Issues surrounding the user-centred development of a new interactive memory aid

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Abstract: Memory problems are often associated with the ageing process and they are one of the commonest effects of brain injury. Electronic memory aids have been successfully used as a compensatory approach to provide reminders to individuals with prospective memory problems. This paper describes the usability issues surrounding the development of a new memory aid rendered on a personal digital assistant (PDA); in addition, it discusses the importance of a user-centred design process for the development of the memory aid and preliminary qualitative findings from interviews and focus groups of disabled or elderly users.

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1 Introduction

At the beginning of this research, a participant who lives with memory loss every day of his life attempted to explain what he wanted in a memory aid. “Imagine a memory which is outside you and responsive to you but doesn’t control you.” The challenge therefore was to design an effective aid providing a natural extension to the memory, which people often do not realise just how much they depend upon.
Memory problems are often associated with the ageing process [19], and are one of the commonest effects of brain injury. Such problems can severely disrupt daily life and put huge strain on family members and carers [54]. Electronic memory aids have been used as a compensatory approach to provide reminders to individuals, and in particular a small pager device has been evaluated with great success. The ‘NeuroPage’ system was developed in the USA by Hersh and Treadgold [15]. The user carries a telephone pager that alerts them by sound or vibration when a scheduled message is displayed on the alphanumeric screen. The overall operation is performed via collaboration between a local memory clinic and a commercial paging service. In consultation with the user and carers, staff in the clinic decide what messages are appropriate and necessary together with the appropriate time and date for transmitting them, and this information is sent to the commercial service that enters the data into their central paging system. The aid has been evaluated [58] in a study involving 143 clients of ages ranging from 8 to 83 years. It has been found to be very successful, particularly with people exhibiting severe memory, attention and organisational problems.

Based on this success, the current study aims to develop an electronic memory aid that will maintain the basic functionality of the pager system, whilst enhancing the service in terms of interactivity and functionality. Enabling two-way communication between a memory aid ‘device’ and a base station can provide to relatives and carers the reassurance that is required to reduce their workload and worry, and can increase the independence of the user of the system.

In the following section we will first discuss different types of memory. Subsequently, we will discuss the antecedents of memory problems such as brain injury or disease and aging, the effects they have on a person’s faculties, and their impact on memory functions and the use of a memory aid.

Increasing the functionality of the memory aid presents challenges regarding the usability of the system. These are addressed in the work reported in this paper through the adoption of a user-centred design approach. This approach to the development also enables investigation of the best way to involve older people in the prototype development. Initial qualitative findings of this process are also detailed.

2 Background

2.1 Types of memory

Many different types of memory have been discussed in literature. They vary according to the criteria applied for classification such as time dependency, type of information remembered, and degree of consciousness of the remembered material. Traditionally, a distinction is made between short-term and long-term memory [4], although researchers note that there is considerable controversy with this dichotomy in the scientific literature [7]. However, for purposes of categorization, we will focus on these two constructs. Short-term or working memory, as proposed by Baddeley and Hitch [1, 2] is thought to be used to store information for a period of seconds, such as when rehearsing a telephone number one has looked up in the phonebook and is about to dial. Baddeley and Hitch's working memory model includes a central executive, which is a memory store that controls two working memory systems, one specialising in non-verbal information (visuo-spatial sketchpad) and the other specialising in verbal information (phonological loop). If a task requires both holding something in memory and doing another task concurrently, the central executive coordinates both systems. Baddeley and Hitch's model also contains a long-term memory system that is considered to be a permanent store for knowledge and events that have accumulated or happened from a few minutes to decades ago. Within long-term memory, stores for different types of information have been distinguished, such as that for autobiographical events (episodic memory) and knowledge about the world and meaning of words (semantic memory) [47]. A further distinction is made between explicit and implicit memory [12, 43], which refers to the degree of consciousness of recollected material; explicit memory concerns the conscious recollection of material and the circumstances of learning it (also declarative memory), whereas some material is often used unconsciously for the execution of

a task (e.g., riding a bike), and it is not necessary to recall how and when or where the material was learned (implicit memory, also non-declarative memory).
The types of memory discussed so far all relate to memory for material that has been processed already and thus relate to retrospective memory. However, frequently we have to remember to do things in the future, such as feeding the cat at 8 PM tonight, for example. This refers to prospective memory, which - although not to be considered a separate memory system but rather a realisation of delayed intentions [8] as noted by Evans [9] - concerns remembering to perform an action in the future at a specific time. This requires planning skills as well as attention and memory.

