Available online at www.sciencedirect.com
ScienceDirect
Int. J. Human-Computer Studies 67 (2009) 139–153
International Journal of Human-Computer Studies
www.elsevier.com/locate/ijhcs

Busy families' awareness needs

Vassilis-Javed Khan*, Panos Markopoulos

Eindhoven University of Technology, Den Dolech 2, 5600MB Eindhoven, The Netherlands

Received 14 February 2008; received in revised form 30 June 2008; accepted 11 September 2008
Available online 25 September 2008

Abstract

This work examines how awareness systems, a class of technologies that support sustained and effortless communication between individuals and groups, can support family communication. Going beyond the evaluation of specific design concepts, this paper reports on three studies that aimed to answer the following research questions: (a) Do families want to be aware of each other through the day? Or, would they perhaps rather not know more about each other's activities and whereabouts than they already do? (b) If they do wish to have some awareness, what should they be aware of? The research involved in-depth interviews with 20 participants, a field trial of an awareness system connecting five "busy" parents with their children and a survey of 69 participants conducted over the web. Triangulation of the results of the three studies leads to the following conclusions: (a) Some busy parents want to automatically exchange awareness information during the day while others do not. (b) Availability of partner for coordinating family activities, daily activities in new family situations, activity, and location information of dependent children are salient awareness information needs for this group. (c) Awareness information needs to vary with contexts, suggesting the need for flexible mechanisms to manage the sharing of such information.

Keywords: Awareness systems; Pervasive computing; Family communication; Communication needs

1. Introduction

This paper examines how developments in the area of pervasive and ubiquitous technologies can support family communication. More specifically, it concerns a class of systems that support sustained and effortless communication between individuals or groups enabling them to build up and maintain an understanding of the activities of each other. Such systems are often discussed as "awareness systems" and their intended role is to allow connected individuals be aware of each other's activities. Awareness of others, it is hoped, can provide a context for one's own activities (Dourish and Bellotti, 1992) or a trigger and context for making communication through existing media more frequent and rich (Romero et al., 2007).

Interest in awareness and systems that will support it spawned from research in Media Spaces in the eighties and nineties (Bly et al., 1993). Media Spaces are communication applications that support sustained video and audio-links between connected parties. The first experiments with such systems concerned office environments. Interest in awareness systems for domestic and social use grew around the turn of the millennium, as the adoption of Internet and mobile telephony in the Western world became widespread. Below we consider some of the most influential works that considered how awareness systems can support family communication.

An early exploration of awareness systems for the home environment was the Digital Family Portrait (Mynatt et al., 2001). The design concept proposed by this project, involved presenting awareness information about a lone elderly to their children, using a digital picture frame. Awareness information would be presented symbolically using graphics decorating borders around the picture of the remote elder. The project evaluated alternative ways to visualize various types of awareness information.

*Corresponding author. Tel.: +00 31402474019; fax: +00 31402473285.
E-mail addresses: v.j.khan@tue.nl (V.-J. Khan), p.markopoulos@tue.nl (P. Markopoulos).

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doi:10.1016/j.ijhcs.2008.09.006

It concluded that the information required for day-to-day awareness of an elderly relative falls into a few general categories that include health, environment, relationships, activity and events.

At about the same time, the Casablanca project (Hindus et al., 2001) proposed two classic concepts of simple and lightweight means of communication between households: The ''Intentional Presence Lamp'' a lamp controlled remotely by a connected household through which remote individuals can signal to each other their presence at home and the ''Scan Board'' which enables two households to share a writing surface.

A plethora of related design concepts have followed since, exploring different settings and proposing a variety of means for connecting closely related people. Sometimes this involves supporting intentional communication acts, as with the Presence Lamp, and sometimes using more background and automated ways of obtaining information about a person's activities, as for example with the Diarist system (Metaxas et al., 2007). This system creates automatically a journal of an elderly person's daily activities (presence at home, going for a walk, cooking, sleeping, etc.) from data collected through a wireless sensor network installed at his or her home. It then presents this information graphically (both instantaneous presence information as well as the journal contents for the past 24 h), in an interactive photo-frame placed in the home of the elder's child.

As this field evolves, there is a growing interest to go beyond simple visualization prototypes and simulations of parts of the system function, to build and deploy fully functional awareness systems and let families use them for some period of time. The motivation driving such field trials, has been to uncover latent and unmet communication needs that such systems may address, to see whether these systems are likely to be used at all by families as part of their daily life and if so what communication patterns arise.

The InterLiving project (Hutchinson et al., 2003) developed simple mono-functional but flexible appliances ('technology probes') to support intra-family communication that they deployed for sustained periods of time in order to study usage patterns and appropriation emerging in actual use. Their ''MessageProbe'' enables members of a distributed family to communicate by posting digital post—It notes on a shared electronic writing surface. Their ''VideoProbe'' connects households with a camera and a video display that help capture and share impromptu images among members of a distributed family.

A trial of the MessageProbe for six weeks with three US families and several months with one Swedish family and a trial of the VideoProbe for short time with two French families showed that coordination and playfulness are two communication needs that have not been sufficiently addressed by existing communication media. Coordination was particularly important but difficult to achieve with the media at their disposal. It was needed for practical things like picking up the children and getting together for activities. The need for playful interaction was observed with both probes in the form of simple, spontaneous games and making faces.

The ASTRA system (Markopoulos et al., 2004) explored the use of sharing daily experiences with a related household, by constructing a ''to-tell'' list, a list of messages and still photographs that are shared as triggers or prompts for a conversation through another medium. ASTRA was a system partly running on a mobile device that supported picture taking and freehand drawing and writing, to create and send a message to an interactive display placed in the living room of a related household (e.g., the households of two adult brothers and sisters). A one-week field trial involving two household-pairs and 13 individuals found that busy families can benefit from the flexibility of this medium, engage in playful patterns of communication, and will not experience increased affective costs relating to unmet expectations, unwanted obligations to communicate or feeling watched over by others (Romero et al., 2007).

