

The Design of a Prospective Memory Aid for Older Adults – Multiminder

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ABSTRACT

Prospective memory (PM) refers to an individual's ability to remember to carry out tasks of delayed intention, such as remembering to attend a doctor's appointment. It was believed that the implementation of qualitative methods to examine older adults' lifestyle, needs and preferences would contribute to the design of a PM aid that older users would find both useful and user-friendly. This paper discusses the development of Multiminder, a PM aid with multiple reminder strategies; a calendar, memo pad, phonebook and timer. The research investigation consisted of a review of literature and current PM aids, a qualitative study using interview, observation and focus group methods, the conceptual and physical prototype design of Multiminder and prototype testing with older users. The results from the prototype testing suggest that the cognitive, physical and psychosocial needs and preferences of older adult users were supported by the PM aid and highlight the potential for the full development of Multiminder.

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RESEARCH OVERVIEW

Prospective memory (PM) involves remembering to do something in the future. Technology mediated PM aids are ubiquitous in today's society, supporting people's PM through devices such as mobile phone organiser applications, oven timers and alarms, digital calendars on computers and digital phones in the home. Although these devices are useful to younger or working populations, the design of these systems are not always suitable for older users (see Needs Analysis, Chapter 3). Older adults exhibit an age-related decline in PM ability (Kidder, Park, Hertzog, & Morrell, 1997; Maylor, 1993b; McDaniel, Einstein, Stout, & Morgan, 2003); however it seems that designers have overlooked older adults as potential users of PM aid devices. An older adult, in the context of this research, is defined as a person aged 60 years and over (WHO, 2007).

The purpose of the current research was to design a prototype for a PM aid for older adults that would support their cognitive, physical and social lifestyle. The aim of the research was to modify features of the environment to suit the capabilities of the older adult, rather than modifying the older adult to suit the technology. The importance of using a user-centred approach to development has been stressed since 1985 when Gould and Lewis laid down what they believed to be key principles to computer design. These principles will be outlined in Chapter 3. A user-centred approach was therefore employed, focusing the design around the user. It was believed that if the needs and preferences of older adults were investigated through qualitative data-gathering and analysis methods, then a prototype of a PM aid could be designed in such a way specific to these findings, that older adults, even those without technology experience, would find it a useful and easy to use the memory aid device. Qualitative methods including interviews, observations and focus groups were implemented to investigate the lifestyle of older adults, how they would benefit from a new technology and how a new technology would fit in with their lifestyle.

The information obtained from the needs analysis was used to formulate conceptual and physical prototype designs. The design strategies that were used in the design process were within the field of Human Computer Interaction (HCI). HCI is the study of the relationships between people and computers, how they use them and how the design can be

improved (Faulkner, 1998). These design strategies included a task analysis, storyboarding, creating user profiles and scenarios, and finally prototyping and prototype testing.

Chapter 1 of this thesis discusses past research concerning ageing and PM. Following this, Chapter 2 critically reviews the literature relating to current memory devices. A qualitative study, using interviews, observations and focus groups, was then discussed in Chapter 3. The information gathered from this study was then implemented into the conceptual and physical prototype design of a PM aid, as outlined in Chapters 4 and 5. Chapter 6 presents the prototype testing of the design with older adults as test users. These methods and techniques were finally discussed in Chapter 7, reflecting on the design of Multiminder and how it compares to other devices, whether the research methods used complemented the study and the directions that future research might take. The development of Multiminder can be seen through the progression of these chapters.

The proposed prototype design differed from previously designed PM aids in that it was designed specifically for older adults, providing multiple reminder strategies that are easy to use and learn, touch screen interaction and also features such as a large display screen and adjustable text and volume controls. It is hoped that this research will lead to further research and development into the design or redesign of technology for older adults.

CHAPTER 1: BACKGROUND & LITERATURE REVIEW

1.1. An Ageing Population

The interest in designing technology for older adults is increasing. This is in part due to the increasing life expectancy of people and the rapid ageing of society that is predicted in the 21st century. Demographic studies have estimated that the percentage of older adults in Ireland will have doubled from the year 2000 to the year 2050. The fastest growing subgroup represents those over 80 years of age, increasing by 5.2% in 50 years. According to population projections this ageing trend will be seen across Europe, with older adults almost 35% of the population by 2050 (US Census Bureau, 2005). See Figure 1 for population pyramids predicting this trend.

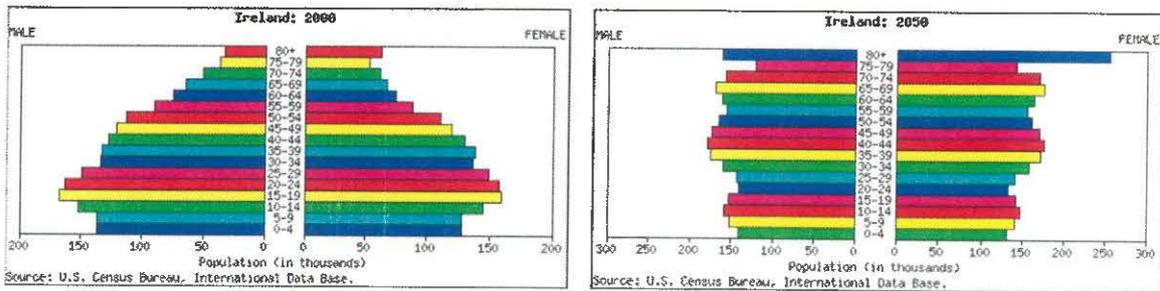


Figure 1: Population Pyramids Projecting Age Change between the Years 2000 and 2050

There are a number of factors responsible for this 'ageing population' including the high number of births during the baby boom period (between the years 1946 and 1964), lower birth rate and the increase in life expectancy (Foos & Clark, 2003). The life expectancy for both men and woman in Ireland has increased consistently in recent decades and now exceeds the European Union average (Department of Health and Children [DOHC], 2007). This means that symptoms experienced with ageing will be more prevalent in future years, for example, difficulties seeing, hearing, communicating, walking or using stairs (Craig & Mindell, 2007). A survey conducted in Ireland by the Central Statistics Office (CSO) in 2006 found that 30% of persons aged 65 and over had a self-reported disability compared to 9% of all persons. The proportion of persons with a disability increased with age, rising rapidly from 19% for the 65 to 69 age group to 59% for the 85

and over age group (CSO, 2007). Similar findings were revealed in a national health survey carried out on the older English population (Craig & Mindell, 2007).

These statistics emphasise how important it is for technology developers to focus their attention on the older user. Designing for older adults requires developers to take into consideration their capabilities and limitations including psychosocial needs and their acceptance of technological supports.

1.2. Age-Related Changes

1.2.1. The Ageing Process

“Ageing refers to an individual passing through time and all that occurs during that passing of time” (Foos & Clark, 2003, p. 28)

Although elderly people today are fitter and healthier than elderly people in the past, the physical characteristics of ageing have not changed, however much they are delayed. Physical changes that occur in the body with increasing age include the gradual depletion of functional abilities due to the decline of muscle strength, muscle power, flexibility, balance and cardio-respiratory endurance (e.g., hand grip and ability to balance, Craig & Mindell, 2007; Laux, 1995). Sensory capabilities are also affected with ageing; the most common being vision and hearing problems although taste, smell and touch sensations are also dulled with age (Huppert, 2003). Typically, older adults experience most hearing deficits for high pitched sounds (e.g., may not hear an oven timer beeping) and by the age of 40 years, visual functioning begins to change significantly enough to affect performance in everyday tasks (Foos & Clark, 2003; Laux, 1995; Wingfield, 2000).

Some capabilities continue to develop throughout our lifetime, such as semantic memory or memory for factual knowledge (Craik, 2000), focused attention (Rogers, 2000), and linguistic knowledge (Wingfield, 2000). Others however decline with increasing age, such as episodic memory (Craik, 2000), divided attention for complex tasks (Rogers, 2000), and touch sensation (Foos & Clark, 2003). Cognitive capabilities refer generally to our mental abilities by which we pay attention to the world, interpret the information around us, learn and remember, solve problems and make decisions (Huppert, 2003). Mayhorn, Rogers, and Fisk (2004) stated that an understanding of age-related changes in cognition is essential in establishing design principles for the application of new technology. Age-related differences in cognitive functioning can be seen to stem from the

reduction of cognitive resources available, impairing older adults' ability to carry out cognitively demanding processes (Kester, Benjamin, Castel, & Craik, 2002). Age-related changes in mechanisms of cognitive ageing (i.e. speed of information processing, working memory function, inhibitory function and sensory function) are also believed to mediate the age-related decline observed in a wide range of cognitive tasks that measure cognitive behaviours such as attention, memory, reasoning and problem solving (Craik, 2000). These mechanisms are responsible for the age-related speed decline of performance for mental processes (speed of information processing), the reduction of on-line cognitive resources available at any given time to process, store, retrieve and transform information (working memory), difficulties focusing on target information and inhibiting attention to irrelevant information (inhibitory function) and problems processing information from the senses (sensory function; Craik, 2000).

1.2.2. Memory Ageing

It is generally accepted that memory abilities decline with age (Charness, 2000; Craik, 2000; Kester et al., 2002; Park, 2000). In simple terms, memory can be broken down into three components; sensory memory (ability to retain sensory information), working memory (responsible for processing, abstracting, encoding and retrieving information) and long-term memory (Foos & Clark, 2003). Long-term memory can be further reduced to procedural (memory of how to do something), episodic (memory for life events) and semantic memory (memory for knowledge and meaning) (Hedden, Lautenschlager, & Park, 2005; Kester et al., 2002). A review of ageing and cognitive neuroscience showed that both cross-sectional and longitudinal studies on memory and ageing revealed significant age-related declines in working memory, episodic memory and processing speed (Hedden & Gabrieli, 2003). In contrast semantic memory and procedural memory abilities remain relatively stable throughout a person's lifetime (Hedden & Gabrieli, 2003; Hedden et al., 2005). Park and Hall Gutchess (2000) suggested that older adults are not significantly affected by the decline in memory abilities because many tasks that they carry out, which may have initially been attention-demanding in the past have become automatic and are performed with no conscious awareness (e.g., the task of driving).

1.3. Memory by Temporal Direction

Memory functions can be divided into two categories by temporal direction: retrospective memory (RM) and prospective memory (PM). RM involves remembering learned information from the past (Guynn, McDaniel, & Einstein, 1998) and has been intensely studied for more than one hundred years starting with researchers such as William James and Hermann Ebbinghaus. Examples of everyday retrospective memory tasks include retrieving a phone number from memory, recognising a familiar place or recalling details of a dinner party. The majority of the literature published on age-related changes in memory is mainly concerned with retrospective abilities of older people. The past few decades have shown a gradual upsurge of interest into people's memory for future intentions, known as prospective memory. There are various definitions of PM. Guynn et al. describe PM as remembering to do an activity in the future whereas, Cohen and O'Reilly (1996) describe it as the activation of representations of a planned action at a planned time, as well as the context of where this action is to take place. Finally, Maylor (1998) describes PM as remembering at some point in the future that something has to be done, without any prompting in the form of explicit instructions to recall. The latter explanation by Maylor will contribute to the understanding of PM that was accepted as part of the current study.

The main focus of this chapter will be on PM as the interest in PM research is gradually growing, specifically in the area of older adults (Einstein & McDaniel, 1990; Einstein, McDaniel, Manzi, Cochran, & Baker, 2000; Huppert & Beardsall, 1993; Huppert, Johnson, & Nickson, 2000; Maylor, 1993a, 1996a, 1998). This does not mean that RM will not be discussed however as RM plays a significant role in PM processes (McDaniel & Einstein, 1992).

1.3.1. Prospective Memory

PM involves remembering to do things at the right time and PM tasks are pervasive to daily living (Driscoll, McDaniel, & Guynn, 2005). PM tasks could be essential actions such as taking medication, to everyday tasks such as remembering to buy milk. Several frameworks have been developed to try to explain what processes are involved in PM. Dobbs and Reeves (1996) claimed that there are six components of PM. These are: (1)

meta-knowledge (the general knowledge about tasks of remembering and the personal knowledge about one's abilities and behaviours), (2) planning (construction and implementation of a future plan), (3) monitoring (remembering at the appropriate time or event that a task is to be done), (4) content recall (remembering *what* is to be done), (5) compliance (one's willingness to execute the task), (6) output monitoring (remembering that the task has been executed). It is suggested that altering the nature of the PM task could consequently alter the components necessary to complete the task (e.g., setting an alarm would eliminate the necessity of the monitoring stage). Craik and Kerr (1996) agreed that these components are necessary for successful prospective remembering however they claim that the critical and defining components involved in the processes are the planning and monitoring stages. Ellis (1996) further suggested that prospective remembering consists of five general phases: (1) formation and encoding of intention and action, (2) retention interval, (3) performance interval, (4) initiation and execution of intended action and (5) evaluation of outcome. These frameworks emphasise the multi-dimensional nature of PM tasks. To support the development of a PM aid in the current research, Dobbs and Reeves' framework will be adopted.

PM is a complex memory function as it consists of the ability to remember to do future tasks at the right time and also the ability to remember what tasks need to be done and whether a task has previously been completed. McDaniel and Einstein (1992) proposed that PM consists of the interaction of two components, those being a prospective component and a retrospective component. The processes supporting the prospective component provide the ability for the individual to recognise a cue as a stimulus that requires further action, whereas the processes supporting the retrospective component allow the individual to retrieve information associated with the cue from memory, providing the relevant information to complete the task. Studies comparing prospective and retrospective components of PM for younger and older adults indicate a clear age-related decrease in task performance for the processes supporting the prospective component (West, Jakubeck, & Wymbs, 2002). West et al. (2002) compared results from PM studies and found that age-related differences were greater for the prospective component than the retrospective component regardless of the number of cues and intentions that were included in the task. It was suggested that these findings indicate that age-related decline in prospective memory

efficiency can result from failures to detect PM cues and also failures to retrieve the meaning associated with the cue from memory. Furthermore, Maylor, Smith, Della Sala and Logie (2002) demonstrated that not only did young participants outperform older participants in laboratory controlled PM tasks (i.e. responding to cues in a film), Alzheimer's disease patients showed significant deficits in the PM component of PM tasks in comparison to age-matched controls.

To further explain PM, a distinction has been made between event- and time-based PM (Einstein & McDaniel, 1990). Event-based PM involves remembering to perform a particular behaviour when prompted by an external cue, such as remembering to phone a friend when you see a picture of her. Time-based PM involves remembering to perform a particular behaviour at a specific time or after a certain amount of time has passed, for example meeting a friend at 2pm for lunch or taking medication ten minutes after eating. Time-based PM is believed to be more sensitive to age-related decline as compared to event-based PM (Einstein & McDaniel, 1990; Driscoll et al., 2005; Park, Hertzog, Kidder, Morrell, & Mayhorn, 1997). This is thought to be because time-based PM relies more on internal control mechanisms and self-initiated mental activities, such as time monitoring (Henry, McLeod, Phillips, & Crawford, 2004). Maylor et al. (2002) compared these components to the priming and free-recall components of RM, where event-based PM (like priming) uses a cued response and time-based PM performance (like free-recall) uses a self-initiated response.