2.2 Antecedents of memory impairments

The causes of memory loss can be manifold, such as traumatic brain injury, strokes, infections and degenerative diseases like Alzheimer's disease and Korsakoff's disease [24], but also age. In the following, we will briefly discuss brain injury and diseases, and their effects on patients' lives and memory. Subsequently, we will discuss the effects of ageing and how it affects memory. Both, brain-injured and elderly people with memory problems represent the target group for the development of the memory aid.

2.2.1 Brain injuries and diseases

The most common causes of traumatic brain injury are vehicle accidents (70%) [31, 46] with cycling accidents, falls, and sports injuries accounting for most of the others. Brain injuries can result in a plethora of motor, sensory, behavioural, emotional, social, and cognitive problems depending on the location and extent of the injury, and the age at which it occurred (for a review see [55]). Damage to the brain stem can lead to difficulties in executing fine movements. Frontal lobe damage may lead to impairments in the sequencing of movements and cerebellum damage my result in gross tremors and staggering gait. However, the causal relationship between head injuries and the resulting movement disorders is less than straightforward, which might be due to the delayed emergence of movement disorders [25]. Stroke patients with hemiplegia, i.e., paralysis on one side of the body, often lose sensation in the affected limbs and thus suffer from sensory impairments. Emotional and social problems often manifest themselves in depression and anxiety [28], and social isolation [53]. Behavioural problems such as physically violent and sexually offensive behaviours can occur as a result of severe brain injury, and personality changes in the brain-injured person often cause great distress to relatives [30]. Cognitive problems such as learning and memory difficulties, impairments of information processing, planning and organization, and slow intellectual activity may occur after traumatic brain injury [32]. Stroke patients often suffer from permanent motor impairments and speech production and comprehension problems, i.e., aphasias, as well as apraxias, that is the inability to execute an action with no evidence of physical paralysis.

These findings highlight that effects of brain injury or disease can be manifold, with memory problems often being only an additional dimension to the overall picture. However, memory problems are one of the most often encountered effects of brain injury or disease [9]. Isolated severe impairments of short-term or working memory occur rarely [26], though it is not uncommon for people with head injury to have some deficit in this area of functioning, in conjunction with a wide range of other difficulties. Similarly, severe selective impairments in semantic memory are not common, though some loss of old knowledge frequently occurs in the context of brain injury or dementia [17, 42].

Following a brain injury, people typically have a gap in their memory for events before the injury occurred. This retrograde amnesia varies from seconds to decades and may reduce with time (for a review see [21]). Many people who have sustained a brain injury have a period of anterograde amnesia, which refers to memory difficulties dating from the time of the injury. This period of post traumatic amnesia has been described to be of variable length and patients lack the ability to store and retrieve new information [38]. A comparison of individuals with post traumatic amnesia and individuals with chronic memory impairment and amnesic syndrome [56] revealed that individuals with post traumatic amnesia show a wider range of deficits in that they exhibit not only memory disorders but also slowing of cognitive functioning and motor speed, poor retrieval from semantic memory (i.e., factual knowledge about the world) and a higher frequency of errors on semantic processing tasks. Brain-injured users characteristically have difficulty remembering most kinds of new information, including future events, although have normal to near/normal immediate memory [54]. One way to gauge the extent to which these problems can affect the every day life of these people is to look at the messages which users programmed into the NeuroPage memory aid system. Wilson et al. [60] report that the most common messages used on this system were "good morning, it is 'day and date'," "take your medication now," "fill in your diary," and "make your packed lunch." These messages reveal an underlying deficiency in basic memory functioning, which has serious implications for day-to-day living. It is at this stage that memory aids can be most effective.

2.2.2 Ageing

In the next 25 years changes are predicted in the overall age structure of the world population with an increase in the proportion of older people; it is predicted that from 1998 to 2025 the population of adults greater than 65 years of age will more than double [48, p. 2]. In Britain, roughly 11 million people were aged over 65 in 1998. By the year 2030, this figure is expected to rise to 14 million people [16]. With increasing age, several physiological but also cognitive changes may occur in an adult's life. Age-related changes are manifold and may affect faculties such as hearing, vision, psychomotor control and cognition (for reviews see [6, 14]). For example, about a third of people over the age of 65 years may experience diseases that affect vision [33]. Elderly people may suffer from long-sightedness, reduced contrast sensitivity and sensitivity to glare, and visual processing appears to be slower [29, 51]. Hearing also declines gradually with age and severe hearing difficulties have been estimated for 32% of individuals between 70 to 80 years of age [44]. In addition, older people show longer response times on complex motor tasks [41] and problems with fine motor control [50].

