



Strategic Promotion of Ageing Research Capacity

Technology to Support Ageing in Place

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*Meeting the challenges of
an ageing society*

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Assistive technologies which provide reminders to assist older people in decision making, particularly in a just-in-time fashion, have significant potential to help older people and their carers. However the requirements of these technologies are not well understood and demonstration systems often rely on complex equipment which is difficult to imagine installed in a normal home setting. This study considered the reminder systems currently used by a small group of older people; their attitudes to technology; and, through some simple experiments, their reaction to certain reminders presented using a variety of simple technologies and formats. Findings highlight the need for systems which can be operated intuitively, and the need to tailor findings to the individual preferences and behaviour of the user.

Key Findings

- Older people use various reminder systems, of which the most usual technology-based system is that of reminder telephone calls from family or friends. Whilst not necessarily technophobes, in general, information technology has not played a major part in their lives, and its use is largely seen as for dealing with exceptions. For example, mobile phones were viewed as being useful for emergencies, not for everyday use. Those people that used call centres, for telephone banking and to pay bills, disliked their impersonal nature, despite their convenience. A personal touch was expected and appreciated.
- The results suggest that spoken reminders, delivered through various means, were most effective when a user was undertaking a task such as reading a newspaper. On-screen reminders were useful when a user was watching the television, but only when repeated. Intrusive phone ringing was irritating, especially when giving reminders about trivial tasks, but effective. Voice reminders provided over the telephone were popular and effective whereas when given over a loudspeaker, were less so.
- Overall, it appears that to be effective, messages and messaging systems have to be tailored to the particular behaviours and routines of the individual.

Introduction

The Issues

Many people want and expect to remain in their own homes as they grow older. Those that do so tend to be healthier and enjoy a higher quality-of-life. However, this independence can lead to vulnerability and put increased demands on health and social services, as well as on families and other caregivers. Deterioration in cognitive ability, memory, and physical dexterity can lead to specific problems around such issues as the neglect of nutrition, medication, physical wellbeing, and social isolation.

Background

Many forms of assistive technology can support independent living, from ramps, rails and stairlifts to **autonomous assistive systems**. These are information technology-based and use telephones, televisions and other electronic devices to provide reminders and cues which assist individuals in their everyday decision making. For example, these systems can be used to help individuals make a meal or catch a bus. However, the requirements of such systems, their usability and acceptability have not been widely considered. In recent years, though, there have been a number of demonstrations of “smart home” technologies, aimed specifically at supporting ageing-in-place. Whilst impressive, these are extremely difficult to install in ordinary homes because they often require significant amounts of custom hardware, software and cabling. The simple technologies considered by this study, however, could make a valuable contribution towards enabling older people remain in their homes.

Recent studies have shown that health-related messages, given at appropriate times, can have a persuasive and positive effect on the behaviour of users. There are many current investigations into the potential of these technologies, which can give reminders and information to support the daily routines of users. These include memory aids such as pill bottle alarms (which are readily available), “aware home” appliances such as the Internet Fridge, and systems to provide reminders about almost every activity in the daily life of the busy family.

Since these emerging technologies, known as **augmented reality (AR) systems**, can be very intrusive, a particular challenge is developing them to be sufficiently flexible and socially acceptable to older people.

The Aims of the Study

The main aim of the study was to develop a small number of AR systems to provide real-time messages to older people in a simulated home setting, and to test these with older people. In more detail the aims were:

- to gather information about older peoples’ perceptions of technology, and identify realistic scenarios where AR systems might be helpful;
- to implement a variety of simple AR systems based on everyday technology and applied to realistic scenarios, and devise experiments to explore perceptions of these technologies.

The Study

The study consisted of two main activities: interviews, and the development and testing of prototype devices.

Older people from the Lincolnshire region were recruited with the help of an Age Concern day centre. Initially, short questionnaires were distributed to gather simple background information and to recruit participants for further research. Those completing the questionnaire were classified in terms of: age range, professional or non-professional background, and gender.

Age	Professional		Non-Professional	
	Male	Female	Male	Female
<60	-	-	1	1
60-70	1	2	-	1
70-80	1	-	-	1
>80	-	-	-	-

Participants completing the questionnaire

Structured interviews were carried out to give the broadest and richest dataset achievable within the project timescale. There was a particular focus on determining older people’s attitudes to the notion that the technology around them could be used to provide reminders and prompts. The question of whether an individual’s background and social-

economic status affected their views on technology was also investigated.

