coordination artefacts from the twenty study families from Calgary, Canada (group (c) of the family calendar study).





QUARTET CHARTS MONTHLY PLANNER

MONTH: JAN / FEB 06

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
22 4:30 ROSE JUBILEATIONS 5:00	23 4:15-5:15 SP PAK 11 6:00 SP babysit 6:15 BRAN - MID-YEAR 13	24 5:45-6:45 PM Bingo BARN	25 FV 8:00 8:00 REN.	26 MASSAGE 8:00 EYE EX 3:30 P/LK MAM 4:30	27 4:15-5:30 SP MAINT 10:15-11:15 FV 11:15-12:15	28 babysit 6:00
29 2:30 ROSE	(30) 8-NO school	31 FV 8:00 4:15-5:30 PM	1 5:45 MEN 11 WHITE babysit 6:15	2 4:00-5:15 GB	3 FV 11:15-12:15 SAIT 4-5:15 BINGO - CONIS SAIT HOLIDAY CARE	4 ROBERS (38)
5 1:45 ED	6 4:15-5:30 SP PPC 4:45	7 FV 11:00-12:00 DENTIST 8:00 cleaning / ADJ.	8 8:15 MUR	9 4:00-5:15 GB	10 FV 8-9:15 NSO-2nd 3:00	11
12 2:30 ROSE END RAB SEASON	13 FV 11:00-12:00 4:15-5:15 SP	JAN. DENT 2:30 14 5:45-6:45 PM	15 P/O GAME	16 NO SCHOOL PALLISER 5:30	17 NO school NSO-2nd 3:00	18 Glenhead & Poking Volunteers?
19 P/O GAME	20 no school	21 FV 8-9:15 4:15-5:30 PM	22 NO GAME	23	24 BINGO 2:00 FV 1:45-3:00 NSO-2nd 3:00	25

PHONE NUMBERS

NAME	NUMBER
()	()
()	()
()	()

MESSAGES

MAX HEART RATE: 220 - AGE

THINGS TO DO...

Katie call Wangul.



RE/MAX 3888

JANUARY

2006

Handwritten notes on yellow sticky note:
 TUESDAY 12:00 PM
 Thursday is fine but have flu
 can decide on Tuesday night

MAINTENANCE CHECKLIST

- ☐ Clean humidifier
- ☐ Clean furnace filter
- ☐ Clean range hood
- ☐ Drain sediment from water heater
- ☐ Check for water heater exhaust leaks
- ☐ Empty & clean central vacuum system

NOTES

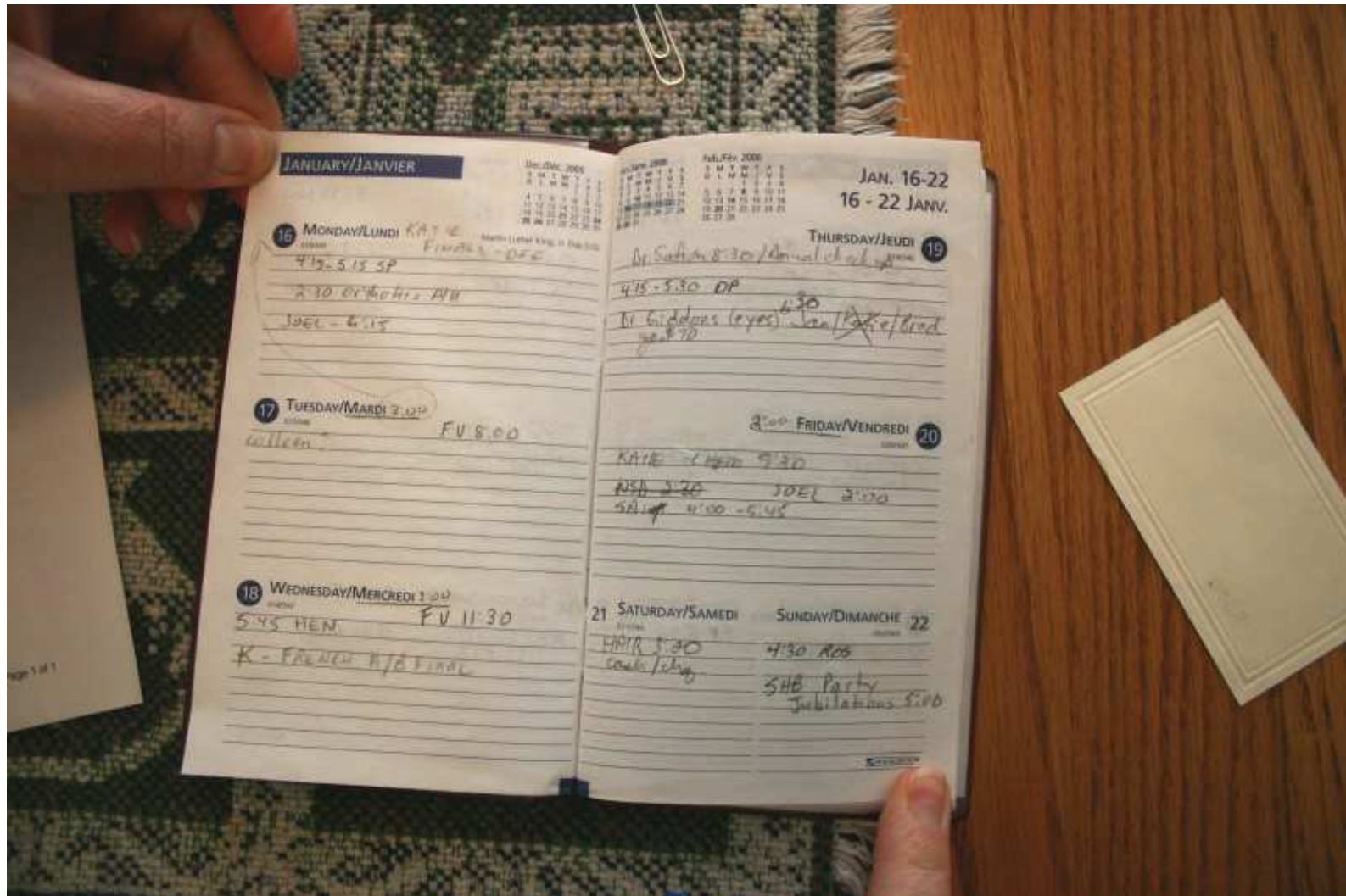
TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
38 P. 1:00 PM (PAPER) B.P. 4:15-5:30 PM	4 P. 6:00 AM STAMP	5 P. 1:15 PM DENTIST B.P. 4:15-5:30 PM (PAPER) B.P. 4:15-5:30 PM	6 P. 1:15 PM DENTIST B.P. 4:15-5:30 PM (PAPER) B.P. 4:15-5:30 PM	7 P. 6:15 AM REN. (PAPER) B.P. 4:15-5:30 PM (PAPER) B.P. 4:15-5:30 PM
10 P. 6:00 AM (PAPER) B.P. 4:15-5:30 PM	11 P. 1:15 PM DENTIST B.P. 4:15-5:30 PM (PAPER) B.P. 4:15-5:30 PM	12 P. 1:15 PM DENTIST B.P. 4:15-5:30 PM (PAPER) B.P. 4:15-5:30 PM	13 P. 1:15 PM DENTIST B.P. 4:15-5:30 PM (PAPER) B.P. 4:15-5:30 PM	14 P. 6:15 AM REN. (PAPER) B.P. 4:15-5:30 PM (PAPER) B.P. 4:15-5:30 PM
15 P. 6:15 AM REN. (PAPER) B.P. 4:15-5:30 PM	16 P. 6:15 AM REN. (PAPER) B.P. 4:15-5:30 PM	17 P. 6:15 AM REN. (PAPER) B.P. 4:15-5:30 PM	18 P. 6:15 AM REN. (PAPER) B.P. 4:15-5:30 PM	19 P. 6:15 AM REN. (PAPER) B.P. 4:15-5:30 PM
22 P. 6:15 AM REN. (PAPER) B.P. 4:15-5:30 PM	23 P. 6:15 AM REN. (PAPER) B.P. 4:15-5:30 PM	24 P. 6:15 AM REN. (PAPER) B.P. 4:15-5:30 PM	25 P. 6:15 AM REN. (PAPER) B.P. 4:15-5:30 PM	26 P. 6:15 AM REN. (PAPER) B.P. 4:15-5:30 PM
29 P. 6:15 AM REN. (PAPER) B.P. 4:15-5:30 PM	30 P. 6:15 AM REN. (PAPER) B.P. 4:15-5:30 PM	31 P. 6:15 AM REN. (PAPER) B.P. 4:15-5:30 PM		

December 2005

4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

February 2006

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20
21	22	23	24
25	26	27	28



1

*This England's
Country Calendar 2006*



Early Northwesterners
Lead from the prairie to the sea
Or to fields where Scotch thistles
Fledge English yeomanry

Early Northwesterners
Lead from the prairie to the sea
Or to fields where Scotch thistles
Fledge English yeomanry

Feed seasons make dark fingers
Errant the green land to the sky.
A velvet peak a rose that lingers,
Round clutch feels being no high.

Safe within their grey stone walls
Proud graceful people stroll
Across empty marble halls
Old tales the pillars tell.

And all across the boundary town
Where the coal burner reigns and reigns,
Shady trails, swamps and snare
In the wily, wily snare.

1 Wed		17 Fri	
2 Thur	6:00pm - 7:00pm	18 Sat	
3 Fri	11:00am - 12:00pm	19 Sunday	
4 Sat	10:00am - 11:00am	20 Mon	
5 Sunday	10:00am - 11:00am	21 Tues	
6 Mon	10:00am - 11:00am	22 Wed	
7 Tues	10:00am - 11:00am	23 Thur	
8 Wed	10:00am - 11:00am	24 Fri	
9 Thur	10:00am - 11:00am	25 Sat	
10 Fri	10:00am - 11:00am	26 Sunday	
11 Sat	10:00am - 11:00am	27 Mon	
12 Sunday	10:00am - 11:00am	28 Tues	
13 Mon	10:00am - 11:00am		
14 Tues	10:00am - 11:00am		
15 Wed	10:00am - 11:00am		
16 Thur	10:00am - 11:00am		

● New Store ● Full Queue ○ Full Store ● Full Queue



FRONT COVER: In a tranquil riverside setting, near the Berkshire village of Aldermaston, stands The Old Mill with its flourishing garden.
DAVID PEARSON

This England's Country Calendar 2006



January

Lakeland Sunset

The sun has set its last life-giving rays
O'er crag and torrent, purple moors and ghyll;
The curlew cries his last shrill mournful note,
The darkness gathers; all is quiet and still.

The sun's warm kiss on these cold
snow-capped peaks
Feeds icy water to the rippling lake.
We mere mortals look on this, and feel
That nature does this for our sake.

We can but wonder at this beauteous sight
Of nature's grand unparalleled array;
We know, beyond all doubt, that after this
The night gives promise of more glorious day.
T. WAUGH

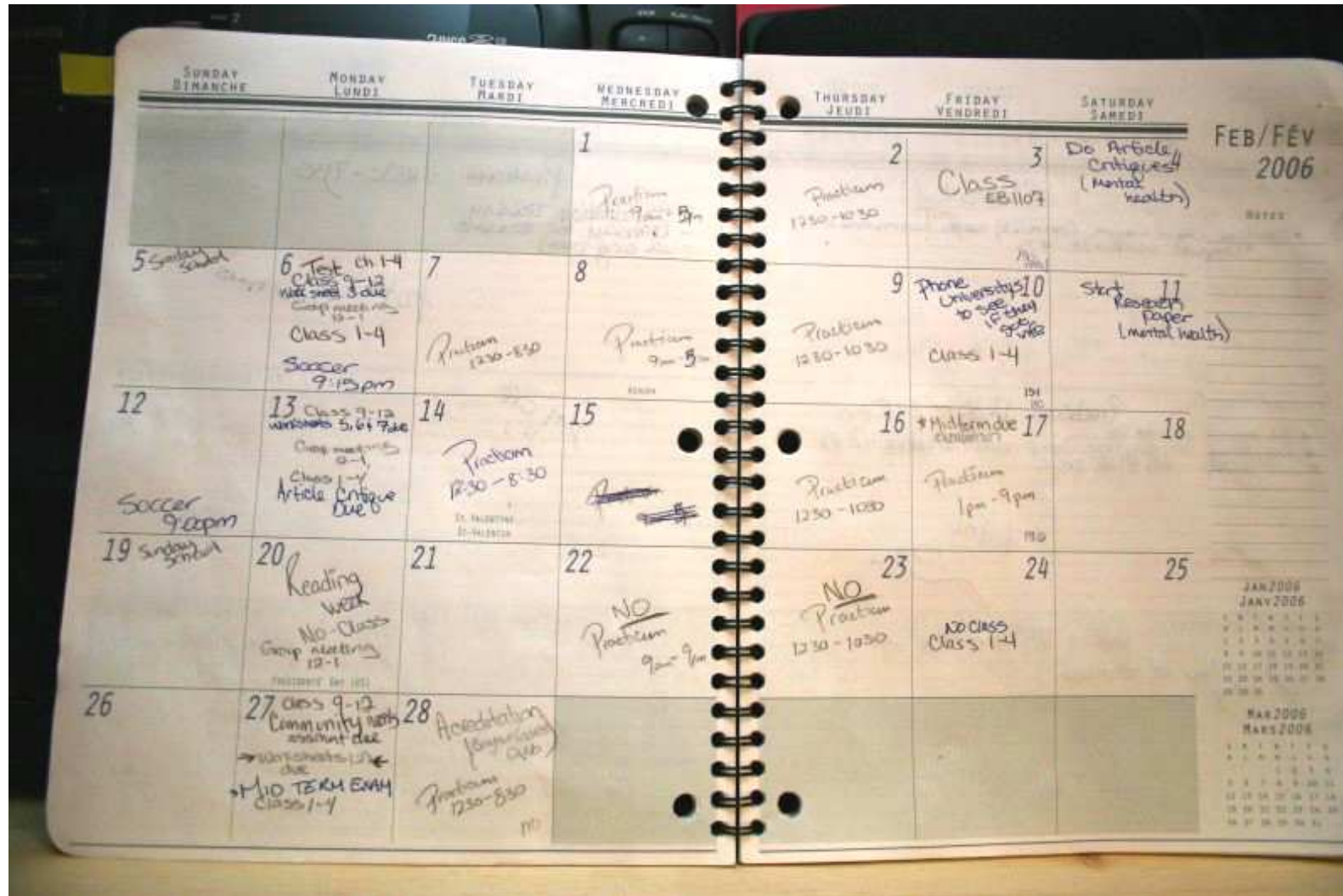
1 Sunday	<i>Longford</i>	NEW YEAR'S DAY THE HOLY NAME OF JESUS	17 Tues	ST. ANTHONY
2 Mon		SHAW HOLIDAY 2.30	18 Wed	<i>Cremona</i>
3 Tues	<i>MEX-10</i>	10 25 am	19 Thur	
4 Wed			20 Fri	<i>Band Camp</i>
5 Thur		WARRING 2.30	21 Sat	ST. AGNES
6 Fri		THE EPITAPHY	22 Sunday	ST. VINCENT
7 Sat			23 Mon	
8 Sunday			24 Tues	
9 Mon	<i>School - Em</i>		25 Wed	COMMEMORATION OF ST. PAUL
10 Tues	<i>Home 10-55 pm</i>		26 Thur	AUTUMNAL EQUINOX
11 Wed	<i>Band</i>		27 Fri	RELOCHING MEMORIAL DAY
12 Thur	<i>Q&A mtg</i>		28 Sat	ST. THOMAS AQUINAS
13 Fri			29 Sunday	
14 Sat			30 Mon	<i>No School</i>
15 Sunday			31 Tues	<i>4-30 - Em with</i>
16 Mon				