Besides sensory and motor control changes, there is also evidence for cognitive changes with age. Reduced intellectual ability with age has been reported [40], however, this decline may only be apparent in complex situations, and also be counteracted by high levels of education, in which case the decline proceeds slower [39]. With respect to memory, age-related changes have also been found (for a review see [45]). Older adults may experience a decline in short-term memory, especially with more demanding tasks [5] or when it is severely taxed [18]. There is also evidence for long-term memory problems: episodic memory impairments are common whereas semantic memory problems only occur in extreme old age [18]. Implicit memory appears to be relatively unaffected by age

[10]. Prospective memory is known to deteriorate in relation to age [27], and this was also confirmed in a recent study by Huppert et al. [19]. In a population-based study of almost 12,000 older participants (65 years+), Huppert et al. found that only 54% of the subjects successfully completed an event-based prospective memory task. Participants were recruited from five centres across the country through their local GPs, with care being taken that the 'very old' (75 years+) were equally represented in the sample. The memory task involved participants being given an envelope and being told that later on they would be asked to write a name and address on the envelope, at which time they should also remember to seal it and write their initials on the back. Ten minutes elapsed between these instructions being given and the task enactment being carried out. Success in this task was strongly and linearly related to age, which is illustrated by highlighting the results in the youngest age group (65-69 years), where 68% succeeded, against the oldest age group (90 years+) where only 19% performed the task successfully. The underlying significance of this research is that just under half the population of adults over the age of 65 in the UK suffer from some form of prospective memory impairment, and that as a consequence the safety and well-being of many older people may be at risk. A device to aid memory therefore has huge potential. In view of the reluctance to new-technology uptake by many older people, it is suggested that a memory aid device may prove even more effective if taken up by the 'young-old' to aid them in later life.

2.3 Current electronic memory aids and usability

Despite the prevalence of prospective memory problems amongst older people, the vast majority of research in this area has focussed on the rehabilitation of individuals from brain injury. A number of ways of improving lost memory functions have been investigated and applied [13]. These include strategies such as artificial mnemonics and repetitive practice (a restorative approach to improving memory) and the use of external aids such as calendars and diaries (a compensatory approach). Whilst some restorative methods have been successful [35], it is the compensatory approach that shows greater potential and should be the "treatment of choice" [36, p. 7], with prospective memory deficits being replaced by prompting the user to carry out tasks and appointments with an external aid.

It is in this area that technology has been used as an aid to memory. Current personal digital assistants (PDAs) and palmtop computers provide time management software which has the potential to be used as a diary / alarm system for people with memory impairment. Kim et al. [22] introduced a Psion Series 3a palmtop computer to a 22-year-old man whose memory skills were poor and who was undergoing rehabilitation for a closed head injury due to a vehicle accident. Closed head injury results from a blow to the head that may or may not result in skull fracture subjecting the brain to mechanical forces [e.g., 24, 55]. At the site of the blow, the bone can mold inward and the caused pressure may force the brain to the opposite site of the skull, resulting in additional bruises, swelling, and twisting or sharing of nerve fibres. The bruises in turn can produce bleeding, which may increase the pressure in the skull; the latter may also be caused by a collection of fluids in the damaged tissue produced by the blow. The patient in Kim's study suffered from diffuse axonal injury with shear petechial haemorrhage and left ventricular haemorrhage with minimal swelling. To compensate for prospective memory problems, staff at the rehabilitation centre programmed alarms to remind him to attend therapy sessions and ask for medication, and the patient was able to carry out all tasks without further cues. In an additional study [23], 12 brain-injured patients used a Psion Series 3a computer to assist with memory dependent activities in their daily lives. In a follow-up interview, 9 of the 12 participants judged the device to be useful to them on a daily basis, whilst all patients recommended that the palmtop should continue to be used in outpatient therapy for brain-injured patients.