1.3.2. Prospective Memory and Ageing

Prospective memory is vital for everyday living and failures in PM can result in a range of consequences, from missing appointments to forgetting to take medication (Groot, Wilson, Evans, & Watson, 2002). Initial studies examining age difference in PM found no significant age-related deficit (Einstein & McDaniel, 1990). Further naturalistic studies also found little age-related difference for PM tasks (see Maylor, 1993a for review of studies) however it was believed that this could be due to the use of external strategies rather than superior PM ability in older adults. More recent studies have produced the opposite outcomes with older adults displaying poorer performance compared to younger counterparts (Maylor, 1993b; Maylor et al., 2002; McDaniel et al., 2003; West & Bowry,

2005). Einstein, McDaniel and colleagues came up with some plausible explanations for the reason why older adults show an age-deficit on PM tasks (Einstein, Smith, McDaniel, & Shaw, 1997; McDaniel et al., 2003). One explanation refers again to older adults' limited resource capacity. Einstein et al. (1997) demonstrated in one of their studies that increasing the complexity of the background task while participants are carrying out a task of delayed intentions significantly affects older adult performance. Furthermore, when the background tasks demands were low, age differences were minimal. This finding coincides with Kidder et al.'s (1997) study that found significant age-deficits in PM functioning when participants were engaged in a high demand working memory task. In a more recent study Smith, Hunt, McVay and McConnell (2007) demonstrated that there is a cost to the performance of background activities when an event-based task is embedded in the background task, for example if you were reminded to call someone whilst measuring ingredients, there would be a cost to performance for the task of measuring ingredients.

The second explanation of PM ageing (McDaniel et al., 2003) demonstrated that older adults do not strategically rehearse the intention of the task over the delay interval, thus maintaining the intention in working memory, whereas younger adults do spontaneously rehearse this intention. They found that when specifically instructed to rehearse the intention over the delay period older adults are more likely to remember to carry out that intention compared to older adults who were not instructed to rehearse. Younger adults showed no performance difference when instructed to rehearse compared to those who were not, indicating that rehearsal was an unconscious automatic process for them. This finding was later contradicted in Kvavilashvili and Fisher's (2007) study which demonstrated that although successful performance on a naturalistic time-based task was related to the number of recorded rehearsals, no difference was found in performance, the rate of rehearsals or the type of rehearsals (internal or external cues) between young and old participants.

It is believed that difficulties in PM tasks could be an early indicator for the onset of Alzheimer's disease (Huppert & Beardsall, 1993; Huppert et al., 2000). Huppert and Beardsall proposed that in contrast to RM tasks where participants with mild Alzheimer's perform at a level between normal and more demented participants, individuals with mild Alzheimer's perform just as poorly as demented participants on PM tasks (such as

remembering to deliver a message). This finding suggests that remembering to execute intended actions may be particularly disrupted in the early stages of Alzheimer's disease, however the validity of the tasks are under question (Maylor, 1996a; Maylor et al., 2002).

Both prospective and retrospective abilities are required for successful functioning in everyday life (Maylor, 1996a). However, it has been suggested that PM failures have a greater impact on the lives of individuals suffering from Alzheimer's disease and their carers compared to RM failures and therefore are more likely to be reported as an early indicator of the disease (Smith, Della Sala, Logie, & Maylor, 2000). This report was part of a questionnaire study investigating the frequency of prospective and retrospective failures in a sample of participants divided into five groups – patients with Alzheimer's disease (rated by carers), carers of the patients, normal elderly and young participants and married couples. All groups rated PM failures as more frequent than RM failures. Furthermore, carers rated patients' PM failures as significantly more frustrating than retrospective failures. This data highlights the effect that these failures have on patients with Alzheimer's disease and their carers and underlines the potential advantage of a PM aid for elderly individuals with Alzheimer's disease. Furthermore, research has shown that spouses of Alzheimer's disease patients acting as primary caregivers are at an increased risk of chronic stress and consequently advanced cognitive decline compared to non-caregiver counterparts (Vitaliano, Echeverria, Yi, Phillips, Young, & Siegler, 2005). This finding again emphasises the need that Alzheimer's patients and their caregivers have for technical assistance in the home.

1.3.3. Prospective Memory and External Aids

Initial studies of PM concluded that older adults outperform younger adults in tasks of delayed intention, such as sending a postcard (e.g., Moscovitch, 1982, see Craik & Kerr, 1996). It was later believed that this superior performance might be due to the use of external strategies by the older participants (Maylor et al., 2002; McDaniel et al., 2003; West & Bowry, 2005). Einstein and McDaniel (1990) defined external strategies as some manipulation of the external environment. There are various forms of external aids available and these can be generally categorised as environmental and portable memory aids (Kapur, Glisky, & Wilson, 2002). Of the environmental aids surrounding us, some

examples include proximal environmental aids such as wall-charts, alarms and items in conspicuous places, and distal environmental aids such as road traffic signs, name badges and uniforms. Portable aids are aids that are clearly visible and easily accessible and include items such as post-it notes, diaries and electronic organisers. It has been hypothesised that older adults are more likely to use external aids to help them remember because they are more highly motivated and may be more aware of their memory impairments compared to younger adults (Harris, 1984). Many studies have found that younger as well as older adults benefit from the use of external aids, and also that individuals are more likely to use external rather than internal strategies to remember intentions (Einstein & McDaniel, 1990; Kapur et al., 2002).

1.4 Cognitive Frameworks in Human Computer Interaction

Human Computer Interaction (HCI) is a multidisciplinary science, lying between the social and behavioural sciences and the science of computer and informational technology. HCI seeks to understand how people make use of devices and systems, and how such systems can be made more useful and usable (Carroll, 2003).

There have been many theories developed to explain the cognitive relationship between a person and their environment within HCI. These theories claim that cognitive processes exist between a person and another person(s) in their environment, and also between a person and artefacts in their environment. Donald Norman termed these artefacts as 'cognitive artefacts' (1991). A cognitive artefact is a device designed to maintain, display, or operate upon information to serve a function (Norman, 1991). Norman believed that cognitive artefacts not only change the task for the user but also enhance the user's performance. For example, a paper list enhances the user's memory, but using the list transforms the task of remembering into a different one. Still using the example of a list as a cognitive artefact, Norman illustrates how the preparation of a list prior to its use allows the distribution of cognition to be dispersed across time and people. This closely relates to the theory of cognitive distribution developed by Edwin Hutchins (Hutchins, 1995).

The theory of cognitive distribution emphasises the social aspects of cognition between individuals and artefacts. It is concerned with representational states and the informational processes around the media carrying these representations

(Hutchins & Klausen, 2000; Perry, 2003). It involves describing a cognitive system which involves interrelationships between people, the artefacts they use, and the environment they are working in (Sharp, Rogers, & Preece, 2007).

Similarly the activity theory studies the interactions of individuals with people and artefacts in the context of everyday activities (Kaptelinin & Nardi, 2007). The activity theory was influenced by Lev Vygotsky as a psychological theory to understand the mental capacities of a human being (Bertelsen, & Bodker, 2003). It emphasises the importance of cultural and technical mediation of human activity. Both the activity theory and the distributed cognition theory suggest that cognition requires tools that enhance human performance.

These cognitive frameworks are very relevant to the current study in that they study the relationships between people and the artefacts in the environment. However, the theories do not particularly focus on artefacts to enhance PM, which is the focus of this study.

A framework is intended to offer advice to designers as to what to design or look for, and to help constrain and scope the user experience for which they are designing (Sharp et al., 2007). The framework that was chosen to aid the design of a technology mediated PM aid was an adaptation of Dobbs and Reeves (1996) theory of PM, as discussed in section 1.3.1. A diagram of the relationships between an older user and a system to aid PM and the processes involved is displayed in Figure 2 on the next page. It can be seen from this model that both the user and the system would be responsible for different and also overlapping stages of the PM process with information being transferred between them. This framework will guide the design process in the following chapters.

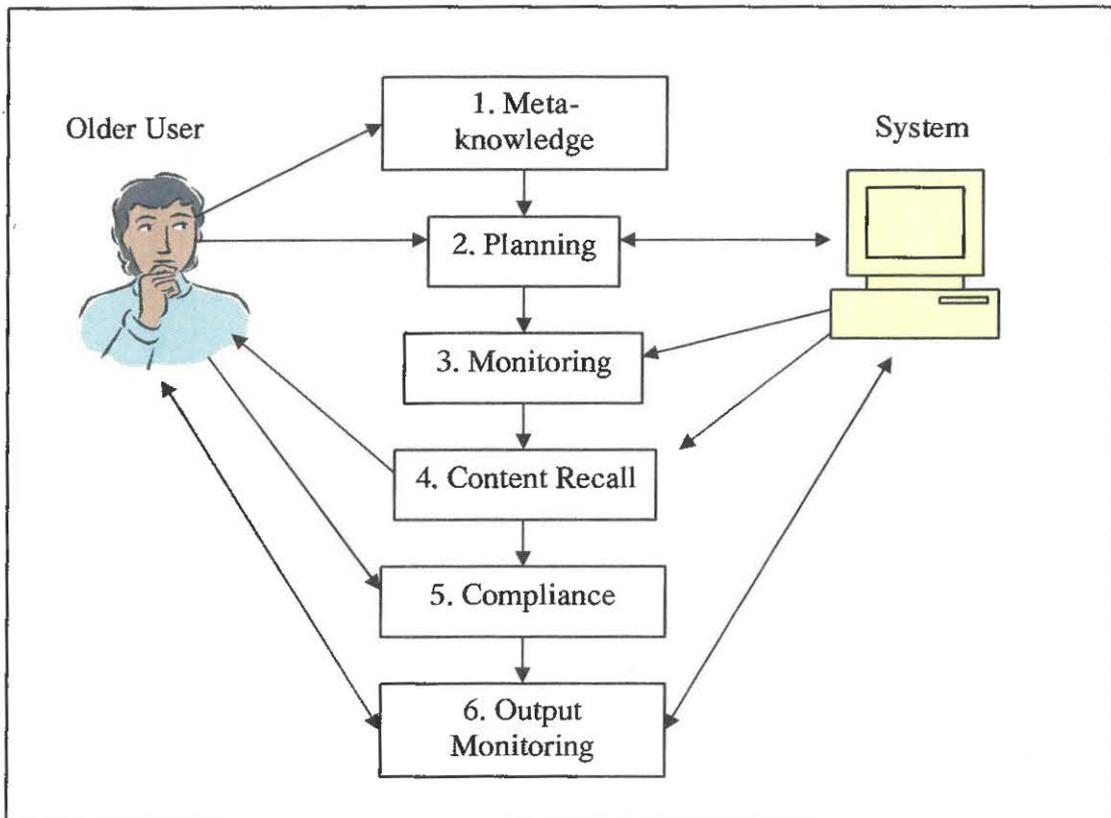


Figure 2: Model of Prospective Memory Process with System, Adapted from Dobbs and Reeves (1996)

1.5. Conclusion

This section outlines the research that has been conducted into cognitive ageing, in particular PM and age-related decline in PM and the external aids that are implemented to compensate this decline. The framework that will be used to guide the design of a new PM aid was also introduced.

Another method of intervention, which is the main focus of this study, is compensatory memory devices for older adults. These devices are used as external aids to support the individual's memory with technology that is designed to meet their specific needs. The next chapter describes some of these devices and evaluates whether they meet the needs of the older user.

CHAPTER 2: REVIEW OF CURRENT MEMORY AID DEVICES

2.1. Introduction

One area of recent interest is the design of PM aids for the older user. The purpose of this chapter is to describe current PM aids that have been developed to assist people in their daily lives and evaluate the advantages and disadvantages of each device. Based on these findings and supported by previous research in the area, recommendations were made towards the design of a new PM aid for older adults.

PM problems are common with ageing (Maylor, 1996b) and elderly individuals have to develop strategies to cope with this impairment, usually in the form of external aids (Maylor, 1993a). This impairment is emphasised in individuals suffering from dementia (Papagno, Allegra, & Cardaci, 2004) and as ageing is the highest risk factor for developing dementias (Keller, 2006), developers are aware that technological supports will be needed to provide relief for carers. PM aids which have been commercially released include Cellminder, ISAAC, and NeverMiss DigiPad (for review see Horgas & Abowd, 2004; LoPresti, Mihailidis, & Kirsch, 2004) and new devices are continually being developed (COGKNOW, Mulvenna et al., 2007).

Although PM aids have been a major focus for designers in recent years retrospective memory (RM) aids, supporting the acquisition of past information, have not been neglected. New developments in this area include conversational tools for individuals with dementia in the form of a touch screen reminiscence device (Alm, Ellis, Astell, Dye, Gowans, & Campbell, 2003) and a retrospective cooking display for absent-minded individuals (Pollack et al., 2003). Pollack (2005) divided cognitive support systems into three categories: assurance systems, compensation systems and assessment systems. According to Pollack an assurance system is technology that monitors the individual in an environment such as their home, detecting changes in activity and health for example, and reporting information to family and carers (e.g., the Digital Family Portrait, Mynatt & Rogers, 2002); a compensation system is one that uses strategies to accommodate the user's cognitive impairments (e.g., Autominder, Pollack et al., 2003); and an assessment system is technology which continually assesses the user's cognitive status in a non-clinical setting (e.g., Wired Independence Square, Carter & Rosen, 1999). This review will specifically

address compensation systems. These systems will include electronic memory aids for individuals with memory problems due to brain injury in rehabilitative care and memory support systems for older individuals with declining memory abilities.

2.1.1. Elderly Attitudes towards Technology

When considering the design of technology for a target population it is important to initially consider how easily the device will be accepted and adapted into the individual's lifestyle. This is especially important when designing for the elderly user as physical, cognitive and psychosocial factors influencing user attitudes need to be considered. Although it has been established in past studies that elderly people have memory problems when compared to their younger counterparts and benefit from external aids (Maylor, 1993a), the attitude of the individual towards memory aids may influence their usage and ultimately the benefit of the aid. Several studies carried out exploring the effect of attitude on computer use (see Czaja et al., 2006 for a review) found that older adults with a more positive attitude towards computers are more likely to use a wider range of technologies. Mayhorn et al. (2004) believe that acceptance of a device can be achieved by introducing the technology into the older adults home when they are high functioning, increasing the level of technological support as motor control, perceptual and cognitive abilities decline.