● New Moon > First Quarter ○ Full Moon < Last Quarter











Loaded: 3:15-4:30
McQuinn
Sun 4th-16
Start

COLDWELL BANKER
KALWEST REALTY

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

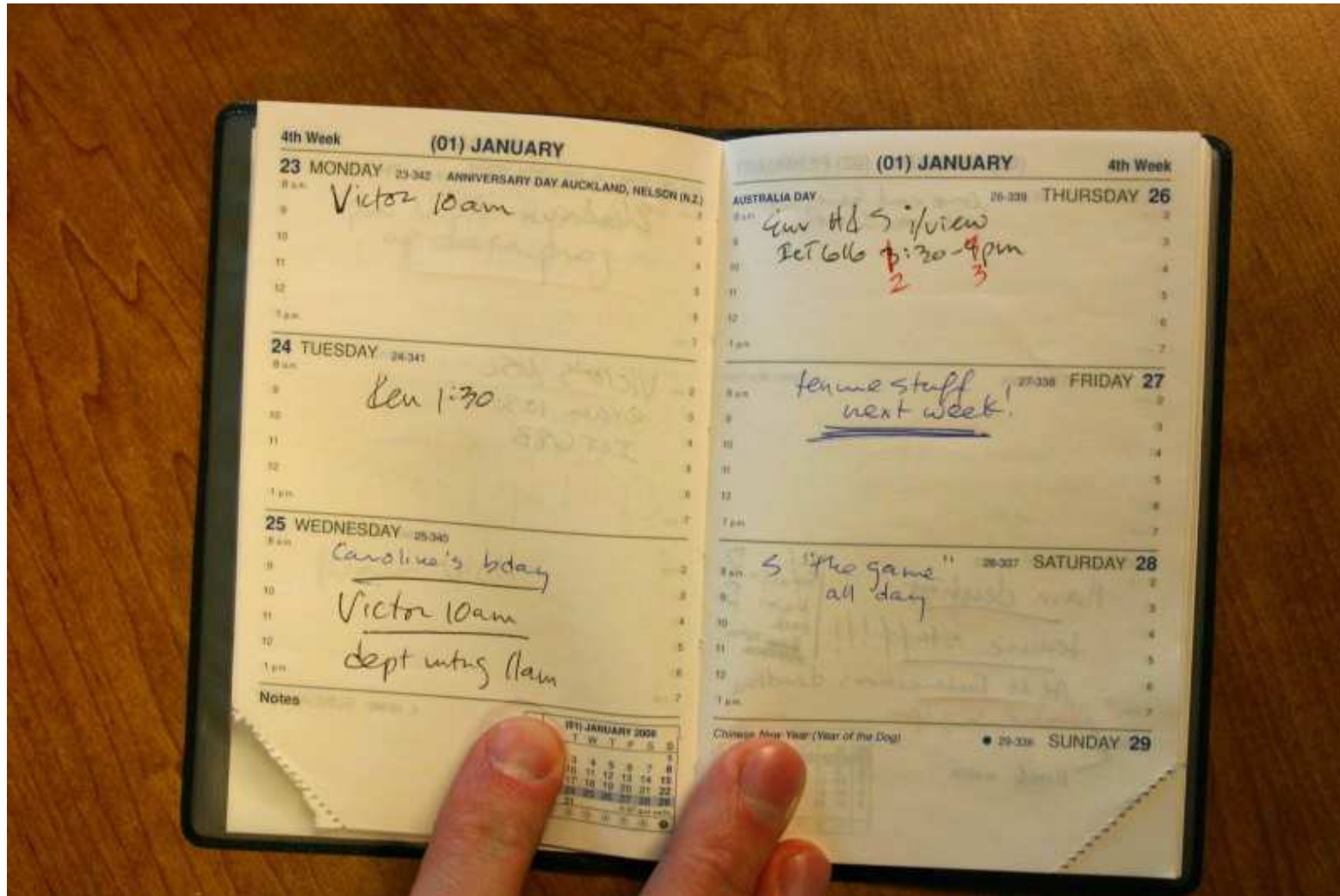
January 06

McQuinn's office is a white flag of peace and tranquility in the heart of the city. The office is located in a quiet area of town, surrounded by lush greenery and a peaceful atmosphere. The office is a reflection of the peace and tranquility that the city has to offer.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday																																																																																				
1 New Year's Day	2	3 ← <i>Swimming in Chalks</i>	4 <i>piano 3:15-4:30</i>	5 <i>CPR 585</i>	6 <i>8:30-9pm</i> <i>Party Sessals</i>	7 <i>The Game</i> <i>test - room - ?</i>																																																																																				
8 <i>curling 4:30</i> <i>library books</i> <i>due back</i> <i>Book 1-6</i>	9 <i>Kids back</i> <i>in school</i> <i>Amanda library</i> <i>Guides</i>	10 <i>curling 7pm</i> <i>Send Greg</i>	11 <i>piano 3:15-4:30</i> <i>Melissa Library</i> <i>Gymnastics starts</i> <i>at school</i> <i>Melissa Art</i>	12 <i>LAC - 7pm</i>	13	14 <i>Anchor 8pm</i>																																																																																				
15 <i>curling 4:30</i>	16 <i>Amanda library</i> <i>Guides 7:30</i> Martin Luther King, Jr. Day (US)	17 <i>curling 9</i>	18 <i>piano 3:15-4:30</i> <i>Melissa Library</i> <i>Amanda Gymnastics</i> <i>Melissa Art</i>	19	20 <i>Fun Lunch</i> <i>Dress Funnig</i>	21																																																																																				
22 <i>No Curling</i>	23 <i>Amanda library</i> <i>Guides 6-8</i> <i>Bowling Winter Club</i> <i>Grade</i>	24 <i>curling 7</i> <i>Play date at</i> <i>Sarah's (Amanda)</i>	25 <i>piano 3:15-4:30</i> <i>Melissa Library</i> <i>Amanda Karate</i> <i>Melissa Art</i>	26 <i>Amanda Gymnastics</i>	27 <i>No School</i>	28 <i>The Game Room -</i> <i>midnight</i> <i>Girls Bowling/Summing</i> <i>Starts.</i>																																																																																				
29 <i>piano recitals</i> <i>curling 4:30</i> Chinese New Year (Year of the Dog)	30 <i>Amanda Library</i> <i>Guides 7-8:30</i>	31 <i>Melissa</i> <i>Dr. Stephen</i> <i>2:30pm</i> <i>curling 9</i>			<div>December 05</div> <table border="1"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td></td><td></td><td>1</td><td>2</td><td>3</td></tr> <tr><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr> <tr><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td></tr> <tr><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td></tr> <tr><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td></tr> </table>	S	M	T	W	T	F	S					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	<div>February 06</div> <table border="1"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td></td><td></td><td>1</td><td>2</td><td>3</td></tr> <tr><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr> <tr><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td></tr> <tr><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td></tr> <tr><td>25</td><td>26</td><td>27</td><td>28</td><td></td><td></td><td></td></tr> </table>	S	M	T	W	T	F	S					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28			
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REALTORS adhere to a strict Code of Ethics and Standards of Business Practice. The code of ethics is a firm set of rules, describing what kind of performance you have a right to expect from a REALTOR. It's your guarantee of professional conduct and the best in service.

January 06



Calendar - Microsoft Outlook

File Edit View Go Tools SpamKiller Actions Help

Type a question for help

New Today 1 Day 5 Work Week 7 Week 31 Month Type a contact to find SpamKiller

Back Day/Week/Month

Calendar

February 2006

S M T W T F S

29 30 31 1 2 3 4

5 6 7 8 9 10 11

12 13 14 15 16 17 18

19 20 21 22 23 24 25

26 27 28 1 2 3 4

5 6 7 8 9 10 11

My Calendars

☒ Calendar

☐ Calendar-Megan

☐ Calendar

Open a Shared Calendar

Mail

Calendar

Calendar

February 2006

Monday	Tuesday	Wednesday	Thursday	Friday	Sat/Sun
January 30 9:30am Cori - CBE 7:00pm Guides - Megan	31 bloodwork Diapers/formula 9:30am electrician	February 1 11:30am Art club - Megan 1:00pm Rod leaves for Tor	2 Choir Groundhog Day (United States) 12:30pm School - Gordon	3 Pd\$400 4:30pm Peter 6:00pm Scrapbooking - St.	4 9:00am Brian 5
6 Gas Bill 7:00pm Guides - Megan	7 12:30pm School - Gordon 2:00pm Dr. Quail - Physical 6:30pm Sylvan Learning	8 11:30am Art club - Megan 7:30pm Carman - grad. st.	9 Choir 9:00am School trip - Megan 12:30pm School - Gordon	10 Electrician Fun Lunch PJ day	11 9:00am Thresea 12 Lincoln's Birthday (United States)
13 Evergreen Theater - Megan Gift card order 11:30am Choir - Megan	14 Beryl COP Safety Talk - Megan Valentine's Day (United States)	15 11:30am Art club - Megan 4:00pm hair	16 No School - Megan 12:30pm School - Gordon 7:00pm Tom	17 No School - Megan Pd\$400 6:00pm Scrapbooking - Tri	18 19
20 Family Day - Alberta (Canada) President's Day (United States) 7:00pm Guides - Megan	21 9:00am Skiing - Megan 12:30pm Jenn 12:30pm School - Gordon	22 9:00am Skiing - Megan	23 9:00am Skiing - Megan 12:30pm School - Gordon 7:00pm Tom	24 9:00am Skiing - Megan 6:00pm Scrapbooking - Tri	25 Paid JP+ 26 Quinquagesima Sunday (Christian)
27 Cantos Music - Megan - School 6:30pm Guides - Megan	28 Independence Day (Egypt) Shrove / Pancke Tuesday 12:30pm School - Gordon	March 1 Ash Wednesday (Christian Reformation)	2 12:30pm School - Gordon	3 Pd\$400 6:00pm Scrapbooking - St.	4 5

103 Items

P6

Calendar - Microsoft Outlook

File Edit View Go Tools SpamKiller Actions Help

Type a question for help

New Today 1 Day 5 Work Week 7 Week 31 Month Type a contact to find SpamKiller

Back Day/Week/Month

Calendar **Calendar** January 30 - February 05

February 2006
S M T W T F S
29 30 31 1 2 3 4
5 6 7 8 9 10 11
12 13 14 15 16 17 18
19 20 21 22 23 24 25
26 27 28 1 2 3 4
5 6 7 8 9 10 11

My Calendars
☒ Calendar
☐ Calendar-Megan
☐ Calendar
Open a Shared Calendar

Mail
Calendar

28 Items

Monday, January 30	Thursday, February 02
9:30am 10:00am Cori - CBE 7:00pm 8:30pm Guides - Megan (St. Davids)	Choir Groundhog Day (United States) 12:30pm 3:00pm School - Gordon 2:00pm 3:00pm Jim 4:30pm 5:30pm agnes 5:00pm 6:00pm monique 5:30pm 6:30pm Theresa
Tuesday, January 31	Friday, February 03
bloodwork Diapers/formula 9:30am 10:00am electrician 12:30pm 3:00pm School - Gordon 6:30pm 8:30pm Sylvan Learning	Pd\$400 4:30pm 5:00pm Peter 6:00pm 12:00am Scrapbooking - St. Davids 7:00pm 7:30pm Rod comes home from Toronto
Wednesday, February 01	Saturday, February 04
11:30am 12:30pm Art club - Megan 1:00pm 2:00pm Rod leaves for Toronto	9:00am 9:30am Brian 10:00am 11:00am Ellen 11:00am 12:00pm Carol
	Sunday, February 05

P6

Calendar - Microsoft Outlook

File Edit View Go Tools SpamKiller Actions Help

Type a question for help

New Today 1 Day 5 Work Week 7 Week 31 Month Type a contact to find SpamKiller

Back Day/Week/Month

Calendar February 02, 2006

February 2006

S M T W T F S

29 30 31 1 2 3 4

5 6 7 8 9 10 11

12 13 14 15 16 17 18

19 20 21 22 23 24 25

26 27 28 1 2 3 4

5 6 7 8 9 10 11

My Calendars

☒ Calendar

☐ Calendar-Megan

☐ Calendar

Open a Shared Calendar

Mail

Calendar

9 Items

Thursday, February 02

Choir

Groundhog Day (United States)

10 am

11 00

12 pm

1 00 School - Gordon

2 00 Jim

3 00

4 00 agnes

5 00 Theresa

6 00 Matt

7 00

8 00

9 00

monique

Tom

P7







Menu : Month February 2006 Mar 2006				
Monday	Tuesday	Wednesday	Thursday	Friday
6 Bfgw Squid	7 Oven'd Fried Chicken Pecogies Veg.	8 Swiss Steak. Rice	9 Pancakes Pork chops Or potatoes Veg	10 Spaghetti Garlic Brood
13 Pork Roast Pot & Veg	14 Meat Pie Salad	15 Pancakes Chicken Pot & Veg	16 Luscious Pasta - Tom Soup / Gravy - Red Pepper	17 Tacos Milk.
20 Hamburgers Soup Pars	21 Roast Chicken Mashed Pot Veg	22 Chicken Noodle Soup Brood	23 Port Chop. Potatoes Dinner	24 Beef Boyle Salad
27 Ribs Pot Br Veg	28 Beef Rainbow Pepper Stir Fry Rice Pot 30min Spang	29 Chicken Hearty Salad	2 Shake & Bake Pork chops Pecogies Veg.	3 Sausage Mashed Pot. Cream Corn
6 Salmon Rice Veg	7 Meat loaf Boiled Pot Veg	8 Left over Meat loaf Fried Pot Veg	9 Chicken Fajitas - Chicken, Broast - Potatoes - Soft taco - Soft taco - Shells	10 Pork Thai Shi Fry Cajun - Beans - Green onion - What's Cooking - Issue #17.

