Where Are You and When Are You Coming Home? Foundations of Interpersonal Awareness

Carman Neustaedter, Kathryn Elliot, Anthony Tang, and Saul Greenberg
University of Calgary
2500 University Drive NW
Calgary, AB, Canada
[carman, elliotk, tonyt, *or* saul]@cpsc.ucalgary.ca

ABSTRACT

A barely explored frontier in HCI is how computers can augment the everyday social world of home inhabitants. Within this rich setting, our own focus is on how people naturally maintain *interpersonal awareness* for members of their household and other individuals in their personal lives. We carried out an exploratory study designed to: a) define the interpersonal relationships critical to home members, and b) articulate the needs of home members for maintaining awareness of the activities and lives of these people. Our results identify three types of interpersonal awareness: home, intimate, and extended awareness. For each type, we identify the people for whom this awareness is desired; the actual awareness information wanted; and the current techniques people use to maintain this awareness. Our results also identify two problems that inhibit people's maintenance of this awareness: time constraints, and distance/time separation. These results motivate and lay the foundations for groupware that augments how home inhabitants maintain interpersonal awareness.

Author Keywords
Interpersonal awareness, ubiquitous groupware.

ACM Classification Keywords
H.5.3. Group and Organization Interfaces: computer supported co-operative work.

INTRODUCTION

Researchers in ubiquitous computing believe computers can be realized as ubiquitous devices found throughout one's environment, where they augment everyday activity of people [3]. One environment of special interest is the technology-enhanced home, e.g., [8,9]. As a socio-technical system, effective design of such a home is predicated on having a strong knowledge of the domestic routines of home inhabitants, and an understanding of the role technology can play in supporting these routines.

Within the rich social setting of the home, our own focus is on how home inhabitants naturally maintain a sense of *interpersonal awareness* of others. From our own lifestyles, it seems clear that people maintain some semblance of awareness for cohabitants such as family members and other housemates. Parents often need to be aware of their children's extra-curricular schedules to coordinate rides. A spouse may become concerned if one's partner does not arrive home when expected. From introspection, we also know that interpersonal awareness extends beyond immediate home members, involving a small group of other individuals—close personal contacts—such as friends and the extended family. Friends may want to know about another's schedule to plan a night out. Families may be concerned about the well-being of an elderly parent who lives elsewhere.

Previous research has focused on understanding awareness in a work and office setting, e.g., [10,5]. While we expect some of that understanding to apply in the home, we also expect that the nuances of how awareness is gathered and used would differ within this personal social context of the home, family, and friends. Some researchers have begun exploring awareness in the home. A few have designed technologies that provide family and friends with a sense of awareness, e.g., [14,16,17,18]. These designs typically assume knowledge of the specific persons that one wants to stay aware of, and of the specific awareness information desired. Other researchers have investigated the relationships and social networks between family and friends [6,12,13,19], and have done ethnographic studies of general communication in domestic settings [1,2].

In this paper, we develop an operational definition of interpersonal awareness that identifies the awareness information desired by home inhabitants, and for whom this information is desired. This definition offers a more global view of interpersonal awareness than considered by the technological innovations mentioned above, but is also
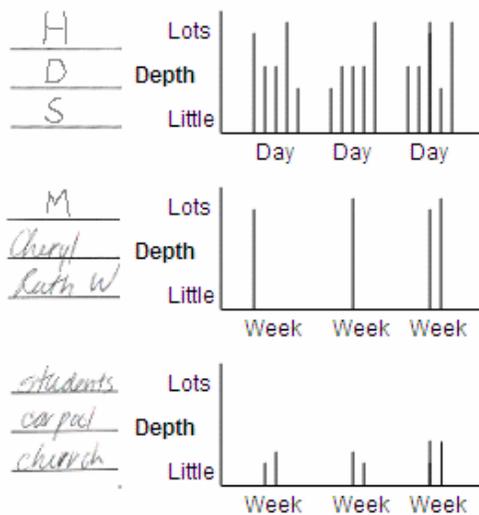
more focused than the social and ethnographic studies of domestic culture. To produce this definition, we performed exercises and contextual interviews in a variety of households. The next section outlines our specific research questions and methodology. Subsequent sections present the study results, where we identify the numbers and types of people for which interpersonal awareness is maintained, and from that offer operational definitions of interpersonal awareness. We close by discussing several implications of how groupware applications should support interpersonal awareness in the home.

METHODOLOGY

Our study focused on answering several research questions using qualitative techniques, including paper-based exercises and ethnographic interviews.

Research Questions

For each study participant, we wanted to answer the following questions.

1. Who does the participant want to stay aware of within their social network, i.e., what is their *sphere of interpersonal awareness* interest?
2. What awareness information does the participant want to maintain about these people?
3. How is this awareness information acquired and maintained?
4. What is this awareness information used for?