Rowan and Mynatt (2005) extended the original Digital Family Portrait with context sensing capabilities and evaluated it with a field trial involving an aging parent and her adult son. The system comprised of a sensor network deployed at the elderly person's home which gathered information about her whereabouts and activities and then presented that information via a photo-frame placed at her child's home. The level of general activity as evidenced by sensor firings at the parent's home was mapped to the complexity of the graphics shown on the border of the photo-frame at the son's home. A diary study was carried out to analyze the use of the appliance by one elderly woman and her adult son for a period of four weeks. The son appreciated being able to monitor his mother's well being without causing undue concerns to her. Also, he used the system as a way of spotting unusual events in the life of his elderly parent. On the other hand, the elderly parent said that the system made her feel less lonely, thus validating some of the motivations behind this design.

Another significant study in this field concerned the design and evaluation of the CareNet Display (Consolvo et al., 2004). This was an ambient display that helped local members of an elder's care network provide her day-to-day care. On the display users could get an overall picture of the elder's condition. The information they could view was about the medication, outings, meals, activities, mood, falls and calendar of the elderly. Data collection was simulated manually and obtained by calling the elder three to six times per day. Members of four care networks of elders (13 people in total) living at home participated in a three-week long field deployment study. During the deployment study displays were deployed to each network at a time. All participants were interviewed before and after the deployment. Researchers concluded that the display had an overall positive effect on the stress levels of the care

network of the elderly and that it raised awareness about the elder's daily life.

More recently, Brown et al. (2007) deployed and evaluated their whereabouts clock; a system targeting the needs for household members to be aware of the location of each other through the day. The "clock" was an appliance hanging on a kitchen wall, concealing a computer display through which awareness information of the whereabouts of family members was presented. The information they provided was very coarse, distinguishing between "home", "work", "school" and an unlabelled region (meaning "elsewhere"). The clocks were installed in five family homes (26 people in total) for a period of at least one month for each family. Their deployment and qualitative interviews explored a range of usage patterns for the whereabouts clock and concluded that such coarse location awareness of other family members can support:

- Coordinating activities; what the authors describe as "put the kettle on" behaviors, e.g., knowing that mom is about to return home dad makes sure the kettle is on when she gets home.
- A sense of reassurance; confirming known or assumed location of another party, reassured family members that things are as normal and as they should be.
- Expressing identity; some participants used their reported location as a way of identifying and expressing activities to others.
- Expressing affection; several messages were sent to the device expressing affection.

The research reviewed above is slowly collecting mounting evidence of the benefits awareness systems can bring to families and the sometimes surprising uses people find for them. The strength of the studies reviewed, especially the most recent ones, is that they examine actual deployment and use of awareness systems for some time (ranging from one to a few weeks), lending a lot of realism and face validity to their results. These studies have focused on a very small and specific set of awareness information that the prototypes tested support and a very small sample of users. In trying to gauge the potential of awareness systems it becomes necessary to triangulate such longitudinal but small scale field deployments allowing for a broader consideration of the types of awareness that might be needed by families and by surveying a larger sample of users that will allow some more general conclusions to be drawn.

More specifically, looking beyond any particular design concept, it is important for the further development of this field to answer the following research questions:

A. Do families want to be aware of each other through the day as is implicitly assumed in this field? Would they perhaps rather not know about each other's whereabouts?
B. If they do wish to have some awareness, what should they be aware of? The question "aware of what" posed as a central question for research in awareness systems by Schmidt (2002) still needs to be answered in the context of family communication.

The field studies reviewed above provide positive evidence regarding the first two questions. However, the evidence they provide is not unequivocal. In most cases (with the exception of Romero et al. (2003)), use of a system was not compared to nonuse and the question whether awareness information is wanted at all is not addressed. Further, these studies are restricted to location information, so it is not known whether similar positive results hold for other types of awareness.

A critical issue in this research field is how to achieve a balance between what information people would like to know about others or, conversely, to make known to others. It is clear that there is a trade-off between trying to address the need to communicate and the need for privacy, but it cannot be taken for granted that this extra level of connectivity and information disclosure between family members is something users need or want.

Consolvo et al. (2004) gathered empirical data by using several methods (privacy questionnaire, interview, experience sampling, voice-mail diary) examining the value of location awareness and disclosure patterns relating to location information. One of their conclusions was that most of the times (77%) people want to disclose their exact location. Their participants did not find it necessary to obfuscate their location. Although a good proportion of participants (24%) reported to disclose their location imprecisely, they also argued that they did so for the benefit of the party receiving information.

In Khalili and Connelly (2006) participants were students. The study used the experience sampling method (Kubey et al., 1996) to find out what information would people share with another person that is calling. During the study participants carried a PDA and throughout the day every participant received queries prompting to choose what context they would like to disclose to a potential caller. The caller was specified by the researchers. Based on (Olson et al., 2005) the researchers chose six distinct categories of social relations between caller and receiver. These included: *Significant other*, *Family member*, *Friend*, *Colleague*, *Boss* and *Unknown*. Although in the context of sharing context information when receiving a phone call, the answer for question A above would be positive. They mention: "70% of participants reported they were willing to use a service that publishes their context information comparable to the one used in our study if their cell phones were equipped with it and if they were provided with a toll to manage their privacy preferences". Moreover, disclosure rates were high with "company" at 74.3%, "conversation" at 69.4%, "location" at 47.4% and "activity" at 46.4%. Especially with the "significant other" (i.e., spouse or partner) disclosure rates were at 76%. Another interesting finding was that "males shared significantly more location information than females for each one of the social

relations''. An interesting question that arises is whether similar results hold for family communication and whether they do also hold when people experience such awareness systems in actual use. Apart from knowing what people do not mind disclosing, an important question that remains is what information they want to share with their families and, conversely, what they want to know about them.

This article reports three studies that aimed to answer the previously posed research questions in their general form, triangulating three research methods: interviews, a field trial of an awareness system connecting parents and children and a survey conducted over the web. Before the details of the studies are given, we first discuss the need for supporting family communication and explore some of the user needs and sensitivities that are specific to this domain.

2. Supporting communication for busy families

The research reported hereby focuses on ''busy'' families with children. i.e., families with two working parents and with children who go to school and follow extra-curricular activities. Such a busy lifestyle that is common in many modern societies leaves less time and energy for intra-family and inter-family communication (Sellen et al., 2004). Although existing media cover a number of family communication needs, they sometimes create affective and cognitive costs and leave other needs unfulfilled, like sharing every-day experiences and ''small news'' reminds of interesting moments and experiences to talk about (Markopoulos et al., 2004). We are interested both in communication between parents as well as communication between parents and children.

