Methods for human-computer interaction research with older people

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Abstract: Experimental research in human–computer interaction commonly uses participant groups that are unrepresentative of demographic realities, being young, technically knowledgeable and highly educated. One way of reflecting society more accurately in research is to include older adults in research groups, but the elicitation of high-quality data from these participants requires alterations in research methods and organization. In the present paper, methodological and organizational experiences from a range of research studies with older participants are reported. It concludes with a list of guidelines for maximizing the research outcomes of working with older adults.

Keywords: Older participants; Methodologies; Guidelines.

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1. Introduction

Researchers interested in older adults and computer systems often comment on the failure of 'mainstream' human–computer interaction (HCI) to consider people over 60 (see, for example, Newell and Gregor 2000, 2002). HCI research rarely reflects demographic reality: 20% of the population in the developed world is over 60, and the median population age is 38.6 (UN 2006), yet most HCI research is focused on younger people, often university or college students. Rather than representing the population as it actually is, much experimental HCI research is thus skewed heavily towards the characteristics (and attitudes) of the highly educated young.

Illustrating this bias, a brief survey of three leading HCI journals (Transactions on Computer – Human Interaction, March 2006; International Journal of Human – Computer Studies, 2006, 64, issues 8 – 10; Interacting with Computers, 2006, 18, issues 1 – 4) shows that in recent issues of each journal, where information about participant ages was given, only two papers from a total of 39 included any participants over the age of 60. By contrast, 18 papers specified that student participants had been used. In the 16 papers where mean ages were given, no average age was greater than 34, with the exception of a single paper concerned specifically with older people (Kurniawan et al. 2006).

In part, this age bias in the research can be explained by the easy availability of student participants within universities. Inclusion of older adults in HCI participant groups has been recognized as challenging: there are documented difficulties with recruiting representative samples of older users. This recruitment difficulty tends to be because those who are willing to volunteer are younger, healthier and with better social networks than those who are not (e.g. Eisma et al. 2004, Ory et al. 2002, Tell et al. 1993). However, if demographic realities are to be reflected in HCI research, it is important to offer techniques to researchers for attracting, retaining and working with older adults. While many excellent guidelines exist to support interface design for older adults (e.g. Morrell et al. 2004, Zaphiris et al. 2007), few exist to support researchers in devising appropriate methods for carrying out their own usability studies. In the current paper the methodological and organizational conclusions from work involving older adults (60–93) are presented as a contribution to existing knowledge and to provide guidelines for those interested in working in the area.

2. Some characteristics of older adult participants

Although older adults constitute a widely diverse group (Gregor and Newell 2001), they differ from groups more typically used for HCI research, often university students. Consideration of these different characteristics is important to help researchers choose appropriate study designs and organizational strategies.

2.1 *Lifestyle characteristics*

Older adults are especially different from students and other more 'typical' participants in terms of lifestyle characteristics: factors ranging from the apparently irrelevant, such as home address, to those as important as education and computer experience are all likely to affect the success of experimental studies if they are not considered at the planning stage.

For example, it may seem self evident, but many older participants will not live close to research institutions, nor can it be assumed that they will be familiar with the layout of a university.

Of perhaps more obvious importance, older adults will have a wider range of educational levels, with a significant proportion having low literacy. Surprisingly, the UK National Literacy survey reported that 60% of men and 70% of women aged 50 – 65 (The Adult Literacy Survey, the section of the International Adult Literacy Survey which tests literacy levels across the UK, only tests adults between the ages of 16 and 65) had a literacy level of 1 or 2, that is, a level insufficient to 'cope with modern life and work' (Social Trends 2000, p. 59). This may be partly explained by levels of formal education: statistics from the 2001 Census in Scotland show that the 60% of people 60 – 64, and 66% of those aged 65 – 74, have no formal educational qualifications (Scrol 2006). Formal education and literacy levels are characteristics in which most older people differ significantly from younger participants, particularly students.

Lack of formal educational qualifications means that it cannot be assumed that older adults will be familiar with experimental techniques: it is important to make it explicit, for example, that silence and concentration are expected during certain parts of an experiment. Variety in literacy levels also means it is important to ensure that the language in consent forms, information sheets and experimental instructions is straight-forward and free from experimental, as well as technical, jargon. Time estimates for reading consent forms should be generous, and a verbal description of the content should also be offered.