We now describe the households we recruited and the specific methodological steps we used in our study.

Participants

We recruited 29 people (16 female, 13 male) across ten different households, where we paid each household $50 for their participation. We took a broad-brush approach where we sought diversity. Five participants were teenagers, sixteen were young-mid adults aged 20 to 39, and eight were middle-aged adults aged 40 to 60. We avoided participants under the age of thirteen, as we thought they would be best handled by a methodology better suited to the young. Participants had a variety of 'work' backgrounds, e.g., students from junior/senior high school students 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. What was in common was that most participants were at least moderately technically inclined.

Method

All stages of our contextual study took place in the participants' own home, as we believed the home defined people's methods and desires for gathering interpersonal awareness information of their family and friends. Over the course of about an hour, each study participant completed three activities: two paper-based tasks, and an interview.

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 discovering how participants would create their own operational definitions of "awareness."

Participants were given what we call a *social target*. By way of example, Figure 1a shows a completed social target created by a study participant. The target contains several concentric rings labeled 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 a particular ring of the target indicates the frequency of the desired awareness. For example, writing a person's name in the centre ring, or bull's-eye, indicated that the participant wanted daily awareness information about that

Figure 1. A participant's social target.

Figure 1a. The entire social target.

Figure 1b. The bull's-eye of the social target.

Figure 2. Interaction frequency graphs from one of the participants.

person. Figure 1b illustrates this for the participant's reference to her H (husband), D (daughter) and S (son) in the center.

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, the top of Figure 1b uses an arrow for the "Carpool" group to indicate that the desired awareness frequency for this group changes between monthly and weekly. We also told participants that they could look at their address book, email contact list, or instant messenger contact list to help them with the activity, but only after first attempting to fill in the social target from memory. In a table on a separate piece of paper (not shown), 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.

Interaction Frequency and Depth
In the second activity, participants were given a set of 16 canonical graphs depicting interaction patterns. Three of the graphs are shown in Figure 2. 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 different graphs depict interaction frequencies that vary from multiple times per day, to once per day, once every few days, once a week, once a month, every few months, and annually. The graphs also vary in the interaction depth between short, non-detailed interactions and in-depth interactions.

For example, the top graph in Figure 2 depicts a relationship where in-depth interactions occur multiple times everyday. The middle graph depicts a pattern of in-depth weekly interactions. The bottom graph depicts a pattern of superficial weekly interactions.

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. If none of the given graphs were a good match for a particular person, a participant could draw the interaction pattern on a supplied blank graph.

Semi-Structured Interview
Following the paper activities, participants took part in a semi-structured interview in their home. 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.

RESULTS
We analyzed activities and observations using an open coding technique to draw out similarities and differences between participants and households. That is, for each observation we 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. We used the research questions discussed in the Methodology introduction to characterize our coding labels, where we did a separate coding pass for each question. For example, our coding for question 2 classified the data as a type of awareness information, while for question 4 we would classify the data by its uses.

While our participant demographics and household compositions are diverse, we found many commonalities between them. Still, we group several results in terms of teenagers, young-mid adults, and middle-aged adults as differences were found between these groups for certain parts of our analysis.

We describe our findings in the next two sections. We first define our understanding of the types of people within a participant's sphere of interpersonal awareness interest, and then we define interpersonal awareness and the mechanisms people use to maintain it.

I: THE SPHERE OF INTERPERSONAL AWARENESS
Figure 1 illustrates a very typical social target from the study, where we see several people in each ring of the target. We 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.

Figure 3 shows the number of entities (people and groups) found on the social target. The central line is the median, the rectangular box is the interquartile range that contains 50% of the participants, while the extents of the vertical line represents the total range. For example, we see that the median for all participants was 19, that 50% of the people had between 16-25 entities on their target, and that the total range was from 12-42 people. For all age groups, we see large interquartile and total ranges, which suggests that the number of entities within people's interpersonal awareness sphere is highly dependent on the individual. Yet median counts for the different age groups (19, 18, 22) are relatively similar, suggesting that people want to maintain awareness of roughly the same number of individuals despite differences in age. We conclude that *people typically maintain an overall sphere of interpersonal awareness for ten to forty people.*

When we asked participants about their social relationships with the people on their social target, their answers suggested that one's sphere of interpersonal awareness contains three overlapping groups: *home inhabitants, intimate socials*, and *extended socials*. We saw that groupings reflect the placement of people on the social target. That is, people in each group share similar time characteristics for awareness updates, as discussed below.