Housework Schedule (2 week Plan)

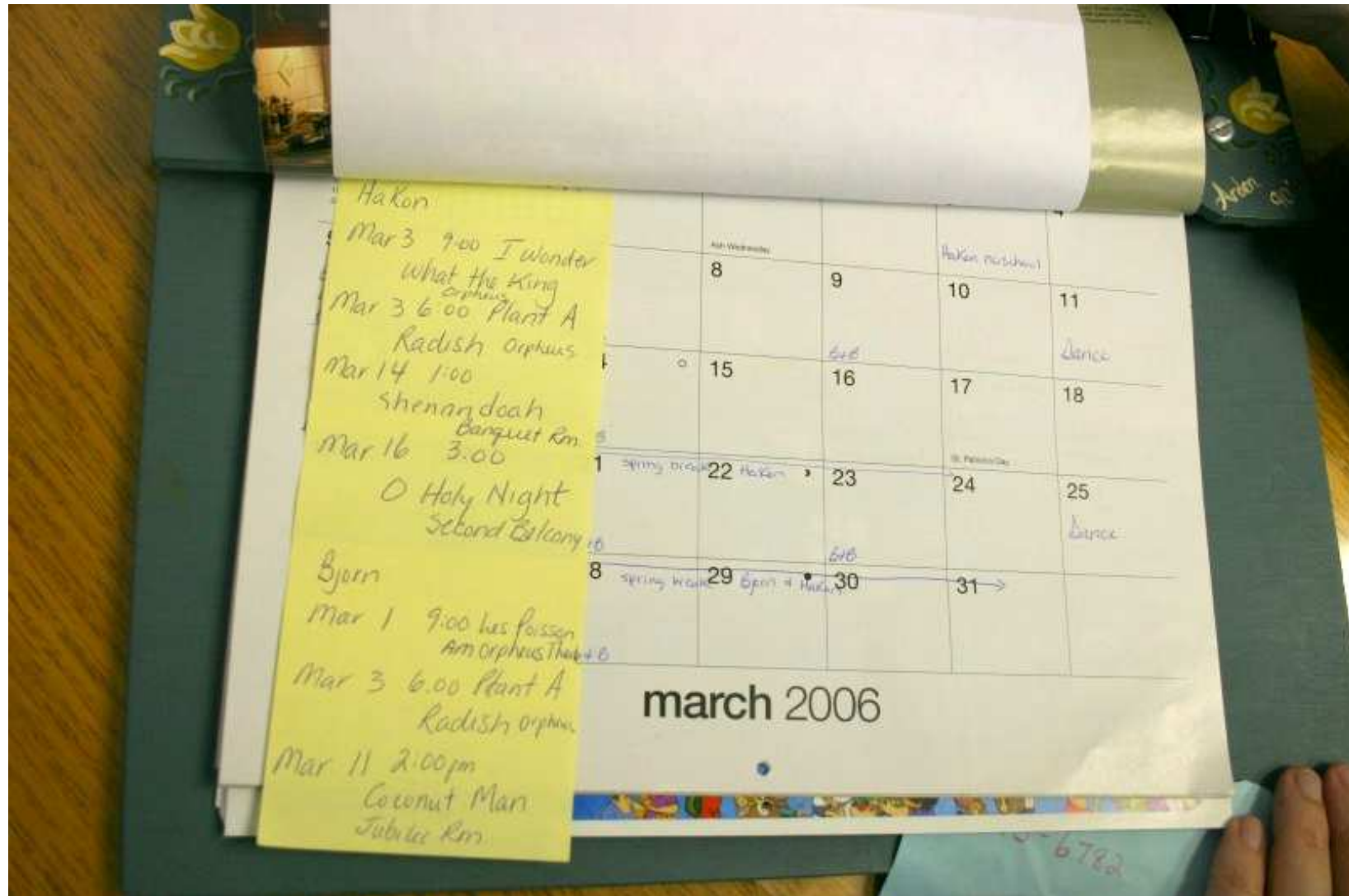
<p>Monday</p> <p>Laundry Day</p> <p>- Clean out Fridge</p>	<p>Tues.</p> <p>Vacuuming (A.M)</p> <p>Wash floors</p> <p>- Clean Stove Top</p> <p>- microwave</p>	<p>Wed</p> <p>Dusting/pledge furniture Kitchen Cabinets</p> <p>- Clean Bathrooms</p> <p>- Empty Diaper Pail</p>	<p>Thur</p> <p>Windexing Windows mirrors</p> <p>- T.V's + Tables</p> <p>- Fingerprints off Walls & light switches</p>	<p>Fri</p> <p>Empty Garbages</p> <p>- Empty Diaper Pail</p> <p>- Organize Recycling</p>
<p>Monday</p> <p>Laundry Day</p> <p>- Clean out Fridge</p>	<p>Tues</p> <p>Laundry Day (For Sheets)</p> <p>Vacuuming (A.M)</p> <p>Wash Floors</p> <p>- Clean Stove top</p>	<p>Wed</p> <p>Dusting/pledge furniture Kitchen Cabinets</p> <p>- Clean Bathrooms</p> <p>- Empty Diaper Pail</p>	<p>Thur.</p> <p>- Windexing Windows Mirrors, Tables,</p> <p>- Fingerprints off walls & light switches</p>	<p>Fri</p> <p>Empty Garbages</p> <p>- Empty Diaper Pail</p> <p>- Organize Recycling</p>

P8



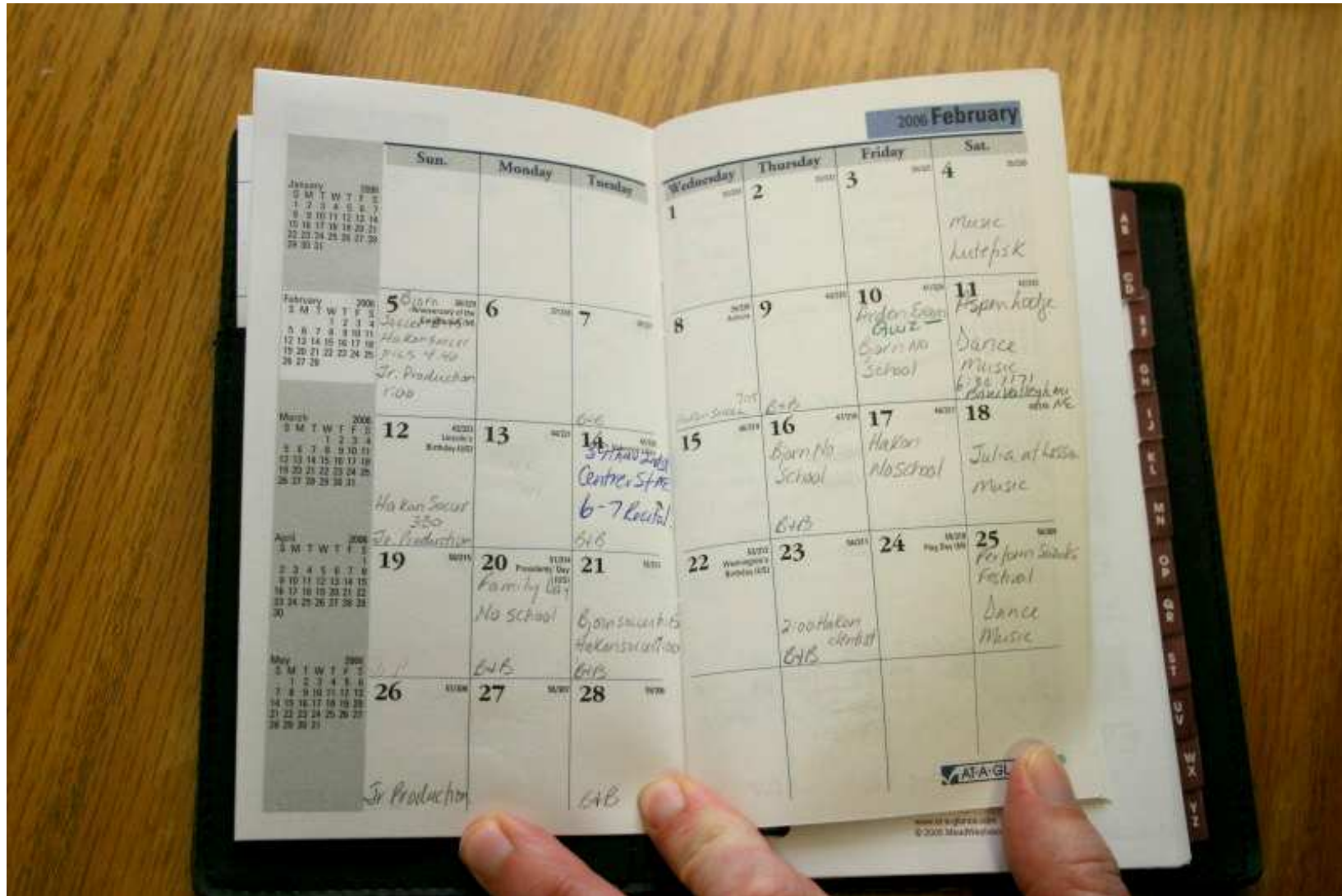


P9



Coconut Man
Tubular Rens

P9





P10





P10





Chapelton, Pinder

February ≈ 2006 ≈

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28				



MARCH

2005

SCHEDULE TIME FOR IMPORTANT THINGS:
 Yourself, family, friends, all meetings, activities, church, etc.
 Your partner, family, friends, activities & community

*Something we're so concerned about going our children what we mean, keep getting up, we mean, we give them what we did have growing up. - John Johnson

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1 First Day of Spring Palm Sunday	2	3	4	5	6	7
8	9	10	11	12	13	14
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22	23	24	25	26	27	28
29	30	31				

Handwritten Notes:

- 6:** 2nd Girl's Camp, 2nd Girl's Camp, 2nd Girl's Camp
- 7:** 7pm Book (Club)
- 8:** 7pm Book (Club)
- 10:** 2-4pm Dr. Frenkel (Spa)
- 11:** 8am-7pm, 6pm-7pm, 6pm-7pm
- 12:** 8am-7pm, 8am-7pm
- 13:** 4pm Tennis w/ Dave Robinson
- 14:** 4pm Tennis w/ Dave Robinson
- 15:** 4pm Tennis w/ Dave Robinson
- 16:** 4pm Zie D. Busby
- 17:** 7pm D. Busby
- 18:** 7pm D. Busby
- 19:** 7pm D. Busby
- 20:** 4pm Zie D. Busby
- 21:** 4pm Zie D. Busby
- 22:** 4pm Zie D. Busby
- 23:** 4pm Zie D. Busby
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- 29:** 4pm Zie D. Busby
- 30:** 4pm Zie D. Busby
- 31:** 4pm Zie D. Busby

P11



"We have consistently sourced a number of great employees from the school - it will continue to be a platform for future hires."
 - Robi Contrada, BSc/BComm '96
 Director, RBC Capital Markets
 (Recruiter; Mentor)