The amount of free time and flexibility that participants have should also be considered: at one end of the spectrum, many retired people lead extremely busy lives, concerned not only with their own interests and hobbies, but often involved in caring for a grandchild. Conversely, some older adults find themselves alone and isolated, with large amounts of free time. This is especially common following bereavement, when familiar structures are removed and the bereaved partner seeks new ways to occupy themselves. Both of these lifestyle patterns can cause difficulty for researchers, but it is important to include people with a range of activity levels since these influence other characteristics, such as cognitive function (Christensen et al. 1996).

Finally, most people over 65 years of age in the UK have never used the internet; figures for internet use by the over-65s have remained consistently around 20% since April 2003 (ONS 2006). This figure hides a pattern of age and gender difference: men are more likely to use the internet than women, and figures for both sexes fall off with increasing age. Among those over 80, only 9% of men and 7% of women use the internet (Soule et al. 2005). Figures for computer use are less recent, but research suggests these too are very much lower for the over-65s (Selwyn et al. 2003). Popular emphasis on 'silver surfers' should not disguise the fact that most people over 65, although clearly not all, are likely to have little direct experience of computers and no experience of the internet.

2.2 *Sensory and cognitive changes*

Ageing is associated with changes in characteristics such as visual and auditory perception, fine motor control and some aspects of memory and cognition (see Carmichael 1999, Hawthorn 2000 for overviews). While many of these changes are only apparent in psychological tests, some can influence participants' ability to, for example, read or hear experimental instructions, use a mouse, or remember steps through an interface. Conversely, superior social skills can mean that older participants may be more likely to involve the facilitator in the task.

2.3 *Mobility and illness*

Some older adults may experience temporary or permanent mobility difficulties. Operations with significant implications for mobility, such as joint replacements, are more commonly carried out on older people: 90% of hip replacements are carried out on people over 55 years of age (Birrell et al. 1999), and mean patient ages for primary hip and knee replacements have been 68.6 and 70.6 years respectively (Dixon et al. 2004). Additionally, many older people suffer from joint pain, which may also affect mobility: in a recent survey, 41% of people over 65 reported pain in hip or knee within a 12 month period (see Birrell 2004).

People living with significant illnesses such as cancer and diabetes tend to be older: at least 7 – 8% of those 65 and older live with a diagnosis of cancer (Forman et al. 2003), compared with around 2% in the population as a whole; diabetes is also more common among people over 60, affecting 6.1% of men and 4.25% of women over 60, compared with a prevalence of 1.6% in the general population (Connolly et al. 2000).

3. Experimental design and methodologies

The characteristics of older adults, summarised briefly in section 2, are important considerations during experimental design. Sometimes it is only necessary to provide more time, explanation or reassurance but in other situations conventional HCI methods can be problematic and can usefully be adapted.

3.1 *Experimental procedures*

Older participants' inexperience with experimental situations can lead to uncertainty about appropriate behaviours. During a recent study on web-pages, several participants brought friends or carers into the laboratory for companionship or support; it was important to make it clear that these companions should not interfere with the experimental process or interrupt the experiment. An alternative approach, which worked well in a subsequent, more informal, study was to accept that companions might attend and to deliberately involve them as additional participants (Sloan et al. 2006).

Additionally, politeness and experience in social situations can often have the side effect of the participant trying to include and involve the facilitator or researcher in the experiment. This can clearly be problematic in formal research situations, and it is important to be very clear about the role of the researcher, and times at which conversation is permitted.

3.2 *Cognitive testing*

Cognitive testing can provide a useful indication of whether participants are experiencing age-related memory or processing difficulties. Given the diversity of older participants, it can be especially useful in ensuring equivalence between different experimental groups.

It is extremely important, however, to recognize the particular resonance that such testing may have with many older participants. Older adults may be fearful of memory changes, and worried about whether such changes have implications for the development of mental illness and decline (Centofanti 1998). Some cognitive tests, for example the Rey Auditory Verbal Learning Test (RAVLT), are based on an expected level of failure; other tests, e.g. digit and reverse-digit span tests, are continued until the participant can no longer give an accurate response (Lezak et al. 2004). It is important that the participant is aware that failure is normal and expected, indeed that it is part of the test. Ensuring that this is clear is, of course, an ethical issue, but it is also important from a research perspective: stress and worry about failure can have a very negative effect on subsequent performance.