As noted by Brown et al. (2007), the auxiliary nature of awareness information has to be stressed. Parents and children who are not separated by distance or other social problems (like divorce) are most likely to have plenty opportunities to communicate with each other. However, especially for younger children, parents may find it problematic to find out what children experience through the day, what problems they face, or even what their achievements and joys are.

Technological solutions that stimulate and facilitate parental involvement in children's lives can be very useful; this can provide important benefits to families and children especially. For example, Bauch (2001) reports the use of a voice-mail messaging application between parents and teachers. The system aimed to increase and improve the communication between them. In this system teachers at the end of the day reflected on the learning experience of their students to a voice-mailbox recording a 60–90 s voice message. Parents were then able to call the system and select the mailbox for their child's teacher and hear the teacher's message. After listening to the message, parents had the option of leaving a response message. This system resulted in a steep increase of information exchange between them, leading to a reduction of school failure and an increase in the number of students who became eligible for academic honor. This case suggests the potential benefits of the deployment of modern communication technologies. While voice mail was shown to have a lot of potential it requires an explicit effort by the teacher that is hard to sustain and so is the case for other explicit and direct means of communication. Arguably, providing awareness information effortlessly can scale-up and facilitate the involvement of parents in their children's lives. Challenges lie in what content should such systems exchange, how it will be used and what type of privacy concerns arise.

3. Interview study

As a first step to assess the relevance of awareness systems for families we conducted in-depth interviews aiming to understand communication patterns of busy parents, the content of their communication, how their communication embeds itself in their daily routine activities and uncover unmet communication needs.

3.1. Participants

The study involved in-depth interviews ($N = 20$) with parents recruited via mailing lists of the Eindhoven University of Technology and Philips Research. All informants were Dutch; 16 of them had young children fitting exactly our targeted user profile i.e., families with two working parents and with children who go to school and follow extracurricular activities. Four had children of older ages, but were included in the study nevertheless to enable contrasts to be drawn during the qualitative analysis of the interview data. Informants had an average age of 40.5 years (31min–52max), average years of marriage: 12.05 (4min–28max), average number of children: 2.05 (1min–3max). All were working either full or part time. There were eight men and 12 women. Half had a high level of education (Masters/PhD) while the other half had more basic education (high school, college). Some of them were able to work for a day during the week at home as well as some had infrequent business travel to a different time zone.

3.2. Interview process

Two researchers ran the interviews independently and exchanged notes after each of these. The interviews were semi-structured. They lasted approximately 1 h and were audio recorded. The interview commenced with an inquiry into specific communication events and activities during a recent weekday. The researchers used a common interview guide. In that all the questions were noted according to the flow of the interview. The first question in the guide asked the participant to describe his or her previous day. Then the interviewer analyzed each incident and prompt to find out whether that was a

typical daily activity. Furthermore, the interviewer focused on and analyzed communication events. For example, a question in the guide included "How do you decide if it is a good time to communicate with your partner?" and "Can you describe a case when it was a wrong moment to communicate?" The interviewer did not strictly stick to the guide in case he had follow-up questions. The interviewer probed into exceptions and regularities for this day and the specific communications, trying to unravel an account of lifestyle and daily communication patterns.

3.3. Analysis method

Data was analyzed qualitatively (Lindlof and Taylor, 2002), following some procedures introduced with Grounded Theory (Strauss and Corbin, 1990). Interviews were fully transcribed; statements were segmented and coded to allow tracing back to the interviewer, the interview session and the interview question. Open-coding was done collaboratively by the two interviewers using paper printouts of each segment and categories were created using affinity techniques. Disagreements were resolved on the spot by discussing the disagreement in place and trying to find a compromise to the issue. The emerging categories were elaborated in vignettes and linked back to the raw data using a custom made software tool. The results are presented below.

3.4. Results

3.4.1. Fear of interrupting

Communications between busy parents during work hours were classed as interruptions to each other's work activities. Concerns about interrupting each other are a theme that came up repeatedly during interviews with the parents. While at work informants reported to resent interruptions, unless for an urgent matter, as they wish to concentrate on their work.

They refrain from initiating communications with each other for fear of interrupting their work, unless for an emergency or a change of plans. Contrary to our initial expectations, parents did not report as much a need for directly communicating affective communication, e.g., to indicate that they think of each other, or to display affection over the phone. However, in most cases parents use a practical reason to communicate as a pretext for a richer, more affective communication. This is consistent with earlier findings, as for example reported by Romero et al. (2007).

3.4.2. Communication needs

We identified several reasons that parents have for communicating during the day. We have clustered them in the following categories: coordination, reassurance and responding to emergencies, exchange of experiences and support in new family situations.

3.4.2.1. Coordination. Coordination between parents concerns mostly children's activities. We saw this theme repeating between different parents. The issue is making sure their schedule does not conflict with planned activities of the children. These activities could be either every-day activities, like going to school, weekly-activities, going to an out-of-school activity or special occasions like going to a birthday party of a friend.

"Micro-Coordination" on the return from work to home has a goal which is to ensure/organize what was commonly referred to as "quality time" in the evening. "Micro-Coordination" has been identified as a need by Ling (2004). For parents quality time is mostly time spent with children, playing, reading, having dinner together, etc. The parent arriving last and still aiming to catch some of the activity coordinates how to fit in the schedule with the other parent at home. Micro-Coordination then can be carried out by a phone call before leaving the office or a mobile phone trying to synchronize arrival at home with the evening activities.

Coordination around children can involve other people as well, especially for unusual circumstances or emergencies. In one case parents asked the help of other children's parents acquainted to them, whereas in another parents asked the help of grandparents. One participant comments:

> Yeah, sometimes in an emergency situation we have to come up with a solution at once and then we have to discuss it with parents of other children and we ask if she can go with them after school.

Coordination about future family activities whether face-to-face or mediated can take place at any time: during the morning, the evening before, some days before. The chosen timing is influenced by how important the activity is considered to be.