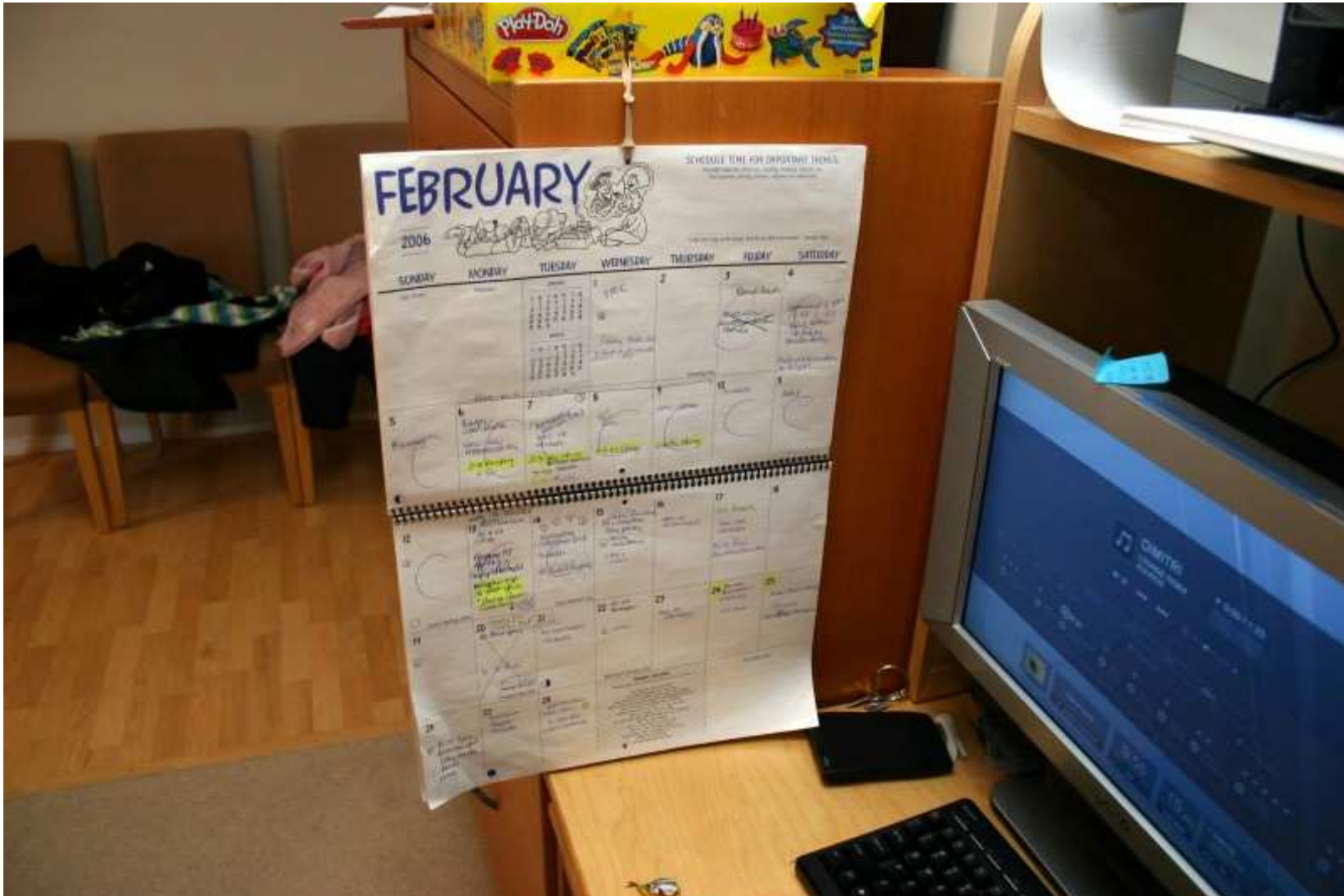
Hire a grad: www.haskayne.ucalgary.ca/careercentre

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30	31					

ENMAX

HASKAYNE
 School of Business
 UNIVERSITY OF CALGARY

A Better Place to Think About Business



PROTEOLAM COBBLER FORM

SCHEDULE TIME FOR IMPORTANT THINGS:

2006 JANUARY

2006

1 **2** **3** **4** **5** **6** **7**

SUNDAY **MONDAY** **TUESDAY** **WEDNESDAY** **THURSDAY** **FRIDAY** **SATURDAY**

1 10:00 AM - 12:00 PM

2 10:00 AM - 12:00 PM

3 10:00 AM - 12:00 PM

4 10:00 AM - 12:00 PM

5 10:00 AM - 12:00 PM

6 10:00 AM - 12:00 PM

7 10:00 AM - 12:00 PM

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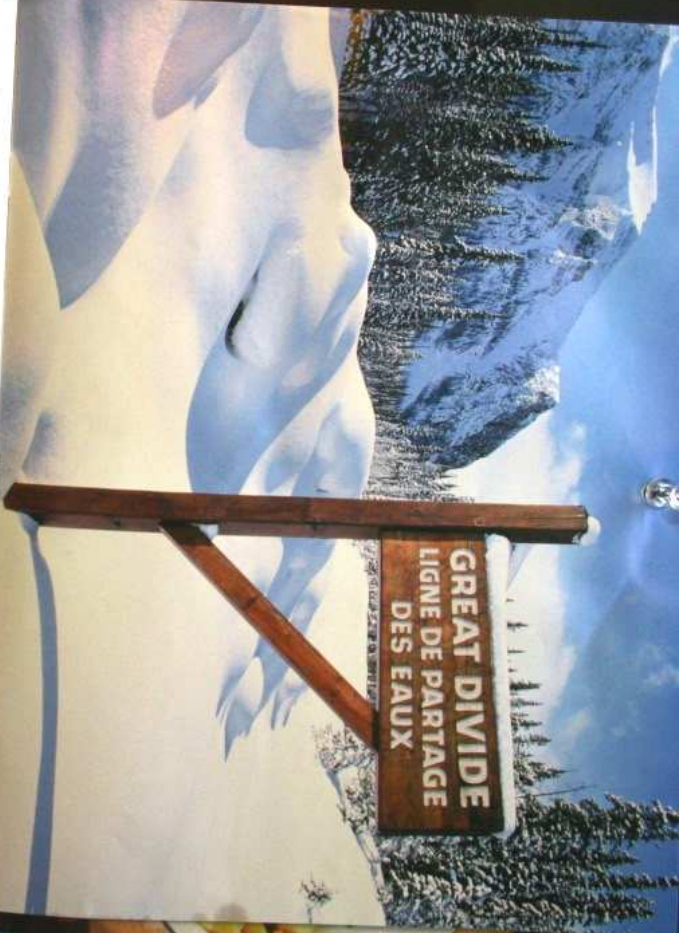
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100 10:00 AM - 12:00 PM

P12





For more information on the many ways you can support the work of the Alberta Cancer Foundation, visit our website at www.albertacancer.ca. We are grateful for the support of many individuals and organizations who help us in our mission to fight cancer.

February 2006

ALBERTA CANCER FOUNDATION

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
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DRUGSTORE Your Health Matters Here
www.drugstorepharmacy.ca

403-652-8650
 FAX 403-652-8652
 Extra Foods
 See back cover for more locations. Pharmacy locations in your area.

February 2006

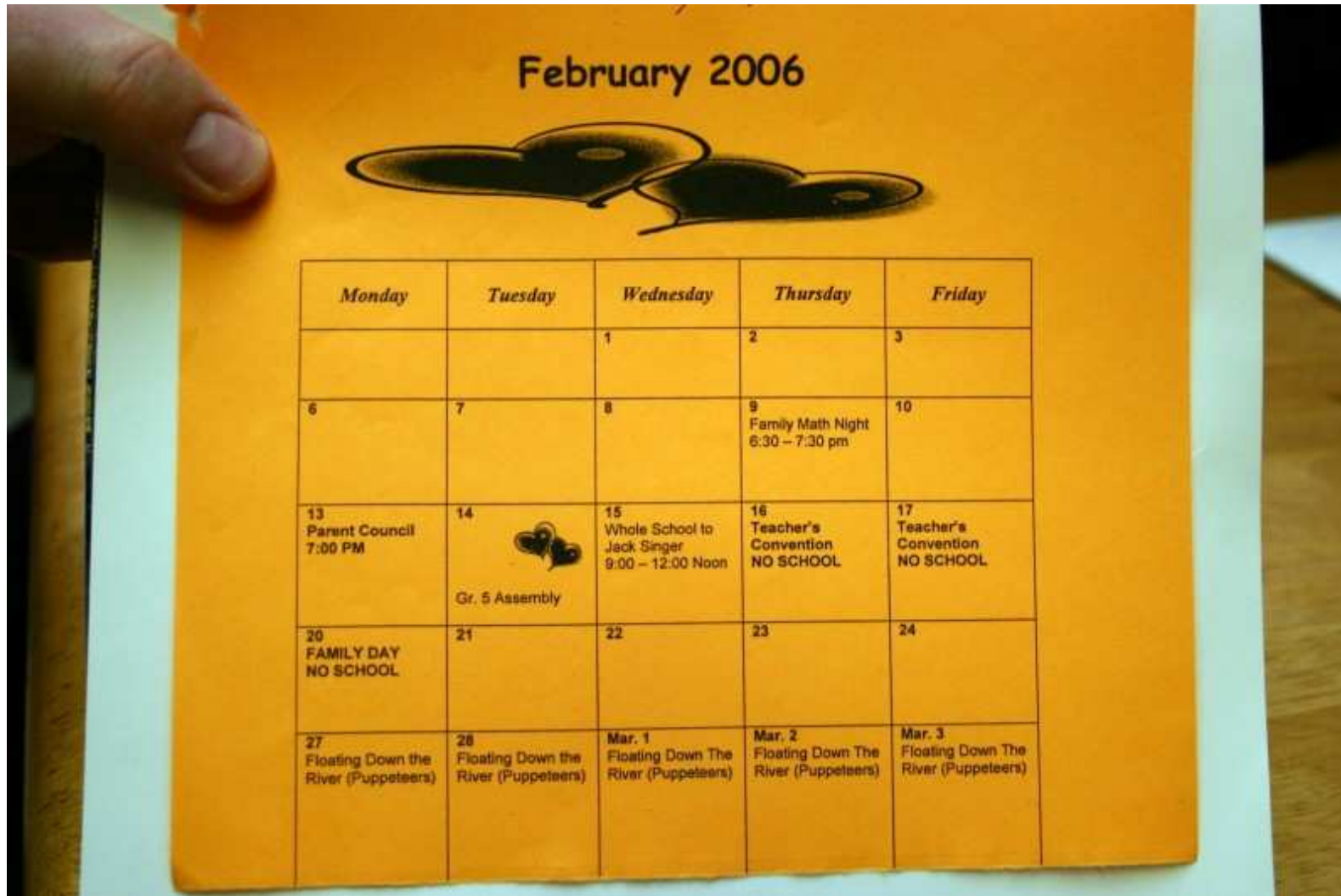
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15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1 No school (Feb?) Ask Midsum + Ryan's reg	2 No school (Feb?) French Channel 5pm Sal = 6.45-7:30 Skate Guitar	3 7pm AB College	4
5	6 T=report card R=Speed Skat 10:10-12:20pm (11-12)	7 R=Speed Skating 10:10-12:20pm R=SS (11-12) T=7:15pm NWSC game	8 R=SS 10:10-12:20pm (11-12) Ryan's b/day Supper 6:40pm	9 Guitar T=6pm Tech NWSC	10 T=7:30pm practice AB College	11 20 party R=9-10:30am FRA T=2:30pm tech NWSC Sal=9am hair
12 R=hockey game 8:15-9:30pm Crossfield Card R=8:15-9:30pm CAB game T=4pm game NWSC	13	14 R=hockey game 8:30pm-9:45pm SFR T=8:15pm game NWSC b/Midsum S/council	15 R=Carnaval S=Nikka	16 R=no school & R=babysitting 9-5pm Doll, lunch, not pad, pen Gustax T=7:30pm Tech R SHOES 5pm	17 R=No school & T=practice 7:30 Canmore	18 R=hockey game 12:15-1:30pm SFT
19 R=9-10:15am IND practice Canmore	20 No school Family Day	21 b/wb meet	22	23 Guitar	24 R=hockey game 5:45-7pm SFS T=practice 7:30pm AB College	25 R=8:45-9:45am HEN practice T=11:30am Tech Tomas' b/day
26 R=3:15-4:30pm VSL Practice T=game 6pm NWSC	27 Springers	28				