A questionnaire study was carried out to investigate community dwelling elderly individuals' attitudes towards technology and memory aids (Cohen-Mansfield, Creedon, Malone, Kirkpatrick, Dutra, & Herman, 2005). The results of this study portrayed interesting findings highlighting the preferences and general experience older users have with technological devices. Of the 100 elderly participants questioned, 58% said that they would be interested in using an electronic memory aid, provided it worked as it should and was affordable. The results showed that the type of person most likely to use an electronic memory aid was an individual with a high level of education, a need for external aids (i.e. problems remembering to do future tasks) and with experience using other electronic devices (e.g., calculator, computer, television, microwave etc.). All participants reported to use at least one external aid regularly with the most popular aids being calendars, address books, paper notes and alarm clocks. Participants stated that they would require an electronic memory aid to accommodate visual and fine motor problems. Where some

favoured small, portable devices for easy concealment others favoured larger devices that had a large screen, large buttons and was not easy to lose. These findings are consistent with a previous study investigating older adults' use and attitudes toward technology (Goodman, Syme, & Eisma, 2003). This research showed that there is an age-related decrease in everyday technology use with the exception of telephones, televisions and microwaves. Some of the problems reported by the participants as to why they do not use modern technologies included feelings of frustration and confusion when using electronic devices, a lack of understanding, fear of being too old to learn how to use new devices, the cost of devices and physical difficulties impeding usage. Melenhorst and colleagues claimed that older adults are critical adopters of new technologies, as learning to deal with the technology takes them, on average, more time and effort (Melenhorst et al., 2007).

It can be concluded with some degree of confidence from the above studies that these issues are important to the older user and should consequently be considered when designing technology for elderly individuals. Therefore an evaluation of current memory aids for older adults will be based on their cognitive features (usability, learnability), accommodation to physical needs (visual, hearing and fine motor problems) and accommodation to social needs (affordability, size, appearance).

There are three goals for this chapter: (1) to outline the needs of older adults, (2) to review current memory aid devices, and (3) to consider how these devices meet the users' needs.

2.2. Memory Aid Devices

Compensation systems are described as memory aid devices that are designed to support the cognitive impairments of individuals and consequently improve performance (Pollack, 2005). Recent research has shown an increase in the use of memory compensation systems to examine their effectiveness in the rehabilitation of traumatic brain injury patients (Flemming, Schum, Strong, & Lightbody, 2005; Kim, Burke, Dowds, Boone, & Park, 2000; Thöne-Otto & Walther, 2003; Van den Broek, Downes, Johnson, Dayus, & Hilton, 2000; Wilson, Evans, Emslie, & Malinek, 1997). The methodologies used in these studies have included case studies following brain injured patients treatment using the technology (Wilson et al., 1997) and also clinical trials where patients were trained to use

the electronic memory aid and then measured on various PM tasks (Thöne-Otto & Walther, 2003). All of these studies yielded positive effects on memory performance with the help of the aid (e.g., participants were more likely to remember to take medication and meet appointments on time with the help of an electronic aid compared to without an aid). Since this progression researchers are now turning their focus to how these memory aids can be adapted and developed for another target user, the older adult (Thöne-Otto & Schulze, 2003). Compensation systems that have been developed for research with older adults range from simple reminders systems to home robotic support systems (see LoPresti et al., 2004; Pollack, 2005). These technologies are more concerned with supporting the users' abilities rather than strengthening them. The six compensation systems that were reviewed for the purpose of this dissertation were *Neuropage*, *MEMOS*, *Memojog*, *Autominder*, *COACH* and *Cooks Collage*.

2.2.1. Current Memory Devices

1. One of the earliest electronic memory aids introduced for memory impaired individuals was *Neuropage*, a portable paging system designed by the engineer father of a brain injured patient along with a neuropsychologist (Hersh & Treadgold, 1994). *Neuropage* was designed as a cueing system to help support PM failures in individuals with cognitive impairment. The device itself is a small pager which can be carried via a belt attachment. Very little learning is involved in the memory aids use as any schedule information is entered through a paging company. Users are issued reminders at particular times through an adjustable alarm/vibrator alert with an explanatory text message. The user can control the pager with a single large button, which makes it suitable for individuals with motor difficulties.

2. A computerised PM aid, *MEMOS* (Walther, Schulze, & Thöne-Otto, 2004), was designed to facilitate the memory impairments of patients with head injury. *MEMOS* combines the use of a central server which communicates with a personal memory assistant (PMA) over a wireless cellular phone network. The PMA was designed specifically for patients with memory impairment. To accommodate for this cognitive deficit the size and usability of the device was taken into consideration making it easy to handle and fault

tolerant. The design of MEMOS is currently under evaluation to adapt it to accommodate its usability for older users (Thöne-Otto & Schulze, 2003).

3. Another mobile memory aid, *Memojog*, was introduced by Szymkowiak, Morrison, Shah, Gregor, Evans, Newell, et al. (2004) to support user's memory for prospective tasks. Memojog contains many features similar to the MEMOS device (Thöne-Otto & Schulze, 2003). One distinct difference however is that Memojog was specifically designed with features to accommodate the limitations and requirements of the older user. Memojog is composed of three main elements which contribute to its function; a PDA device for the elderly user, a central server and a database that can be accessed through any computer with Internet access. Text based action prompts with an accompanying alarm are issued to the user to remind them of prospective tasks.

4. *Autominder* was designed as an adaptive PM aid on a mobile robot platform with an integrated screen display for older adults to help them adapt to cognitive decline and assist them with tasks in their home environment (Pollack et al., 2003). Autominder is described as an intelligent cognitive orthotic system (i.e. assistive technology for cognition), which issues prompts about prospective tasks to the user at appropriate times. The difference between Autominder and previous PM aids is that it has the ability to adapt the user's schedule depending on the behaviour detected by sensors installed throughout the home. The device reasons about whether and when to issue reminders to the user based on their observable actions and task execution.

5. Technological devices have been developed to assist individuals with memory impairments, however they are usually limited to users with early dementia (Mulvenna et al., 2007; Szymkowiak et al., 2004), as it is believed that these users still have the potential to learn new techniques and are more willing to try new strategies to help them manage symptoms. An alternative to this idea was introduced as a computerised cognitive orthosis called *COACH* (Mihailidis et al., 2000). COACH was designed as an instructional memory aid for users with mild to severe dementia to help them perform everyday tasks in the home with less dependence on their carers. Although procedural memory for tasks such as hand washing is relatively preserved in individuals with dementia, degeneration is displayed in the late stages (Bourgeois, 2002). Aside from promoting independence for the user,

COACH could provide assistance in place of a carer in a bathroom environment avoiding any possible embarrassment.

6. As can be seen from the previously discussed electronic memory aids, designers have focused their attention primarily on prospective aids for memory impaired users reminding them to carry out activities of daily living, generally to make appointments on time, to take medication appropriately and to carry out any other necessary tasks in their day-to-day lifestyle. Tran and Mynatt (2003) developed a slightly different type of memory aid compared to these in that it focuses on just one activity of daily living; cooking. *Cook's Collage* was developed as a retrospective memory aid for absent-minded individuals to refer to while cooking, to help cue them for their next cooking action. The idea behind this device is that a camera captures the cook's actions, taking picture images whenever the cook adds a new ingredient into the mixture and displays the actions on a flat-screen monitor. The authors claim that with the help of this system the user should be able to scan the most recent action images and continue where they left off without any ambiguity or delay.

2.2.2. Needs of the Older User

Several questions could be considered to determine what features are appropriate and important for the design of a new electronic memory aid for an older user in terms of the cognitive, physical and social needs. A summary of how the electronic memory aids, Neuropage, MEMOS, Memojog, Autominder, COACH, and Cook's Collage meet the needs of the older user in terms of these factors is displayed in Table 1 on page 21 and 22.

2.2.2.1. Cognitive Needs of the Older User

Older adults are more likely to show memory failures than younger adults and ageing is one of the highest risk factor for the development of cognitive disorders (Keller, 2006). Therefore it is critical that an electronic memory aid device provides sufficient support to the intended user and is designed with an older user's abilities and limitations in mind. To establish whether the electronic memory aids meet the cognitive needs of the elderly user several questions were put to the design:

- What type of memory does the aid support and does it do this successfully?

- Is the device usable for the intended user and would a cognitively impaired elderly user be able to interact with it?
- Is any input required from either the elderly user or carer?
- Can the user or carer obtain feedback from the device to inform them of their position?
- Is there flexibility allowed by the device to suit the user's current situation?

2.2.2.2. Physical Needs of the Older User

The issues surrounding the physical needs of the user cover a wide range of usage issues. It is the physical design and the output information which is in question here. This includes how information is displayed (e.g., text, alarm, vibrator, voice etc.), how information is inputted (e.g., touch screen, buttons etc.), and whether the system is mobile or portable:

- Does the device cater for visual/auditory/motor decline?
- Is the device or information from it easily accessible for the user or carer?

2.2.2.3. Psychosocial Needs of the Older User

Goodman et al.'s (2003) study highlighted what social factors determine older adults' attitude towards technology. They showed that older participants were less likely to use new technologies as they did not want to show an outward lack of understanding towards technology, and that they wanted to avoid feelings of frustration and confusion if they did not understand it. It was also reported that it was important for a device to be easily concealed and affordable. With these issues in mind the following questions should be considered when analysing technology for older users:

- How much interaction is required of the user?
- Is any training needed for its usage?
- Is the size of the device appropriate for its intended use?
- Does the design of the device stand out from other technology devices?
- Is the cost of the device reasonable?

Table 1: Evaluation of How Electronic Memory Aids Discussed in the Literature Meet the Needs of the Older User

Memory Aid	Neuropage	MEMOS	Memojog
Cognitive	<ul style="list-style-type: none"> • PM aid. • Requires little user input. • Input dependent on paging company which may act as limitation but useful for inexperienced tech user. • No way for user to confirm action completed or delay reminder. 	<ul style="list-style-type: none"> • PM aid. • Input entered by user via handheld computer or carer/professional carer via central server. • Task confirmation function and reminder delay function. • Emergency contact function. • Little learning involved. 	<ul style="list-style-type: none"> • PM aid. • Requires schedule input from user or carer. • Task confirmation function, carers contacted if task not confirmed. • Minimal action steps. • Coverage problems reported when modifying diary. • May cause confusion to cognitively impaired users.
Physical	<ul style="list-style-type: none"> • Small and portable. • Alarm/vibrator alert, with text: multimodal. • Large button to control, easy to use even for motor impaired. • Small screen. 	<ul style="list-style-type: none"> • Portable, lightweight device. • Users can leave voice messages if they want to input data which is then decoded from central server. • Quite a large screen for visual display with a few clearly labelled soft buttons. • Alarm can be adapted for user. 	<ul style="list-style-type: none"> • Small portable device. • Quite a large visual display. • Adaptable alarm. • Keyboard integrated into hardware caused problems when inputting information.
Psychosocial	<ul style="list-style-type: none"> • Very small device, therefore easily concealed. • Promotes independence for activities of daily living. 	<ul style="list-style-type: none"> • Small portable ubiquitous device. Promotes independence for user. • Assists as contact device in crisis situations (user confused or disorientated). 	<ul style="list-style-type: none"> • Small portable device. • Holds personal information (family details). • Carers not reliant on others to input data as device easy to use. • Promotes independence for both user and carer.

Table 1: Evaluation of How Electronic Memory Aids Discussed in the Literature Meet the Needs of the Older User (Continued)

Memory Aid	COACH	Autominder	Cook's Collage
Cognitive	<ul style="list-style-type: none"> • Instructive memory aid. • Encompasses prospective and procedural memory. • Requires no input from user. Carer can observe users progress through computer. • Short instructional prompts given only if action is not carried out or completed. • Reduces dependence on aid. 	<ul style="list-style-type: none"> • PM aid. • Flexible reminder system which adapts the users schedule depending on the user's actions and makes assumptions about these actions. • Schedule inputted by carer with user. • Could potentially make assumption failures and result in over reliance of system. 	<ul style="list-style-type: none"> • RM aid for cooking. • Interruptions, absent-mindedness and action slips. • Requires no input or learning.
Physical	<ul style="list-style-type: none"> • Audio output from integrated speakers. • Hearing dependent. 	<ul style="list-style-type: none"> • Device set into mobile robot to be used in home environment. • Works with visual display and sensors. • Robot includes sensitive displays, microphones for speech recognition and speakers for speech synthesis. 	<ul style="list-style-type: none"> • Screen can be implemented to suit height of user for viewing. • No input required. • Only visual output, i.e. visually dependent. • Images may not be clear to an elderly user.
Psychosocial	<ul style="list-style-type: none"> • Promotes independence for user for procedural tasks which may be affected in late dementia. • Reduces embarrassment for individual if help is need in washroom. 	<ul style="list-style-type: none"> • Adaptive functions allow user to change their routine without updating system. • Automatic search for best schedule update. High technology device. • Some elderly users may be apprehensive using it 	<ul style="list-style-type: none"> • Promotes independent cooking. • Could be seen an item of prestige. • Can be used by people of all ages therefore users not seen as incapable if using.

2.2.3. Evaluation of Current Devices

To evaluate the current memory aids the needs of the target user can be again divided into the three categories, cognitive, physical and psychosocial, and the questions outlined above can be put to their design.

2.2.3.1. Cognitive Issues of Devices

From the six memory aids reviewed, five of them support PM tasks. As PM tasks contain both a PM and a RM component (McDaniel & Einstein, 1992) the devices not only remind the user of future tasks but also store the information that is to be remembered. From the literature concerning the design of these systems and based upon the published evaluations, it appears that these technologies support the type of memory that was intended, and all devices prove to be more beneficial to users' performance on delayed intentions than internal strategies alone. Only MEMOS, Memojog and Autominder require input from primary users. This has both positive and negative effects, the former being that the user has control over what information is inputted into the device and the latter being that users may not feel confident entering information or it may be too complex, particularly in the case of cognitively impaired individuals.

In general, external memory aids act as a form of prosthesis or compensation for everyday memory function, providing cues to the users to initiate an action (Kapur et al., 2002) rather than improving the user's memory. According to Harris (1984), "An active reminder obviates the need for monitoring because it eliminates the prospective aspect of the memory task leaving just the retrospective one" (p. 89). This is true of the five PM aids. The users are not required to time monitor during the delay period as the devices are programmed to alarm the user at appropriate times and thus the amount of attentional resources required to carry out the intention is reduced. These devices support time-based PM functioning, which is particularly beneficial to older user as it is age sensitive (Einstein & McDaniel, 1990; Park et al., 1997). Autominder and COACH also have the ability to support event-based PM functioning as they have the ability to adapt their reminders based on observation of the user's actions. A positive attribute of the COACH system which is lacking in the other devices is that it only issues cues to the user when they are needed, reducing the chance of the individual becoming dependent on the system.

As Dobbs and Reeves (1996) outlined in their framework of PM functions, the last phase of the process (output monitoring) requires individuals to remember whether a task has been performed. We already know that older adults have poorer PM compared to younger adults (Maylor, 1996b; Einstein et al., 2000; West & Bowry, 2005) and that individuals with dementia are further affected (Huppert et al., 2000; Maylor et al., 2002), therefore it can be predicted that a PM aid with a feedback function would considerably benefit older users. From the literature we are told that MEMOS, Memojog, COACH and Cook's Collage contain this function for either the primary user or caregiver to observe.