Home Inhabitants
As the name suggests, *home inhabitants* contain those people who live with the participant. These people are either roommates or family members of the participant. Collectively, all study participants but one wanted to maintain an awareness of their home inhabitants on a daily basis. This was indicated by their placements on the social target and on the interaction frequency graphs (although graphs chosen varied in the level of interaction depth). As a typical example, Figure 1b illustrates how the participant placed her live-in husband H and teenage children D and S in the 'daily awareness' bull's-eye of the social target. We also see in Figure 2 that these family members were listed next to the top graph, indicating that the participant interacts with her family members multiple times most days and that, in this case, the interactions are in-depth.

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. 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.*

While home inhabitants are clearly important and have their own unique attributes, they are actually a subset of a larger group called intimate socials, and they will be discussed further within that context.
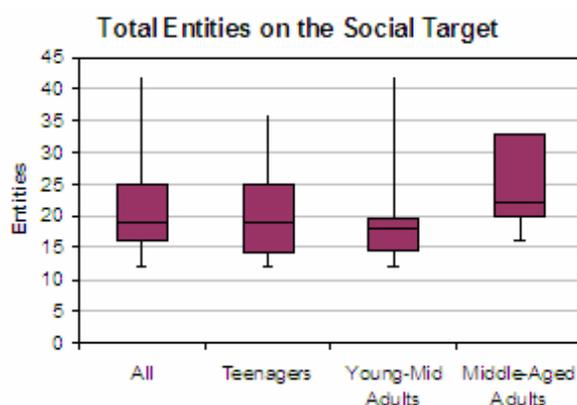

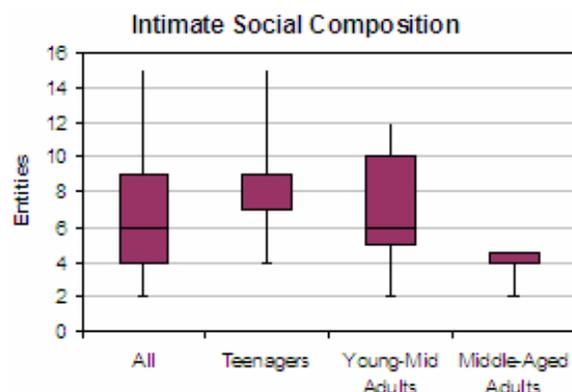**Figure 3. Median number of entities on social targets.**

Figure 4. Median number of intimate socials.

Intimate Socials
Composition. The *intimate socials* group contains those people for whom the participant has a strong need for awareness. Each and every participant felt there was a group of people who could be considered intimate socials. As we will see shortly, this is usually a superset of the Home Inhabitants group. For example, the participant from Figure 1 felt she was closest to her husband and two children who lived with her (in the daily ring), and her mother who lived elsewhere (in the weekly ring). She had a strong desire to maintain awareness of all of them. Figure 2 also shows that the participant has detailed daily interactions with her family members and detailed weekly interaction with her mother.

How many people comprise intimate socials? Figure 4 shows the median number of intimate socials for each person grouped by age. The median for all participants was 6, teenagers was 9, young-mid adults 6, and middle-aged adults 4. The higher number of intimate socials for teenagers can perhaps be attributed to their typical inclusion of immediate family members along with school friends. Middle-aged adults generally had fewer intimate socials than young-mid adults; most middle-aged adults in our study group had their own children, and their intimate socials typically contained only immediate family members, e.g., a partner and children. The large range for young-mid adults suggests that the number of intimate

4

socials for this group is mostly based on personal preference. Of course, this is a small sample and we may be supposing too much from these modest differences. Still, we can conclude that *in general people have four to ten individuals within their intimate social group for whom they have a strong need for awareness.*

Our open coding revealed that four types of people comprise these intimate social groups.
- *Home inhabitants* were included by all but one participant, and some included *only* home inhabitants in this group.
- *Significant others,* e.g., husband/wife, fiancé(e), girl/boyfriend, were included by all participants as an intimate social.
- *Immediate family members*—parents, siblings, and children – were included by all but two participants. One individual, who listed only two intimate socials, preferred little family contact. The other was a grade twelve student who, because of his age, preferred awareness of friends over family.
- *Close friends* were included by almost three-quarters (72%) of participants. Work colleagues were included by only three people.

We conclude that *intimate socials are typically those individuals with whom someone lives with or has a close personal relationship with, be it a family member or close friend.*

Is proximity a key factor in deciding who is in the intimate circle? Our results suggest that while proximity is important, it is not the only dominant factor. First, many intimate socials were included by our participants who were not home inhabitants. About two-thirds of our participants (66%) included people from the same city, about half (48%) included people from a different city but within the country, and about one quarter (24%) included people from a different and far-away country. Second, even though all participants included those people who they lived with, their reasoning for including them was mostly family-based versus proximity-based. Over four-fifths of our participants said their main reason for including someone as an intimate social was because s/he was close to them as s/he was considered family. In contrast, only four participants gave living together as their dominant reason. Other reasons given include shared interests in extra-curricular activities and hobbies (eight people), and work, school, or similar personalities (two people). Most teenagers' included friends from school because they would see them frequently. We conclude that *in general people are intimate socials because they share a close personal relationship, usually being family members, or close friends. A lack of proximity makes it more difficult for someone to be an intimate social member, but it does not prevent it.*