Hearing loss is another factor which can impact on successful performance in cognitive tests; indeed, it is formally recognized in scoring instructions that auditory impairment affects performance on such tests. However, hearing loss can also make the test process confusing and frustrating for the participant, particularly if they have difficulty hearing experimental instructions or items. Such frustration, if it is not recognized and addressed, can lead to withdrawal from studies.

Finally, researchers should be cautious of adopting stereotypical expectations about older adults' cognition: in a recent study, several participants had well-developed strategies for memorizing items. These participants' scores on a battery of cognitive tests were well above the population average, and considerably higher than the predicted score for their age. Interestingly, these strategies are often associated with activities such as playing Bridge.

3.3 *Self-reporting*

The combination of inexperience with computers and experimental techniques can place considerable stress on processing capacity. In some cases, age-related reduction in processing capacity can exacerbate this stress. These factors can reduce the efficacy of participant self-reporting and the HCI techniques that depend upon it.

When user perceptions are being sought, self-reporting is a useful tool that often elicits excellent data. However, the quality of the data is affected by processing capacity, education, physical impairments and memory and this can reduce the technique's efficacy with older participants. Working with older participants with little or no computer experience, it is important to recognize the limitations of the technique, and this is especially so if the participants are inexperienced with computers and with reporting.

One problem that arises is lack of detail: older participants with little computer experience may find it difficult to identify anything other than a general impression, such as 'I'm finding this difficult today.' Confusion among older beginners is often general, poorly articulated and non-specific.

Inexperienced older participants may perceive their difficulties as related to the keyboard. Commonly at the beginning of a study, participants comment on being nervous about using the keyboard, and in several cases measure their own progress by reference to the keyboard: e.g. 'I found more of the letters today, I think I'm getting faster.' In general, there are few references to on-screen interfaces, especially in studies where participants are only introduced to one interface. Older participants often seem to regard the interface as 'the computer' and, without examples, the concept of alternative interfaces is not easily understood.

3.4 *Thinking aloud*

Older participants' difficulties with self-reporting are especially clear in laboratory situations. The concurrent 'think aloud' approach, where the participant describes what they are doing as they do it, is a standard method for trying to understand participant perceptions (Ericsson and Simon 1993, van Someren et al. 1994). However, research studies have demonstrated limitations of concurrent think aloud with this group: as older research participants, particularly those with cognitive impairments, struggle with unfamiliar interfaces the process of thinking aloud can interfere with the completion of the experimental task (Dickinson et al. 2005b, Fisk et al. 2004).

Once more, it is important to emphasize the diversity of older participants: some individuals produce excellent data when asked to use concurrent thinking aloud. The most dramatic example of this was a retired surgeon who was very experienced in explaining his actions as he carried them out, because he had done this during surgery. The process thus took him very little effort. The difficulty, of course, of using the approach with a range of participants is that data are not elicited from the less articulate or from those who find the combination of tasks difficult in terms of processing capacity.

To elicit data from the widest possible range of participants, various alternatives have been tried. In an eye-tracking study aimed at eliciting older beginners' initial understandings of web pages, a variant of the retrospective think aloud method (Ericsson and Simon 1993) was used (Dickinson et al. 2005a). In the present study, participants were initially asked to look silently at a web page for 20 s. Subsequently the web page was re-presented and participants were asked to describe it. High quality data were produced with this approach. The difficulty with use of this strategy is, however, the think aloud description with re-presentation of the stimuli must be considered as contributing to user learning, therefore potentially confounding experimental results.

A less successful alternative was tried in a recent study of email use. The focus of the study was the process of user learning and it was therefore decided that re-presentation of the stimuli would risk confounding the experimental data. Task completion was separated from the description of the participant's thought processes with an approach called 'tell me what you did': the participant attempted a task and, when the attempt was completed, the facilitator asked the participant to report what they had done. Processing and memory difficulties meant that this approach was not effective. Older participants often found it very difficult to recall what they had done in order to complete a task. Complete beginners were often too focused on the physical procedure of moving the mouse or typing to recall the series of steps they had taken, e.g. 'I don't really know what I did, except move the mouse, which came into it. I've never really had dealings with the mouse before so this is all rather mysterious. But I'm getting the idea that you need to pull it towards you on the table, not lift it . . .' (participant A).