Overall these memory aids are successful in their aim to support either the PM and RM of the target users and have emphasised the importance of clear and simple designs, particularly with Neuropage. Furthermore, more recent designs such as MEMOS and Memojog have taken on board issues that were not met in former designs again like Neuropage. Ideally, it would be more appropriate for older adults to use technical systems that they are familiar and comfortable with to help them perform daily activities, however this issue may be resolved in coming years as the number of technology users coming into late adulthood increases.

2.2.3.2. Physical Issues of Devices

As briefly outlined previously in this paper there are physical aspects that show age-related declines in task performance with a decrease in both functional and sensory abilities (Huppert, 2003). Fisk, Rogers, Charness, Czaja, and Sharit (2004) suggested that in order to enhance the likelihood that older adults will successfully adapt to technical devices, issues of visual and auditory perception should be stressed as these senses are the most affected by ageing. These issues are, to a point, acknowledged in the design of the current memory aids. All of the devices are dependent on at least one functioning sense. For example, Cook's Collage requires functioning vision and COACH requires functioning hearing to make use of the aid. The other memory aids, such as Neuropage, MEMOS, Memojog, and Autominder use both visual and auditory output. All of these devices use sound adjustable alarms to obtain the user's attention with Neuropage having the added function of a vibrator alert. Text is the most common form of reminder output, however it is suggested that Autominder might also make use of speech synthesis for relaying explanatory messages. In

most of these cases the potential of the memory aid is limited by the systems hardware (Hersh & Treadgold, 1994; Szymkowiak et al., 2004), a problem which has to be expected when using commercial devices (e.g., pagers, PDAs, mobile phones etc.). Szymkowiak and colleagues note that the use of commercially available PDAs do not offer multi-modal output such as vibrator alert, speech output etc. They also suggest that the design for entering information could be improved as difficulties using the touch screen keyboard were found, particularly when users wanted to increase the text size.

In terms of motor functioning, all of the memory aids were integrated on devices suitable for portability in the cases of Neuropage, MEMOS, Memojog, and Autominder, or were easily accessible, such as Cook's Collage and COACH. The portable memory aids used lightweight devices such as pagers and PDAs with the exception of Autominder, which was integrated on a mobile robot. It was also noted that a touch screen function was the main mode of interaction for all devices apart from COACH. Neuropage used only one large button for user interaction increasing its ease of use. These functions enhance usability for users, such as elderly individuals, who might have fine-motor difficulty (Fisk et al., 2004).

2.2.3.3. Psychosocial Issues of Devices

It is predicted that if older adults accept and use technology mediated memory aids to support PM and RM functioning, they could sustain their independent lifestyles for longer. The design of the memory aids predicts whether the older adult will accept and use these memory aids. The first issue to be considered is the amount of interaction that is required of the user to use the memory aid and whether its benefit outweighs other external aids, such as calendars. Firstly, COACH and Cook's Collage requires little or no interaction from the user. Neuropage requires only for the user to accept and read their reminder whereas MEMOS, Memojog and Autominder require the user or caregiver to enter the user's schedule and to accept or postpone reminders. Autominder is designed to automatically alter the user's reminders depending on observable behaviours, thus, reducing the user's need to manually change their schedule into the device. Information can also be entered via an external computer by individuals such as care professionals, if either the primary user of

caregiver does not feel confident to do so. These functions might decrease the apprehension elderly people feel towards technology (Goodman et al., 2003).

From the literature it seems that all researchers allow training time for participants before the devices were evaluated. Although a device should ideally require little or no learning, training with an instructor, a video or manual would help familiarise the user with the system, increasing their confidence and comfort when using the memory aid alone. Another issue to be considered is whether the device will cause embarrassment to the user, amplifying their difficulties to the public. The portable memory aids discussed here are all small devices that can be easily concealed, with the exception of Autominder that is meant to be used in the home. They also use commercially available hardware systems which are ubiquitous in today's society making them indiscernible as memory aids and also moderately affordable, important features to older user's attitudes according to Cohen-Mansfield et al. (2005) and Goodman et al.'s (2003) findings.

Cohen-Mansfield and colleagues (2005) found that individuals who were most likely to use an electronic memory aid were those with a need for external aids and who had experience using electronic devices. They also found that all participants used at least one external aid. Therefore it follows that an important influencing factor predicting older adult's use of electronic memory aids is their familiarity with technology. This highlights the importance of good training material incorporated before the devices are used.

Each of the memory aids contained unique features of psychosocial importance that set them apart from the other designs. For example, COACH allowed late stage dementia patients more independence in the restroom, reducing social embarrassment; MEMOS allowed users to contact a caregiver in crisis situation; Memojog provided a function for users to store personal information such as family details; Autominder adapted to the user's behaviour eliminating unnecessary repeated actions; Neuropage provided a simple solution for patients to help them gradually assimilate back into their normal lifestyle; and Cook's Collage acts as an action reference taking some pressure off harassed absent-minded cooks.

2.3. Conclusion and Present Research

Much work has been accomplished in relation to PM and compensatory memory devices to support this function in both normal older adults and cognitively impaired older

adults, as can be seen from this literature review. The overall purpose of the systems is to prolong the individuals' independence in their home. However, there is a fine line between the user being independent with the help of a memory aid and being over-dependent on the technology itself. For this reason, it is important that these technologies are designed to act as a support for the user rather than a substitute carer.

Future research might take on board the limitations of the systems discussed to produce a device which has both multi-modal input and output to accommodate for age-related physical and cognitive decline.

2.3.1. Implications for the Current Study

The advantages of evaluating current devices are that the positive design components and the system design limitations of each memory aid are outlined and can be compared to each other. This information can be used to improve the design of a new PM aid. The above evaluation outlines the user's needs and the cognitive, physical and psychosocial issues that should be addressed in the design process according to the past research.

Initially the purpose of the research was to investigate the potential of a PM aid for older adults with early stage Alzheimer's disease. Past research has shown that PM is particularly affected in individuals with this disease (Huppert & Beardsall, 1993; Huppert, et al., 2000; Smith et al., 2000). Furthermore, the research also suggested that carers of individuals with memory impairments could also benefit from the support of a digital PM aid (Vitaliano et al., 2005). Informal meetings with people who suffer from early Alzheimer's disease and professional carers indicated that an expert understanding of the disease is necessary to develop a device that supports its symptoms.

The PM aid devices that were reviewed in this chapter mainly focused on supporting individuals with brain injury or older adults with memory impairment. Consequently, the focus of PM aid development has not been on healthy older adults, who also show an age-related decline in PM skills, as described in Chapter 1, section 1.3.2 (Maylor, 1993b; Maylor et al., 2002; McDaniel et al., 2003; West & Bowry, 2005). With this in mind, it was decided that the proposed PM aid would be designed based on the criteria needed to support healthy older adults.

CHAPTER 3: NEEDS ANALYSIS

3.1. Research Objectives and Approach

The objective of this research study was to design a new PM aid that uses technology to support older adults in their daily lives. To design a new technology that is acceptable to the older user and accommodates their cognitive, physical and psychosocial needs, a user-centred design approach was implemented.

User-centred design is a design philosophy that is discussed in a multitude of text books by renowned designers and authors such as Donald Norman and Jakob Nielsen, and adopted as an approach in the design of technology worldwide by developers, including major corporate companies such as IBM (Ominsky, Stern, & Rudd, 2002). Gould and Lewis (1985) recommended three principles of design that they believed would assist in the development of useful and easy to use computer systems. These principles were: (1) Early focus of users and tasks, (2) Empirical measurement, and (3) Iterative design. These principles require the designer to know who the potential users are; their abilities and behaviours and the nature of the tasks needed to be accomplished with the system. They also outline the importance of involving the user in the design of the system, observing and recording their reactions and performance to printed scenarios and later examining their interaction with prototypes of the system. Gould and Lewis emphasise the importance of iteration in design, making changes to the system when errors are observed and retesting it again. These principles form the basis for user-centred design and contribute to the key characteristics of more recent user-centred approaches, such as 'interaction design' (Preece, Rogers, & Sharp, 2002).

The difference between interaction design and HCI, put simply, is that traditionally HCI is concerned with the study of computer systems whereas interaction design concerns the study and design of all interactive systems (Sharp et al., 2007). Preece et al. (2002) describe interaction design as a user-centred approach for designing interactive systems to support people in their everyday lives. Interaction design was the approach that was used to guide the design and development of the PM aid in the present research study. The four basic activities involved in interaction design are: (1) identifying needs and establishing requirements, (2) developing designs, (3) building interactive versions of the designs, and

(4) evaluating designs (see Figure 3). An outline of the techniques, the purpose for these techniques and the stage in the system's lifecycle that they should be carried out are outlined in Table 2 on the following page (Abrams, Maloney-Krichmar, & Preece, 2004; Preece, et al., 2002).

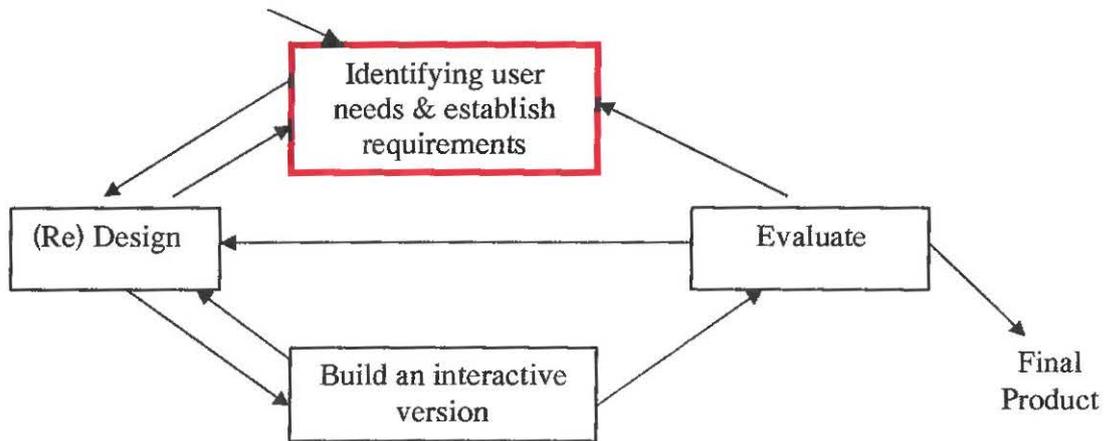


Figure 3: Interaction Design Lifecycle – Stage 1 (Preece et al., 2002, p. 186)

Table 2: Interaction Design Techniques (Abrams et al., 2004)

Technique	Purpose	Stage of the Design Cycle
Background interviews and questionnaires	Collecting data related to the needs and expectations of users; evaluation of design alternatives, prototypes and the final artefact	At the beginning of the design project
Sequence of work interviews and questionnaires	Collecting data related to the sequence of work to be performed with the artefact	Early in the design cycle
Focus groups	Include a wide range of stakeholders to discuss issues and requirements	Early in the design cycle
On-site observation	Collecting information concerning the environment in which the artefact will be used	Early in the design cycle
Role playing, walkthroughs, and simulations	Evaluation of alternative designs and gaining additional information about user needs and expectations; prototype	Early and mid-point in the design cycle
Usability testing	Collecting quantitative data related to measurable usability criteria	Final stage of the design cycle
Interviews and questionnaires	Collecting qualitative data related to user satisfaction with the artefact	Final stage of the design cycle

The interaction design approach and techniques were used to guide the design of the proposed PM aid device in the current study. The first stage of the interaction design approach is to identify the user and establish the user requirements (Preece et al., 2002). The review of literature and current memory aids partially contribute to this stage however a needs analysis approach will also be applied to establish a full understanding of the older user. This involves applying data-gathering techniques which will then be analysed and interpreted. The information that was obtained from these methods was used in the conceptual and physical design of Multiminder.

3.1.1. Augmentation versus Deficit Approach

The augmentation approach hypothesises that a person becomes more capable when the functionality of a cognitive artefact is added to a person's own cognitive functioning (Kuutti & Kaptelinin, 1997). This means that performance by a person using a cognitive tool to perform a task would be better than the same person performing the task unaided. The theory links in with Norman's description of how cognitive artefacts enhance a person's abilities whilst also changing the structure of a task (1991). Enhancing a person's capacities to support their involvement in activities is an obviously desirable attribute for a PM aid. However, it may not be sufficient to investigate cognitive augmentation for older adults unless possible cognitive deficits are firstly explored. It was established in Chapter 2, section 2.1.1, that older adults are more likely to use an electronic memory aid if they have a need for external aids (Cohen-Mansfield, 2005) and it cannot be ignored that there is an age-related decline in PM performance (Einstein & McDaniel, 1990). This research evidence suggests that the most appropriate approach to gathering design criteria is to focus on how an electronic memory aid would support PM for activities where problems exist, or in other words taking a deficit approach.

3.1.2. Methodology

The purpose of data gathering is to collect sufficient, rigorous and relevant data so that a set of requirements can be produced (Sharp et al., 2007). The main data-gathering techniques in interaction design are interviews, questionnaires and observation (see Table 3). The method or methods to be selected as most appropriate to the study depend on various factors such as the focus of the study, the participants involved and the resources available. These methods will be discussed in more detail below and the rationale for the choice of method will be stated.

Table 3: Alternative Research Methods and Purpose of Use

Method	Purpose
1. Interviews	Exploring issues
2. Focus Groups	Collecting multiple viewpoints
3. Questionnaires	Answering specific questions
4. Observations	Understanding context of user activity

1 & 2 - Interviews are any person-to-person interaction between two or more people with a specific purpose in mind. An interview that involves a group of participants is commonly known as a focus group. Interviews are an appropriate method to explore sensitive issues, such as memory decline, as the interviewer has the opportunity to prepare the interviewee before the questions are asked. Interviews also allow for flexibility in that the interviewer has the freedom to formulate additional questions within the area being investigated. The benefit of a focus group is that it allows people to put forward opinions in a supportive environment that they may not in a one-to one based interview (Sharp et al., 2007). These points emphasise why interview and focus group methods would be suitable in the context of the current research.

3 - A questionnaire is a written list of questions which a participant reads, interprets and responds to. Questionnaires are an appropriate method for gathering specific data from a wide number and range of participants. However the response rate for questionnaires can be low and the responses may not be answered in the way that is required. As the research is at an exploratory stage, it was decided that questionnaires were not an appropriate method to use.

4 - Observation is a method of watching and listening to a phenomenon as it takes place, appropriate when you are more interested in behaviour rather than the participants' interpretation. Observation helps designers to understand the user's context, tasks and goals (Sharp et al., 2007). It is sometimes difficult for an individual to explain how they achieve a task; therefore it is impossible for a researcher to get a complete and accurate picture. Observation techniques are useful in obtaining information about a task that cannot be obtained from other methods such as interviews. Observation was deemed a suitable

method for the purpose of this study to obtain information about the participants' natural behaviours and habits.