Participants reported that calendars or/and agendas are important means of sharing information. The importance of calendars is previously mentioned in the literature (Crabtree et al., 2003). All sorts of family activities will be written on the family calendar. A participant mentions:

> Of course we have to plan things, because otherwise if we both have an appointment or whatever yeah, we have to find a babysitter. At home I have a, maybe I haven't told you, also a calendar from school that all activities from the school, holidays plans all those things are mentioned on the school holiday calendar and this is also what I use for our private things. So both of us we write that 〈her husband〉 goes here or not, so that is also a kind of medium that we use. Very important! I cannot do without that.

3.4.2.2. Reassurance and responding to emergencies. A general conclusion drawn from the data is the overriding importance that working parents give to staying aware of the well being of their children. For example, parents purchase communication devices for the children in order

to keep in touch with them, and they mention they are always interruptible for them during working hours. Being in touch and being able to react in cases of emergency are two important needs for parents.

3.4.2.3. Exchange of experiences. Parents also express they like to exchange positive experiences with their partners and children. In the words of a participant:

> I would be more interested in a system that I could see for instance my children doing for the first time this or that.

And another excerpt:

> It depends on what she did this day. But I will ask about the things she went to. She will also tell about the things I didn't know other things that came up. About the things bought something new in a shop which is nice she wants to show it to me and something for the house or clothes and then I will say "yes it is very nice".

The importance of sharing experiences right at the moment they happen was also emphasized with the design of the ASTRA system (Markopoulos et al., 2004).

Moreover, parents highlighted the need to share experiences in special situations that involve strong emotions. For example, after a job interview, after a very challenging activity at work or when a really bad experience had occurred. In the words of our participants:

> But if I am just with my work … during normal … I would say no (about sharing activity) it's more the exceptional periods that there is something going on and we need the reassurance from each other. But that's not the standard.

And another excerpt:

> For example a month ago, he is a lorry driver and he went driving on the highway and something came that cracked his window shield. So he was much impressed by that, he called to me.

3.4.2.4. Adapting to new situations for the family. As mentioned earlier, parents do not contact their partners or other family members frequently when they are at work. However, some of them remarked this changes if the family is facing a new situation to which they are not used to, such as an illness of their child or business trip; or adapting to a new lifestyle like new job, pregnancy, new born baby, moving to a new house.

Among the families we interviewed one couple, who had a young child and the wife was pregnant, explained it was difficult to maintain their earlier patterns of communication because they had to arrange too many practical issues to which they were not accustomed.

Another example was of a couple in which the grandfather had recently died. They decided it was better for the grandmother, to live closer to their family. Thus, the parents besides their job and family were helping the grandmother to move in town and arrange all the financial affairs for her. That fact initiated more communication between the parents.

Parents on business trips do not contact their family as frequently as they wish because of time difference, busy schedules. Their priorities are to let home know they arrived safely and if possible they like to be kept up to date with activities back home and give an impression of their own whereabouts at the distant location.

3.4.3. Separation of home and work

Contrary to all this evidence regarding the need to stay aware of each other, parents described consistently the need to have a clear separation between family life and work. After leaving their work, participants want to switch their mind to the family sphere. Evenings at home are a busy time, during which they multitask with most activities related to caring for the children and interacting with them, despite that they often have to bring work back home. The next morning, once out of the house they also want to "switch their mind" back to work and devote themselves to it.

3.4.4. Parental involvement

Parents cherish the relationship between them and their children. Caring for the children clearly came out as a central motivation for family connectedness. Wanting to be involved in their children's lives emerged as a category of particular importance, influencing the behavior, communication and awareness needs of the working parent throughout the day.

Increased parental involvement is recognized to provide benefits for the development of children socially and academically (Blanchard, 1997; Hoover-Dempsey et al., 2005). There have been several attempts to support communication between parents and children and to inform parents of school activities. For example, the use of voice mail to support communication between teachers and parents by Bauch (2001) discussed earlier in this paper.

While such a direct system such as a voice mail has a lot of potential it only supports communication between teacher and parent and it requires an explicit effort by the teacher. This kind of effort may be hard to sustain over longer periods of time and to scale-up for a large number of pupils. Awareness systems connecting parents to their children through the day could address this limitation, by supporting the semiautomatic capture of relevant information and its use as a complement to extant communication channels, including face-to-face communication or even voice mail.

3.4.5. Skepticism regarding an always on channel

While many statements of interviewees suggested the need for awareness and sharing information for activities through the day, parents were very skeptical regarding an "always on" awareness display. For example, interviewees

suggested that when at work they might prefer not to have information they cannot react to (e.g., if their child is missing them) or that the constant availability of information about their children might distract them from their work, disturbing the boundaries they try to maintain between their work and their private lives.

3.5. Conclusion

The interview study identified several communication needs for busy families. They need to coordinate, share experiences regularly, to be reassured regarding the well being of each other, to respond to emergencies, etc. Connectedness is centered around children, whether this means being informed of their whereabouts or adjusting the day plan to optimize the time spent with them and for them.

Parents appeared very skeptical of the concept of awareness systems: a continuous trickle of information about each other was found distracting and violating a desirable separation between home life and work life. This result of course is based on self-reported attitudes expressed outside a specific context and without reference to a specific technology. Interviewed parents found it hard to relate to the concept of awareness systems so we felt that exposing parents to using a system comparable to the class of systems we envision would provide richer and more reliable outcomes.

4. Field deployment of an awareness system for parents and children

It was felt necessary to triangulate interviews with other research methods that are more sensitive to context and that refer to a realistic experience of using awareness systems. This was especially important since one result from the interview study concerning the low acceptability of a continuously available awareness display, sheds doubt upon the whole notion of awareness systems for family communication and seems to contradict the positive experiences reported in field trials of awareness systems in a range of studies in this field (discussed in Section 2 as related work).

We set up a simple awareness service for parents and their children during a two week long field trial. While we do not suppose that the specific system tested is the solution they require, it embodies some important characteristics of the type of systems we are interested in and as such serves to solicit relevant reactions and opinions from them. This was evaluated with a field deployment involving eight parents and five children, lasting two weeks.