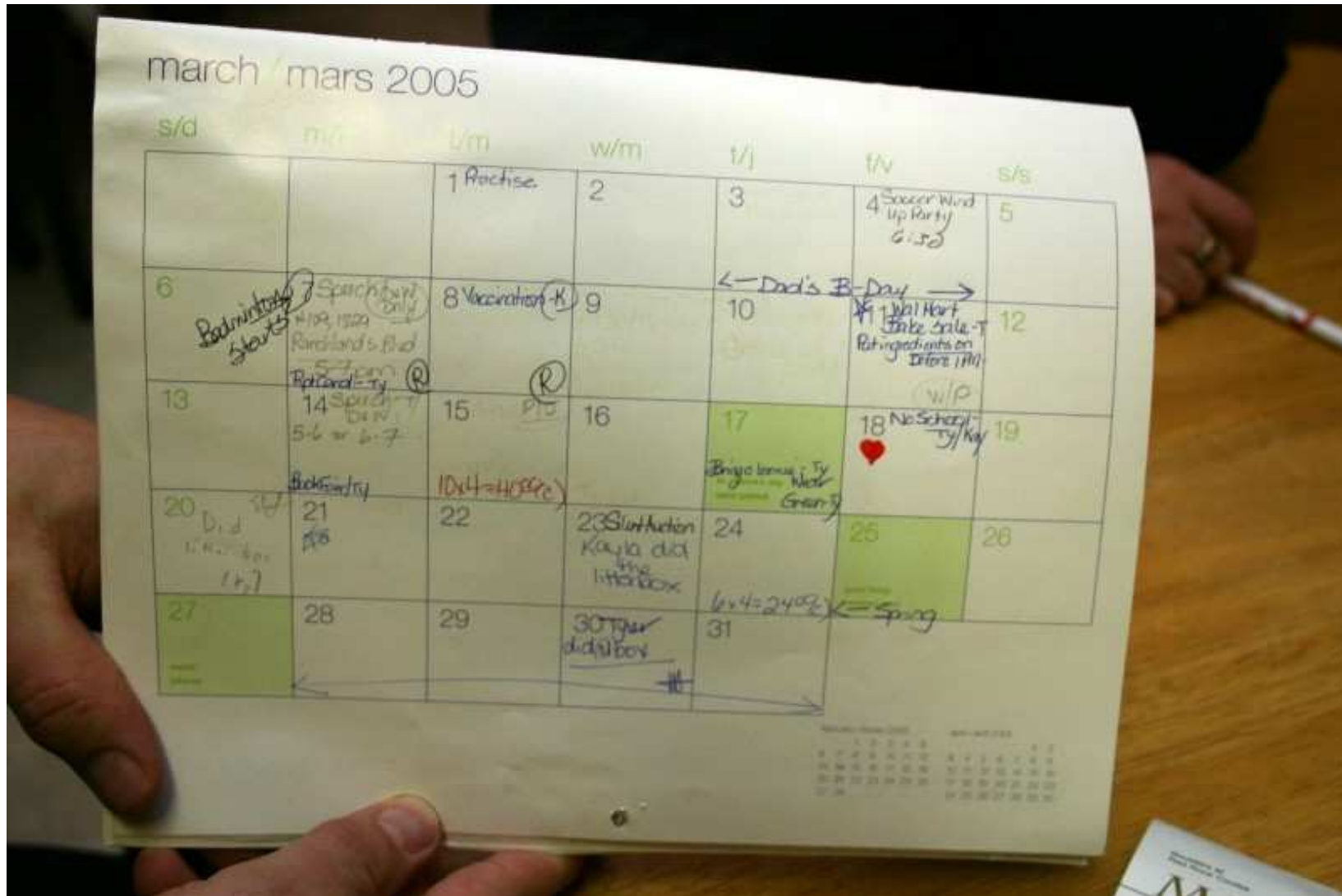
March

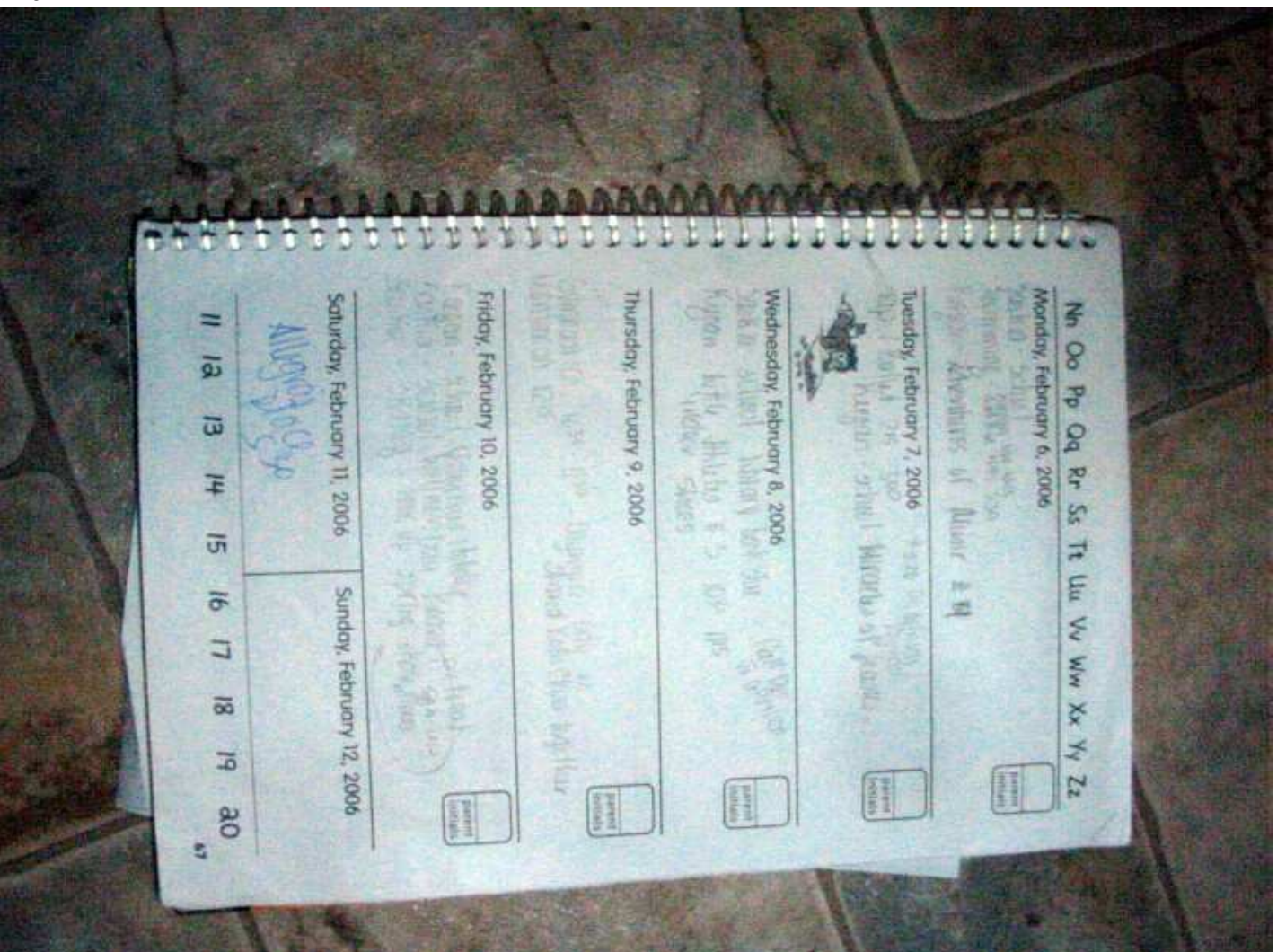
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P15









February

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28				

P16







P17



January 2006

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1 New Year's Day	2 New Year's Day Holiday	3 (3-33) 7:51	4 (3-31) 10:54	5 8:12 10:53	6 (2-36) 11:45	7 9:30 2015
8 10:00	9 8:11 6:30	10 4:42 11:12	11 4:07 (12-)	12 4:02 10:50	13 4:10 21:00	14 3:32 20:32
15 7:20 7:50	16 4:07 15:07	17 3:59 7:26	18 3:06 10:32	19 10:00	20 21:32	21 3:42 26:03
22 3:50 21:03	23 10:41 2:07	24 10:40 Sun 10:45 Mon	25	26	27	28
29 22:46	30	31 21:29 2:00 Mon 19:30			DECEMBER S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	FEBRUARY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

FREE TRIAL!
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www.ceragem.com



Did you **CERAGEM** today?
Automatic Thermal Massager

FC B+ CE UK

Did you **CERAGEM** today?

February 2006


Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday																																																																						
275-5155 447 When 565-5716-10			1	2	3	4 17:00 book recovery																																																																						
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12	13	14	15	16 11:00 Edmonton	17 7:00 PM Vancouver	18 6:12 theater																																																																						
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26	27	28			<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> JANUARY <table border="1" style="font-size: 8px;"> <tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr> <tr><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td></tr> <tr><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td></tr> <tr><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td></tr> <tr><td>29</td><td>30</td><td>31</td><td></td><td></td><td></td><td></td></tr> </table> </div> <div style="text-align: center;"> MARCH <table border="1" style="font-size: 8px;"> <tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr> <tr><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td></tr> <tr><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td></tr> <tr><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td></tr> <tr><td>29</td><td>30</td><td>31</td><td></td><td></td><td></td><td></td></tr> </table> </div> </div>		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31				
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www.ceragem.com



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Automatic Thermal Massager

PC E-1 CE RoHS



Mom's "to do" List

2004

Jan 4th ⊕

Summer as Maernu
Pillows/Memory Clothes
Sewing Machine - Jan Ann
Proposal School (Crafts/Play)
⊕ Summer Badge
~~Security Awareness~~
Organize Closet
Drawers.

Aerosec.

Life Year (End-Season)

Plan for Fairing

Gift for Christie

Season Guide Blanket

Kleener/Carry Hurnow

Get her Ann's Hat

Re Do Resume,

Dish ~~Decorate~~

Chevyable Vithen C.

Bring Bat Book Back

~~Wash~~ Bats~~Wash~~ Bats~~Wash~~ Bats

Wash Bats

Battery. Envelopes.

P19

March 2004

March 2004							April 2004						
Monday	Tuesday	Wednesday	Thursday	Friday	Sat/Sun	Notes							
March 1 University of Calgary Application Due		March 2 M Tech Interview: Bill 6AM	March 3 Interview: Bill 9AM Tech			Dr. Lechner May 13 3:45PM Re. Sal. Home							
Basics of PATH Inner Garden 6:45 - 9:30	March 4 Bill EXAM	Kids First Meeting 7PM Church	Mama 9AM No Sparks	March 5 Library	Turkey Supper	• Bake Apple Crisp Dinner Linker 6-8							
Bill begins work		9:45 Munnogram				April 2nd - Wedding Photo Shoot							
Inner Garden 7-9:30	To Fun Ty Goon		Sparks	Parent/Teacher Conferences No School 5:45 Mexic. Museum Day • Banks and girls		April 1st - Driving Permitting Agency Service • Driving Williams, Vaughn, G.							
Pay Protek	Cancelled Baked Apple Crisp Church by Pans	Mama 9:00		Kyle - IMAX	Kaitlyn Birthday 2PM 10th Martini Celebrating G	April 10th - Auction \$10							
Inner Garden	Library	Mexic. Dinner All	Sparks		Day Out with Wildcat Catland	260 7985							
					Sunday School Dinner GOD'S MERCY'S	April 8th - Home City							
					14.1 4th St. New Pinto/Stacy Teachella B. day Tentative 9:00	Possible Bday Delivery							
Inner Garden		Library	Sports Beach Party	Dad's 5th Bday	Sunday School	April 30th - Sparks Sleep Over							
BECCA Nicole's Bday 6PM Madrugada	Budget:			Rehearsal 6PM Friday Ben. Parley, Phil 5PM	Working Photo Shoot. 2:30 Alvadore Bkfst Sheraton Courtyard	Auction 7PM-10PM 10th							
Inner Garden	Mama 9AM		Outdoors Sparks	No School		Tues day May 2nd Volunteer All DAY							

2/26/2004

February 2006

February 2006							March 2006						
S	M	T	W	T	F	S	S	M	T	W	T	F	S
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Monday	Tuesday	Wednesday	Thursday	Friday	Sat/Sun
Diet begins Wright ± 137		Swim	Swim	Swim	Swim 11:15-11:30 AM
Start De-tox					Have alone Course 10-noon Silly Sunday Church
Monteney 2-3 Mason Key	Monteney 9:00-10:00	Swim	Swim	Swim, Chris De-tox ends	Swim ADD DAIRY - DIET
Brownies MONTENAY SWIM 3PM	Joe 2-4 Echick 1:50-3:00 Course 4:45-6:45 Language + Learning		Bill Home	Counsel 2PM Dinner Here	
Monteney 1:45-2:45	Monteney 9:00-10:00	Give them homework	Teacher's Convention	Teacher's Convention	Swim ADD wheat - DIET
Brownies	Course 4:45-6:45	No School	Bill Home	6-7 Carmen study	
VV 1/2 Price	Monteney	Swim	Swim	Swim, Chris	Swim Co) Sleepover Dinner Candle Party
FAMILY DAY Brownies	Course			Counsel 2PM	ADD wheat - DIET
Monteney	Best Practices Paper Due 25%				
Brownies	Math - 3-4 1/2 hrs Course				

Christine Ellis

March 22 Parents Drug Awareness Program II 25th 7PM Kayleigh Sleepover

2/1/2006

P20





P20


OCTOBER

2005



SCHEDULE TIME FOR IMPORTANT THINGS:
 Morning: sunrise, break up, reading, hobbies, church, etc.
 Your morning: family, friends, relatives & community

"All kids are gifted; some just open their packages earlier than others."
 Michael Carr

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY																																																																																				
Kids' Chores:	Reminders:	To Do: Compost/discard dead annuals. Replace summer annuals with asters/mums. Plant spring bulbs. Store tender summer bulbs. Rake leaves. Compost remnants of veggie garden. Empty and clean pond. Empty and store flower containers. Add mulch to plant beds. Install bird feeders.	LAMB CURRY (Note: see notes next to it; discard enough for company) Prepare 1 cup frozen rice according to package directions. 1 pound lamb shoulder trimmed and chopped into bite-sized pieces. Cook meat with 1 tbsp. flour. Brown meat in 1 tbsp. oil in a skillet over medium heat. Drain fat. Cook 1 onion, 1 celery stalk, 1 carrot and 1 green apple. Add 1/2 cup minced garlic, 1 tsp ginger, 4 tsp curry & 1/2 cup coriander leaves to skillet. Add vegetables to skillet and sauté over medium heat for 20 minutes. Add 1 14-oz can tomatoes and 1/4 cup vegetable stock and sauté for 10 minutes. Add 1 dried apple, 1/2 cup raisins and 1/2 cup cashews to skillet and simmer for 5 more minutes. Serve over rice with salad.	SPINACH SALAD WITH HONEY YOGURT DRESSING Whisk together: 1/2 cup low-fat yogurt, 1 tbsp honey, 2 tsp lemon juice. 1/2 tsp minced ginger, 1 tbsp grated orange rind, salt and pepper. Set aside. In a large salad bowl, place 1 lb pre-washed spinach, 1/2 cup sliced mushrooms and 4 chopped green onions. Toss salad with honey yogurt dressing.	SEPTEMBER <table border="1"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>TH</td><td>F</td><td>SA</td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td>1</td><td>2</td></tr> <tr><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr> <tr><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td></tr> <tr><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td></tr> <tr><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td></td></tr> </table>	S	M	T	W	TH	F	SA						1	2	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		NOVEMBER <table border="1"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>TH</td><td>F</td><td>SA</td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td>1</td><td>2</td></tr> <tr><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr> <tr><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td></tr> <tr><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td></tr> <tr><td>27</td><td>28</td><td>29</td><td>30</td><td></td><td></td><td></td></tr> </table>	S	M	T	W	TH	F	SA						1	2	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			
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25	26	27	28	29	30																																																																																					
S	M	T	W	TH	F	SA																																																																																				
					1	2																																																																																				
6	7	8	9	10	11	12																																																																																				
13	14	15	16	17	18	19																																																																																				
20	21	22	23	24	25	26																																																																																				
27	28	29	30																																																																																							
2	3 Cubs 7-8:30 Mountain Zambist 9pm 	4 Guidance 6-8 CP Retake  3-4:30	5 Tennis 8:00  3-4:30 leaders meeting 7:00pm 1st MATHS class	6  G.R. Dry Day CHSAA Banquet 5:30 - 8:00	7  G.R. Dry Day Baz - Dry Day (CPH's)	8																																																																																				

Handwritten notes on the right side of the calendar:
 Bottle Drive 10-2
 #TCAstapart Day (Drive)



Appendix D. LINC Participatory Design Study Materials

This appendix presents materials used for the participatory design of LINC.

Note: this study was conducted at Microsoft Research in Redmond, WA, (and not on campus at the University of Calgary) therefore it does not have nor need approval from the University of Calgary Ethics Board. However, the study used ethical protocol consistent with the expectations of the University of Calgary Ethics Board. A standard Microsoft Corporation consent form was used for participants which is not included.