A qualitative method that uses a combination of the above techniques is ethnography. Ethnography is a method traditionally used in the social sciences to explore the social organisation of activities. It involves using a collection of data-gathering techniques, observation for the most part and also interviews, questionnaires and studying artefacts used in activities (Sharp et al., 2007). It seeks to understand the routine, daily lives of people focusing on the predictable patterns of human thought and behaviour (Fetterman, 1998). Ethnography requires using techniques such as participant observation (observer becoming a member of the group they are studying) and in-direct observation (e.g., diaries), appropriate to long-term studies. Traditional ethnography studies require 6 months to 2 years or more in the field (Fetterman, 1998). Although ethnography would have been a viable method to apply to the study, the methods that were selected were interviews, observations and focus groups.

None of the methods on their own elicit data that is one hundred percent reliable and accurate (Kumar, 1999). Triangulation is a strategy that involves using more than one technique to investigate a phenomenon. For example, interviews to target specific user groups, observations to understand the context of task performance and focus groups to build a consensus view. This approach allows for a comparison of findings across techniques leading to more rigorous and reliable findings (Sharp et al., 2007). Methodological triangulation was implemented to gather information about older adult's needs and preferences in relation to PM and technology (O'Leary, 2005). As previously mentioned above, the data-gathering techniques that were chosen, included interviews (with professionals and older adults), observations (of older adults' daily activities) and focus groups (of older adult's technology needs) (Abrams et al., 2004). Each method was individually approved by the Psychology Applied to Information Technology Ethics Committee (PAITEC) of the Department of Learning Sciences at IADT Dún Laoghaire. Ethical approval was essential to ensure the rights of the participants were being adhered to and to secure the integrity of the research. Issues that were paid particular attention to throughout project were informed consent (see Appendices A1, B1 and C1 for each method's consent form) and informing the participant that they could choose not to answer

particular questions or withdraw from the study at any time. All of the participants were given an outline of the purpose of the study, how they would be involved in it and their contribution to the research. Also, the research methods may have come across as personal or intrusive to some participants (e.g., questions about memory decline in the interviews and following the participants in their home for the observation method), therefore it was important to the research that the older adults knew of their rights as a participant.

3.1.3. Research Analysis

The method used to analyse the research data was the approach known as inductive thematic analysis. An inductive approach concentrates on identifying themes that are linked to the data themselves (Braun & Clarke, 2006). As a hypothesis was not already formed prior to interviewing, this approach allowed for the themes to emerge from the interview transcripts.

Other methods of analysing qualitative data that are probably more widely known are the grounded theory, discourse analysis and content analysis. The grounded theory is an approach that aims to develop theory from systematic analysis and interpretation of data. According to Thomas (2003), the outcomes derived from both the inductive thematic analysis and the grounded theory may be indistinguishable but the thematic approach is a more straightforward approach. Discourse analysis and content analysis are also methods that could be considered to analyse the qualitative data. Discourse analysis involves the study of the dialog, such as the meaning of what was said in an interview, how words were used to display meaning. Discourse analysis is strongly dependant on interpretation, the context and the reflection and construction of language on psychological and social aspects (Sharp et al., 2007). Content analysis on the other hand focuses on categorising data from pieces of text and studying the frequency of these categories. One type of content analysis is known as conceptual analysis, where a concept is chosen for investigation and analysed. Conceptual analysis has also been termed thematic analysis which suggests similarities between the methods (Palmquist, Carley, & Dale, 1997, as cited in Nelson & Nelson 2004).

Thematic analysis differs from the better known analytic methods such as the grounded theory and discourse analysis which seek patterns in the data but are theoretically bound (Braun & Clarke, 2006). It is acknowledged that these analysis techniques, in

particular the grounded theory and content analysis, are suitable options, however the method preferred for the present study was thematic analysis. According to Braun and Clarke (2006) some of the advantages of using a thematic analysis are that it is flexible, a relatively easy and quick method to learn, can generate unanticipated insights, and can usefully summarize key features of a large body of data.

Thomas (2003) proposes that the purposes underlying the development of the general inductive approach are to reduce the raw data into a brief format, to establish links between the research objectives and the summary findings and to develop a model about the underlying processes evident in the raw data. Thomas claims that the inductive approach is intended to aid an understanding of the meaning in complex data through the development of summary themes or categories from the raw data. The process of the inductive approach follows the transcription of the raw data, multiple readings of the text, coding and categorising the data, identifying themes, using diagrams to display the data and making conclusions about the findings. The process of coding involves putting a label to units of interest in the text (words or phrases) and interpreting meaning about the unit of text. These segments are put into appropriate categories and a memo is written about the category. This approach allows for patterns to emerge and links to be made. Overlapping categories are reduced to create a more specific model incorporating key categories or themes (see Appendix A4 for an example).

3.1.4. Research Participants

The participants that took part in the research were recruited from one local area through personal invitations including face-to-face visits and telephone calls. The older adults were contacted following the suggestion of mutual acquaintances. Older adults were more likely to agree to participate after the mutual contact was mentioned and they were informed that the researcher lived within their community. This method was also successful for Chisnell, Lee, and Redish (2004) investigating older adults' use of websites. Purposive sampling was used, whereby participants over the age of 60 years, cognitively healthy and relatively independent (i.e. occasionally relied on others for tasks such as driving them to the supermarket) were selected. The participants were considered cognitively healthy if

they had not been diagnosed with any dementia related diseases and if they were living independently in their home without carer assistance.

3.2. Method 1: Interviews

3.2.1. Overview of Interview Method

Interviews were conducted as a data-gathering technique to collect relevant information regarding the needs and requirements of older adults. To gain a comprehensive knowledge of this area a sample of professionals working with older adults and a sample of older adults were interviewed.

The aim of the interviews with professionals working in the area of ageing was to define what memory problems and need requirements older adults experience, from a professional point of view. The aim of the interviews with older adults was to explore the needs and requirements of older adults in relation to PM tasks in the home, such as remembering to make appointments, do chores etc. It was also important to uncover what methods were being used by older adults in their home and what the benefits and problems were with older adults using these methods.

The interviews took on a semi-structured format – the interview schedule contained both open and closed structured questions. This allowed the interviewee to elaborate on certain topics and also to introduce new topics that were perhaps not considered previously while maintaining a degree of structure to the interview. Interviews were conducted face-to-face with the participant in the participant's home and were recorded, with the participant's permission using an audio recording device. Paper notes were also taken to record information that the researcher considered important, such as noting any memory aids in the home that the participant did not think to mention.

Three features were considered to be important to the design and use of technology for older adults, as previously discussed in the Chapter 1 and 2. These were found to be cognitive, physical and psychosocial requirements. Therefore, the contents of the interview consisted of questions relating to memory changes and strategies, physical changes and lifestyle changes that people experience with ageing (see Appendix A2 for Interview Schedule).

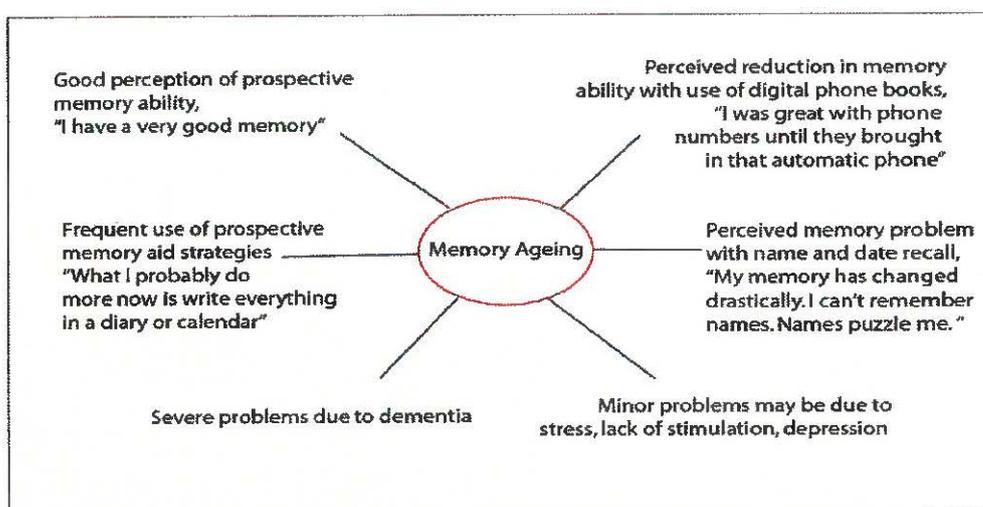
3.2.2. Coding and Analysing the Interviews

The inductive thematic approach was used to analyse the raw data. To begin the analysis process, the interviews were transcribed from the audio recording, coded and key points were identified and categorised into relevant sections. Many of these categories were overlapping and were further reduced to develop an appropriate model of the themes. As the research question was to investigate the cognitive, physical and psychosocial lifestyle of older adults, a summary of the findings were divided into these categories. The second research question was to identify the positive and negative factors of the memory strategies used by the older adult participants.

3.2.3. Identifying Themes from the Interviews

Four themes were identified throughout analysis of the raw data. As previously mentioned the transcripts were studied and coded to pick out key points relating to the research question. The coded data was used to categorise the information into relevant sections and subsections (see Appendix A3). To avoid overlapping themes, the categories were refined and the final themes emerged. The themes identified were; Memory Ageing, Physical Problems, Ageing Attitude and Social Network and Activities. Figure 4 displays these themes along with supporting information from the interviews.

It was found from the interviews that these themes are important factors for older adults in relation to their current lifestyle. A worked example of how these themes were reached is provided in Appendix A4.



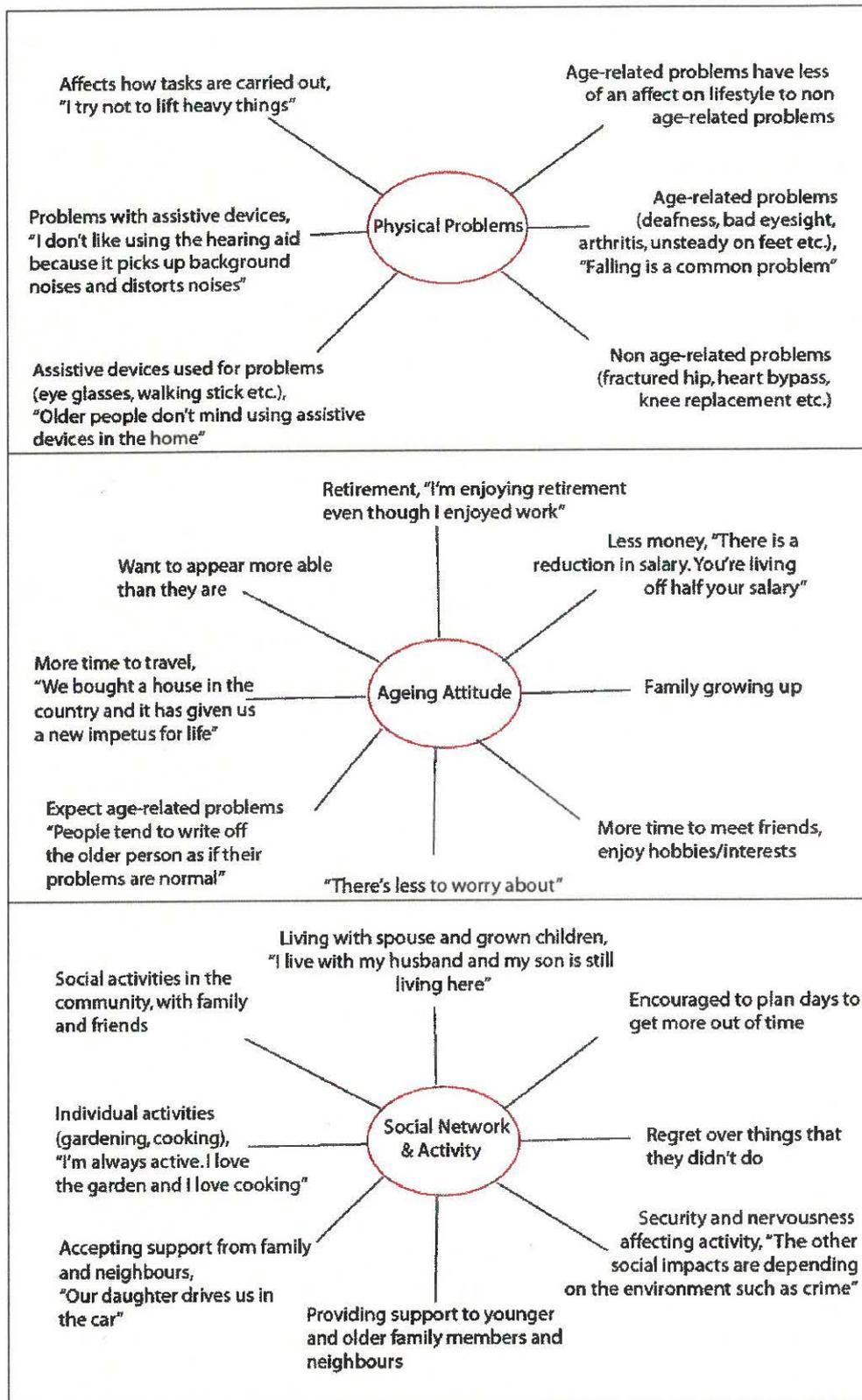


Figure 4: Themes and Key Points Identified from Interviews with Older Adults and Professionals

3.2.4. Professional Interviews

To gain an understanding of an older adult's lifestyle from a professional point of view, three professionals working with older adults were interviewed. The fields of profession included a geriatrician, a counsellor and a care worker. The interviewees were given questions related to their job but all following the same theme; the cognitive, physical and psychosocial changes older adults experience. Due to the nature of their professions the interviewees had experience with older adults of various abilities. For example, the geriatrician dealt mainly with older adults who experienced cognitive difficulties, the counsellor dealt with older adults experiencing emotional difficulties and the care worker dealt with people with physical difficulties. Due to these differences, a summary of findings will be discussed under headings according to occupation.

3.2.4.1. Professional Interviews - Summary of Findings

Geriatrician

The professionals that participated in the interviews had experience working with older adults of various cognitive abilities, from healthy adults to dementia sufferers. The interviews showed that it is not only healthy older adults who make use of external memory strategies. It was found from the interview with the geriatrician that older adults who have cognitive impairments also use memory aids such as post-it notes to help them remember to do tasks.

It was found from the interview that the main physical complaints that are come across from older adults are sensory problems, being unsteady on their feet and injuries from falling. It was reported that these problems affect how the older adult carries out tasks, and that many use assistive devices for major problems or use household furniture to move about the house.

The development of assistive devices has given many people suffering with physical problems new independence. According to the interview with the geriatrician however, many people have problems using assistive devices. Some of the reasons for this included; embarrassment using assistive devices in public, standing out, being seen using aids that mark them as old or helpless, and also wanting to appear more able than they are, "*Some of them just don't like the appearance of it, and the frame in particular they don't like*" (P.