Others simply could not recall:

> Facilitator: Can you remember the steps?
> Participant (B): No, I don't think I can . . . well I had to, I had to . . . No, I don't know really.

Although the process was limited as a way of understanding participant perceptions, it provided fascinating information about how little was remembered of the recent procedure. Factors affecting processing capacity, such as task difficulty or whether or not typing was involved, and participant experience with the technique and the task, did mediate this pattern, but nonetheless, older participants rarely remembered processes accurately until they had repeated them several times.

3.5 *User diaries*

Further difficulties with self-reporting emerged in a recent study where older participants spent 'practice' sessions using email. In order to record aspects such as the tasks successfully completed, perceived task difficulty, etcetera, a worksheet approach was adopted. The approach was based on the standard usability methodology of user diaries (e.g. Colbert 2001, Czerwinski et al. 2004, Rieman 1993), and the technique of 'adventure sheets', used previously with older participants (Bailey et al. 2005).

This worksheet approach proved problematic. Older beginners who were struggling to learn and understand the process of completing specific email tasks (such as sending an email) rarely had attention free to complete worksheets in any detail. If they tried to do so it was after a task was completed and they were unlikely to recall the precise sequence of events. The fact that diaries interfere with users' tasks is not a new discovery: as Czerwinski et al. note, 'journaling tends to add to the interruption of the flow of daily events' (Czerwinski et al. 2004, p.176). However, the extent to which carrying out new and challenging tasks made it difficult to keep a record was striking. Most of the high-quality information received in this way was from those with more experience, who had resources free to concentrate on filling in worksheets.

A second problem, that affected a sub-group of users, was difficulty with the physical process of writing because of problems with motor control. For this group, writing demanded considerable physical effort and they tended to write as little as possible. Both of these factors meant that the people who faced the most difficulty learning to use email were also those least likely to provide useful information via worksheets.

It was clear that, for this group, writing was itself a barrier to the recording of their thoughts, but it was not evident whether another means of recording user perceptions would be preferable: audio recording was unlikely to be a solution since people were working in the same environment as others, and typing was slow, laborious and painstaking – highly unlikely to facilitate the recording of impressions.

Talking one-to-one to participants was the most effective way of eliciting information, and even then the process of discussing the procedure tended to interfere with the procedure itself. It seems unlikely that there is a complete solution to this phenomenon.

3.6 *Timing*

Working with older participants, particularly those who are not experienced computer users, can also make it necessary to reconsider timing issues. It is desirable to be flexible about timings, although this can be difficult in a formally designed experiment. In such cases, the most important aspect is to plan for more time than expected; this additional time will often be necessary.

3.6.1 Task timing. Older participants can be anxious to discuss their performance or, in email studies, to explain what they are writing (and why). This is often a result of participant politeness and a social desire to include the researcher in the activity. Repeatedly asking participants not to discuss things may have a negative effect on user attitudes; it can thus be difficult to time tasks accurately.

3.6.2 Study timing. As Hawthorn has noted in his review of the literature (Hawthorn 2000), older adults find learning about computers more difficult, they are likely to forget more readily, and it will take them longer to attain competence than it will for younger people.

In two recent studies on email, sessions took place once a week, a standard time-period in this sort of research (e.g. Straka and Clark 2000). It became evident that, from the perspective of maximizing user learning, twice-weekly sessions would have been preferable. Most participants did not have enough free time for this approach, however. Ecologically the weekly approach was quite valid: most classes on computer use are weekly, and without a computer of their own at home people were unlikely to practise regularly.

Another timing factor that should be taken into account in planning the length of a study was that some participants, especially complete beginners, took longer than anticipated to develop autonomy in using the email system. Again, this is a relatively common finding in the research (Straka and Clark

2000, Namazi and McClintic 2003). This underlines the importance of flexibility in timing; where necessary, experimentation was extended to allow participants to attain confidence and autonomy.