Further studies by van den Broek [49] and Willkomm et al. [52] have evaluated the use of a Voice Organiser device as a memory aid. The Voice Organiser is a handheld dictaphone that can be programmed to replay messages at time periods specified orally by the user. The user is alerted to a message by an alarm, and on pressing a button the message is replayed. Van den Broek asked five subjects with significant acquired prospective memory impairment to perform prospective memory tasks, both with and without the Voice Organiser, over a period of three weeks, respectively. All subjects improved their performance with the introduction of the Voice Organiser, with three subjects establishing a routine that persisted to a certain extent following the removal of the device. Similar results have been obtained by Wilson et al. [57], who report that a severely memory-impaired user of NeuroPage improved on the majority of selected target behaviours, such as preparing a meal. For example, beginning to prepare a meal in the evening increased from a 50% success rate before the use of the pager to a 100% success rate during pager use. For some tasks, the higher success rate was maintained once the pager had been removed, due to the establishment of a routine. Other key points emerging from this study were that the subjects remained in control by choosing the wording of their own messages, and that the pager was seen as prestigious rather than as embarrassing.

A common thread within the evidence available is a consideration of who might benefit from such technology. Wilson and Moffat [61] found that learning to use electronic organisers produced great problems for memory-impaired people. In addition, the brain-injured patients in the study by Kim et al. [23] discussed earlier received supervised training with the palmtop twice a week during regular therapeutic sessions, which suggests that the level of training required does not diminish with advanced use of the device. When this is considered in conjunction with recent research which shows that memory-impaired people benefit from errorless learning techniques [3, 59], it is clear that the training required to learn how to use electronic memory aids should be minimal and produce as few errors as possible. In contrast, current time-management software running on PDAs requires at least some training for an average user. Although the ease of use of such software applications varies across the range of devices available and the platform on which they run (PalmOS/PocketPC/EPOC), they are not designed for memory-impaired people. Wright et al. [62] conducted a study in which an interface specifically designed for brain-injured users was employed on two styles of PDAs. It was found that users who had suffered traumatic brain injury could use the PDAs successfully as memory aids, pointing to the need for a custom designed interface for such users. Usability is therefore a key factor in determining whether an electronic organiser can be successfully employed as a day-to-day memory aid.

A parallel report on WAP usability (the technology used to access the Internet from mobile phones) [34] provides detailed evidence of the problems that arise in creating usable systems for small screen space, such as mobile phones and PDAs, for average users. Although users were generally able to use the devices to access the Internet, user acceptance suffered considerably when faced with long website connection times and the need to scroll through numerous pages to access information or links. This contributes to a difficult usability problem that can only hamper the use of small devices as external memory aids for the non-average computer user, e.g. the elderly or memory-impaired. One of the critical points for usable interface design in this perspective is the decline in the ability to process items in working memory [37] that occurs with age. Zajicek and Morrissey [63] highlight this point by suggesting that memory impairment reduces the ability of users to build conceptual models of the working interface. From these findings, it is evident that specific web pages for small display screens have to be designed for entering and accessing data on these devices. This demand is clearly indicated by a user group that would require a minimal load on working memory, and therefore complete visibility of the page structure is desirable.

Further factors influencing the use of small, electronic memory aids by older people are changes in vision, including declining visual acuity, contrast sensitivity and reduced sensitivity to colour, particularly blue-green tones [14], all of which make a small PDA interface difficult or impossible to see. When combined with difficulties in control of fine movement [50], and the impact this would have on the ability to manage a small touch screen device, older people present a user group with very specific needs in this design area.

Together these factors point towards an interface with reduced and clearly displayed functionality, which minimises the load on working memory. This implies intuitive usability that requires minimal training and visibly maintains the structure of the system at all times.

2.5 Insight and the use of a memory aid

The previous discussion focused exclusively on features of the memory aid that make it usable. However, features of the clients who use the device are at least equally relevant as they refer to motivational or acceptance issues. For example, Wright et al. [62] suggested that the patient's insight into the need to use a memory aid is related to its usage. This point was also discussed by Giles and Shore [11] who suggested a number of criteria to determine the usefulness of an electronic memory aid for a client, such as near-average intelligence, mildly impaired reasoning skills, insight into deficits and "functional disorder resulting from significant memory impairment (p. 411)." More specific suggestions were made by Kapur [20], who distinguished between general factors and specific factors to be considered in the use of the memory aid. General factors (i.e., factors that are generally relevant for neuropsychological intervention and memory rehabilitation) are age, premorbid knowledge and skills of the client, physical disabilities, family / carer influence on a therapeutic programme, the client's daily routine and behavioural problems. In this respect, the severity of memory problems and insight and concern about memory difficulties are of great importance. Specific factors (i.e., factors that relate to the particular use of a memory aid to overcome memory problems) include type of memory aid, how often it has been used in the past, if the user is given a choice of preferred memory aids, involvement of spouse/carer to encourage use of the memory aid, and appropriate training of the client, for example, to recognize when it is appropriate to use the memory aid. Thus, the development of a memory aid is not an isolated process, focussing only on the identification of suitable interface features for a particular user group, but should also consider characteristics of the users and their surroundings. Factors relating to user insight, preferences to use a device and a surrounding support system may be decisive for the successful use of a memory aid.