Changes in compositions. Most participants felt that their intimate socials rarely changed, and when they did it was for major reasons. The primary reason for changes, reported by over half our participants (59%), was life changes by either the participant or their intimate socials. These included moving to a different city, changing jobs, retiring, changing schools, graduating from school, getting married, or the death of an intimate social. Other reasons included a change in one's schedule, meeting new people, or a change in one's personalities or interests, or proximity of loved ones. Several participants also commented that they maintained more awareness and contact with certain individuals at different times of the year. For example, one participant's contacts depending on the sports season, e.g., golf in the summer, hockey in the winter. For the most part, these changes did not affect the composition of the intimate social network. Thus, *the composition of one's intimate social network is generally only affected by life changes.*

Awareness and Interaction Levels. A strong need to maintain awareness of an intimate social does not necessarily imply a frequent need. While all participants had intimate socials for whom they desire a near-daily awareness, almost half the participants (45%) had intimate socials for whom they desired only weekly awareness. To break this down further across all participants, of the total 189 intimate socials, participants desired daily awareness for about 72% of them, daily to weekly awareness for about 6%, weekly awareness for about 19% of them, and about 2% for less than weekly awareness.

We 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, a person may be satisfied with weekly updates of someone in their intimate circle: they had a strong need for this information, but the weekly update sufficed to fulfill that need. We conclude that *in general, people desire daily awareness of most intimate socials, yet a daily awareness does not make someone an intimate social.*

How do interaction frequencies relate to awareness frequencies for intimate socials? Interaction frequency almost always matched the frequency that one desired awareness information: 184/189 intimate socials had the same interaction and awareness frequencies. Almost three quarters (70%) of the total intimate socials maintained daily interaction with participants, about 11% daily to weekly interaction, about 16% for weekly interaction, and less than 3% for interaction less frequent than weekly. The variation in interaction depth is similar. Of the 189 intimate socials, about three quarters (76%) of them had detailed interactions with the participants, about one-fifth (19%) had non-detailed interactions and the remaining varied in between the two. We conclude that *in general most people maintain daily interaction with a large portion of their intimate socials. Moreover, the majority of all interactions with intimate socials contain detailed exchanges of information.*
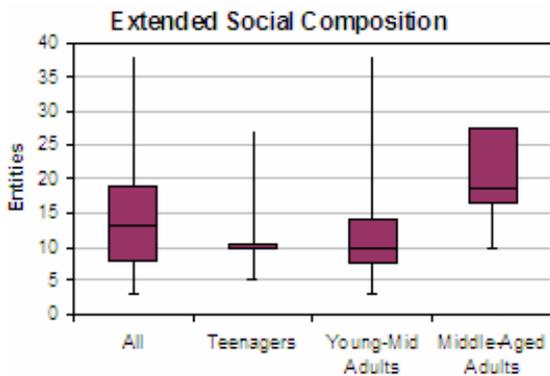
Figure 5. Median number of extended socials.

Extended Socials

Composition. The *extended socials* group contains the family and friends of interest to a particular person where the need for awareness is much more discretionary. We do not include home inhabitants or intimate socials in this group as they share different awareness characteristics than this group (discussed shortly). For example, in Figure 1a, the participant listed 26 individuals and 6 groups, other than home inhabitants and intimate socials, for whom she desired to maintain awareness.

How many people were part of the extended socials? Figure 5 shows the median number of extended socials for each age group. The median for all participants was 13, teenagers was 10, young-mid adults 10, and middle-aged 18.5. These numbers suggest that as one ages, the number of extended socials for which awareness is desired increases; middle-aged adults tended to list more extended socials than the other age groups. All participants included friends as extended socials, about two-thirds (66%) included co-workers/teachers, two-fifths (41%) included siblings, and about two-thirds (66%) included other relatives. We conclude that *in general people want to maintain awareness of three to twenty-eight extended socials, but their need for awareness of these people is discretionary.*

Changes in Composition. 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. We conclude that *in general the extended social group is fairly static, but can be affected by changes to the intimate social group.*

Awareness and Interaction Levels. 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. 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 to maintain awareness. We conclude that *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 then they are able to maintain.*

II: INTERPERSONAL AWARENESS

We now define interpersonal awareness by articulating the awareness information desired for each type of contact, the mechanisms used to maintain awareness of that contact, and the uses of this awareness information. As we will see, each of these differs depending on the group a person is in. Because of this variability, we describe three types of interpersonal awareness: home, intimate, and extended awareness. Our distinctions and discussions are derived from our analysis of the paper exercises and the follow-up interviews. To ground our analysis in real life, we begin each section with an actual scenario given by a study participant.