D.1 Paper Prototype Study Description

The following description should be read to each participant at the beginning of the study to inform participants of the procedures prior to giving consent. Italicized text is instructions to the investigator.

Introduce yourself and show them the Control Room (e.g., nothing funny is going on and an entire room of people aren't watching you).

My name is _____, and I will be giving you instructions on what to do and will answer your questions.

We're studying how people currently use calendars to plan and schedule family activities. Our goal is to understand how a family calendar for the home should be designed.

Tell them about the experiment.

The study will first involve us asking you about your own calendar usage and experiences.

Next, we'll show you a paper prototype of a possible design that we have made for an electronic family calendar. We will ask you questions about our design and are really looking for areas where you feel the design could be improved. Throughout the study we will be recording your comments providing that this is fine with you.

If it is fine with you, we'll be video taping the session in case there is anything we don't have a chance to write down.

Tell the participant that it's OK to quit at any time.

If you feel uncomfortable, you are free to quit at any time. Do you have any questions at this point?

Consent Form: *Give them the consent form to sign. If it is not signed, do not proceed.*

Pre-Study Questionnaire: Ask the participant to fill out the pre-study questionnaire.

Step 1: Participants' Calendar

Proceed with discussion about the participant's calendar.

We would now like you to describe to us how you use the calendar(s) that you have brought in. Please tell us what you use the calendar for, when you use it, and who uses it.

Do you have any other calendars at home that you could not bring but routinely use?

Follow-up with questions about the participant's calendar usage and needs.

Step 2: Tasks

A subset of the following tasks should be completed with each paper prototype. The participant should play the role of the user in each scenario.

Tasks are ordered as follows:

Simple introductory tasks (1,2)

Important tasks (3,4,5)

Less-important tasks (6-to end)

We're now going to have you go through a series of tasks with a paper prototype. The idea is to try and uncover any usability problems that we may have with the interface.

Talk about the paper prototype a bit.

Here's the prototype. You will see it is made entirely of paper and < person > will play the role of the computer and update the screen as needed. < person > will be taking notes and will provide you with any help along the way. Because the interface is made of paper, things may be slow or we may mess up. If certain parts of the system are not designed yet or unavailable, < person > will just say "System down."

Please be patient with us and remember that we are evaluating the system and not you. If you uncover any problems, it is the fault of the system and not your own.

The system is designed to run on a display hanging on your kitchen wall (like a Tablet PC). You can interact with the calendar using a stylus / pen by clicking, dragging items, writing, etc. Here's your stylus.

Describe Think Aloud procedure.

While you are performing the tasks we are going to ask you to think aloud. This just means actually saying out loud what you are doing and why you are doing it. It helps us to better understand what you are doing. Would you like an example?

If you forget to think aloud, we may prod you during the tasks by saying something like, "and what are you doing now?"

Describe the family scenario to them.

I'm now going to describe to you a family for whom you will play the role of the mom when you go through the tasks. While this may not reflect your current lifestyle, we hope that the tasks you will perform do in fact reflect things that would actually occur for you.

However, please tell us if any of the tasks that we have you perform are different than what you and your family would really do in the given situation.

The Usable Family:

Marge and Phil Usable are parents of two children, Dawn aged 7 and Lacey aged 15. Both Marge and Phil work outside of the home. They have one car that is typically used by Marge during the day to commute to work and in the evenings by either parent to take the children to various extracurricular activities. Phil typically takes public transit to and from work. Dawn and Lacey are both generally involved in a variety of extracurricular activities outside of school.

Summary:

Marge – mother

Phil – father

Lacey – daughter, age 15

Dawn – daughter, age 7

D.2 Digital Prototype Study Description

The following description should be read to each participant at the beginning of the study to inform participants of the procedures prior to giving consent. Italicized text is instructions to the investigator.

Introduce yourself and show them the Control Room (e.g., nothing funny is going on and an entire room of people aren't watching you).

My name is _____, and I will be giving you instructions on what to do and will answer your questions.

We're studying how people currently use calendars to plan and schedule family activities. Our goal is to understand how a family calendar for the home should be designed.

Tell them about the experiment.

The study will first involve us asking you about your own calendar usage and experiences.

Next, we'll show you our prototype of a possible design that we have made for an digital family calendar. We will ask you questions about our design and are really looking for areas where you feel the design could be improved. Throughout the study we will be recording your comments providing that this is fine with you.

If it is fine with you, we'll be video taping the session in case there is anything we don't have a chance to write down.

Tell the participant that it's OK to quit at any time.

If you feel uncomfortable, you are free to quit at any time. Do you have any questions at this point?

Consent Form: *Give them the consent form to sign. If it is not signed, do not proceed.*

Pre-Study Questionnaire: *Ask the participant to fill out the pre-study questionnaire.*

Step 1: Participants' Calendar

Proceed with discussion about the participant's calendar.

We would now like you to describe to us how you use the calendar(s) that you have brought in. Please tell us what you use the calendar for, when you use it, and who uses it.

Do you have any other calendars at home that you could not bring but routinely use?

Follow-up with questions about the participant's calendar usage and needs.

Step 2: Tasks

A subset of the following tasks should be completed with each paper prototype. The participant should play the role of the user in each scenario.

We're now going to have you go through a series of tasks with our prototype design. The idea is to try and uncover any usability problems that we may have with the interface.

Family Scenario

I'm going to describe to you a family for whom you will play the role of the mom when you use the prototype. While this may not reflect your current lifestyle, we hope that the tasks you will perform do in fact reflect things that would actually occur for you.

Please tell us if any of the tasks that we have you perform are different than what you and your family would really do in the given situation.

Marge and Phil Usable are parents of two daughters, Dawn aged 7 and Lacey aged 15. Both Marge and Phil work outside of the home. They have one car that is typically used by Marge during the day to commute to work and in the evenings by either parent to take the children to various extracurricular activities. Phil typically takes public transit to and from work. Dawn and Lacey are both generally involved in a variety of extracurricular activities outside of school.

Describe the Inkable Family Calendar and the colour scheme used for the events currently displayed:

Phil	Father	Blue
Lacey	Daughter, age 15	Green
Dawn	Daughter, age 7	Orange
Family / unassigned		Yellow (default)
Mariners Games (downloaded)		Pink
Marge	Mother	Red

Please be patient with the system as it is still a prototype and may crash.

Also, remember that we are evaluating the system and not you. If you uncover any problems, it is the fault of the system and not your own.

Think Aloud.

While you are performing the tasks we are going to ask you to think aloud. This just means actually saying out loud what you are doing and why you are doing it. It helps us to better understand what you are doing. Would you like an example?

If you forget to think aloud, we may prod you during the tasks by saying something like, "and what are you doing now?"

Sitting Vs. Standing.

We are going to have you stand-up for the first half of the tasks and sitting for the remainder. If you need to sit down at any point, please let us know.

D.3 Pre-Study Questionnaire

In this survey we define household to mean any children and adults you live with. For example, a spouse, partner, roommates, kids, parents, or au pair. If you are uncomfortable answering any of the questions please skip them.

1. How many people (children and adults, including yourself) live in your household? If you share custody of any children, please include them. _____

2. Which age category do you fall into? (circle one)

- a) 18 – 30 years
- b) 31 – 45 years
- c) 46 – 60 years
- d) Over 60 years

How many people in your household fall into these age categories (including yourself)?

0 – 2 years	
3 – 4 years	
5 – 8 years	
9 – 11 years	
12 – 17 years	
18 – 30 years	
31 – 45 years	
46 – 60 years	
Over 60 years	

3. Do you work outside of the home?

- a) Yes
- b) No

4. If you work outside the home, what is your occupation?

5. If you work outside the home, how many hours per week do you work?
- a) 40 + hours
 - b) 30 – 39 hours
 - c) 20 – 29 hours
 - d) Fewer than 20
6. Do you have a car for each member of your household that can drive?
- a) Yes
 - b) No
7. What is your family status?
- a) Single
 - b) Couple (married, domestic partner, etc.)
 - c) Prefer not to say
8. If your family status is ‘couple’, what is your partner’s gender?
- a) Male
 - b) Female
 - c) Prefer not to say
9. If your family status is ‘couple’, what is your partner’s occupation?
-
10. If your family status is ‘couple’, how many hours per week does your partner work outside of the home?
- a) 40 + hours
 - b) 30 – 39 hours
 - c) 20 – 29 hours
 - d) Fewer than 20
11. If additional adults (besides a partner) reside in your household, do they work outside the home? If so, indicate the number of hours for each individual adult.
-
-
12. Would you say that you are the primary calendar scheduler in your home for family activities?
- a) Yes
 - b) No
13. How often do you use a Tablet PC?
- a) Never Used
 - b) Have used once or twice
 - c) Every few months

- d) Monthly
- e) Every few days
- f) Daily

14. How often do you use an electronic device with a stylus / pen? (e.g., PDA)

- a) Never Used
- b) Have used once or twice
- c) Every few months
- d) Monthly
- e) Every few days
- f) Daily

D.4 Paper and Digital Prototype Tasks

Task 1: Today: June 15, 2005

Lacey usually arrives home after school around 4 pm. You arrive home from work at 5 o'clock and can't find Lacey anywhere.

Find out where Lacey is currently.

Where is Lacey? _____

Task 2: Today: June 20, 2005

You are at work and realize you will have to stay late tonight past your usual 5:30 pm. You need to check the home calendar to see if you have any commitments for tonight. Luckily, you can view your home calendar through a web page at work.

Check the home calendar and see if you are free tonight.

Are you free tonight?

- a.) Yes
- b.) No

Task 3: Today: June 20, 2005

Part I: You receive a call from your friend, Susan, who wonders if the family is available to come to her house for dinner on Friday around 6. You check your schedule.

Check the calendar to see if anyone in your family is busy.

Is anyone in your family busy?

- a.) Yes
- b.) No

Part II: You tell Susan that Friday is fine, but that you have to check with Phil.

Schedule the event as 'tentative' (requiring Phil's approval).

Do you see a 'tentative' event with Susan's family on your calendar for Friday?

- a.) Yes
- b.) No

Part III: When Phil arrives home that night you tell him about the get-together. Phil says that it is fine so you confirm the event.

Confirm that the time is fine.

Do you see an event on your calendar with Susan's family for Friday that is no longer tentative?

- a.) Yes
- b.) No

Task 4: Today: June 20, 2005

Part I: Susan discovers that her family can no longer meet on Friday with your family. Susan calls you to explain the situation and asks if Saturday is fine. You check your family calendar.

Check if Saturday is free.

Is Saturday free?

- a.) Yes
- b.) No

Part II: You see that your family has no plans for that evening. You change the date of the event.

Change the date of the event.

Do you now see an event with the new date?

- a.) Yes
- b.) No

Part III: When Phil arrives home that night he sees that the event has changed but he remembers he had not yet put in the calendar that he bought tickets for the family to see the circus that night. Phil tells you about the circus tickets. You remove the get-together with Susan from the calendar, and then enter the family event for the circus. The circus runs from 6:30 – 8 pm.

Remove dinner event with Susan.

Add a family event for next Saturday.

The next day, you call Susan to discuss a new date for their families to get together.

Do you now see the circus event scheduled for Saturday?

- a.) Yes
- b.) No

Task 5: Today: June 21, 2005

Part I: You receive a phone call from an old friend, Kimberley. Kimberley is in from out of town and wants to get together with you tomorrow night (Wednesday) around 7. You check the calendar to see if you are responsible for any of the childrens' activities tomorrow.

Check the calendar to see if you are responsible for any of the childrens' activities tomorrow.

Are you responsible for any of the childrens' activities tomorrow?

a.) Yes

b.) No

Part II: You realize that you and Phil only have one car so you tell Kimberley that it is probably fine as long as Kimberley picks you up. You'll have to confirm with Phil though and then get back to her. You add the event to the calendar.

Schedule the event with Kimberley tentatively until you can check with Larry.

Do you now see the tentative event on your calendar?

a.) Yes

b.) No

Task 6: Today: June 21, 2005

Lacey arrives home one day from school and tell you that she just heard from her band teacher that they may be going on a band trip in the fall for a week starting September 13th. The date is not yet confirmed but you add this trip to the family calendar as a tentative event so your family knows Lacey may be away that week.

Schedule a tentative event for the trip.

Do you see a tentative event for the trip now?

a.) Yes

b.) No

Task 7: Today: June 21, 2005

Part I: Dawn is involved with music recitals every week. You need to resolve any conflicts between her schedule and the recitals for the remainder of this week. You view everyone's events to see if there are any conflicts.

Check for conflicts.

Are there any appointments that conflict with Dawn's recitals?

a.) Yes

b.) No

If so, which day? _____

Part II: You see that Lacey's gymnastics appointment on Thursday conflicts with Dawn's recital. You need to tell Lacey that she will have to get a ride with a friend. You set the appointment as a 'to do' item until you can talk to Lacey.

Make the appointment a 'to do' item.

Task 8: Today: June 21, 2005

You've just found out that Phil's soccer practices will be Tuesday nights from 7 to 8 pm starting next Tuesday until the end of July. You schedule a recurring event for the practices.

Schedule a recurring event for the soccer practices.

Do you see a recurring event for the practices?

- a.) Yes
- b.) No

Task 9: Today: June 21, 2005

Lacey has decided to join field hockey with her school. She has told you that practices will be next Wednesday, the following Tuesday, and then the following Monday. Each runs from 7-8 pm.

Schedule a recurring event for the practices.

Do you see a recurring event for the practices?

