Designing Reminders for the Home: The Role of Home Tours

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Abstract

As part of a comprehensive mixed-methods user requirements analysis for the design of reminder systems for assisted living we carried out 'Home Tour' Interviews in the homes of older users. Semi-structured interviews focusing on what people forget and what strategies they use for reminding themselves were augmented by a 'tour' of the home (documented by photography) in order to better understand the home context and environment we were designing for. Interviews were carried out in conjunction with a survey (N=378) and six focus groups targeting older users and people with sensory impairments. Thematic analysis of the interview data, observations, and photos yielded a richer understanding of the tools and techniques used to remember in the home and their social and physical context. We argue that in-depth home tours can be successfully combined with traditional methods such as large surveys to truly include the user in the design of care-related technologies. We conclude that techniques including a richer understanding of the user and their context will ultimately lead to more usable and acceptable technologies for the home.

Keywords

User centered design, home tours, multimodal interfaces, personalisation, reminder systems, assisted living, reminders, telecare, smart homes.

Scoping the Design Space for Reminders

In this paper, we report the findings from a series of seven home tours that were conducted in order to inform the design of reminders for assisted living in the home. The home tours were part of a comprehensive user requirements study that also comprised of six focus groups, which provided important feedback on prototypes and demonstrators, and a questionnaire survey (N=379), reaching a wide range of individuals.

People with care needs can find it difficult to remember to do tasks around the home. This can be due to normal cognitive ageing [15], to the conditions for which they need care (e.g. [6]) or to their medication regime (e.g. [1]). People need to be able to remember crucial tasks such as upcoming appointments, taking medication and general house-hold tasks in order to remain independent. Reminder systems are therefore a central component of assisted living solutions that enable people to remain active and independent in their own homes for as long as possible [4].

Despite the undisputed benefits, the uptake of assisted living technology such as reminder systems is still comparatively low [2]. There is little work on the design of the presentation of reminders, although good design is crucial to success and uptake of reminder systems. We argue that reminders need to be effective, accessible, adaptable, and acceptable. Reminders are effective when users can understand what they are supposed to be doing if they attend appropriately to the reminder. Accessible reminders are easy to perceive and process for the widest possible range of users including people with sensory impairments. Adaptable reminder systems can be configured to accommodate the devices and modalities available in the home as well as the users' dynamically changing care needs and context. Acceptability is the most elusive of the four criteria. Although acceptability is highly subjective and personal, it is a necessary precondition of successful adoption. Acceptable reminders quickly become a part of life, while unacceptable reminders are a constant source of irritation and may be switched off or ignored.

Many approaches have been used in the design of domestic technology in the home. Often, home environments are recreated in a lab setting (e.g. [16]), and in some cases entire lab homes have been built [12]. Such an approach allows a level of control appropriate for designed human-computer interaction experiments. When problems with the technology occur, the experimenters can intervene straight away, which is particularly important when working with potentially vulnerable populations such as older people. However, this kind of controlled setting fails to capture the rich texture of people's individual, personal space, in particular the activities and routines [3] and the presence of other people living in or visiting the home, who will also be affected by reminders [10].

Vastenburg *et al.* [17] proposed an intermediate design, where participants received carefully controlled reminders in their homes. While participants recorded their current activity as reminders were presented, other aspects of the environment were not observed or analysed. A complementary, more ethnographic, approach relies on cultural probes or diaries [5,7]. A full ethnographic immersion into the home can be problematic be-cause the home is a very private space [11]. In cultural probes, users have full control over the materials seen by the researchers. They record relevant aspects of their home using a variety of media and materials – writing, audio recordings, video, photos, and sketches. Leonardi *et al.* [7] used cultural probes to explore the interaction between spaces in older people's homes and the activities and objects situated there.

Home Tours are semi-structured interviews in the homes of users accompanied by a guided 'tour' of the home [8]. In addition to audio recordings and field notes, photography can be used to capture people, places and objects of importance. Home Tours allow researchers to gain insights into how people live, what is important to them in the home, and objects and activities of direct relevance to the design exercise. Importantly – the tour aspect empowers the user to be not only included in the design process but also an active player in generating user requirements.

Home Tours

Method

We conducted seven Home Tour based interviews with users in their own homes (see Table 1). In four homes, people lived on their own, two homes were inhabited by couples, and one home was inhabited by a multi-generational family.