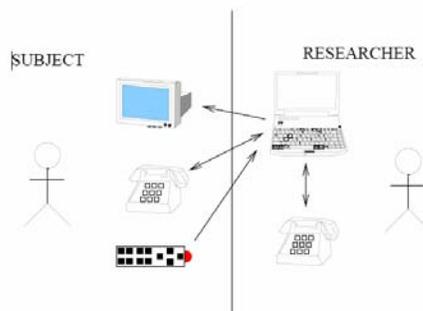
This was followed by the development of a prototype 'living-room' system featuring a wireless network incorporating typical home devices: telephone (both conventional and cordless), a remote control device, analogue radio and TV. These devices behaved like conventional consumer electronics, but could be interrupted to present *synchronised persuasive messages* to the user.

In consultation with local care professionals, four scenarios were developed. The scenarios captured everyday behaviour in which two factors became the prime focus: time dependency and urgency (criticality). For example, attending an appointment is both time dependent and critical, whilst remembering to watch a particular TV program is time dependent but not critical. Whilst it is possible to classify the scenarios in other ways (such as difficulty, and amount of extra information required) these two categories had consistent implications for the types of reminders to be used.

	Critical	Non-Critical
Time Dependent	Attend an Appointment	Watch a particular television programme
Time Independent	Take medications	Water household plants

Scenarios chosen for reminders to be issued during evaluation

To evaluate each of the participants' reactions to the persuasive reminder system an experiment was set up where the researcher, hidden from the user, took the role of a computer system. For example, when the participant made a response to a question on a computer screen, or pushed a particular button on a device, the researcher generated an appropriate visual or aural response. For each scenario "acceptable reminders" were defined; an order of escalation was determined; and "success" and "failure" conditions were set in place.



Schematic of Wizard-of-Oz (WoZ) approach to evaluation experiments.

Participants were not taught how to use the system, but written instructions in the style of an instruction manual were provided, and they were shown how to use the remote control. This was done to simulate the home situation, where there is often a lot of everyday technology, but there is usually little access to explicit instructions.



Participant taking part in WoZ based evaluation of reminder system

The image above shows a participant performing a distraction task, in this case reading a newspaper. This was intended to simulate an everyday routine while the participant was exposed to various reminders. Two reminder devices can be seen: a telephone and the television. During the experiments, the participants were questioned about the reminders shown to them. This was done to find out how persuasive and intrusive the participants thought the reminders were, with the intention of discovering which reminders worked well for each scenario.

Findings

The Interview Study

The interview scripts were analysed in order to: understand what technology was commonly used by the volunteers and how; the participants' attitudes towards technology; and the level of interest and desire to use technology.

In the home, four of the participants used technology that had been primarily bought and set up by relatives. This technology was not always well received, reflecting that any commercial assistive technology should recognise the needs and preferences of the target end user (the older person) rather than the customer (potentially a care giver or relative). Relatives also provided the most common form of technical support, with participants unanimously complaining about the quality of manuals and the design of interfaces for the more complex products. Services that met with most approval were facilities such as telephone banking, remote bill payment and suchlike. Only one participant actively tried to avoid such services.

None of the participants used the Internet on a regular basis, although two had used it in the past. Even though the two Internet users also said they undertook some office tasks such as producing newsletters, the use of computers was low and there was little familiarity with this technology even by those with professional backgrounds. They reported little experience with desktop computers during their careers. None of the participants used interactive television services, despite all but one having access to digital, satellite or cable TV.

The participants' attitude to technology varied. There was little confidence with using technology, particularly among the female participants. Yet during the experiments, there was no obvious difference in **reminder recognition performance** between the male and female participants. Also, the five participants who used call-centres most were those who found the impersonal nature of services like call-centres most irritating. This could have been because either the convenience of call-centres outweighed their irritations, or the participants had no other option but to use them.

Participant A -

"I had a little trouble with it [a video recorder]...as a new thing."

"I can't hear the phone in the kitchen, so I was offered something on the wall [a strobe] that flashed. I said wouldn't it be better if I had a cordless phone?"

"It [the remote control] looked a bit complicated to me...[I prefer] anything that's not too complicated."

Participant B -

"I've had it [an old mobile phone] given to me - a cast-off from my children."

- "Would you actively avoid buying one [a mobile phone] with more features (cameras etc)?" -

"Yes, as they're more expensive...I wouldn't mind if experimenting with them wasn't so expensive."