- a.) Yes
- b.) No

D.5 Post-Study Questionnaire

1. What was your favorite thing about the family calendar?

2. What was your least favorite thing about the family calendar?

3. How did you find working on the calendar standing up?

4. How did you find working on the calendar sitting down?

5. If you could change something in the family calendar, what would it be and why?

D.6 Paper Prototypes

Paper prototypes were created and evolved at the end of each study day over a course of three days. This meant between two and four individuals saw each paper prototype design. Here we show the basic paper prototype idea where some participants saw minor deviations from it. The original paper prototypes used with pilot participants had hand drawn prototype screens with multiple layers of paper pasted with Post-It Note glue more similar to original PICTIVE concepts. This technique was very difficult to use for multiple participants because they were required to sometimes write on the prototype or it was augmented as a result of decision suggestions. Therefore, the study required multiple hand drawn versions of the prototype to be created ahead of time, one for each participant. Given this, we abandoned the strategy of overlying paper and instead created hand drawn prototype versions (shown here) on the Tablet PC, which could be easily modified and printed.

MONTH WEEK DAY

SUN	MON	TUES	WED	THURS	FRI	SAT
			1	2	3	4
◀ JUNE 2005 ▶						
5	6	7	8	9	10	11
	Grandma visits →					Phil Soccer
12	13	14	15	16	17	18
			Lacey drama 4-5:30			Phil Soccer
19	20	21	22	23	24	25
	Plumber in evening	Phil doctor 3pm	Lacey ballet	Dawn recital	Lacey drama	now lawn
26	27	28	29	30		



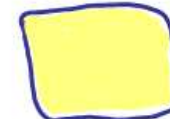
NEED TO SCHEDULE



PHOTOS



EVENTS



MONTH

WEEK

DAY

◀ JUNE 19-25 ▶

SUN 19MON 20TUES 21WED 22THURS 23FRI 24SAT 25

Any

Morn

Aft

Eve

Dawn practice

Phil doctor 3pm

Plumber in evening

Lacey basket

Dawn recital

Lacey doctor

Mow lawn

Lacey

Family

MARGE

PHIL

LACEY

DAWN

CAR

ADD

NEED TO SCHEDULE

PHOTOS

ADD

ADD

JUNE 2005

EVENTS

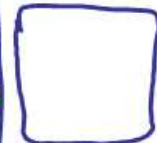
MONTH WEEK DAY

MON, JUNE 20

	MARGE	PHIL	LACEY	DAWN
Any				Dawn practice for recital
Morn				
Aft				
Eve		Plumber in evening		



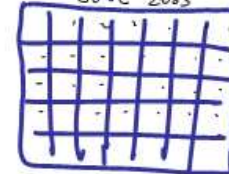
NEED TO SCHEDULE



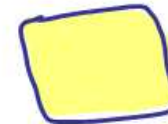
PHOTOS



JUNE 2005



EVENTS



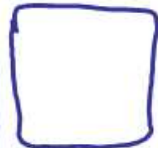
MONTH WEEK DAY

◀ WED, JUNE 22 ▶

	MARGE	PHIL	LACEY	DAWN
Any				
Morn				
Aft				
Eve			Lacey ballet	

 FAMILY
 MARGE
 PHIL
 LACEY
 DAWN
 CAR
 ADD

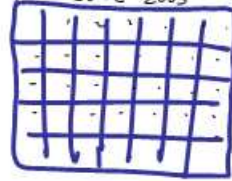
NEED TO SCHEDULE



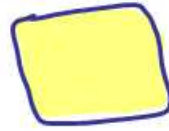
PHOTOS




JUNE 2005



EVENTS



MONTH WEEK DAY

THU, JUNE 23

	MARGE	PHIL	LACEY	DAWN
Any				
Morn				
Aft				
Eve			Lacey doctor	Dawn recital

FAMILY
 MARGE
 PHIL
 LACEY
 DAWN
 CAR
 ADD

NEED TO SCHEDULE

PHOTOS

JUNE 2005

EVENTS

MONTH WEEK DAY

◀ FRI, JUNE 24 ▶

	MARGE	PHIL	LACEY	DAWN
Any				
Morn				
Aft			Lacey drama	
Eve				

Family icons: FAMILY, MARGE, PHIL, LACEY, DAWN, CAR, ADD

NEED TO SCHEDULE

Empty box for scheduling

PHOTOS

Box with ADD button for photos

Recycling bin icon with arrows

JUNE 2005

Calendar grid for June 2005

EVENTS

Yellow sticky note for events

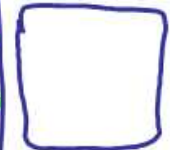
MONTH WEEK DAY

◀ SAT, JUNE 25 ▶

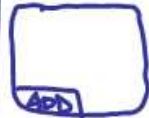
	MARGE	PHIL	LACEY	DAWN
Any		mow lawn		
Morn				
Aft				
Eve				



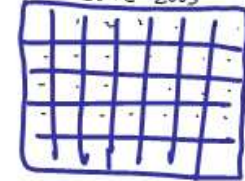
NEED TO SCHEDULE



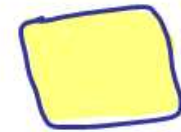
PHOTOS



JUNE 2005



EVENTS



MONTH WEEK DAY



Any

Morn

Aft

Eve

FAMILY
MARGE
PHIL
LACEY
DAWN
CAR
ADD

NEED TO SCHEDULE

PHOTOS



JUNE 2005

EVENTS

Appendix E. Challenges for Family Calendar Development

This appendix discusses some challenges faced for family calendar development. These challenges are not new to software development (e.g., many other applications require synchronization through a server) and nor are the solutions used within LINC to address them. That said, they are identified here to aid the future design and prototyping of digital family calendars.

E.1 Client Synchronization

Digital family calendar design requires multiple calendar clients to run and synchronize from a variety of locations. One common approach for prototyping distributed groupware applications that do this is to use a notification server (Boyle and Greenberg, 2005), which transmits changes made in one client through a server to other clients. These notifications are typically sent as they occur. This approach could be used for digital family calendars, yet network connectivity can easily be faulty in home environments (at least currently). This means that if network connectivity goes down, clients could miss pertinent calendar updates from other clients. To overcome this, we designed LINC to run primarily in an ‘offline’ mode. This means that changes are not sent to clients as they occur. Instead, every 20 minutes (this interval can be set by families) clients attempt to synchronize with the server. If connectivity is down at the time of synchronization, clients try to synchronize at the next time interval. The idea of offline synchronization is by no means new; it has even been implemented as the heart of commercial groupware products such as Lotus Notes.

This synchronization model meant several things for development. First, we had to create several separate databases for LINC: one for each client, and one for the server. Each client database, as well as the server’s database, maintains two tables: one detailing the current set of *events* on the calendar, and one detailing the *changes* made to the calendar.

When clients synchronize with the server, they transmit their known changes since their previous synchronization. Second, during each client's synchronization, the server needs to resolve potential conflicts between client changes. Our model uses a synchronization scheme where the most recent change is always used. Yet, in some cases, a client may not synchronize for a long period of time and this client may have the most recent change to an event. While that client is in offline mode, other clients may update the event despite not having the most recent change. For this reason, each time a client synchronizes, the server must check the time of each change to ensure the most recent update is in fact being applied. Change awareness features in our user interface also meant that each client needed to receive a list of changes made by other clients. This helps alleviate user confusion over changes made to the same event by different clients.

E.2 User Interface Design

The user interface of LINC also contributed challenges during development. Chapter 8 highlighted general challenges with modes when designing for pen-based interfaces. In addition, we also experienced difficulties with the placement of calendar events. LINC was designed to be simple and flexible to use where users could choose their own positioning for events within day squares on the calendar. Yet each event still needed to be associated with a particular start and end date. However, LINC's flexibility meant that users could position an event in *any* location of a day's square, where the edge of a note may straddle various calendar days. Our initial solution used the top left corner of an event's note to identify the start date for an event (e.g., the day under the note's top left corner was assumed to be the start date). The bottom right corner of an event's note was used to identify the end date for an event. Through testing, we realized that this solution did not work well as the bottom right corner of a note would sometimes hang into the subsequent week on the calendar. This causes the event to appear in the system as though it is occurring over a week long period. Our current solution instead uses the top right corner of the note to identify the end date of the event. This still has its problems but presents an improved solution. Even though this challenge is somewhat trivial in nature, it represents a larger problem when designing systems to be highly flexible for users. Flexibility may not be precise, but storing information about interface components often requires precision.

Appendix F. LINC Field Trials Study Materials

This appendix presents materials used for the field trials of LINC.

Note: this study was conducted at both the University of Calgary (two families) and at Microsoft Research in Redmond, WA (two families).

F.1 Study Recruitment

Investigators:

Carman Neustaedter and Saul Greenberg, University of Calgary
A.J. Brush, Microsoft Research

Purpose: The purpose of this research is to better understand how to design domestic coordination technologies by observing the effects of a digital family calendar on coordination routines of families

Procedure: The study will involve you and your family using a digital family calendar as your primary family calendar over the course of four weeks. The study will involve the researchers interviewing you about your current coordination routines and your usage with the software.

Objective: The research objective is to understand how families currently use calendars and other domestic artefacts to coordinate activities so that we may better understand how to design coordination technologies for the home.

Commitment: Your participation in the study will last for approximately four weeks and you will be compensated for your time with software, vouchers, or cash valued at approximately \$300. We will supply the digital calendar and computer for it to run on for the duration of the study.

We are looking for families of various sizes and demographics. At least one parent should spend a large portion of his or her workday in front of a computer.

To Participate or For More Information:

Send email to: carman@cpsc.ucalgary.ca

F.2 Description

This is a description that will be read to the participant family at the beginning of the study to inform participants of the procedures prior to giving consent. Italicized text is instructions to the investigator. We may not read the script verbatim as it is intended as a sample to lead discussions. However, procedures for obtaining informed consent will be followed.

Introduce yourself.

My name is _____, and I will be outlining the study for you and answering any questions that you may have.

We're researching family coordination routines and family calendaring in an effort to understand how to design a digital family calendar for the home.

Tell them about the experiment.

In this study, you will be asked to use a digital family calendar called LINC as your primary family calendar. LINC will be running on a Tablet PC that we will be supplying you with for the duration of the study. LINC is an early design of a digital family calendar and we are interested in knowing how it fits into your current coordination routines and where it does not fit so well. Based on your feedback, our goal is to improve LINC and also find implications for family coordination technologies in general.

The study has three main stages that your family will participate in:

1. We will first have each adult family member complete a pre-study survey (if we did not already have you complete this before we came to your house). Next we will use the survey as a discussion piece and interview you about your family's current coordination routines. Here we would like you to describe to us how you manage and coordinate family activities and stay aware of the activities of your family members. We ask that you show us the various items that you use to coordinate activities, which could include things like a paper calendar, whiteboard, or daytimer, and describe how your family uses them. If it is fine with you, we'd like to take pictures of these items and their normal locations.
2. Next we will introduce you to the digital family calendar called LINC. We'll show you how it works and will help set it up with you including picking a location for it and also transferring information from your current calendar to LINC. We will leave the digital calendar in your home for the duration of your study and collect information from you about your use with it using a number of techniques:
 - a) LINC will be collecting data as you use it. It logs the events you place on the calendar, when you move them, delete them, etc. This is so we can understand

aspects such as how many events you put on a day and how often events change dates. The logged data will remain confidential and be anonymous when we publish our findings.

- b) We will give you a family diary where we'd like each of you to write down any thoughts you may have about using LINC or your coordination activities and routines. The more you write the more we will be able to understand how LINC is fitting in, or not fitting in with your lifestyle.
 - c) We will come by for an initial visit with you in a day or two to see how things are going with LINC. After that point, we'd like to return each week for a regularly scheduled time to meet with your family to discuss the week's activities and go over your entries in the journal.
 - d) 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.
3. At the end of the deployment phase of LINC, we will come back to your house and interview you about the entire deployment to gather feedback from you about LINC. We would like to gather your thoughts as you reflect on your experience in using a digital family calendar as your primary family calendar.

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.

Give them the consent form to sign. If it is not signed, do not proceed.

Proceed with a pre-study survey for each adult family member.

Proceed with interview.

Ask participants if it is okay to photograph their calendar and other coordination items.

Setup LINC in the home location of their choosing.

Ask if they would like LINC setup on their home PC.

Ask if they would like LINC setup on their work PC.

F.3 Consent Form

Research Project Title: Understanding the Effects of a Digital Family Calendar

Investigators:

Carman Neustaedter and Saul Greenberg, University of Calgary

A.J. Brush, Microsoft Research

The University of Calgary Conjoint Faculties Research Ethics Board has approved this research study.

This consent form, a copy of which has been given to you, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Purpose: The purpose of this research is to better understand how to design domestic coordination technologies by observing the effects of a digital family calendar on coordination routines of families.

Participant Recruitment and Selection:

To be a recruited for this study, we ask that you allow us to use and analyze your results from the study.

Procedure:

The study will involve the use of a digital family calendar within your own home over the course of four weeks. It will include several stages:

- a) initial interviews and a survey with you and your family about your current coordination routines
- b) the actual use of the digital family calendar within your home
- c) weekly interviews throughout the course of the study to discuss how you are using the digital calendar
- d) follow-up interviews at the completion of the study

The study will involve the researcher(s) coming to your home to interview you and your family. You must also use the digital family calendar throughout the study as your family's primary calendar.

Confidentiality:

Your anonymity will be strictly maintained. Reports and presentations will refer only to a participant identification number and will be in a secure filing cabinet or on a secure computer. Confidential information will be hidden from photos and videos prior to the publication of results from this study, unless prior consent is given.

Data Collection:

Questionnaire and observation will be collected and kept by the researchers at the University of Calgary in a secured office space. Software logging and database information will be kept on a secure server at Microsoft Research. Only the researchers will have access to the records/data. All data will be destroyed after a period of 3 years.

Risks:

There are no known risks, however, if you feel uncomfortable you are free to quit at any time. All information collected from a person that withdraws will be destroyed.

Investigators:

Carman Neustaedter is a PhD student under the supervision of Dr. Saul Greenberg, Professor in the Department of Computer Science at the University of Calgary. A.J. Brush is a researcher at Microsoft Research in Redmond, WA, USA.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. If you have further questions concerning matters related to this research, please contact:

Carman Neustaedter (carman@cpsc.ucalgary.ca) or
Dr. Saul Greenberg (saul@cpsc.ucalgary.ca)

If you have any concerns about the way you've been treated as a participant, please contact Bonnie Scherrer in the Research Services Office, University of Calgary at (403) 220-3782; email bonnie.scherrer@ucalgary.ca.