Our home tours occupy a middle ground between ethnography and cultural probes. A researcher visited participants for 1-2 hours and interviewed them specifically about reminding and remembering, and took pictures of relevant objects and spaces with the participants' permission. The interview was augmented with a tour of the home to capture current reminder strategies and their context. Interview responses and comments during the tour were recorded using a digital audio recorder. Photographs were taken of objects used to remember and strategies used to remind people to do things in and around the home.

Our home tours were guided by the following research questions:
1. what users need to be reminded of, i.e. the tasks they forget to do at home
2. why users need reminders, i.e. reasons for forgetting
3. what strategies are used to remember, i.e. what techniques and technologies people already successfully use
4. how users would like to receive reminders, i.e. the devices available to and preferred by users and the modalities available and accessible to users.

All photos and audio were stored digitally and tagged in relation to the context of the interview and observations made during the tour. Framework Analysis [14] was used to identify and categorise salient themes.

#	Participants	Description
1	Mrs. AM	Single older woman (76)
2	Mrs. EH	Single older woman (74)
3	Mr. PL	Single man (39)
4	Mrs. R	Single older woman (89), Parkinson's, mobility problems
5	Mr. & Mrs. G	Husband (65) and wife (64)
6	Mr. & Mrs. L	Husband (72) and wife (72)
7	Family PM	Grandmother (65), mother (37), two children (11, 9)

Table 1: Overview of home tours

Results

Compared to the questionnaire survey and the focus group study, the home tours added an invaluable opportunity for the participants to demonstrate what strategies worked for different reminding tasks, and what the social and physical context for using each reminder strategy was. Some of those strategies, in particular physical reminders, were not fully covered in the survey and focus group data. Home tours were also particularly

useful for raising issues of privacy and confidentiality, which did not emerge strongly in the other data.

Existing reminder strategies and tools

The reminder strategies mentioned fall into three main categories, paper reminders such as calendars and diaries, physical and other visual reminders such as objects that are linked to the task that needs to be remembered, and technological reminders that use devices such as mobile phones.

All participants used paper-based reminders such as calendars, diaries, and sticky notes in their everyday life to remember (Figure 1). Many people had multiple calendars, diaries and notebooks and complex systems for working between them. For example, one calendar might be reserved for family events and appointments, another for an individual's activities. Participants who kept both a calendar and a diary reported explicit strategies for copying selected diary appointments onto the calendar while some remained in the diary only. Often calendars and diaries were annotated with additional notes and information. The systems people used were varied and often very individualised to the person, or couple using them.

In addition to storing reminders, diaries and calendars were also used as a memory aid for information about past events that was needed to plan for future events. One couple (Mr and Mrs L) noted down when they had replaced watch batteries so they knew when the next replacement was due. Mr L (male, 72) recorded information gained at important medical appointments on the original entry when he returned home, and looked back in the diary when the next appointment came up to see what the doctor had said at the last appointment.

> Mr L (male, 72): *"The doctor said my blood was fine in Jan so I don't need to get it checked again til next time…"*

Figure 1: Paper based reminders – calendars and diaries

Another common reminder strategy involved physical and other visual reminders – placing a visually meaningful or salient object in a place where it would be noticed. Examples include keeping library books near the door, making it impossible to leave with-out them, leaving glasses and bus passes in a bowl by the front door where they are sure to be noticed (Figure 2(b)), and hanging a plastic bag over the front door handle to remember items to take to a friend's house.

Mrs EH (female, 74): "*If I leave them [library books] there you see I am bound to remember them … I can't go out the door without seeing them …*"

Packaging was sometimes used as a visual physical reminder. For example, Mrs EH left out empty food packaging to remind her to log her daily food intake on the computer. Mrs EH also left out nearly finished grocery items to remind her to put them on the shopping list (see Figure 2a). Other examples included placing pill packaging near a TV or phone to act as a medication reminder.
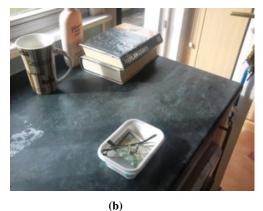

(a)   (b)

Figure 2: Physical/visual reminders

The kitchens were the room talked about most, and the room visited longest across all home tours. All participants used kitchen surfaces as part of their reminder systems. To-do lists, and messages and reminders for other people in the household were often left on the fridge (see Figure 3a) or a blackboard or whiteboard (Figure 3b) were often used for to-do lists and leaving people messages or reminders. The fridge was also used for storing cards with information about upcoming appointment cards, and blackboards were used for shopping lists. One participant [Mrs G] even mentioned that she once took a photo of the shopping list on the blackboard so she could take the shopping list out of the house.