3 Approach to developing a new memory aid

The approach taken in the current research was to pinpoint the deficiencies highlighted in the currently available electronic memory aids and use this as a basis to investigate and formulate the requirements for a new external memory aid. The areas where improvements could be made are perceived to be:

(i) The lack of two-way communication between user and carer through the aid; the potential is given to overcome problems memory-impaired users have when learning how to use the device by allowing both users and carers to access the device remotely. Commercially available devices allow either the user or a third party to enter data. A device that allows the memory-impaired user to do some simple functions such as acknowledging prompts, while a carer can execute other functions such as data entry, may be more efficient for a memory-impaired user. Once the user has learned how to acknowledge prompts, s/he could then learn in stages and gradually how to perform other functions, such as data entry.

Task sharing of user and carer is possible through the use of mobile devices with access to the Internet, and is in line with the suggestion of Kapur [20] to involve spouse/carer to encourage the use of the memory aid.

(ii) Commercially available software applications being unsuitable/difficult for memory-impaired users to learn and interact with; customisation of memory aids for users results in the device being successfully used [62]. This issue would definitely have to be considered in the design of a memory aid.

(iii) Devices with small screens displaying small text and making interaction difficult for older users due to poor vision, dexterity or impaired mental models. As small screen spaces can be cumbersome for average users due to scrolling and hard to find links [34], they are likely to be even more unsuitable for individuals with motor problems and impaired sensory functions such as vision. If web pages are used, page structure and links should be visible at all times to reduce the load on working memory.

With these factors in mind, research was undertaken into suitable technologies that are currently available. PDAs with mobile technology were identified as suitable devices, as they allow two-way communication and can be programmed to allow customisation for a particular user. Concurrently, discussions involving both older and brain-injured people were conducted to gather information on the use of memory aids from a user perspective, which is discussed next.

3.1 User-centred design process

3.1.1 Methodology: interviews and focus groups

At the beginning of this project we needed to get an overview of what people required in a memory aid, and to generally understand what their problems were. We decided to conduct interviews and focus groups catering for both elderly and memory-impaired individuals who were referred to us based on reported memory problems. The plan was to use these data for developing a first prototype, which would then be evaluated in a more formal trial with memory-impaired participants in the next stage.

In order to begin designing the prototype, 10 older (4 males and 6 females) and 7 memory-impaired (3 males and 4 females) people were interviewed about their current strategies for remembering in their day-to-day lives. The age of the elderly participants ranged between 54 and 86 years (average age = 72.9). The age of the memory-impaired individuals ranged between 22 and 54 years (average age = 38.4). Participants were recruited from sheltered housing and a disability rehabilitation clinic in the local area. Interested volunteers were suggested to the researchers by management or carers, and the interviews were conducted within the homes of the participants or within a day centre, which the individuals attended.

Following a structured interview procedure, participants were asked about the memory aids that they currently use, such as a calendar or notebook, together with any other strategies used to help them remember things. They were also asked about their experience in using technologies such as mobile phones and personal computers, what they considered to be an acceptable size and weight of a memory aid, and what they would ideally like a memory aid to do for them.

In addition to interviewing, 4 focus groups were conducted with older residents of sheltered housing schemes. These proved to be very valuable. The discussion focused on the problems people had with their memory, together with opinions on the PDAs, which were passed round to the participants. Interesting findings from these meetings were the responsiveness the participants showed to the technology, despite many of them never having seen devices of this nature before. Interaction with the touch screens, which are the main input mechanism for the majority of PDAs, proved to be an intuitive concept to which this particular group of older people quickly adapted.

It was also interesting to note that a group of more than 3 individuals within a focus group became hard to manage, as difficulties with hearing, attention and the ability to follow the thread of a conversation proved to hamper many participants contribution. Future methodology for user-centred design may need to consider this when involving older people in design and prototype development.