Interpersonal Home Awareness

Scenario: how interpersonal home awareness is needed by two working parents. Linda lives with her husband Larry, and two children, Susie and Tommy. Linda is a music teacher and tutors students out of her home. Larry is an engineer and sometimes his job requires him to travel out of town. Susie and Tommy are in junior high school and are both heavily involved in extra-curricular music activities. Linda and Larry have two vehicles, but must still coordinate who is going to pick up or drive each child to and from school and band practices. This involves knowing when Larry is out of town and when he will be finished work on a given day, along with knowing when Linda is scheduled to teach music lessons.

What is it? Interpersonal awareness of home inhabitants is primarily associated with knowing availability or scheduling information about one's home inhabitants. All but three participants (90%) said they wanted to maintain awareness of schedules about their home inhabitants. According to participants, awareness maintenance meant having a general knowledge of where people are, when they will be home, and when they are free to partake in activities. Scheduling is more associated with planning, and included knowing someone's daily plans, plans for the weekend, and work schedules. Participants said that daily plans could include specific things like what was being planned for supper, or more general things such as someone going to school or work.

Participants also wanted to maintain other awareness information. Over half (55%) wanted to know about the work activities of their home inhabitants, e.g., how their work or school day went. About half (48%) said they wanted to know about social activities and personal

relationships, e.g., what they have been doing outside of work/school, who they are dating. Other less-reported types of awareness included health and general well-being, and house administration items (e.g., whose turn it was to clean). We conclude that *interpersonal home awareness is characterized as a general knowledge of the schedules and availability of one's home inhabitants, and an understanding of their work and social lives.*

How is it maintained? All participants maintained interpersonal home awareness through direct interaction, primarily face-to-face with their home inhabitants. This was natural because they lived in the same home. Of course, home inhabitants often leave the home over the course of a day, e.g., going to work, or shopping. In these cases, a third of the participants (34%) reported augmenting their awareness information using an instant messenger; a quarter (24%) reported using a landline phone or cell phone; and, less than a fifth (17%) reported using email. A few participants, normally young-mid adults who were frequent computer users, even used technologies like instant messenger to communicate with home inhabitants while both were at home. Nearly all participants used some form of notes to indicate awareness information. These could include personalized notes to someone (left on sticky notes, message pads, or pieces of paper in opportune locations) or notes on wall calendars[1]. Over one quarter of the participants (28%) reported using the presence, absence, and/or location of personal artifacts as a means for gathering awareness information that did not include direct interaction. For example, participants reported using the presence or absence of cars, bicycles, and keys to know who was home or away. We conclude that *in general, interpersonal home awareness is gathered primarily through direct interaction with home inhabitants, most often through simple face-to-face communication or notes, and secondarily through the presence, absence and location of personal artifacts.*

What is it used for? Between two-thirds and three-quarters of the participants (69%) gave two primary uses for maintaining interpersonal home awareness: to coordinate one's own schedule, and to gather personal knowledge. For example, parents often commented that they needed to know their children's schedules in order to coordinate their own schedules and rides to various activities. This was seen in the scenario at the beginning of this section. 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. Teenagers wanted to know the availability of their friends, so they could "hang-out" with them. Obtaining personal knowledge is attributed as the glue that helps individuals maintain their personal relationships. We conclude that *in general, interpersonal home awareness is*

used to coordinate one's own schedule of activities and maintain personal relationships by having a general understanding of the work and social lives of one's home inhabitants.

Interpersonal Intimate Awareness

We consider interpersonal intimate awareness for those members of that group *who do not live together*. As already described above, home inhabitants have their own unique awareness characteristics.

Scenario. How interpersonal intimate awareness is needed by a husband and an aging parent. Doug is retired and lives with his wife and two university children. Six years ago, Doug's father passed away and, as a result, Doug has became more concerned about the well-being of his mother who lives in a different city. Doug's interaction with his mother has increased since his father's passing from monthly to daily / weekly phone conversations. Doug likes to know how his mother's week has gone, what types of things she has done, and whether she has had any difficulties with things like the finances.

What is it? Almost three-quarters of our participants (72%) reported that interpersonal awareness of those intimate socials who are not home inhabitants is primarily concerned with knowing about one's social relationships and activities. Social information included knowing what types of social activities people participate in and how they turned out, how personal relationships were going, and what people thought about shared interests (e.g., the latest hockey score). In contrast to knowledge of schedules for home inhabitants, social information for non-inhabitants mostly refers to details about social activities which have already happened. This was seen in the scenario at the beginning of this section.