Mrs G (female, 64): "*I write my things up … you know when I realize I need them … I mean I did once take a picture on my phone so I could take it with me …*"

Five out of seven of the participants described using specialized off the shelf solutions such as pill dispensers to remember to take their medication. However, these were often combined with additional physical reminders such as packaging near the TV. None of the participants had electronic pill dispensers.

Finally, some participants used mainstream technologies including mobile phones - popular in the younger users (PL and Family PC) - to send reminders to themselves.

PL (male, 39): " *I set my alarm on my phone for loads of thing … like for when I need to check something or turn it over in the over half way through cooking … that kind of thing.*"

Cooker timers were also used to deliver reminders. For example, Mrs G used the timer to preset a 'time up' alarm for how long her grandchildren were allowed to watch TV or play on the computer.

Figure 3: Kitchen Surfaces as to-do lists

Social Context and Privacy

The home tours were particularly useful for discussing the effect of social context on the type of reminders people would find acceptable. The issue of privacy for example was discussed several times across the home tours.

> Mrs EH (female, 74): " ...*well I don't know...I am not sure I would mind. Well maybe it would be better if it knew when people were in and it could send it just to me – you know on my watch or my phone maybe.*"

> Family PM (Female, 37): "*I wouldn't want all my messages sent to the system so that everyone could see them. I would need to be able to pick which ones went to my phone [mobile] so that only I could see them.*"

Mrs AG commented that she would like speech if she was on her own but not if she had guests over. If she was in a social setting she would prefer something more subtle and more private to her. On the other hand, Mrs G felt strongly that she would want speech reminders if she had guests so that everyone would know what the reminder was and she wouldn't have to explain it.

> Mrs G (female, 64): " *I mean I wouldn't care [whether it was speech or not] you know ... it would be better than having to explain to everyone what the funny wee noise was all about.*"

Different preferences for reminder delivery, both regarding devices and modalities, were a source of potential conflict. For example, reminders that are acceptable to the main user can be perceived as highly intrusive by others. This aspect is comparatively neglected in the literature on intrusiveness, where the focus is on not unduly intruding on the activities of the intended recipient [16].

> Mr L (male, 72): "*Yes to the TV would be ideal so I could see it … especially if it could be sent from the computer in the other room …*"

> Mrs L (Female, 72): "*well … hang on a minute … what if I am watching my programs … you would need to have it as a wee star in the bottom corner … I wouldn't want to be interrupted all the time with a big message …*"

Whether a device or a display was considered to be acceptable or desirable for reminder presentation also depended to some extent on the user's generation. This was obvious in the family home tour. The 37-year-old mother discussed solutions that were based on her mobile phone, the young children liked the idea of wearable devices, and the grandmother was keen to use mainstream technologies such as the TV. Family members were well aware of each other's diverging preferences, as the following quote by the 9-year-old boy shows:

> Family PC (Male, 9): "*I would want it to like a hair band or a watch … you know telling me to remember my school stuff … but then mum could get her reminder to her phone cos she is always on that…*"

Implications for Design

The main message for designers that emerges from our home tours is the need for personalisation. All participants wanted reminder systems to be tailorable to the person to reduce annoyance and increase acceptability. In particular, users expressed a need to have a system that would easily fit in to their daily routine. What is more, reminder systems need to be able to deal with the varying needs, preferences and abilities of multiple occupants, and indeed end users, of the same system. In the following pages, we focus on three central aspects of personalisation, spatiotemporal context, shared interaction spaces, and free choice of device and modality.

Spatiotemporal Context

Many of the reminder strategies that people reported or suggested were influenced by place and/or time. Often, reminders were in visually prominent places, such as a fridge door or a blackboard or a front door. In terms of 'place', reminder strategies mainly revolved around the perceived hub of the home (e.g. the kitchen) or of a person's current or planned activities (e.g. going to the library the next day). Like Leonardi *et al.* [7], we found that the kitchen was a central place in the home, and many reminder strategies focused on kitchen devices. Reminder systems would therefore at least need to have an option to allow setting and/or receiving of reminders in the kitchen. From our survey, the living room emerged as an additional hub that would need to be accommodated.

Even though it is important to deliver reminders at the hub of the home, other spaces need to be covered as well, in particular the hallway. Our home tours show that many different locations were used to store reminders, in particular visual, physical cues. In our survey, some people noted that their reminder systems broke down because they did not check their main visual reminder (calendar or diary) in time and therefore forgot to carry out a task. Indeed, many people reported that they sometimes walked into a

room and forgot why they had entered it. Clearly, localised reminders are needed. Only reminder systems that acknowledge physical context and can deliver reminders to different devices and locations will fit in with such a range of existing strategies.