3.6.3 Evaluation timing. It is also important to choose carefully when to 'sample' participant learning in longer-term studies. The researcher should be aware that learning does not follow a smooth upward curve: in a recent longitudinal study of beginners most participants underwent a 'crisis' week in which they struggled to complete basic tasks, needed repeated help and reported that they felt they were getting nowhere. Such experiences could lead to considerable frustration, but in all cases preceded a 'breakthrough' week when everything fell into place. The longer-term nature of the study made it possible to identify these patterns, which happened at different times for different people, but most commonly occurred between weeks three and six. Measures taken during the crisis week would not have reflected the genuine performance or experience of the participants, but the crisis week remained a common part of the learning process.

3.7 *User diversity and experiment design*

We noted in Section 2 that older adults constitute an extremely diverse group: indeed the main justification for treating them as a unit in this paper is that, in general, they tend to differ from groups currently over-represented in HCI research, such as students or young software designers.

It is established in the literature that groups of 'older people' are often more diverse than younger groups in part because of the increased likelihood of illness or age-related impairment, in part also because of the wide age-range that the term 'older' conventionally covers, e.g. anyone over 60 or 65, and in some cases, anyone over 50. While ageing is associated with an increased risk for factors such as tremors, memory difficulties and mobility problems, this simply widens the range of functionality and makes the group more diverse.

Some study designs, for example, working with beginners and interface manipulations, make it desirable to use a between-subjects experimental design. Older participant diversity makes it important to carefully control the experimental conditions and measures.

4. Working with older adults

Appropriate experimental design is a vital component of eliciting high-quality results from older participants. However, it is equally important to manage organizational issues to ensure ongoing access to a representative and useful sample of older people. This section concerns 'nuts and bolts' issues about the organization of the research. Although such issues may appear peripheral, they are central to successful and valid experimentation: the recruitment and maintenance of a varied and representative sample can only take place through making appropriate organizational decisions.

4.1 *Recruitment*

The most appropriate methods for the recruitment of a useful sample of older participants depend on the purpose of the research and the characteristics of the sample required. The UTOPIA database was developed (see Eisma et al. 2004) to attract a range of potential participants; active user interest is now maintained through bi-weekly computer classes and research opportunities are advertised on the class website.

In several recent studies, however, non-computer users have been required. Recruitment methods used have included working with local charities and use of local media.

4.1.1 Local charities. Contact with local charities is valuable because it allows access to a range of participants who are not recruited in terms of their interest in computers. However, there have been organizational difficulties with this approach: participants' contact details are normally withheld from researchers and initial participant screening is carried out by the charities. Despite careful description of the sample required, it has been difficult to ensure that all participants are appropriate for the relevant study. For example, on one occasion a participant for an eye-tracking study was found to be

legally blind when he attended the session; on another occasion a participant recruited as having no computer experience talked knowledgeably of using Google on his home computer. Since such issues are discovered during the screening interview at the beginning of the experimental session, this approach has proved inefficient and therefore expensive as a method of recruitment.

4.1.2 Local media. Use of local media was found to be a more successful means of attracting older adults with little or no computer experience; indeed, a feature-length article in The Courier (Dundee's local newspaper) was the most successful single strategy used, resulting in phone calls from over a hundred volunteers within three days. The direct contact from the participant meant that screening could be carried out before research sessions were arranged.

4.2 *Attending the university*

It is important to ensure that instructions for finding the university and the specific research space are clear and unambiguous. It is useful to provide details such as which buses stop nearby, what parking arrangements are available, and what a taxi driver should be told to ensure she finds the correct building (and correct entrance). Insufficient directions have resulted in organizational difficulties such as focus group participants arriving at significantly different times; participants being unable to find the venue and participants dropping out of studies because of the difficulties and confusion of finding their way around the University campus. In recent studies, the following have been routinely provided in all invitations to participate in research:

(a) the address of the building with contact details and alternative phone numbers;
(b) a photograph of the building, indicating the entrance;
(c) a map of the university campus, including the surrounding area;
(d) a map of bus stops in the area, and their relationship to the research venue;
(e) a description of parking procedures, including whether or not parking is likely to be available close to the venue.

Follow-up telephone calls are made to ensure that the participant is confident about finding the venue.