For other awareness information, about half of our participants (48%) wanted to know details about one's work life, while over one-third (38%) wanted to know others' health and well-being. Scheduling information was desired by only a fifth of our participants (21%) and this was primarily by teenagers or those with significant others to whom they were not married, e.g., fiancés, girl/boyfriends. Less common awareness information included life plans such as career or school goals, and home administration information (for an elderly parent). We conclude that *in general intimate interpersonal awareness is the knowledge of the social relationships and activities of intimate socials and, for some individuals, knowledge of their work life and general well-being.*

How is it maintained? All participants used conversational real time interaction techniques to maintain awareness of intimate socials. Between two-thirds and three-quarters (69%) used the telephone; and about half reported using an instant messenger application (52%), and/or face-to-face communication (45%), and/or email (45%). One person used hand-written letters. People would almost always

---

[1]A companion submission provides full details of how home inhabitants maintain interpersonal awareness of each other.

choose the mechanism that was most convenient to reach the other person. For heavy computer users, email and instant messenger were favored. For individuals "out and about," cell phones were favored. Some teenagers said that they preferred to use instant messenger because it allows people to have multiple conversations at one time and they could even perform other activities while having a conversation. Middle-aged adults favored the telephone. Those with intimate socials in a different city or country preferred to use more affordable alternatives to the telephone such as email. A small number of participants (14%) reported awareness gathering techniques that did not require conversation. One teenager and three young-mid adults used instant messenger handles to gain awareness information, where their instant messenger contacts would change their name/handle to reflect their current activity or social state. We conclude that *in general, intimate interpersonal awareness of those not living together is gathered primarily through conversational real time interaction using technologies such as telephones, cell phones, email, and instant messenger, where the choice was dictated by convenience.*

What is it used for? Three quarters of participants (76%) reported they used the personal knowledge garnered through intimate interpersonal awareness primarily to maintain their personal relationships with others. Almost half (45%) of participants also reported using intimate interpersonal awareness to help coordinate activities with their intimate socials. Coordination for intimate socials, as opposed to scheduling for home inhabitants, is generally at a higher level of knowing, i.e., when someone is free is more important than knowing one's complete schedule. We conclude that, *in general, intimate interpersonal awareness is used primarily for maintaining personal relationships, and secondarily for coordinating activities.*

Interpersonal Extended Awareness
Scenario. How extended interpersonal awareness is used by a university student and her small group of friends. Cynthia considers most of her friends to be just acquaintances. While Cynthia frequently works on assignments with them, their discussions tend to be about these assignments, or major events such as the recent break-up of Cynthia with her long-time boyfriend.

What is it? Between two-thirds and three quarters of participants (69%) wanted to know about social events of their extended family and friends; about a third (34%) wanted to know health details; and just over half (55%) wanted work-related information. Unlike home inhabitants and intimate socials, awareness information about extended socials was desired at a higher level, typically focused on major events or life changes. We conclude that *in general, extended interpersonal awareness is the knowledge of life events and changes involving the social life, work, and health of extended family and friends.*

How is it maintained? All participants maintained extended interpersonal awareness through direct interaction. Three-quarters of the participants (76%) reported using the telephone to maintain this awareness; over half (55%) used email; a quarter (24%) used instant messenger; and two-fifths (41%) used face-to-face communication. In many cases, face-to-face communication allowed people to learn indirectly about other extended contacts. For example, children in one family learned about the health of a grandparent by talking with their mother after she had phoned the grandparent. Instant messenger was typically used only by teenagers and young-mid adults. We conclude that *in general extended interpersonal awareness is typically maintained through direct conversational interaction mechanisms such as the telephone.*

What is it used for? Extended interpersonal awareness is primarily used by people as personal knowledge; people like to know how their social contacts are doing and what major changes or events have happened in their lives. All but three participants (90%) reported this desire. A fifth of the participants (21%) wanted to maintain aspects of their own schedule based on the knowledge of extended contacts. This generally involved planning visits to see these contacts. For example, one family wanted to know how a parent/grandparent's health was and would plan trips to see her based on this. We conclude that *in general extended interpersonal awareness is maintained because people like to know how their social contacts are doing.*

DISCUSSION
We summarize our findings for each of the three types of interpersonal awareness in Table 1. The table lists, respectively by column, the types of interpersonal awareness, the people for whom this awareness is desired, the desired awareness information, the current means to gather this awareness, and the uses for this awareness. In general, we have found that *interpersonal awareness is a naturally gained understanding of the social relations of one's personal contacts.*

The results of our study identified two main problems specific to the maintenance of interpersonal awareness. First, we found that people want to maintain awareness about more people than they are actually able to achieve simply because of time constraints. People commented that they only had so many hours each day. They found it difficult to stay aware of people outside of the ones they lived with, and that it was difficult to provide these others with awareness information about themselves. For those not residing in the same home, time would be required to email, phone, or meet up with that person.