The study aimed to answer the following questions:

- Is there a need for parents to have awareness information during the day about their children?
- Is such a system perceived as disruptive?
- Are such systems perceived as privacy-threatening for the children?

4.1. Participants

We recruited five families from an international school fitting the profile of ''busy parents''. More specifically we looked for participants that:

- Were married or cohabiting,
- Had at least one dependent child,
- Both parents in the household worked a minimum of 20 h a week,
- Had children between the ages of 6 and 10.

We covered all of our requirements except the third. Three of the couples we recruited had only one member who was working full time whereas the other did not work, in total five children and eight parents (three couples and two parents) took part in the research. The children were 10 years old studying in the seventh class. They were fluent in English. It was a culturally mixed group consisting of one Korean, one Taiwanese, one American and two British. The average age of the participating parents was 43; they had been married on average 13.8 years and had on average of 2.2 children.

Our participants were highly educated and hold higher than average positions in their employment. We can distinguish two groups of users among participating parents. The ones that used the system in the office (4) and the ones that used it at home (4). The four office users were fathers and the four home users were mothers. None of the participants worked at our University (Eindhoven University of Technology) or had any other relation to this research.

4.2. Process

First, we held a briefing session at school where we handed the software for the PC application, the week before the trial. At least one of the parents for each child attended the briefing session where we presented background information to the research, introduced the study and answered questions they had. By handing out the CD a week in advance they had time to install the application, try it out and we could fix any technical problems that were experienced.

We then let parents experience the prototype for one week. At the end of the first week parents were asked to complete a short web questionnaire. At the end of the second week we interviewed the parents. We analyzed those interviews qualitatively. Only one researcher carried out all the tasks.

4.3. Materials

4.3.1. Child awareness system prototype

The prototype we used had three main components. First, was a small Bluetooth headset device. Participating children were asked to turn this on and keep it in their

Fig. 1. Graphical presentation of awareness information.

pocket every morning. They carried this device till the end of the school day and then turned it off and left it in the class so that they could turn it on and carry it again next morning.

Next, we installed a PC with an Internet connection and a USB Bluetooth dongle, at the classroom, running XP SP2 and our software[1] which queried every minute for the presence of the children's devices. After querying, our prototype made a record in a database server at the University.[2] Along with the almost-real-time presence information about children the database contained information regarding their daily schedule.

The client application for the parents queried through http, the database server at the University and presented the information to the parents' desktop. We also developed an alternative solution for the parents' in case they could not install our prototype. This was a dynamic web page presenting exactly the same information. We preferred parents to install our prototype in their desktop so they would not associate this awareness service with a website or another web service. It actually turned out that one parent who had a Macintosh could not install the software. This parent used the alternative web application.

In our prototype, parents could view three possible images. These are shown in Fig. 1. By moving the mouse over the image parents would see more detailed information about when the last check was made by the PC in the classroom. It was developed to always "float" on top of other windows on the desktop (see Fig. 2). Using two buttons parents could minimize or close it.

4.3.2. Data collection

4.3.2.1. Web questionnaire. Parents were asked to complete a web questionnaire which contained five questions. The questions were:

1. How would you rate your experience with the system?
2. Why did you rate your experience with ⟨answer of 1st⟩ in the first question?
3. Did you feel that using the system influenced your conversations with your child? (If yes why? If no why?)

[1]The prototype application running at the PC in the classroom was developed with C#. For querying the Bluetooth devices we used OpenNETCF. It was compiled for Windows XP.

[2]MySQL was used as the database server.

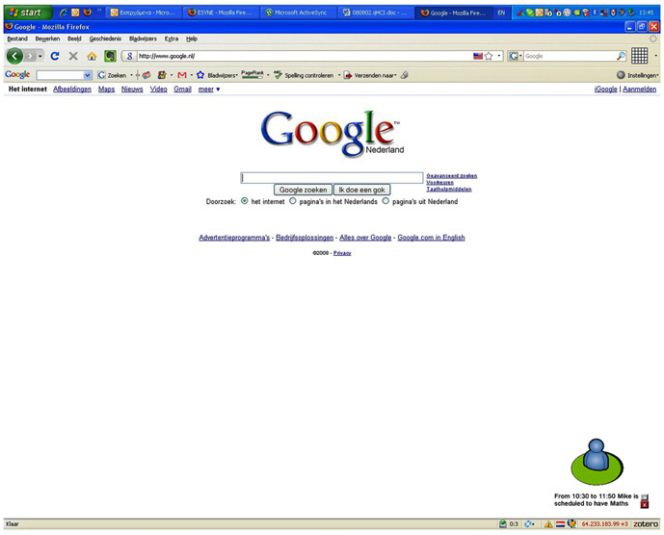

Fig. 2. Screenshot of a parent's desktop.

4. What information were you missing from the system?
5. How do you think your children feel about the system informing you about their activities in this way?

Participants were asked about their first week's experience, if they felt the system influenced their conversation with their child, what information was missing and how the child felt about it. Along with the parents we interviewed the children participants too.

The purpose of having this questionnaire was twofold:

1. To get insight to the participants' experience halfway through the trial.
2. To anchor the final interview with the answers they provided.

4.3.2.2. Interview. Families were interviewed after two weeks. The interview lasted approximately 30 min and began by discussing their response to the web questionnaire. This was followed by an open discussion about usage, feelings and the overall experience of the system. Both participating parents and children were present. Children were asked about their experience of the system as well as if they felt their privacy had been compromised.

4.4. Results

The web questionnaire proved to be relatively useful. The system was rated by three participants as "Neutral", two participants as "Good" and one participant as "Very good". The participants who rated it as "Neutral" felt neither irritated nor enthusiastic by it. They expressed the need of more detailed information in terms of the child's presence and the child's activities. The participants who rated it as "Good" liked the fact that they were able to know the time schedule and its presence in school. One participant mentioned the system influenced her conversations with her child as now she could ask her child reasons for not appearing in school hours. They also raised the concern of their children disliking such a system due to feeling that their privacy was comprised. It is noteworthy to mention that two couples reported in the web questionnaire that their child was excited by her parents' involvement and was actually the one who was checking on whether they were using the information she was providing.