3.1.2 Qualitative findings

The findings from these sessions produced several points. Perhaps unsurprisingly, the most commonly used aid amongst interviewed people was a calendar or notebook. Examples of these were to plan the week ahead, take medicines, and remind the user of social events and appointments. The diverse and specific responses to questions regarding the ideal functions of a memory aid made the results hard to categorise. For example, one user wanted the memory aid to “tell you where you have put something down,” whereas another wanted the memory aid to make a call for the user. A clear theme, however, was that participants wanted to be reminded not only of what they had to do, but *why* they had to do it. A further concern voiced by the users was the usability of the system. The need for big buttons, clear prompts, a “nice and friendly” system and user control were all statements that revealed the users’ awareness of their need for a usable as well as a useful aid. In addition, many of the younger, memory-impaired users were aware of the hardware requirements of a memory aid and asked for a flashing light, an alarm, voice recognition and portability. This technical awareness was not evident in the older group of subjects, as one might expect from a generation of people less exposed to developments in technology.

This information produced the general hardware requirements for the prototype memory aid, which provided guidance for investigating the potential technologies that are currently available to be utilised in the aid. Mobile phone technology is currently being integrated into PDA devices, and new technologies and devices are frequently appearing in the market in this rapidly expanding area. The potential for the use of this technology as a memory aid is enormous, as it allows for a truly interactive system that can keep the memory-impaired user in contact with a remote, possibly unmanned base, potentially avoiding the necessity of a call centre for a functional system. Remote access to the device could be provided through a base station, which could also be accessed remotely from any PC connected to the Internet. This would allow reminder messages to be entered into the system from a large number of suitable locations at any time of day, and thus be completely independent of a third-party call centre.

3.1.3 Development phase: initial and future prototypes

Following the evaluation of these findings, the first prototype was developed as a web-based system running independently on a PDA. This provided a measure of what the interface of the memory aid could look like, and a basic functionality that allowed users to explore interaction with the system. The prototype’s aim was to reduce the load on working memory by ensuring that the most important elements of the system are visible at all times. This is in itself a challenge, and exaggerates the usability problems presented by the small screen size of the PDA. The prototype interface was implemented on a PDA running the Windows CE 3.0 Pocket PC operating system. The PDA was equipped with a touch screen. The size of the display (a non-reflective TFT LCD with 65,536 colours) is 240 x 320 pixels (approx. 78 x 60 mm). The PDA dimensions are 124 x 87 x 26 mm and its weight is about 300 g. Figure 1 depicts some of the interfaces implemented on the PDA. Figure 1a shows an example of an action prompt the user could receive. At a set time an alarm sounds and the prompt is displayed. The user can then switch off the alarm by selecting one of two options (remind again or don't remind again) by tapping on the respective virtual button on the touch screen. Figure 1b shows the default display that allows users to access information for particular days. The display can be changed using the touch screen. The user can go forwards and backwards by one day using the "+Day" and "–Day" buttons, and can also access the calendar by tapping the "View Month" button. Other information such as addresses and birthdays can be accessed using the "Diary Info" button. Reminders can be entered after tapping the "Modify Diary" button. Once reminders are entered, they are synchronised with a remote database via mobile telephony.

Figure 1

The continuation of the development phase will be informed by a series of pilot evaluations with users of this initial prototype. This will involve tracking the users' movements through the system in order to identify potential usability problems or functionality which is redundant or missing, together with videoed observation for interpreting the user feedback. Such interactive evaluation and gathering of feedback will enable design iteration, ensuring that the ideas developed are sound before further prototypes are developed.

The second stage prototype will be implemented for use within an extended informal trial period carried out by the Oliver Zangwill Centre in Ely, who form part of the multi-disciplinary team involved in the current study. Results from this study will be fed back to the design team for a major system revision. The final prototype will be formally reviewed with memory-impaired and older users.

4 Conclusions

Memory has been shown to decline with age and may be affected by brain injury. Although technology has been used and proved to have a positive effect on helping with memory problems such as prospective memory impairments, usability and technological difficulties have limited the potential in terms of the number of users who can benefit from these aids. These difficulties have also reduced the extent to which the aids can contribute to longer lasting independence and safety of users. The current study is work in progress to develop an interactive memory aid using a user-centred design methodology. Challenges raised include the difficulties in combining usability and functionality on a small device to be used by older people with very specific needs in both of these areas. In addition, insight into the need to use a memory aid has been identified as a relevant factor for its use. Focus groups and interviews provided data to inform the initial design of the memory aid which is going to be tested in further evaluations. The current study aims to meet challenges identified in this user-centred process, and to develop a new aid that can be used easily and practicably in everyday situations.

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