Second, we found that when people are separated by distance or time, it is more difficult to maintain interpersonal awareness. Similar results have been found in studies of workplace awareness [10]. Interpersonal awareness was most easily gained for those residing in the same household. Naturally, when people are co-present

Type of Awareness	People	Information	Gathering Means	Uses by importance
Home awareness	Home inhabitants: family members and/or roommates	*Primary*: scheduling and availability; *Secondary*: details about one's work and social lives	*Primary*: face-to-face interaction; technology such as phones (when not co-located); *Secondary*: artifact visuals, e.g., presence of cars or keys	*Primary*: coordinating one's own schedule; *Secondary*: personal knowledge and relationship maintenance
Intimate awareness	Intimate socials outside the home: significant others, family members, close friends	*Primary*: social activities and relationships; *Secondary*: work life and general well being	Direct interaction technology, e.g., phone, instant messenger	*Primary*: personal knowledge and relationship maintenance *Secondary*: coordinate social activities
Extended awareness	Extended family and friends	Life events and health	Direct interaction technology	Personal knowledge

Table 1: The three types of personal awareness.

interpersonal awareness can easily be gained using face-to-face communication. When schedules become busy and people are not always home together, time becomes an issue and interpersonal awareness becomes more difficult to maintain and extra efforts are required. For those not living together, distance becomes an issue and even greater efforts are needed to maintain interpersonal awareness. People must actively seek out interpersonal awareness information, again by attempting to contact the people for whom awareness is desired.

Both of these problems stem from the same basic issue: in almost all cases, interpersonal awareness is gathered through direct conversational interaction techniques, such as face-to-face communication, the telephone, instant messaging, or email. Fortunately, modern society is supplying an increased number of indirect relationships using technologies such as messaging or email, and many relationships move back and forth between face-to-face interaction and mediated interaction [11]. Grinter and Palen [4] and Schiano et al. [15] also found a widespread use of messaging media for supporting social relationships, particularly amongst teenagers.

While the use of direct interaction techniques to gain awareness may not appear to be problematic, these techniques limit the awareness information that is made available to people, the amount of people with whom a person can maintain awareness, and makes it especially difficult or expensive (e.g., long distance phone bills) to maintain over distance. Moreover, technologies that are used by people to gather interpersonal awareness (e.g., email, instant messenger) were not specifically designed with awareness in mind. Rather, they were designed to support interaction.

DESIGN IMPLICATIONS
The problems with gathering interpersonal awareness suggest that it would be beneficial for people to have technologies that provide lightweight mechanisms for gathering interpersonal awareness. These solutions could allow awareness to be maintained for more people, or could support the maintenance of awareness for those separated by distance or time. People want to interact with their contacts and many enjoy simply hearing another's voice. We are not attempting to limit or restrict awareness gathering techniques to those not requiring interaction. Rather, we are suggesting that technologies designed specifically to support interpersonal awareness can be used by home inhabitants to strengthen the current techniques they use for interpersonal awareness maintenance.

Gathering interpersonal awareness is typically a very natural and lightweight process when people are physically co-present. This may even go unnoticed for the simple reason that it is embedded in people's everyday routines; that is, it is a part of both the physical and social world that people inhabit. Dourish's [3] theory of *embodied interaction* identifies this and the need to develop computational devices that leverage our presence in the real world. Using Dourish's theory, we define *embodied groupware* as groupware applications that participate in the everyday-world practices of people to afford users with contextually sensitive interaction opportunities. Thus, user interaction with embodied groupware understands the user's context and provides the user with opportunities for natural lightweight interaction specific to the current context. Interpersonal awareness is one particular domain that can benefit from embodied groupware applications because interpersonal awareness is inherently embedded in the social and physical world of the home.

This observation leads us to suggest embodied groupware applications to support each of the three types of interpersonal awareness we have identified in an effort to solve the two main problems people face when gathering interpersonal awareness: time constraints and distance or time separation. Applications designed to solve these problems for each type of interpersonal awareness should pay particular attention to the operational definitions of interpersonal awareness that we have provided for each. That is, they should have a clear understanding of the user group identified, the type of awareness information desired, and the role of the awareness information for maintaining

social relationships. Designs can then be created to reflect the physical and social context in which interpersonal awareness resides.

CONCLUSION

We present an exploratory study with the goal of providing an operational definition of interpersonal awareness to aid the design of groupware applications for supporting interpersonal awareness. Specifically, our research contribution lays in the identification of three types of interpersonal awareness—home, intimate, and extended interpersonal awareness—where we articulate the users for whom each type of awareness is desired, the types of awareness information desired, and an understanding of the current techniques people use to maintain interpersonal awareness. Along with these operational definitions, we have identified two problems currently faced by people in the maintenance of interpersonal awareness: time constraints and distance or time separation.