Participant's Name

Date

Participant's Signature or Signature of Parent/Guardian

Date

Investigator's/Witness's Signature

Date

A copy of this consent form has been given to you to keep for your records and reference.

F.4 Photograph Consent Form

Investigators:

Carman Neustaedter and Saul Greenberg, University of Calgary

A.J. Brush, Microsoft Research

This consent form authorizes the investigators to use the photographs taken during the study without modification for illustrative purposes in the dissemination of the study's results, including but not limited to, presentations and publication of papers and/or theses.

Participant's Name

Date

Participant's Signature or Signature of Parent/Guardian

Date

Investigator's/Witness's Signature

Date

A copy of this consent form has been given to you to keep for your records and reference.

F.5 Pre-Study Family Information Sheet

In this survey we ask 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.

For each question, circle only one answer unless otherwise asked.

1. Name: _____
2. How many people live in your household including yourself? If you share custody of any children, please include them.
 - a) 1
 - b) 2
 - c) 3
 - d) 4
 - e) 5
 - f) 6 or more
3. 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	

4. What is your family status?
 - a) Single
 - b) Couple (married, domestic partner, etc)
 - c) Prefer not to specify

5. How many cars does your household own?

- a) 1
- b) 2
- c) 3
- d) 4
- e) 5 or more

Technology Usage

This section asks about the technology your family uses at home and on the go.

6. How many hours per week (on average) do the members of your household use computers, including both work and personal use? *(Check one box per row)*

Name (e.g. me, spouse, ...)	N/A	1	2-10	11 – 20	21-30	31-40	40+

7. How many personal computers do you have in your home? Please include any work related laptops that you often use at home.

- a) 0
- b) 1
- c) 2
- d) 3
- e) 4
- f) 5+

g) How many of your computers are located in each of these places at home?

	Number of Computers (e.g. 0, 1, 2 ...)
Mobile laptop	
Home Office	
Kitchen	
Living room	
Family room	

Dining room	
Bedroom	
Garage	
Attic	
Closet	
Other	

10. What is the speed of the primary Internet/modem connection you use at home?

- a) No connection
- b) 33.6K (or slower) dial-up modem connecting over a regular phone line
- c) 56K (or faster) dial-up modem connecting over a regular phone line
- d) Dial-up modem (unsure of speed) connecting over a regular phone line
- e) ISDN line
- f) Cable modem (your cable TV company provides your Internet service)
- g) DSL or ADSL modem (high speed phone line)
- h) T-1 or T-3 Line
- i) Satellite connection
- j) Some other way
- k) Don't know

11. Do you have wireless access in your home (e.g. your own network, shared neighborhood network)?

- a) Yes
- b) No
- c) Don't know

12. What types and how many mobile device(s) do you and other members of your household (if applicable) own? We consider Smartphones to be cell phones.

	Number (e.g. 0, 1, 2, ...)
Cell phone with activated internet access	
Cell phone without internet access (or unactivated)	
PocketPC or other PDA with internet access	
PocketPC or other PDA without internet access	
Other	

F.6 Potential Pre-Study Interview Questions

These questions will not be asked of every participating household. They are intended only as potential questions that may be asked to encourage participants to explain their *current coordination routines*. Other questions will be asked based on responses and the family's routine.

General Item Questions

1. What items do you use to plan and coordinate family activities?
e.g., calendar, note pad, daytimer, electronic organizer, other software
2. Why do you use these items for coordination?
3. Where are these items located? Why are they located there?
4. What type of calendar do you primarily use? Why that kind?
5. What are the main problems you face in your coordination routine, if any?

Scheduling

1. Who in the family adds things to this calendar? Why?
2. What writing utensil do people use to add or change things on the calendar?
3. When do people add to the calendar? Why that time?
4. What do you do if you need to schedule something when away from the home? (e.g., dentist office)
5. How many events do you typically put on a single day in your calendar?
Does it vary during the seasons? Does it vary during the weeks?
6. How do you change events on your calendar?
7. How do you remove events from your calendar?
8. How do you handle tentative events on the calendar?
9. How do you resolve conflicts with family activities?
10. Do you use colour in any particular way on your calendar?
11. Can you show us the last event you added to your calendar?
12. Can you walk us through how you would add a new event?
13. What do you NOT put on the calendar? Why?

Gathering an Awareness of Activities

1. Who looks at the calendar? Why? When?
2. How do you know where other family members are or what activities they are doing?

F.7 Potential Weekly Interview Questions

These questions will not be asked of every participating household. They are intended only as potential questions that may be asked to encourage participants to explain how they have used LINC *throughout the week* and how it has affected their coordination routines. Other questions will be asked based on responses and the entries in the family journal.

General Questions

1. Did you have any particular problems with LINC this week?
2. What items did you use to plan and coordinate family activities?
e.g., calendar, note pad, daytimer, electronic organizer, other software
3. Why did you use these items for coordination?
4. Where are these items located? Why are they located there?

Adding Events

1. Who scheduled events this week?
2. What types of events were scheduled this week?
3. When did you schedule the events?
4. How did you schedule the events?
5. What colour did you make the notes you added?
6. What colour was the ink you used?
7. How did you find adding events into LINC? Did it support what you wanted to do?

Resolving Conflicts

1. Did anyone have to resolve conflicts with the calendar? Which events?
2. How did you resolve the conflicts?
3. When did you resolve the conflicts?
4. Did LINC support you in resolving conflicts?

Remote Scheduling

1. Who scheduled events away from home this week?
2. Why did you have to schedule events away from home this week?
3. How did you schedule the events?
4. When and where did you schedule the events?
5. Did LINC support you in scheduling events while away from home?

Changing Events

1. Who changed events this week on the calendar?
2. Why did you need to change events?
3. How did you change them?
4. Did LINC support you in changing events?

Gathering an Awareness of Activities

1. Who looked at the calendar this week? Why? When?
2. How did you know where other family members are or what activities they are doing?

F.8 Potential Post-Study Interview Questions

These questions will not be asked of every participating household. They are intended only as potential questions that may be asked to encourage participants to explain how they have used LINC *over the course of the study* and how it has affected their coordination routines. Other questions will be asked based on responses and the entries in the family journal.

General Questions

1. What parts of your family's coordination routines did LINC work best for?
2. What parts of your family's coordination routines did LINC work not work well for?
3. What items, if any, did you use to plan and coordinate family activities along with LINC?
e.g., calendar, note pad, daytimer, electronic organizer, other software
4. Why did you use these items for coordination in addition to LINC?

Adding and Changing Events

1. Did the people who usually schedule events change during the course of the study?
2. Did your process for adding events change at all during the course of the study?
3. How does this compare to before LINC?
4. How does this compare to a paper calendar?
5. Did LINC support adding events as you would like to?

Resolving Conflicts

1. Did the people who usually resolve conflicts change during the course of the study?
2. Did your process for resolving schedule conflicts change during the course of the study?
3. How does this compare to before LINC?
4. How does this compare to a paper calendar?
5. Did LINC support resolving conflicts as you would like to?

Remote Scheduling

1. Did the people who usually schedule events while not at home change during the course of the study?
2. Did your process for scheduling events while mobile change at all during the course of the study?
3. How does this compare to before LINC?
4. How does this compare to a paper calendar?
5. Did LINC support remote scheduling as you would like to?

Gathering an Awareness of Activities

1. Who looked at the calendar and how often did they to understand where other family members were?
2. What other ways did you use to find out learn about the whereabouts and activities of your family members?

F.9 LINC Install and Demo

As much as possible, have the people in the household doing the install and work with LINC.

1. Get machine on wireless network (probably want the keyboard for this)
2. Make sure that you have the family member do the install of LINC. Put the setup program on the desktop and have them click it.
3. Walk them through the install and entering their family name and password
4. Do a quick demo and then have them start putting in information

Make sure that you cover all of the following:

- € Make an appointment (ink and drag)
 - € Edit the appointment (double click, arrow menu, tool bar option)
 - € Talk about reminders
 - € Talk about time range on event
 - € Talk about recurring events
 - € Change date range and time on appointment (Show what happens when a ribbon event wraps around to next week)
 - € How to change colour of appointment
 - € Custom colour of appointment
 - € Erase ink on an appointment
 - € Custom ink colour on appointment
 - € Text entry on the appointment
 - € Delete an appointment (arrow menu, make big and choose X)
 - € Changes dialog
 - o Undo deletion
 - € Options dialog
 - € Going to next month
 - € Show Day View
 - € Explain Messages space
 - € Show how if you drag events off the calendar they get big again
 - € Explain how the events go to the server and show Manual Options(for setting how
5. Show them LINC Web (hopefully on another computer)

- € Bookmark location?
- € Changing the IE settings
- € Logging in

F.10 Ethics Approval



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MEMO

CONJOINT FACULTIES RESEARCH ETHICS BOARD
c/o Research Services
Main Floor, Energy Resources Research Building
3512 - 33 Street N.W., Calgary, Alberta T2L 1Y7
Telephone: (403) 220-3782
Fax: (403) 289 0693
Email: bonnie.scherrer@ucalgary.ca
Thursday, January 26, 2006

To: Carman Neustaedter
Computer Science

From: Dr. Janice P. Dickin, Chair
Conjoint Faculties Research Ethics Board (CFREB)

Re: Certification of Institutional Ethics Review: Understanding the Effects of a Digital Family Calendar

The above named research protocol has been granted ethical approval by the Conjoint Faculties Research Ethics Board for the University of Calgary.

Enclosed are the original, and one copy, of a signed **Certification of Institutional Ethics Review**. Please make note of the conditions stated on the Certification. A copy has been sent to your supervisor as well as to the Chair of your Department/Faculty Research Ethics Committee. In the event the research is funded, you should notify the sponsor of the research and provide them with a copy for their records. The Conjoint Faculties Research Ethics Board will retain a copy of the clearance on your file.

Please note, an annual/progress/final report must be filed with the CFREB twelve months from the date on your ethics clearance. A form for this purpose has been created, and may be found on the "Ethics" website, <http://www.ucalgary.ca/UofC/research/html/ethics/reports.html>

In closing let me take this opportunity to wish you the best of luck in your research endeavor.

Sincerely,

Bonnie Scherrer

For:

Janice Dickin, Ph.D., LLB., Faculty of Communication and Culture and
Chair, Conjoint Faculties Research Ethics Board

Enclosures(2)

cc: Chair, Department/Faculty Research Ethics Committee
Supervisor: Saul Greenberg

CERTIFICATION OF INSTITUTIONAL ETHICS REVIEW


This is to certify that the Conjoint Faculties Research Ethics Board at the University of Calgary has examined the following research proposal and found the proposed research involving human subjects to be in accordance with University of Calgary Guidelines and the Tri-Council Policy Statement on *"Ethical Conduct in Research Using Human Subjects"*. This form and accompanying letter constitute the Certification of Institutional Ethics Review.

File no: **4645**
Applicant(s): **Carman Neustaedter**
Saul Greenberg
Department: **Computer Science**
Project Title: **Understanding the Effects of a Digital Family Calendar**
Sponsor (if applicable): **MSC**

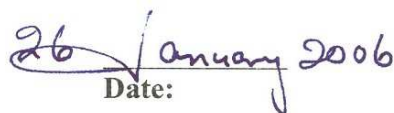
Restrictions:

This Certification is subject to the following conditions:

1. Approval is granted only for the project and purposes described in the application.
2. Any modifications to the authorized protocol must be submitted to the Chair, Conjoint Faculties Research Ethics Board for approval.
3. A progress report must be submitted 12 months from the date of this Certification, and should provide the expected completion date for the project.
4. Written notification must be sent to the Board when the project is complete or terminated.



Janice Dickin, Ph.D, LLB,
Chair
Conjoint Faculties Research Ethics Board


Date: 26 January 2006

Distribution: (1) Applicant, (2) Supervisor (if applicable), (3) Chair, Department/Faculty Research Ethics Committee, (4) Sponsor, (5) Conjoint Faculties Research Ethics Board (6) Research Services.

Appendix G. Co-Author Permission



UNIVERSITY OF
CALGARY

I, A.J. Brush, give Carman Neustaedter permission to use co-authored work from our papers in his thesis chapters and to have this work microfilmed. Papers and chapters include:

- "The Calendar is Crucial: Coordination and Awareness through the Family Calendar in Chapters 5-7
- "LINC-ing the Family: The Participatory Design of an Inkable Family Calendar" in Chapter 8
- "LINC in the Home: Field Trials of a Digital Family Calendar" in Chapter 9

11/6/2006
Date

A.J. Brush
A.J. Brush



I, Kathryn Elliot, give Carman Neustaedter permission to use co-authored work from our papers in his thesis chapters and to have this work microfilmed. Papers and chapters include:

- “Interpersonal Awareness in the Domestic Realm” in Chapters 2 and 3
- “Understanding Interpersonal Awareness in the Home” in Chapters 2 and 3
- “Time, Ownership and Awareness: The Value of Contextual Locations” in Chapters 2 and 3

Nov. 1st, 2006.

Date

Kathryn Elliot

Kathryn Elliot

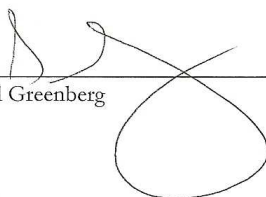


I, Saul Greenberg, give Carman Neustaedter permission to use co-authored work from our papers in his thesis chapters and to have this work microfilmed. Papers and chapters include:

- “Interpersonal Awareness in the Domestic Realm” in Chapters 2 and 3
- “Understanding Interpersonal Awareness in the Home” in Chapters 2 and 3
- “Understanding How to Design Awareness Appliances for the Home” in Chapters 2 and 3
- “Time, Ownership and Awareness: The Value of Contextual Locations” in Chapters 2 and 3
- “The Calendar is Crucial: Coordination and Awareness through the Family Calendar in Chapters 5-7
- “LINC in the Home: Field Trials of a Digital Family Calendar” in Chapter 9

Nov 1 / 2006

Date


Saul Greenberg