For older adults, particularly those who find walking difficult or painful, it is important to site the experiment as close to the entrance of the building as possible. In the past it has been found that even participants who did not specify a mobility difficulty in conversation with the researcher have had difficulty walking to research laboratories. On one occasion it was necessary to obtain a wheelchair to take the participant to the research laboratory. Stairs are a particular problem, but long corridors also present a barrier. If it is vital that participants should walk down such a corridor, it is important to ensure that there are opportunities and places to rest, and also that plenty of time is allowed for the process.

4.3 *Regular attendance at the university*

Additional problems arise when studies are longitudinal and demand more than one visit to the university. For some studies, making payment to participants can be useful (e.g. Dickinson et al. 2005b) as this can produce a 'contract' effect between the researcher and the participant; in studies where this approach was used a 100% attendance rate was attained over up to four sessions. However, this strategy has limitations; not least, confusion about who will receive payment for the experimental session. In one study, participants were told that a certain cash sum would be paid for each session; several misunderstood this and attended their first session bearing cheques made out to this cash sum that they intended to hand over to the researchers.

This misunderstanding, however, reflects an important factor: learning about computer systems is often seen as valuable and worth investing in. This provides an alternative strategy for retaining study participants. A recent study on email systems attracted and retained over 30 older participants for a minimum of twelve sessions by offering not only basic email experience but also a subsequent free computer course. This strategy is more time consuming, but is a useful approach for studies where finances are limited, or where participants are keen to learn about computers. It is particularly

helpful if it is important that participants do not practise computing skills between sessions; the promise of a course where practice will be encouraged can help persuade people to wait.

A further issue is the maintenance of regular attendance: issues such as family responsibilities, illness and operations can impact upon the ability of older participants to attend reliably over a longer time period. In one recent study, from an initial group of 35 participants: three missed sessions because of medical operations; one participant postponed the start of the study by five weeks because her husband was unwell; two participants had scheduling difficulties because of responsibilities looking after grandchildren and several, having no other fixed appointments, went on short holidays, necessitating re-arrangement of one or more sessions. Three volunteers had to withdraw entirely from the project because of illness.

Strategies for managing this involved considerable flexibility in terms of scheduling sessions, an initial group that was larger than the intended experimental group to allow for withdrawals, and the recognition that such delays were part of the life experience of the older participants, and as such, while frustrating for the research team, added ecological veracity to the research. These factors are not unusual in such a group. It would have been unfortunate, from a research perspective, to lose those participants whose health, for example, necessitated re-scheduling of research sessions, since they are representative of a wider, often marginalised, group of potential users.

5. Demographic concerns

Including older adults as participants in research studies is important to ensure an accurate reflection of demographic realities. It may appear from the difficulties listed above that the best strategy could be to conduct research in other contexts: people's homes, for example. However, this clearly cannot be achieved in a controlled manner and, with appropriate adjustments to study organization and design, it is possible to elicit high quality experimental data from this participant group.

6. Considerations for studies with older participants

The issues discussed above should be considered during the planning and design phase of an experiment. Difficulties can be overcome but not without some flexibility and effort. The list presented in Table 1 is a first step towards supporting researchers in planning and carrying out successful research studies with older participants.

7. Conclusions

It should not be necessary to point out that defining older adults in terms of impairments, limitations or illnesses is to take a superficial, stereotypical view, which can only impact negatively on research. Older adults are a widely diverse group, particularly compared with groups such as undergraduate students who are frequently used as study participants. Diversity can mean that techniques that work for some may not work for others; one danger is that inappropriate research strategies may not appear as such until the study is finished, producing outcomes that reflect the experience of educated, experienced and articulate participants, while failing to access the experience of those who are less well educated, less experienced with computers or less articulate (in other words, those participants who are most representative).

This unevenness may be attributed to the ways in which HCI research strategies have been developed and tested: often with highly-educated, generally young, people, who are accustomed to research and the techniques involved. When members of the participant group are at variance with this profile, conventional techniques may produce poor results.

These reflections should not be seen as a fundamental criticism of usability techniques, however. Relatively small adjustments to research techniques, careful ongoing monitoring of the information received, and flexibility with time and approaches are enough to maximize the production of valuable information from a range of older participants.