Participant C -

"[Devices don't annoy me] once they're set up. It's getting them to work in the first place!"

(On call centres and mechanistic technology in general) "Even people who know the technology under certain circumstances want to talk to someone...a problem is lack of training for people on the end of the phone - they've got a script and if you ask a question off the script they don't have a clue what you're talking about."

"If it [the phone] is flashing for no reason it doesn't seem important."

"My wife writes them [appointments etc] down so I don't have to, really."

Selection of responses from participants during structured interviews when discussing in-home technology

Other interesting comments included what was seen as the misuse of technology - particularly mobile phones. Three participants had mobile phones "for emergencies only" and disapproved of these being used in public places. One participant commented on the prevalence of web addresses on "things like adverts and radio programs" which gave the impression that they felt excluded from full participation.

There was no consensus. Participants expressed curiosity about, for example, premium mobile phone services, the Internet and computers in general. However, none had plans to acquire any of this technology, reflecting their passive approach to technology acquisition.

Aside from the useful information about what technology they preferred to use (phones) and that which they did not (anything that appears "too complicated" in the words of one participant), existing reminder strategies used by the participants were discussed with a view

to using future research work to imitate some of these. Three of the participants reported relying on family members to provide reminders, implying that phone-call reminders might be quite successful (as it proved to be). Two reported using diaries and calendars, while two more used various ad-hoc systems of note taking. One relied on memory alone.

From this, it was decided that any future system would need to be flexible in the way it accepted input from the users, in terms of reminders, if it is to be used at all. In the case where carers are putting reminder information into the system on behalf of an older person, a more structured (rather than naturalistic) approach might be suitable, such as a notebook or diary.

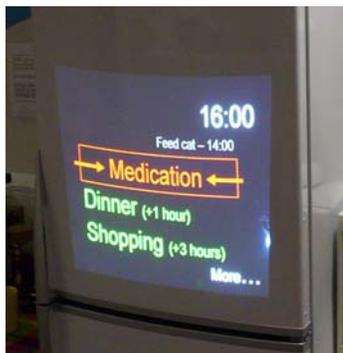
The Experimental Study

The context of the reminder delivery was important, and subjects reacted differently depending on what they were doing and the scenario the reminder(s) were used for. In almost every case, the participants received and understood the reminder, but often required further prompting. Reminders were often noticed when they were in a different "mode" to the distraction task. For instance, spoken voice reminders were particularly effective when the user was reading the newspaper; on-screen reminders were effective when users were watching television, but often only when the reminder had been repeated.

The intrusive ringing phone reminder was felt to be irritating when used for a trivial task like reminding the user to watch television at a particular time. Nevertheless, they were effective in all cases. The synthesised voice

reminder was particularly popular and effective when received over the phone, indeed the clarity was commended by two participants. However, when the same reminder was delivered over the loudspeaker system, it was thought to be unclear. This may be because the ringing of the phone, or the action of dialling voicemail, focuses the user's attention so they are receptive and concentrating when the message eventually arrives.

The voicemail system caused the most confusion, particularly in the case where a voicemail was left and the flashing telephone or single ring reminder types were used to alert the participant to its existence. Instructions for the use of voicemail were left on the desk at the beginning of the experiment, but only one participant discovered these independently. This highlights two points: without prior experience of voicemail neither of these reminders was particularly intuitive, and relying on manual use was not effective. Combining reminders elsewhere in the experiment (for example, tones with on-screen reminders) is probably an appropriate strategy here for though the flashing/ringing phone reminders weren't themselves informative, they quickly caught the attention of the participant. Finally, differences between participants' interpretations of the same reminder indicated that, for maximum effectiveness, systems would need to be tailored to suit the habits of the individual user.



Example of mock-up of reminders being projected - in an augmented reality fashion - on an everyday household appliance



Further example of an augmented reality display on a kitchen appliance

Discussion and Implications

The majority of older people want to maintain an independent lifestyle and remain in their own homes. Evidence suggests that older people who remain independent are healthier and enjoy a higher quality of life than those reliant on residential care. However, unsupported independence may lead to vulnerability, and this can also put increased demands on carers. By supporting ageing-in-place, there can be direct benefits for both the individual and those who care for them. Direct cost benefits arise from a reduction in demand for expensive residential care, and more generally on other areas of the healthcare system. In addition, the burden on spouses, families and other caregivers can be greatly reduced.