McCormack, personal interview, February 26, 2007). McCormack claimed that there were three types of people when it came to using assistive devices; those who refused to use them and used other methods instead (e.g., furniture walking), those who pretend to use them and leave them on display, and those who embrace them. Older adults are also more likely to use assistive devices in their home, away from the public eye.

One of the main problems, according to the geriatrician, is that people, both young and old, expect problems with ageing and therefore do not seek advice or help with age-related problems occur, *"People in Ireland are very accepting of disease and dysfunction"* (P. McCormack, personal interview, February 26, 2007).

Counsellor

The information about older adults' psychosocial issues mainly came from the interviews with the counsellor and geriatrician. Some of the negative points that were made that were thought to determine the activities of an older person were; isolation due to bereavement or retirement, financial problems, fear of going out in public if they are out of a social network and the environment affecting social activity (e.g., transport and crime).

The counsellor being interviewed maintained that a good social network is essential for a person to sustain an active lifestyle. A good social network is also needed to help with life changes, such as the bereavement of a spouse, *"Older people seem to cope better when they have children and grandchildren and when they're involved"* (V. Mannian, personal interview, February 19, 2007)

Mannian stated that her older clients are encouraged to organise their days and to plan ahead, *"If they're not at all organised, that is where problems can occur"* (personal interview, February 19, 2007). The older adults are also encouraged to take up hobbies, join organisations or volunteer themselves post-retirement.

Social Care Worker

According to the interview with the care worker, older adults with major physical difficulties and confined to their home make use of memory aids, such as writing appointments on a calendar and writing a shopping list to give to the carer, *"Most of them would use shopping lists...and they would use calendars for writing in doctors*

appointments and things like that” (L. Hughes, personal interview, March 5, 2007). This shows that the use of external memory aids are not limited to a certain type of user and are ubiquitous forms of reminders.

In relation to physical issues, the care worker had experience working with people with more severe physical problems where the person’s activity was limited (e.g., clients using a wheelchair). The older adults were dependent on the carer to help them out of bed and to do other daily activities, such as cleaning the house.

3.2.5. Older Adult Interviews

A total of ten participants were interviewed as part of this study. Participants were interviewed in their home at a time that was convenient for them. The advantage of conducting the interview in the participant’s home was that the participant could physically demonstrate to the interviewer strategies that they used in their home. It also allowed the interviewer to see objects in the home that the participant may not have thought to mention.

The participant sample included six female and four male subjects. Participant ages ranged from 61 to 89 years with a mean age of 77. Nine out of the ten participants were fully retired and one participant was semi-retired.

3.2.5.1. Older Adult Interviews - Summary of Findings

Cognitive Issues

The older adult participants in this interview study were all cognitively healthy individuals. Some participants however said that they noticed a change in their memory as they aged. All of the participants who said that they thought their memory had changed said that the main problem they found was that they were slower recalling dates and/or names, "*Sometimes forgetting names and that*" (older participant, personal interview, March 6, 2007).

Participants did not find any changes to their PM but all participants used external PM strategies to help them remember. This included using portable aids such as paper notes and also environmental aids like having a specific place for items so that they could find them easily. All of the participants used three or more strategies to help them remember to do PM tasks, "*What I probably do more now is write everything in a diary or calendar*" (older participant, personal interview, March 2, 2007).

It was noted that in many cases participants merged several strategies to carry out one task. For example, an older adult said that they put their medication on the kitchen table (putting object in conspicuous place) so that they can take it after their breakfast each morning (routine) and their other medication on their bedside locker to be taken later that day. They used a tablet dispenser (assistive device) for their medication which they fill every day (routine). Another participant said that each morning they check their calendar to see if they have any appointments. This is again incorporating two different strategies, routine and a calendar.

It was noted that the participants adapted their behaviour to accommodate for the problems they found with memory aids. For example, one participant found it difficult to hang the calendar on the wall so therefore kept it in a drawer. Another participant said that if they found problems with a strategy they would not use it or would change it to suit them. One participant, for example, said that if they could not find a piece of paper to write a note they would write it on the calendar.

Physical Issues

The problems associated with ageing that people said they experienced included; a general feeling of getting older, slowing down, having less energy, problems with hearing and sight, stiffness in bones, arthritis, long term injuries due to falls, and heart bypass operations, *"I'm a bit slow getting around"* (older participant, personal interview, March 2, 2007), *"The knees are a bit stiffer"* (older participant, personal interview, March 8, 2007).

The areas in which participants said were affected by these physical problems included; walking long distances, lifting heavy objects, driving, and doing manual work for long periods (e.g., gardening, hoovering, *"I don't like hoovering, pushing, pulling it, lifting it up every step and putting it back"* [older participant, personal interview, February, 27, 2007]). Participants said that the objects they used to assist them with daily tasks included; walking sticks (either one or two), eye glasses, hearing aid, and jar openers.

Psychosocial Issues

The participants in this study were all healthy normal older adults living independently in their home. Eight of the ten participants were living with a spouse, four of which also lived with their adult children. Two participants therefore lived alone.

From participant reports, it appears that the majority of the sample led a very active and social lifestyle. Eight of the ten participants said they leave their home regularly and are involved in groups and activities such as the Active Retirement Association, educational classes, physical activities (golf, swimming, gardening and walking) and voluntary services, *"I'm belonging to every group there is"* (older participant, personal interview, February 19, 2007), *"I'm always active"* (older participant, personal interview, February 27, 2007).

Participants said the major changes that they experienced after retirement were that they had more time to do what they wanted; they could relax more and meet friends more regularly and had less to worry about. They also said that they found it hard to adjust, from being very busy to having a lot of time on their hands, *"Having a lot of time on your hands. I couldn't get used to it to begin with, I felt guilty"* (older participant, personal interview, March 8, 2007). The reduction in income was also a factor.

On the whole, the participants were fully independent in terms of doing daily tasks. In some cases participants relied on family members or neighbours to provide them with lifts to places, to transport heavy materials for them or to do heavy duty tasks such as vacuuming. Most of the participants said that they help family members, either younger or older, or neighbours with their tasks including shopping, washing, and babysitting.

The participants in the sample seemed to be involved in a good social network. These included family, friends and community involvement. The family network seemed to be the most prevalent for all of the older adults.

3.2.6. Memory Strategies

The memory strategies used by older adults were investigated. The purpose of this was to use the information to help design a compensatory PM device that will maintain the positive factors associated with the traditional strategies and eliminating the negative factors if possible, while also taking into account the themes identified from analysis of the interviews. The table below (Table 4) illustrates the positive and negative factors of everyday external memory strategies, reported by participants. The strategies were divided into 4 categories: cueing, physical, electronic and note based (Brown, Pinnington, & Ward, 2004). Common positive features which were identified for most of the strategies were that; they reminded the user to do the task, they can be displayed clearly, they can be kept or thrown away, they help to organise plans; handy and easy to use, good for irregular reminders. Some common negative features that were identified by the older adults were that; the user has to remember to write or display reminder, the user could forget to check reminder, the user could lose it; they look untidy if built up, some are not easy to display, they might make your memory lazy, and also that the user might not hear the reminder alarm.

Table 4: Outline of Positive and Negative Memory Aid Strategy Factors

	Method	Positive Comments	Negative Comments
Cueing strategies	Alarm/clock etc.	<ul style="list-style-type: none"> • Alarm good for waking up early • Radio alarms used to listen to morning news • Oven timer easily accessible for cooking • Can leave kitchen and do something else while cooking • Alarm on timer lets you know when something is ready • Reduces chances of burning food 	<ul style="list-style-type: none"> • Might not hear alarm • Have to learn how to use • Manuals often difficult to understand • Can rely too much on alarm
	Asking someone to remind you	<ul style="list-style-type: none"> • Reassurance • Reinforce your own memory • In case you forget • Seeing person again might remind you of task • Person might do task themselves 	<ul style="list-style-type: none"> • Person might forget to remind you
	Putting objects in conspicuous place	<ul style="list-style-type: none"> • Reminds you to do something with object • Put in obvious place it can be easily seen • In case you forget • Handy reminder • Kept where it is needed (e.g., medication kept at breakfast table to be taken after breakfast) • Know where everything is if put in specific place 	<ul style="list-style-type: none"> • Have to remember to put it out in first place • Can clutter up space • Someone could move it • Might still forget and walk past it
Physical strategies	Routine	<ul style="list-style-type: none"> • Gets you into a habit • Organises you • Encourages activity • You know what you will be doing that day • Reminds you to do daily tasks • Can do things automatically without thinking (e.g., buying same food each week) 	<ul style="list-style-type: none"> • You don't feel like doing it sometimes • Can get obsessed with it • Can be predictable • It's annoying if you have to break it

Table 4 (Continued): Outline of Positive and Negative Memory Aid Strategy Factors

Physical strategies	Tick off	<ul style="list-style-type: none"> • You can see what you have done • Can see what still has to be done • Don't do tasks more than once • Good discipline • Get satisfaction from it • You get more done when organised 	
Electronic strategies	Text alert	<ul style="list-style-type: none"> • Good for irregular reminders • Sound alarm alerts you to reminder 	<ul style="list-style-type: none"> • Might forget or lose phone
Note based strategies	Paper notes	<ul style="list-style-type: none"> • Can leave a message for someone else • Can look at note when need to be reminded • Can put it in conspicuous place • Can keep • Can throw out after it's used • Can put pen and paper in suitable place when needed 	<ul style="list-style-type: none"> • Can be untidy if not thrown out after needed • Might not have pen and paper handy when needed • Easy for someone else to see if note is private
	Diary/calendar	<ul style="list-style-type: none"> • Good reminder • Can put notes on it you want to keep • On display • Can see it easily • Reminder of dates • Easy to organise future plans • Don't double book your time • Good to remind you about irregular tasks • Easy to use • Can be used to write a message if paper note not available when needed • Can keep after year is up • Keeps a record • Other people can see what you are doing on certain days 	<ul style="list-style-type: none"> • Can forget to check calendar • Pages can fall to wrong month • Many only show present month. Awkward if you want to see dates on past or next month. • Can be difficult to hang up on wall • Have to throw out when finished, too bulky to store

Table 4 (Continued): Outline of Positive and Negative Memory Aid Strategy Factors

Note based strategies	Diary/calendar	<ul style="list-style-type: none"> • Nice images can be visually pleasing • Can confirm own memory • Good for reminding you about details of a tasks, time and place of appointment etc. • Can check calendar at start of every month, week or day to see what is planned 	
	Hand	<ul style="list-style-type: none"> • Easily accessible • Can't lose it • Reminds you 	<ul style="list-style-type: none"> • Can wash off
	Address/phone book	<ul style="list-style-type: none"> • Can put it beside phone • Mostly used for irregular numbers • Handy • Good reminder • Don't have to remember numbers • Numbers easy to access • Easier than public book • Can refer to it for reassurance • Can use a list in a book and in mobile phone 	<ul style="list-style-type: none"> • Could lose phone or book with numbers stored • Makes your memory lazy • Don't know anyone's numbers because its in the phone
	Memos	<ul style="list-style-type: none"> • Remind you • Can put them in various places • Handy • Can throw out after 	<ul style="list-style-type: none"> • Can lose them • Can fall off place they are put • Can look untidy
	Lists	<ul style="list-style-type: none"> • Reminds you • Keeps you within limits of the list • Can forget items without it • Good to remind you to get irregular items • You can bring it with you • You can write it and give it to someone else • Saves time in supermarket • Can tick off items • Needed more for getting a lot of items • Used as habit 	<ul style="list-style-type: none"> • You can forget to bring it with you • You can lose it • You can forget to write items on the list

3.2.7. Interview Conclusions

The themes that have emerged from the interview method give an insight into how older adults view their lifestyle and the issues that both positively and negatively affect them. The professional interviews outlined the importance of a good social network in an older person's life to encourage activity and avoid isolation. It was also made clear that cognitively healthy older adults should, generally, maintain memory abilities, and that problems may be due to environmental issues or illnesses. The professionals also found that older adults should successfully maintain an independent lifestyle, if they are not suffering from severe cognitive or physical problems.

On the whole, the older adults interviewed were not greatly affected by ageing in a negative way. The findings suggest that the participants have adapted their environment and activities to suit their current situation. For example, many of the participants used reading glasses to help with their eyesight or other assistive devices for related problems. Also, after retirement many of the participants took up classes or hobbies, socialised with family and friends more, moved county or travelled more to fill up the extra time they had. Most participants had a good perception of their memory abilities and used strategies to help them remember to do future tasks. However, the participants identified problems with these strategies that did not fit their needs and requirements.

3.3. Method 2: Observations

3.3.1. Overview of Observation Method

The purpose of the observation study was to investigate the cognitive, physical and psychosocial behaviour of a sample of older adults and gather data that may have been overlooked with the interview method. Several themes were identified throughout the analysis of these interviews as outlined in the previous section. Therefore the aim of the observation study was to either support the emergence of these themes or to question their relevance to the design of a prospective memory aid for older adults.

Naturalistic observation involves the observation of a participant's behaviour as it naturally occurs with limited intervention from the observer (Shaughnessy, E. Zechmeister, & J. Zechmeister, 2003). The observation study took place over approximately a one hour time period. A home-visit prior to the observation was also carried out for each participant

to help familiarise the participant with the observer's presence in their home and to help reduce any unnatural behaviour caused by the process.

It was expected that the participant may interact with the observer, such as initiating conversation or asking questions. It was believed that the best approach in this situation was to react naturally to the participant, as to ignore any attempt of interaction may encourage unnatural behaviour (Hayes, 2000).

3.3.2. Observing the Participant

Four older adults were observed for the purpose of this method. The age of these older adults ranged from 62 to 89 years with a mean age of 73.5. Observations were conducted in the participants' home. The time of day that the observation took place varied with each participant depending on their individual daily routine.

Observations were recorded using a paper and pen method. Some examples of behaviour that would be recorded include; the participant using reading glasses, squinting while reading, looking at a clock or problems remembering what they had planned to do. Observations were unobtrusive; the participants were not interrupted throughout the observation period and the participant was free to stop or postpone the observation period at any time if needed. The observer followed the participant as they carried out tasks but gave enough room for the participants to move around freely. The participant was also accompanied when doing tasks outside the home, as the tasks were part of the participant's daily schedule.

3.3.3. Observation Analysis

3.3.3.1. Summary of Recorded Data

Participant 1: During the observation period the participant made brown bread, walked to the chemist to buy and take her prescription, went to the bank to get a statement, returned and cleaned up the kitchen, made breakfast and took the bread out of the oven.

Participant 2: The participant had just made scones when the observation period began. She put the oven on to cook them, cleaned the downstairs and upstairs toilet, cleaned kitchen floor, marinated meat for dinner later, took the scones out of oven and made tea.

Participant 3: During the observation the participant cleaned the dishes in the kitchen, wrote up paper reports to send in the post, cleared items in the garage when looking for something, hung clothes on the washing line and did some garden tasks.