Interviews were transcribed and analyzed qualitatively focusing on finding evidence relating to selected themes.

4.4.1. On disruptiveness

Contrary to the interview study, participants in this field trial did not experience any concerns or disruptions resulting from the continuous availability of awareness information. When participants were asked if it was disruptive they mentioned that this was not the case. In the words of a participant: "it was no more demanding than a ping from an email or a PDA or another website, it wasn't sufficiently big".

On the other hand, office users complained about the space the application took on their screen. This was especially so for laptop users who were compelled to minimize it. Once minimized it was forgotten. The fact that screen space is important for work use denotes the need of having a separate device (e.g., a photo-frame, or a physical output device) for providing awareness information.

Home users noted the system was not disruptive. Their home computer was used only intermittently and having this application running was a reason for the users to check the information this application was providing. For one participant, checking the system regularly became habitual for the short time of the field study. Whenever she was in the kitchen, she would peak at what was going on in the class of her child.

4.4.2. On privacy

Participants did not report any privacy concerns. When explicitly asked, both children and parents responded negatively. A child participant mentioned: "it just felt normal".

On the other hand, parents thought that if children were older there would indeed have been privacy concerns raised. Their view is in agreement with (Caughlin and Petronio, 2004) who argue that children have loose privacy concerns before adolescence. Indeed, the study by Fraser et al. (2006) involved participants in their adolescence, who experienced serious privacy concerns regarding family communication.

When children were asked if the device created a feeling of being "looked over the shoulder" they unanimously said that this was not the case. Even three of them, on some occasions, forgot that the Bluetooth device was in their pocket and carried it back home. This shows that the device easily fitted their routine and was not something bothering them. In their words: "I didn't even feel it was on me", "I totally forgot about it".

4.4.3. The feeling of involvement versus the feeling of surveillance

The study was also positive regarding the feelings of involvement in children's lives. In the words of one participant who was a home user: "it actually stirred the spirit of involvement rather than the spirit of surveillance and I didn't expect that". This particular participant liked the fact that the child felt that the mother was more involved in her life.

Moreover, this same participant reported that the system helped in posing more meaningful questions to the child about her day based on the schedule information. This participant's observation was that the child would easier respond to questions:

> I always ask them about what happened at school but you sometimes get a word or nothing. If I would ask something like: "what was science like today" it kind of focuses them (referring to the child) cause otherwise the day becomes blur.

Another unexpected observation of the same couple was that they became more sensitized to their child's need to communicate with them. Their child would ask at the evening if they had checked the system and asked them for more details about the way it was working.

4.4.4. Awareness information that could add value to awareness systems in a school context

Higher precision information would be generally appreciated. Detail regarding the exact location of the children. One of our participants put it very eloquently: "half the story is worse than no story at all". This was a comment we received by all participants. Nevertheless, participants expressed a concern; they did not want to have information that would make them worry without the ability of reacting, e.g., if the system would show that there was a scheduled outdoor activity whereas the child was sitting in class. Such contradictory information might create a tension as it would make the parent feel worried, on the other hand, the parent knows that responsibility is handed over to the teacher. This observation seems to confirm the interview study. In light of these statements, we believe that an important acceptance factor for awareness systems is

how they impact upon the accountability of parents and teachers and whether they create new concerns and responsibilities for parents who could be expected to react to awareness information shown to them.

An exception to not wanting to have to react to what is displayed to them concerned the safety of the child, e.g., they would want to be informed when the child leaves the school periphery unattended. This was expressed by several participants. One home participant who was checking the prototype every day would welcome a "red icon" among the gray and green. That red icon would denote danger. Note though that the same participant added that such a system might be a solution for the school rather than the parents.

Another participant stressed the need of having richer social information regarding "special occasions". These occasions would include school assemblies, happenings and generally social activities. One more participant wished to be able to observe the social dynamics between the participating children during the day. Another parent mentioned that she would check the prototype when there was a break scheduled because she wanted to be sure her child was out (presumably) playing with other children rather than sitting inside the classroom. It seems observing social interactions between the children is a pronounced need for parents; however, this finding seems to apply only to younger children.

4.5. Discussion

Awareness information is valued by parents and the reservations expressed in the interview study are largely dispelled. An important consideration for designing awareness systems is their information content: parents expressed the need for more detailed and rich information about their child.

Reflecting on the differences between this study and the interview study we need to note participants did not express any interest in affective communication (contrary to the findings of the interviews) as they would use other media for this purpose. Another difference between the interview study and the field deployment was the attitude towards an always on system. In the interview participants were skeptical about that concept whereas in this field study most participants recognized value in having such systems in place.

A limitation of the field trial was that it could only provide feedback regarding the availability of a specific (small) set of awareness information. To understand the potential of awareness systems, one has to examine more systematically what information do users want to share with each other. The next section reports a survey set up for answering this question.

5. Survey

The survey presented was aimed at finding which awareness information do busy parents value about each other and secondly, to examine whether information flow should be symmetric or not. Social translucence (Erickson and Kellogg, 2000) has been proposed as a way to describe the symmetric needs for transparency and accountability between users of communication systems. Hong and Landay (2004) discussed minimum information flow asymmetry as a way to ensure privacy protection between connected individuals. Despite that such works have a strong logical and theoretical motivation but as yet, the argument for symmetry in awareness systems has not yet been demonstrated empirically. Most (if not all) research prototypes discussed in the section on related work are essentially asymmetric.

5.1. Process

Aiming to construct a set of descriptors for awareness information that a system could provide between family members we surveyed related research literature including papers on the topic of awareness systems published in the following conferences in this field: CHI, CSCW, Mobile HCI and Ubicomp. The collection of these conferences provided an up to date and rather comprehensive coverage of the research field and captured developments not always published in an archival (journal) format. We included only papers describing systems and system concepts published between 1996 and 2006.

In each case, we examined the essence of the information that the awareness system was intended to communicate abstracting away from how this information was collected or presented. For example, Cadiz et al. (2002) described in their paper Sideshow, an awareness system that displays among other information traffic conditions at a particular location in the city. This is displayed on a PC based application. For our survey we retained only the fact that traffic conditions are communicated. Thus the statement we formed is presented in Table 1.