Ageing-in-place is greatly facilitated by traditional and well-established assistive technologies. These technologies include adaptations to the home, in which electronic technology, such as the community alarm, can play an important role. There is good sense in exploiting the potential of electronic based assistive technologies, especially autonomous assistive systems, which support decision-making for healthier and safer living.

As part of a general trend in exploiting electronic devices, this study has considered how to develop flexible automated reminder systems which are affordable; tuneable to individual needs; discreet but attention-grabbing when required; and which respect people's social interactions and activities.

It was found that older people use different personal reminder strategies. These include relying on family members who may give phone call reminders, keeping diaries, calendars and notes, and memory joggers. Generally, they disliked impersonal services, such as those provided by call-centres, and preferred the interaction which accompanies a telephone conversation.

For most, however, there was a view that technology (whether it was the telephone or some other device) was there for emergencies, and was not something which played, or should play, a major role in an individual's life.

Because of the increasing prevalence of technology, there were feelings of being excluded from some aspects of modern life. All of those involved had little experience of computers or computer based technologies, and there was little confidence in using these.

The format and delivery of automated reminders needs to be straightforward, but sufficiently effective so as to capture the attention of the individual, without becoming bewildering to manage or irritating. Quite simply the reminder system has to be simple and capable of being operated in an intuitive fashion.

Various approaches were trialled in the study with some success, although the effectiveness of a particular reminder system was to some extent dependent on the particular activity taking place at the time. Spoken reminders worked well when someone was undertaking a quiet task such as reading, but less so when watching TV, for which, repeated on-screen messages worked best. Overall, it appears that to be effective, messages and messaging systems have to be tailored to the particular behaviours and routines of the individual.

This raises issues not about the costs of the basic technology, which this study showed could be based on cheap and readily available equipment, but about the costs of understanding how individuals spend their time and tailoring systems to suit their patterns of behaviour. It would be all-too-easy to end up with a nightmare scenario of multiple systems to cover all behavioural patterns, defeating the very object of contributing to a peaceful and comfortable home environment.

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The Study

The study received financial support from SPARC of £28,994 and ran for 12 months ending in April 2007. Additional support was provided by the University of Lincoln.

More information about the study can be found on the SPARC website www.sparc.ac.uk and obtained directly from the investigators.

As a result of this SPARC project, the research team is currently involved in the authoring of a number of research bids.

Bibliography and Key References

Lawson, S.W., Nutter, D., Wilson, P. 2007. Design of interactive technology for ageing-in-place. Invited submission to HCI International 2007, *12th International Conference on Human-Computer Interaction*, 22-27 July 2007, Beijing

Intille S.S. 2004. A new research challenge: persuasive technology to motivate healthy aging. *IEEE Transactions on Information Technology in Biomedicine (Special issue on Pervasive Healthcare)*, 8 (3) pp. 235-236.

Fogg B. J. 1998. Persuasive Computers: Perspectives and Research Directions. *Proc of ACM CHI 1998*, 225-232.

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SPARC

SPARC is a unique initiative supported by EPSRC and BBSRC to encourage the greater involvement of researchers in the many issues faced by an ageing population and encountered by older people in their daily lives. SPARC is directed, managed and informed by the broader community of researchers, practitioners, policy makers and older people for the ultimate benefit of older people, their carers and those who provide services to older people.

SPARC pursues three main activities:

Workshops to bring together all stakeholders interested in improving the quality of life and independence of older people.

Advocacy of the challenges faced by older people and an ageing population and of the contribution of research to improving quality of life. SPARC is inclusive and warmly welcomes the involvement of everyone with a relevant interest.

Small Awards to newcomers to ageing research, across all areas of design, engineering and biology and at the interfaces relevant to an ageing population and older people. In 2005 and 2006 SPARC received 185 applications for support in response to two invitations for competitive proposals of which 34 were supported.

Executive Summaries

SPARC is supporting its award holders through funding, mentoring, a prestigious dissemination platform, professional editorial assistance, international activities and provision of contacts. Each of the projects has been small, yet the enthusiasm for discovery, and impatience to contribute to better quality of life for older people, has more than compensated for the very limited funding which was provided.

This executive summary is one of a series highlighting the main findings from a SPARC project. It is designed to stand-alone, although taken with summaries of other projects it contributes to a formidable combination of new knowledge and commitment by newcomers to ageing research, with a view to improve the lives of older people. This is a tangible contribution towards ensuring that older people receive full benefit from the best that research, science and technology can offer.