Participant 4: The participant made lunch for herself and her husband during the observation. She ate lunch with her husband while watching the television and cleared up. She then took some clothes from the clothes drier and put them away and then prepared potatoes for dinner.

3.3.4. Identifying Themes from Observations

Coding was used to group similar material into sets to identify the themes. The codes that were used throughout the raw observational data and memos explaining their meaning and relevance can be seen in Appendix B2.

The coding of information into smaller sets allowed for themes to be identified. The themes that were most prevalent were; Memory Strategies, Physical Ageing, and less prevalent themes that emerged were Social Network and Technology. The relevance of these themes to the observation notes is evident in the diagrams below (see Figures 5 & 6). Here we can see the themes, sub-themes and supporting information from the field notes.

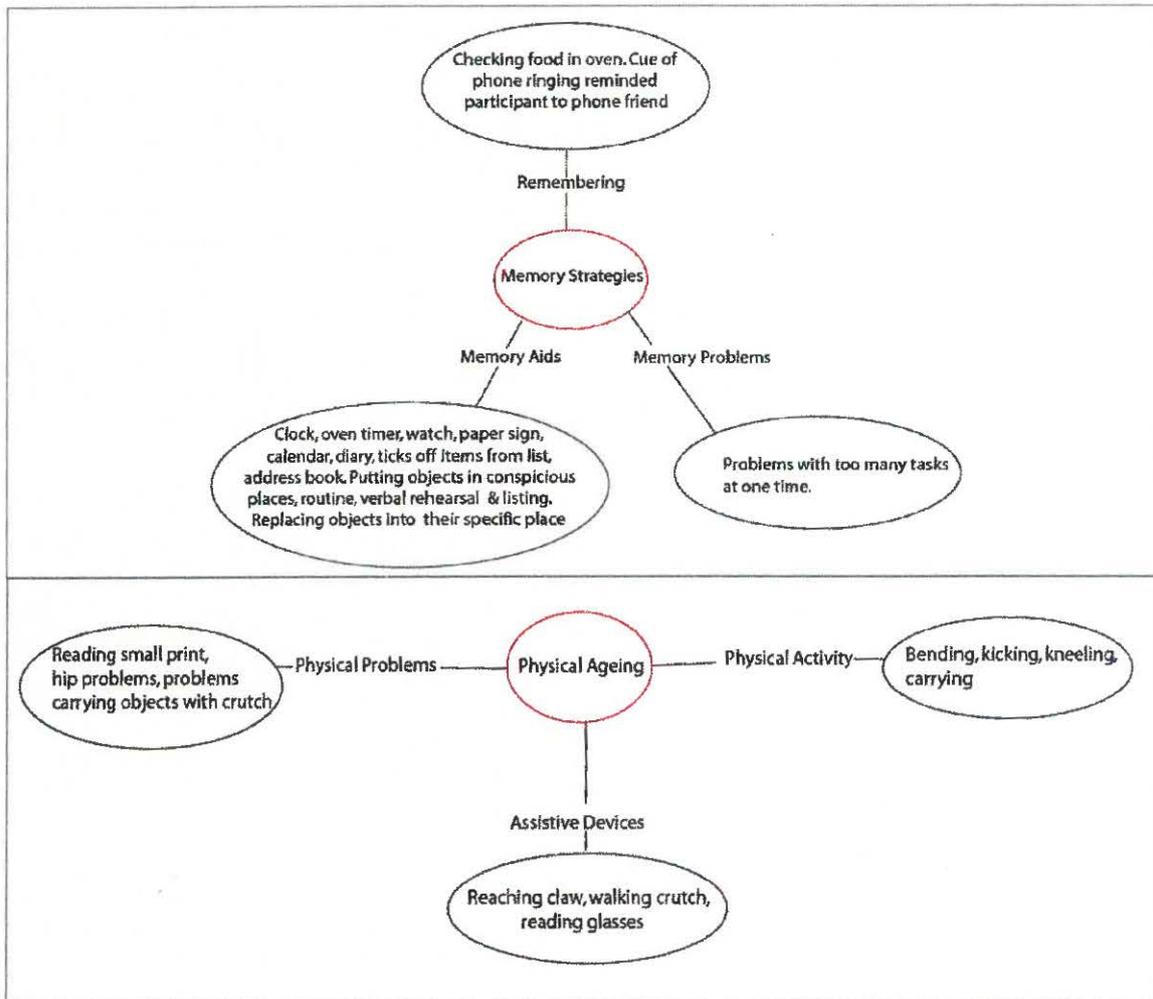


Figure 5: Developed Themes from Observation Data

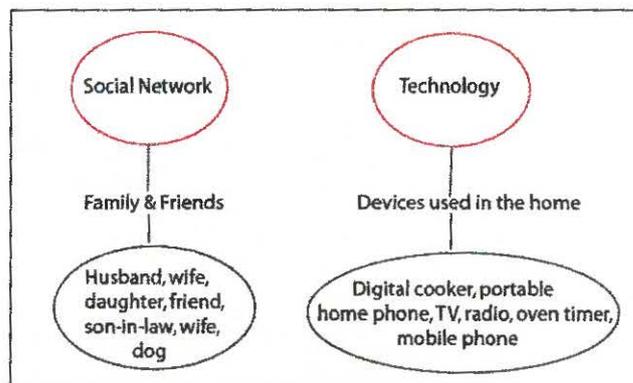


Figure 6: Sub-Themes from Observation Data

3.3.5. Observation Conclusions

Analysis of the observational data allowed themes to emerge which were relevant to the cognitive, physical and psychosocial issues surrounding the way in which older adults carry out daily tasks in their home. A key factor that was identified was that memory aids are prevalent in the home and frequently used when doing tasks. However some of these aids were not very practical for the participant. For example, one participant with hip problems used an oven timer that required her to bend over to hip level to see the time. Physical Ageing emerged as a theme as the tasks carried out by the participants required relatively good physical abilities. It was observed that the participants' abilities affected how the tasks were conducted (e.g., used reading glasses or held text at a distance from eyes) but did not limit the participant from carrying out the task. Only one participant showed obvious difficulty when carrying out tasks but used assistive devices to help and adapted her strategies (e.g., making multiple trips and leaning on furniture) to accommodate the problem.

Social Network and Technology were identified as minor themes because while they were relevant to the participants' behaviour while carrying out their daily tasks, they did not greatly affect it compared to the other two themes.

The observations provided a glimpse into the way in which an older adult carries out tasks in their home and how the identified themes affect how they do these activities.

3.4. Method 3: Focus Groups

3.4.1. Overview of Focus Group Method

Focus groups were the third method of data-gathering conducted. Focus groups are essentially discussion groups with users or potential users of the PM aid. This allows for the opportunity for users to discuss their needs, feelings, experiences and opinions about a product and to propose alternative ideas and suggestions (Fisk et al., 2004). There are four main stages to the focus group method: (1) planning, (2) recruiting, (3) moderating and (4) analysing and reporting (Morgan, 1998).

3.4.2. Planning the Focus Groups

The purpose of the focus group was to discuss the participants' use of technology, the positive and negative aspects of various devices (e.g., PDA, laptop & mobile phone), and to ask their opinions on the proposed memory aid using a low-fidelity prototype. These issues were again related to the cognitive, physical and psychosocial lifestyles of older adults.

This information can then be used to determine the type of technology that would be most suitable to older adults' needs and preferences and to make any necessary changes to the design idea.

The questions used in the group were generated using a conversational style to ensure that the participants felt comfortable enough to add their opinion into the discussion. The first two questions were opening questions, to familiarise the group with each other and the moderator (see Appendix C2 for schedule).

3.4.2.1. Recruiting Focus Group Participants

Participants were recruited from the Active Retirement Association and held in a local community centre. Persons were invited to take part in the focus group provided they were over 60 years of age. Twelve people volunteered to take part in the focus group and it was discussed what day and time would be appropriate for all involved.

3.4.2.2. Moderating the Focus Group

The researcher acted as moderator throughout the focus group. The moderator was responsible for putting questions to the group and maintaining focus. A voluntary assistant

moderator was also present in the room and was responsible for noting key points, observations, quotes, and drawing out a diagram of the seating arrangement. The session was recorded using a voice recorder device.

3.4.2.3. Focus Group Analysis

The type of analysis used was note-based analysis. This relies primarily on field notes taken during the focus group. The audio recording of the focus group was not transcribed but used to verify specific quotes and to help put written points into context. A primary analysis was conducted immediately after the focus group to make sense of the written information and to discuss the findings while they were still fresh in the mind (Krueger, 1998). Further analysis involved reviewing the raw data, interpreting the results, categorising similar concepts and allowing themes to emerge.

3.4.3. Focus Group Summary

Morgan (1998) and Nielsen (1997) agree that more than one focus group is necessary, as the outcome of any single session may not be representative. Morgan claims however that two to three groups is sufficient in smaller studies where the sample is not diverse and that there is little to be gained with further focus groups if the discussions reach saturation and become repetitive after these sessions. This was true of the current study, where the participants were of similar age and lived in the same area, and it was clear after the second focus group that the discussions had reached saturation. Two focus groups were therefore carried out for the purpose of this project. Both focus groups were held in a quiet room with a table with surrounding chairs, both taking place at 10:30am one day after the other. Twelve people volunteered to attend the focus groups altogether, six of whom attended on the first day but only four turned up the second day. The groups consisted of four females and two males in the first group and four females in the second group. The discussion period was between 40 and 50 minutes. Participants were offered refreshments and were asked to read and sign the consent form before the discussion began.

The focus group began with the participants introducing themselves and giving a piece of information about themselves to the group. This process helped to make the group feel more comfortable speaking in front of each other. The moderator gave a brief summary

about the project, the purpose of the focus group and how the participants' involvement would be of benefit. Questions were then put to the group about their experience with technology and devices, the features they find difficult or easy to use and their opinion on the proposed design and design features (see Appendix C2). All of the participants contributed to the discussions. There was no noticeable gender difference between the participants' comments or behaviours.

3.4.4. Initial Design Concept

An initial design concept was used as part of the focus group method to gather feedback about the conceptual design and design layout (see Figure 7). The concept was created bearing in mind design considerations based on the data collected from the two previous methods, the understanding of PM, and the review of existing PM aids. The areas that were investigated throughout this part of the focus group were; the features that should be made prominent or redundant, the style of the icons and the features that would increase usability and learning for older users.

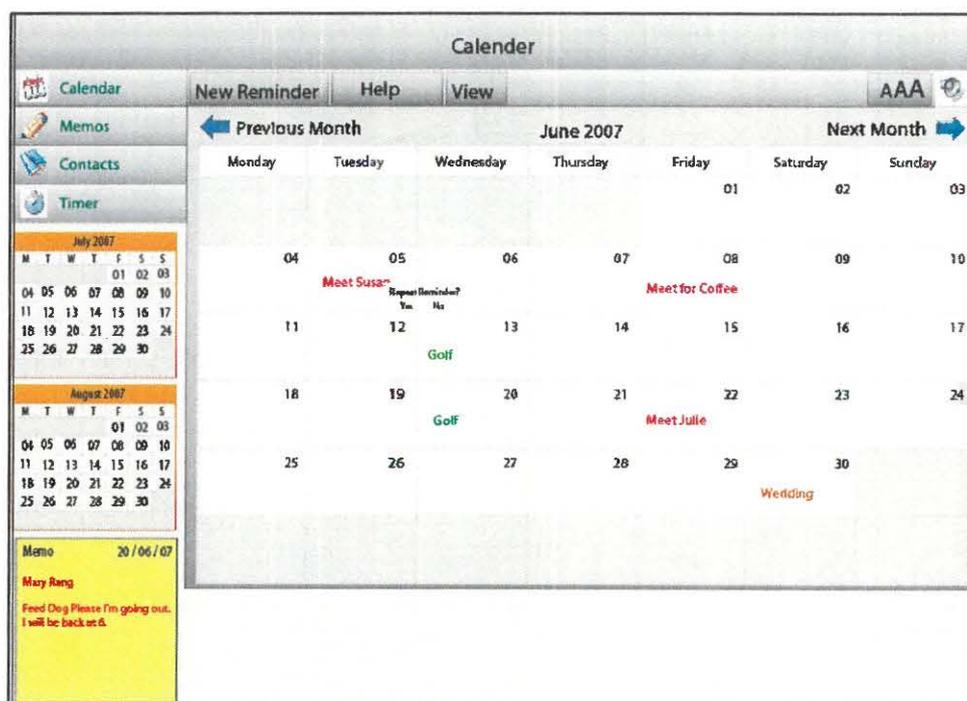


Figure 7: Initial Design Concept of Prospective Memory Aid

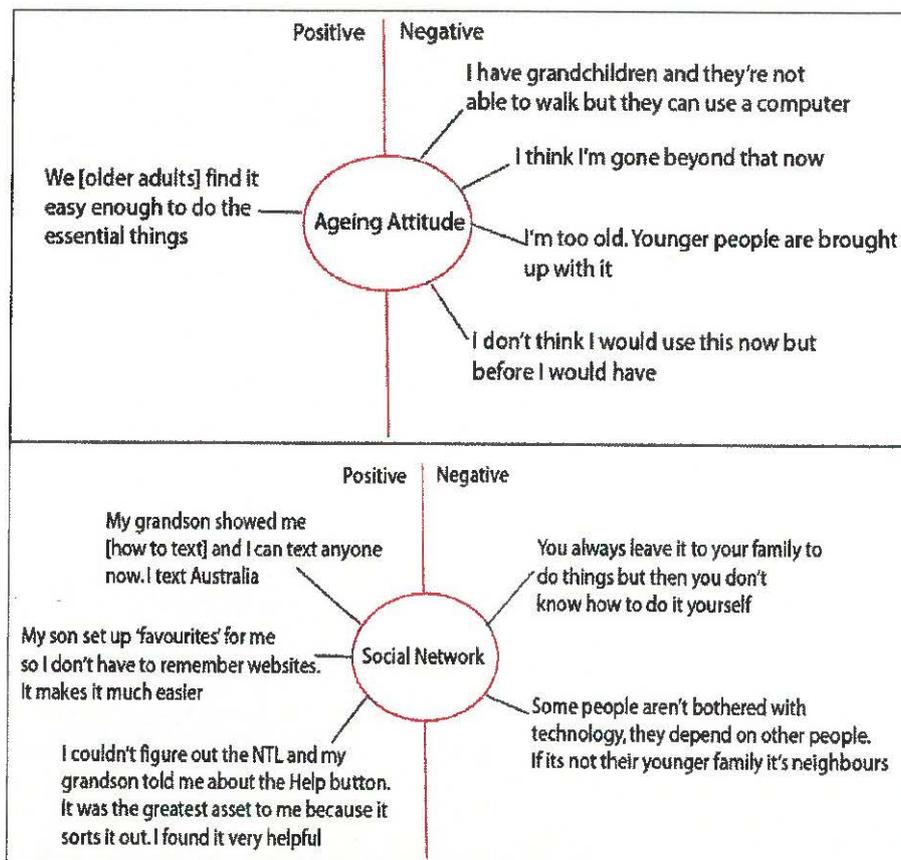
A feature that was thought to be useful for older users was colour categorising to show levels of importance. The participants had contrasting opinions about how prominent they wanted different sections to be displayed. Some of the older adults thought that a small display in the corner would be satisfactory, however, others wanted a large display. The participants in the groups thought that the options to increase the alert volume and text as required to suit the user's sensory abilities was an advantage over other reminder methods.