The review included 16 papers. Overall awareness information seems to cluster around the repeating themes of location, availability, presence and activity descriptions. In addition to the literature review, we added statements regarding information needs of busy parents that we obtained from the transcriptions of the interview study described above.

In total we derived 41 statements describing awareness information that can be shared between busy parents. This list is not complete in anyway, as one might be able to

Table 1
Example of the two statements we formed

Share	Receive
My spouse is informed about the traffic conditions near the location I am	I am informed about the traffic conditions nearby the location my spouse is

dream up an infinite range of information types, at different levels of details and referring to different aspects of people's lives. Rather, it is taken to represent the range of possibilities explored in this research field as well as the ones explicitly reported by our informants to be relevant to them.

Note that it is different to actively wish to share information and not minding if others view it. Consequently, we asked participants to rate each of the above statements using the following scale: I want, I don't want but I don't mind, I don't want. The I don't want but I don't mind scale might initially sound bizarre.

However, there might be cases that someone would not mind sharing information and at the same time someone would want to receive this information, or the other way round.

Exchanging information implies both sharing and receiving. For each of the types of information identified above, we asked a question regarding the willingness to share and a question regarding the willingness to receive this information. Just to give an example of a statement, we had a statement for information regarding traffic at the location of the partner. Someone might be interested in sharing or receiving that information. Therefore we had to phrase a statement for sharing and a statement for receiving. The example is presented in Table 1.

The questions about sharing and receiving can be asked disjointly or conjointly. For example, we could ask "How willing are you to share this information?" about the statement: "My spouse is informed about the traffic conditions near the location I am" and then "How willing are you to receive this information?" about the statement: "I am informed about the traffic conditions nearby the location my spouse is". Alternatively, we can ask this question about the compound statement: "I am informed about the traffic conditions near the location my spouse is and my spouse is informed about the traffic conditions near the location I am".

Asking disjointed questions suggests an asymmetric information flow whereas the conjoint question on sharing and receiving suggests a symmetric information flow. To examine whether attitudes of partners are influenced by an assumed symmetry or not, we split participants asking half of them two questions (separately about sharing/receiving: disjoint) and the other half one question (conjoint).

We created an online application which randomly assigned participants to each condition. Also, the application presented the statements to the participants in randomized order and recorded their ratings.

5.2. Participants

Sixty-nine respondents were recruited through advertisements placed at an online forum for parents as well as by sending email adverts to secondary schools. Thirty-four of them saw the statements in two steps (for receiving and for sharing) as explained previously. Thirty-five of them saw the statements in one step as explained previously. The order, in this case, both within a statement and overall was randomized.

5.3. Hypotheses

The study had two hypotheses.

H1. Couples asked in a way representing an asymmetrical exchange of information will be more willing to exchange information than when asked in a way representing a symmetrical one.

H2. Spouses are willing to receive more information than they are willing to send.

5.4. Analysis

For questions phrased disjointly (implying asymmetric flows), the willingness to share was obtained by the logical conjunction of one parent wanting to or not minding to share and the other partner wanting or not minding to receive the information. For example, if a participant rated the question: My spouse is informed about the traffic conditions near the location I am *I don't want* (*logical False*) and for the question: I am informed about the traffic conditions nearby the location my spouse is with *I want* (*logical True*) then the result of the logical conjunction would be *False*.

For each statement, we calculated the proportion of participants choosing to share it (those stating *I want* or *I don't want but I don't mind*). For each statement we then calculated whether the two proportions differed significantly using confidence intervals ($a = 0.05$).

For testing the second hypothesis we calculated the proportions of statements where receiving and disclosing awareness information would be acceptable (*I want*, *I don't want but I don't mind*) and compared the using confidence intervals ($a = 0.05$).

5.5. Results

For all 41 statements there was no significant difference found between the proportions reported when assuming symmetric or asymmetric information flows, so H1 was rejected. Similarly, H2 was rejected for each and every of the 41 statements representing awareness information except of the statement: "My spouse is informed that I am away from my office, I am informed that my spouse is away from his/her office" where it appears that couples would like to receive this information more than they wish to make it available for their spouses.

5.5.1. Content of information exchange

We were interested in the statements that emerged to be most and least wanted to be shared and received.

Least wanted awareness information was represented by the statements in Table 2. They seem to represent too detailed and specific information. Considering information parents do not mind sharing (Table 3) they also seem to be very specific and detailed and two of them are related to computer activity. On the other hand (and this is what we would expect), parents seem to be interested in sharing broader information like how they are feeling and if they do not want to be disturbed (Table 4).

Least wanted statements to be received are presented in Table 5. One of them is also found in Table 2 (does not want to be shared as well). As was the case with sharing information parents do not want to receive very detailed information. The same idea is also reflected with the statements that do not want to be received but parents do not mind receiving them anyway (Table 6). They all represent information which is very detailed. It is naturally not surprising that the statements that are most wanted to be received are exactly the same with the ones that want to be shared with the exact same order (Table 7). This again reflects the wish of having symmetric exchange of information.

Table 2
Awareness information parents want to share the least ($N = 69$)

My spouse is informed about the general noise level of the room I am in	44%
My spouse is informed that I am a few minutes idle behind my computer	47%
My spouse is informed about what the title of my next meeting is	50%

Table 3
Awareness information that most parents do not mind sharing ($N = 69$)

My spouse is informed that I am logged out from my computer	62%
My spouse is informed that I am having a break	56%
My spouse is informed about my Instant Messenger status	53%

Table 4
Awareness information parents want to share the most ($N = 69$)

My spouse is informed that I am wishing him/her a good day	74%
My spouse is informed that I do not want to be disturbed now	71%
My spouse is informed about how I am feeling today	68%

Table 5
Awareness information parents want to share the least ($N = 69$)

I am informed that my spouse is a few minutes idle behind his/her computer	38%
I am informed about how many times my spouse spoke with other people today	50%
I am being informed about what is going on in the room my spouse currently is	50%

Table 6
Awareness information that most parents do not mind receiving ($N = 69$)

I am informed that my spouse is engaged in an Instant Messaging conversation with another user	50%
I am informed about when my spouse is close to the supermarket	50%
I am informed about the medication my spouse has taken during the day	50%

Table 7
Awareness information parents want to receive the most ($N = 69$)

I am informed that my spouse is wishing me a good day	74%
I am informed about how my spouse is feeling today	62%
I am informed that my spouse does not want to be disturbed now	59%

5.6. Conclusions and discussion

We presented an online survey of 69 busy parents regarding their communication needs. Overall we can draw the conclusion that parents are willing to provide and receive awareness information. Considering the type of information they wish to communicate, it seems that more expressive means of conveying emotions and intentions are needed; high level content and especially content relating to feelings is valued more than communicating trivia enabled by technology.