Our work uncovers an under-explored niche for developing embodied groupware applications to support the maintenance of awareness in the lives of home inhabitants. Through our operational definitions of interpersonal awareness, designers and practitioners can benefit with an informed understanding of interpersonal awareness. Our future work includes continued investigations of the intricacies of interpersonal awareness along with the design of groupware systems to address the problems we have articulated.

Caveats. Some types of awareness information are prominently reported by participants and are thus obvious candidates for generalization. However, we must remember that people will have their own ideosyncratic information that they want when being aware of another. This will likely depend on the nuances of their interpersonal relationship. We also caution that our study contained only a modest number of Canadian households as participants. Still, because we saw many commonalities in spite of the diversity of the households chosen, we believe that our results will generalize to the broader 'Western' culture, although the actual mechanisms used for maintaining awareness may differ (e.g., mobile phone usage in Europe currently far exceeds that of North America).

ACKNOWLEDGMENTS

REFERENCES

1. Crabtree, A., Rodden, T., Hemmings, T., and Benford, S., Finding a Place for UbiComp in the Home, *Proc. Ubicomp 2003,* Springer-Verlag (2003), 208-226.

2. Crabtree, A., Hemmings, T., and Mariani, J., Informing the Development of Calendar Systems for Domestic Use, *Proc. ECSCW 2003,* Helsinki, Finland, (2003).

3. Dourish, P., *Where the Action Is: The Foundations of Embodied Interaction*, MIT Press (2001).

4. Grinter, R.E., and Palen, L., Instant Messaging in Teen Life, *Proc. CSCW 2002,* ACM Press (2002), 21-30.

5. Gutwin, C., Workspace Awareness in Real-Time Distributed Groupware, Ph.D. Thesis, Computer Science, University of Calgary, Canada, Dec 1997.

6. Hill, J., Fonagy, P., Safier, E., and Sargent, J., The Ecology of Attachment in the Family, *Family Process*, 42(2), June 2003.

7. Hindus, D., Mainwaring, S.D., Leduc, N., Hagström, A.E., and Bayley, O., Casablanca: Designing Social Communication Devices for the Home, *Proc. CHI 2001*, ACM Press (2001), 325-332.

8. Intille, S., Designing a Home of the Future, *IEEE Pervasive Computing*, April-June 2002, 80-86.

9. Kidd, C., Orr, R., Abowd, G., Atkeson, C., Essa, I., MacIntyre, B., Mynatt, E., Starner, T., Newstetter, W., The Aware Home: A Living Laboratory for Ubiquitous Computing Research, *Proc. CoBuild 1999*, LNCS Vol. 1670, Springer-Verlag, Berlin (1999), 191-198.

10. Kraut, R., Egido, C., and Galegher, J., Patterns of contact and communication in scientific observation, *Proc. CSCW 1988,* ACM Press (1988), 1-12.

11. Ling, R., Direct and mediated interaction in the maintenance of social relationships, in Sloane, A. and van Rijn F. (eds) *Home informatics and telematics: Information, technology and society,* Kluwer (2000), 61-86.

12. McCarty, C., The Meaning of Knowing as a Network Tie, *Connections: J. International Network for Social Network Analysis*, 18(1), (1996), 20-31.

13. McCarty, C., Structure in Personal Networks, *Journal of Social Structure*, 3 (1), (2002).

14. Mynatt, E., Rowan, J., Jacobs, A., Craighill, S., Digital Family Portraits: Supporting Peace of Mind for Extended Family Members, *Proc. CHI 2001*, ACM Press (2001), 333-340.

15. Schiano, D., Chen, C., Ginsberg, J., Gretarsdotti, U., Huddleston, M., and Issacs, E., Teen Use of Messaging Media, *Extended Abstracts of Proc. CHI 2002*, ACM Press (2002), 594-595.

16. Siio, I., Rowan, J., and Mynatt, E., Peek-A-Drawer: Communication by Furniture, *Extended Abstracts of Proc. CHI 2002,* ACM Press (2002), 582-583.

17. Tollmar, K., and Persson, J., Understanding Remote Presence, *Proc. NordiCHI 2002,* Arhus, Denmark, ACM Press (2002), 41-49.

18. Vroubel, M., Markopoulos, P., and Bekker, M., FRIDGE: exploring intuitive interaction styles for home information appliances, *Proc CHI 2001, Interactive Video Posters,* ACM Press (2001), 207-208.

19. Webster, C. M., Freeman, L. C., and Aufdemberg, C. G., The Impact of Social Context on Interaction Patterns, *J. of Social Structure* 2(1), (2001).

Contributions and Benefits Statement:

Provides an operational definition of interpersonal awareness and user problems faced when gathering this awareness. Designers gain an understanding of how to design groupware applications for interpersonal awareness.