There are many reasons to focus on increasing the efficacy and inclusiveness of usability research strategies: not only is the population as a whole rather older than the normal population of

Table 1. Some considerations for planning research studies involving older participants.

Procedural Issue	Suggested Solutions	Reasons
Written documentation (e.g. consent forms, information sheets, experimental directions).	Ensure readability. Font size should be at least 14 point. Language should be straightforward, 'every day' English, with particular effort taken to avoid jargon and terminology.	Older participants may find small font sizes harder to read (Akutsu *et al.* 1991, Bernard *et al.* 2001). Wide variety in literacy and education levels, with a significant proportion of older adults having relatively poor literacy.
Experimental instructions	Be especially careful to ensure that participants understand experimental instructions before you begin. Be prepared to repeat instructions (if necessary using different words) throughout the experiment.	Inexperience with experimental conditions can mean uncertainty about appropriate behaviours. Additionally, memory issues may make it necessary to repeat instructions.
Companions	Be prepared for participants to ask to bring – or simply to bring – companions for moral support. Have a strategy for coping with and accommodating companions, depending on the formality of the experiment, such that they do not affect the experiment.	Attendance at a research venue can be an intimidating experience. Companions, while helping to reduce participant anxiety, can also interfere with experimental conditions if not situated properly.
Cognitive testing	Explain clearly at the beginning of cognitive testing the instructions and the level of performance expected. If necessary, when failure occurs make it explicit that this is to be expected. Do not automatically use 'age-specific' scales.	Older adults can be very vulnerable to worries about the effects of ageing on memory and cognition. Diversity and highly effective strategies mean that age-specific scales may produce a ceiling effect.
Think aloud procedures	Be aware of potential problems with both 'concurrent' and 'retrospective' think aloud techniques.	Concurrent think aloud places significant stress on inexperienced computer users and often fails to produce useful data. Conversely, retrospective think aloud often produces excellent data, but the process may confound experimental measures.
User diaries	Be aware that inexperience and other factors will affect the data received; check regularly that desired data is being collected; follow up rapidly with one-to-one discussions.	Difficulties with memory, processing and physical problems with writing can reduce the usefulness of information gathered through user diaries. One-to-one discussions are normally the best way of eliciting information from inexperienced computer users.
Balanced measures	Combine subjective and objective measures.	Beginners can find it difficult to express specific problems with an interface. Additionally, the explanation given by a participant often differs from that given by an observer. Richer information from multiple approaches makes it more likely that useful data will be gathered.
Timing	Be as flexible as possible. In more formal experimental situations, where flexibility may be more difficult, budget generously for time.	Older participants commonly take longer to complete tasks and to achieve autonomy than researchers anticipate.
Recruitment	Choose appropriate recruitment strategies. Be cautious about situations where participant vetting is carried out by someone outside the research team, for example an employee of a local charity or other agency.	Strategies vary according to the research. It is often wasteful and inefficient to depend upon others to vet participants.
Instructions for visit to research space	Ensure directions are clear and explicit; provide a range of information about finding the venue and contact numbers. Include information about what to bring (e.g. reading glasses, hearing aid) and check by telephone beforehand that the information has been received and understood.	Older participants may have to travel some way to attend the university; unlike students they may not know the campus well. Variations in literacy mean that directions should be as clear as possible. Telephoning to check beforehand helps to reassure participants and encourages attendance.
Reaching research space	Minimise the amount of walking that participants need to do to reach the research space. Avoid stairs.	Some older participants may find it difficult to walk further than a few metres. Many find stairs a significant barrier.
Retaining participants	Adopt an appropriate strategy to retain participants: the offer of free computer classes is often very effective.	Offering something in return for participation increases participant retention and can create a more positive relationship.
Longer-term study Maintenance	To maintain participation in a longer term study it is important to be flexible about session times and any re-scheduling.	Participants or their family members may be ill, or busy, and occasional re-scheduling is preferable to losing participation in a study.

research studies tends to be, but, with the increasing 'domestication' of technology, the growing focus on smart houses and assistive technologies, and the computerisation of home entertainment, older people are more exposed to technologies than ever before. By making some appropriate changes to research techniques and study organization, usability researchers can reflect the needs and wants of older people for technologies, an undertaking that has financial and economic, as well as political and ethical, implications.

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