There was no difference found in preferences regarding sharing awareness information, whether a symmetric or an asymmetric system is assumed. This suggests that for simplicity and efficiency, in future surveys we need only survey the need to "share information".

Having found no imbalance regarding the willingness to share or receive information supports the "Principle of Minimum Asymmetry in Information Flow" proposed by Jiang et al. (2002) for designing ubiquitous information systems and the concept "Social translucence" by Erickson and Kellogg (2000).

There are limitations to the method of online surveys, such as not having control of the participants who are answering (self-selection bias) and the often discrepant expressions of attitudes to the actual behavior of people as users. To address these limitations an experience sampling study (Kubey et al., 1996) is currently under way to examine the preferences and attitudes of people as they move in different contexts and engage in their daily activities.

6. Summary of results

6.1. Constantly available awareness information is largely appreciated by parents, though not by all

In the interview study major skepticism regarding an always on display was raised while in the field deployment and the survey study most participants recognized value in having such systems in place. The latter result partly confirm studies of Brown et al. (2007), Consolvo et al. (2005), Rowan and Mynatt (2005), Romero et al. (2007) and Metaxas et al. (2007) which all found evidence of participants appreciating the value of awareness information.

The negative finding might be a result of the way the interview study was run. Respondents were not asked to consider any specific awareness information or any specific situation before judging whether awareness information would be useful. Also, results from the field trial that refer to a concrete and actual experience of a system have to be taken as more reliable than the interview study. An alternative explanation could be that the families surveyed differed systematically with regards to their communication needs. It could be that families belong to different communication types; (Koerner et al., 2004) classify families into four categories according to their communication types. The ones that were keen in exchanging information would probably be either *Pluralistic* or *Consensual* (preferring to share experiences and discuss things openly) whereas the ones that were not that keen would probably be *Laissez-faire* or *Protective* (who prefer to keep things private and not openly discuss matters with other family members). The potential influence of family communication types upon the acceptance of awareness systems is an issue of further research.

6.2. What do parents want to be aware of?

The most valued awareness information concerns:

- The availability of their partner to communicate,
- Daily activities and trivia but only in unusual and challenging family situations and,
- Activity and location information from their dependent children.

These are three conclusions we can trace back in the interview study. The particular group of busy parents has not been investigated under the prism of awareness information needs and therefore these conclusions add to the literature of awareness systems.

Affective communication did not appear as a high priority during the interview study but was found to be an important priority during the survey study. This may be because the interviewee's were not explicitly asked to evaluate whether they need other means for affective communication. Affective communication has attracted the interest of researchers of communication between couples (Strong and Gaver, 1996; Brave and Dahley, 1997; Tollmar and Joakim, 2002; Vetere et al., 2005) who seem to support the results of the survey.

The survey study has provided evidence in favor of the argument for providing symmetrical awareness information to the two parents. This finding supports the concepts of *social translucence* and the *minimum information flow asymmetry*; most experimental awareness systems for family communication discussed in the introduction do not seem to support this symmetry.

6.3. Awareness information needs are context dependent

In the interview study we found that parents refrain from initiating communications with each other for fear of interrupting their work. However, a number of exceptions were raised referring to emergencies, change of plan, wishing to be available for their children, or when having to deal with unusual and changing circumstances as a family. In short, the interviews suggested a lot of variability and context sensitivity to awareness needs.

This conclusion is supported by the field trial; whereas sometimes the prototype was not considered disruptive, parents expressed the wish not to receive information on which they cannot react. In the case of the survey study, there were always statements that participants do not mind to share or receive them. Although we did not ask the participants, it is very probable they rated statements in such a way that they would sometimes want to share/receive them but not all the time.

This conclusion contrasts the principle characteristic of awareness systems, which is to support a constant flow of automatically assembled information. Current experimental systems do not offer the option to users to specify contexts where they would be willing to share/receive information and contexts where they would not be willing to share/receive information.

With these three studies we contribute in informing designers of awareness systems for busy families. We contribute in finding what information is exactly needed for this group; we have presented evidence that such systems should be symmetrical in terms of information exchange and we identify specific contexts where exchange of information is particularly important to busy families.

Acknowledgments

The research reported has been funded by the Dutch Ministry of Economic Affairs, under its Innovation Programme on Man-Machine Interaction, IOP MMI. We would like to thank S. Mota, W. IJsselsteijn and B. de Ruyter for their contribution in this research.

Table A1
Statements used (in the way when wished to be shared) in the online survey study

That I am a few minutes idle behind my computer
That I am logged out from my computer
That I am available for communication at home
That I am available only for urgent calls at the office
That I am away from my office
That I do not want to be disturbed now
That I am in a meeting
That I am working on something
That I am at home
That I am busy
About the general noise level of the room I am in
About what is going on in the room I currently am
That I am in my desk at the office
That I am engaged in an Instant Messaging conversation with another user
That I can be accessed by telephone right now
About how I am feeling today
That I slept well today
About how much exercise I had today
About how many times I spoke with other people today
About how long have I walked today
About the schedule I have for today
About when my next meeting is
About what the title of my next meeting is
About the traffic conditions near the location I am
About my Instant Messenger status
About the weather forecast of the region I am
About the news headlines I am reading
About a comic strip I saw
About when I am close to the supermarket
That I am close to a friend
About the location I currently am
About when I am driving the car/motorcycle/bicycle
About the medication I have taken during the day
About the meals I took today
About a few pages from a book I like
That I am wishing him/her a good day
About when I leave my workplace
That I left the children at school
About when I picked up the children from school
That my computer is on
That I am having a break

Appendix

Statements used in the online survey study is shown in Table A1.

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