Many successful reminder strategies also rely on temporal context. They closely link reminders for tasks that are likely to be forgotten with deeply ingrained habits and routines. For example, Mr and Mrs L commented that they put their night-time medication beside their toothbrush, since they never forget to brush their teeth last thing at night. Designing electronic reminder systems that can hook into such routines is challenging, because such systems will need to monitor whether the user is at the appropriate stage of their routine, and plan reminder presentation based on current environmental data, information about the user's schedule and habits, and a specification of the nature and duration of the tasks that need to be executed [13].

Shared Interaction Spaces

Many reminders can be perceived not only by the intended user, but also by other people who share the home interaction space, such as family or visitors. Our home tours provided rich information about the implications of this fact on reminder design. The couple and family home tours in particular highlighted some of the conflicts that individual differences can create. Therefore, reminder systems need to be personalised not just to the user, but also to other people who live in the home, because reminders should not unduly disrupt them.

Unobtrusive reminders that cannot be easily interpreted by visitors provide privacy, especially if users do not want to be seen as needing care. For example, while spoken reminders are necessarily explicit, and therefore clearly indicate the users' care needs, the meaning of non-speech sounds such as Earcons needs to be learned [10].

Detecting or even inferring social context is not easy. Reminder systems should at the very least, acknowledge that social context needs to affect the 'decisions' made about what reminders to send, where to send them, and how to send them. Some of this decision process can be programmed at design time as we learn more about reminders in a social context. This should be combined with decisions made by the system at run time as it learns what devices are available and learns what the users' needs and preferences are. Finally, reminder systems should also encourage user-defined input to these decisions so that users can specify their current preferences, the room they are in, or whether they have guests for example.

Device and Modality Choice

We have argued that reminders are most effective when delivered at the right location and at the right time. However, they also need to be delivered through the right device using the right modality. Our findings clearly show that systems should be configurable based on the devices that are currently acceptable and available to the user. In order to support multimodal multi-device reminder delivery, systems need to be able to monitor the set of available devices. In addition, configurations need to be regularly revised to ensure the users' current needs and preferences are appropriately reflected. Well-designed configuration interfaces can facilitate this with a minimum of effort [9].

While age might influence the interaction techniques that users are familiar and comfortable with and therefore find most acceptable, as demonstrated by the family

home tour, we would caution against creating reminder technology packages that are mainly differentiated by the intended age group. Each person weighs the tradeoffs between modalities differently, and therefore, should be able to choose from a range of options. This also holds for sensory impairments. The adults interviewed in the home tours did not have any significant sensory impairment. Our survey results and focus group data (presented in detail elsewhere) however show that people with a self-reported sensory impairment are as likely to want reminders presented using the impaired modality as people without impairment. This is an important finding that designers might have otherwise overlooked.

Additionally, people's preferences and abilities all potentially change over time as their health improves or declines, or as they get more familiar with a reminder. Future research will look at reminder systems deployed in the context of the home and monitor how people's preferences and responses to different reminders evolve over time.

Conclusion

If novel electronic reminder systems are to be usable and acceptable they will need to exploit existing metaphors and strategies of reminding. Knowledge of the home and the structure of daily life are required to ensure that reminder systems can be integrated into daily life. Electronic reminders should support or augment existing practices and strategies and encourage people to self manage in the home rather than completely replace the working memory or independence of people as they grow older at home.

In this paper, we reported the results of a series of in-depth home tours that were designed to inform the design of reminders for assisted living in the home. Compared to other forms of user requirements gathering, interviewing people in their own homes allowed us to study reminding and remembering in context. As a consequence, the tours yielded a much richer picture of the successful tools and strategies that people use in and around the home to remember tasks and activities of daily living. Being asked about reminders in their own home also made it easier for people to think about aspects that are specific to the home such as privacy and conflict with others' needs and preferences.

Methodologically, the home tours we conducted are a useful compromise between full ethnographic observation, which may be too intrusive, and cultural probes [5,7], where the participant decides what is fed back to the researcher. Since the research participants act as "tour guides", they can control what the researcher sees. At the same time, the researcher can notice objects and arrangements in the home environment that may not strike the participant as relevant.

In conclusion, home tours are a valuable tool for the design of home care technologies. They are an important addition to more traditional techniques such as surveys and focus groups, in particular when social and physical context affects how the technology being designed might be used in the home and integrated into people's lives.

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