The focus group participants were brought through various icon examples to see what style they preferred and what icons were self-explanatory or already known. All of the participants recognised the cursor as a pointer and the arrow icons as backward and forward options. The hand icon was more ambiguous however but the group were happy with the explanation that it meant something could be selected on the screen. In relation to deciding which icons would best represent the reminder sections the group were unanimously confident about which icons they would recognise and which meant nothing to them. For example, the icon AAA which is widely known to web users as a text enlargement option was meaningless to the older adults in the group. However it was agreed that the icon displaying a magnifying glass would be recognised to contain the appropriate function. The group also said that they would not recognise the volume icons commonly used on computer interfaces (displaying a speaker and sound waves). It was thought that an image of a human ear would better represent the volume function. An important point to note was that where a text label was presented as an option with other picture based icons, the participants chose the text version. Supporting this finding, Nielsen and Tahir (2002) stated that icons should not be used in screen designs when simple text links are clearly differentiable from each other. It was accordingly decided that only text links would be used in the design of the PM aid, the added benefit was that the text could be made larger from the free space that the icons had taken up. All of this feedback was used to modify the original design to create a design more appropriate for older adults' needs and preferences.

3.4.5. Identifying Themes from Focus Groups

The notes taken from the group session, including the audio recording, were studied and discussed between the moderator and moderating assistant. Codes were drawn up to

identify similar patterns and key points within the discussions (see Appendix C3). Memos were also written to provide meaning and context to the discussion points. This allowed for themes and issues to emerge from the raw data. As there was a divide in opinion, each theme was divided into positive and negative aspects. These points are important to consider for the design of a technology system for older adults. The themes that were identified were; Learning, Ageing Attitude, Social Network, Physical Ageing, and Usability (see Figure 8). Learning relates to how the older adult would learn to use a device and their attitude towards learning to use it. Ageing attitude relates to the participants' feelings about the stage they are at in life compared to younger people. The theme Social Network takes account of how the people around the older adult influence their use of technology. Physical Ageing emerged from the information the group gave about the technological features that would be needed to accommodate for physical problems related to ageing. Finally the theme Usability relates to the main features that are needed for technology to be useful to older adults.



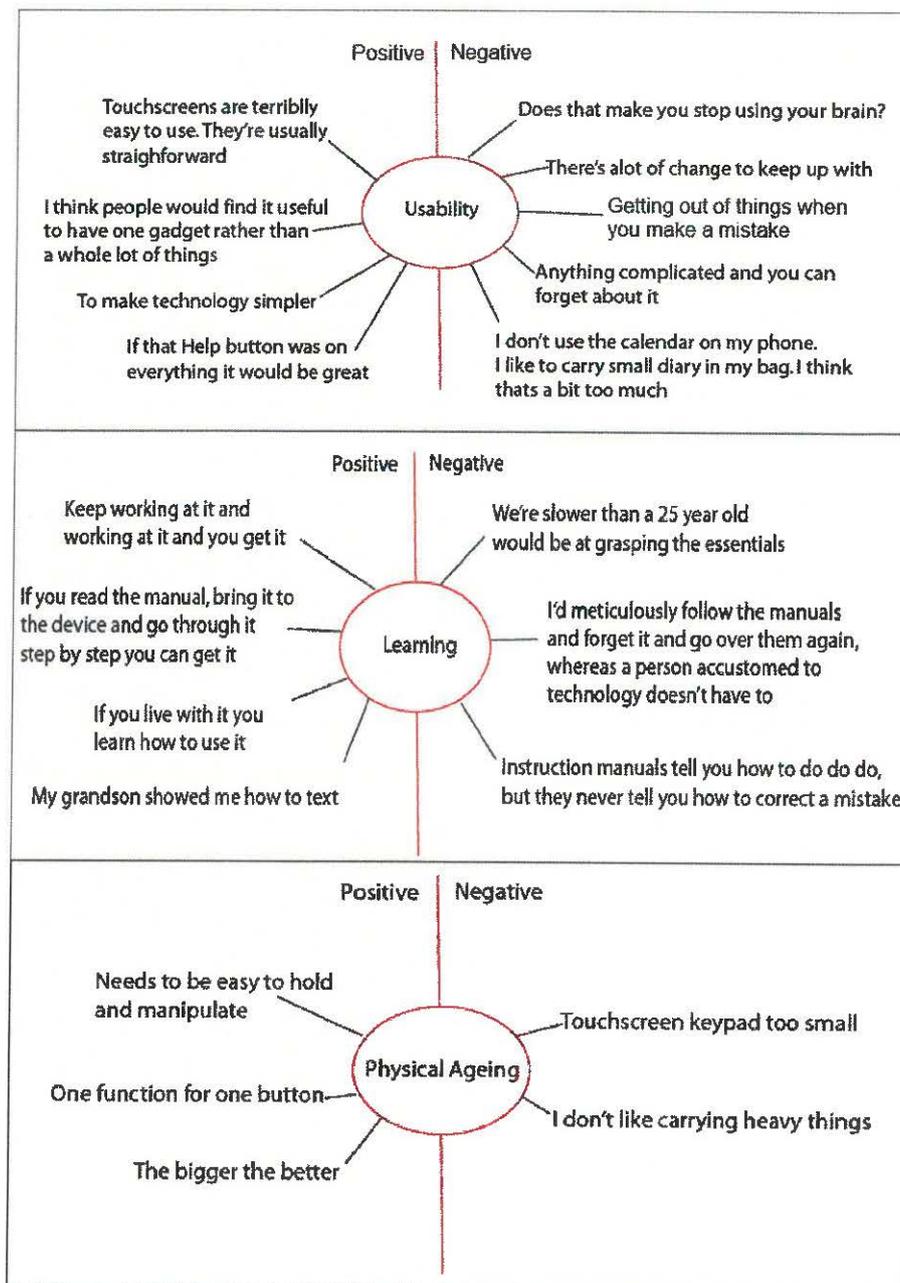


Figure 8: Themes and Key Points Related to Emerging Themes

3.4.6. Focus Group Conclusions

As expected there was a divide between participants' experience and opinions about technology. Technology preferences on the other hand were very similar for all participants. The overall consensus was that technology should be simple and easy to use, have large features and allow for errors to be made and corrected.

Participants found that user manuals do help older people to learn how to use technology however older adults more than younger would need to refer back to the manual several times before the features are learnt. It was also believed that user manuals do not inform the user on how to recover from errors.

It was found from the focus group that older adults with a social network close to them are more likely to learn how to use technology successfully. Many of the participants in the group mentioned learning how to use the internet, digital television and mobile phone texting with the help of their grandchildren. One participant admitted that it was easier for older people to ask their families to do things for them but then they would never learn themselves. Participants said that they use technology so that they can do essential things and they do not bother with additional features, such as the calendar on a mobile phone. They said that they use a phone to call or take calls from people and text people but prefer to carry a small diary in their handbag for making appointments when outside the house because that's what they always did. Physical problems which the device would have to accommodate for included poor hearing, poor sight, and difficulty manipulating small items. The group also said that they did not like to carry heavy items if the memory aid was portable. Much of the divide between the participants, in relation to their opinion about technology, was related to a negative ageing attitude. Some of the participants felt that they were beyond learning how to use new technologies and that they were too old. Other participants felt that their physical problems such as poor eyesight restricted them from using new technologies. The group agreed that they would be more likely to use technology if there was a Help option, if the device did what it was supposed to do in just a few steps and if there was an easy way to recover from errors.

Issues which were questioned about the PM aid were its financial cost, whether it would make you over-dependant on it, whether notes could be saved and where it would be used. It can be concluded that although many older adults have reservations about technology, they do find technology useful to perform "*essential*" tasks and have valid opinions about the problem features technological devices have for older users. Overall it was agreed within the focus groups that technology features should be accommodating for the older user and that devices should be easy to use and easy to learn.

3.5. Final Needs Analysis Themes

A description of the methodologies used in the data-gathering process and an analysis of each method has been outlined above. For each approach (interviews, observations and focus groups) themes have been identified from the obtained data using an inductive thematic approach. Although some of the themes identified varied with each method, other themes were very similar in context. The themes which emerged from each method and were most prevalent related to memory (including strategies and learning), physical ageing (including problems and assistive devices), social network and activity and ageing attitude (see Figure 9). The themes identified across the methods overlap slightly. Therefore, the themes were further reduced to produce the final themes; Memory Ageing, Physical Ageing, Ageing Attitude and Social Network and Activity. These themes will be the primary basis for the design of a compensatory PM aid. Other information which will be used to determine the design will be from the data gathered concerning the positive and negative features of memory strategies, and the usability and icon features identified as important for older adults in the focus group.

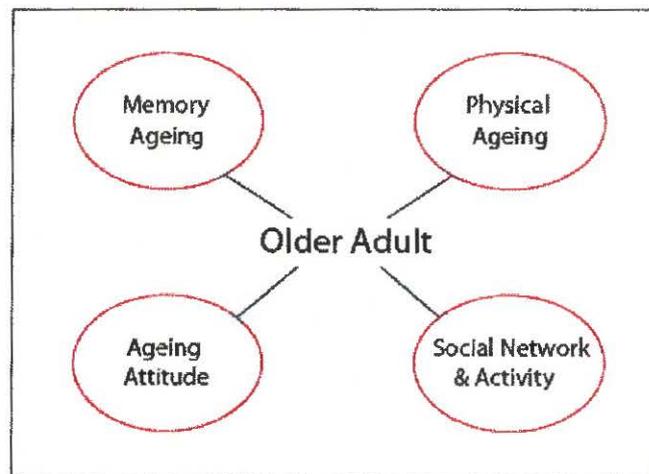


Figure 9: Final Themes

It was necessary for the successful development of a PM aid that the outcomes of the data-gathering are reliable and valid. According to Silverman (2005), “reliability refers to the degree of consistency with which instances are assigned the same category by different observers or by the same observer on different occasions” (p. 224). The reliability of the

data from the current study can be firstly displayed through the quality of the data recording. Extensive paper notes were taken throughout all of the methods, and for the interviews and focus groups the procedures were recorded using an audio voice recorder. An assistant facilitator was also present with the focus groups to ensure that reliable notes were taken. Quotations from the interviews and focus groups have been included and an example interview transcript is provided in Appendix A4. The raw data from the methods is available for further inspection or alternative interpretations on request. The research can also be considered reliable based on the consistency of the instances being examined, and the interpretation of these instances displayed in the coding and categorising of the data throughout the analysis. For example, for all of the data gathering techniques, questions relating to the themes cognitive, physical and psychosocial issues were investigated. The interpretation of this investigation revealed a common thread throughout the findings highlighting the importance of social networks and lifestyle to older adults, the effect of physical and memory problems on their daily activities and the actions they take or do not take to accommodate these difficulties. Perhaps the argument of reliability would be stronger for the study had a second researcher analysed and coded the data to compare the results. However the true reliability of the analysis will be tested when these themes are applied to the design and critiqued by potential older users during the prototype phase.

A study is considered 'valid' if it accurately represents the social phenomenon to which it refers (Silverman, 2005). The validity of the current research is displayed throughout the unbiased selectivity of the data obtained. In other words, the information that was gathered from the research methods both support and refute the want or need for new technology by older adults.

In addition to this, each method's validity was increased through various factors. For example, the validity of the interview schedule was strengthened through pilot interviews, ensuring that the questions were comprehensible and relevant to the study. For the observation method, time was spent with the participants prior to the observation session to allow the participants to become relaxed and familiar in the company of the researcher, increasing the validity and reliability of the behaviour being observed. Pilot studies were also conducted for the focus group method and feedback was obtained. The flexibility of

the focus groups meant that if the participants felt a topic or point was not valid, they provided information that was valid and relevant to them.

Golafshani (2003) concludes that reliability and validity can be interpreted as trustworthiness, rigor and quality in qualitative research. Triangulation methods are typical in qualitative research for improving the reliability and validity of the research or evaluation of findings (Golafshani). Through triangulation it can be seen that similar themes emerged from each method, interviews, observations and focus groups, supporting the validity and reliability of the qualitative research.

3.5.1. Summary of Needs Analysis

The focus of this chapter was to describe the methods that were used to establish the needs and requirements of older adults that should be considered for the design of a technology mediated PM aid. Analysis of data acquired from a series of interviews, observations and focus groups identified the themes Memory Ageing, Physical Ageing, Social Network and Activity, and Ageing Attitude. These themes will form the basis for the development of a PM aid. The initial concept was introduced to intended users during the focus group method. The feedback from this session encouraged further development of the concept. The next chapter will discuss in more detail the design concept behind the PM aid and the profile of intended users.

CHAPTER 4: DESIGN CONCEPT

4.1. Introduction

The second stage of the user-centred design process is to develop the design concept (Abrams et al., 2004, Figure 10). The conceptual design of a system involves moving from the requirements gathering to the initial design. The data obtained from background research, review of existing memory aids and the needs analysis approach was used to create typical user personas, task scenarios and the design concept.

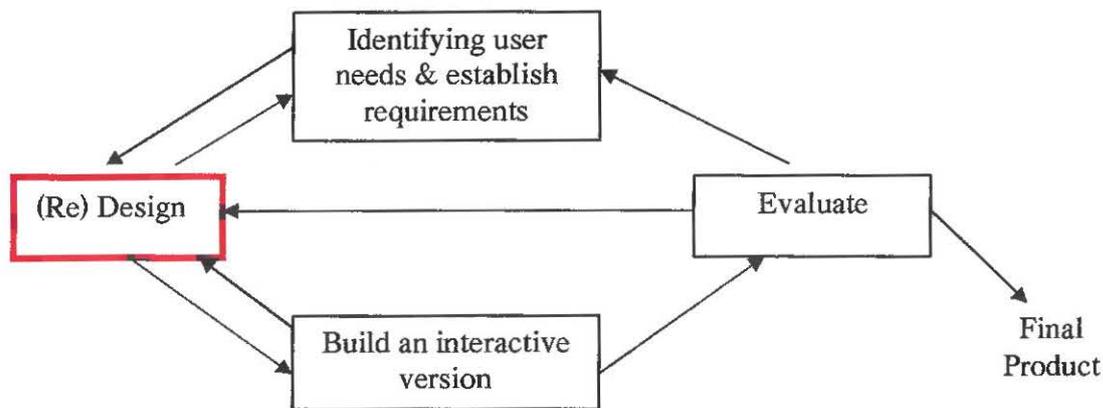


Figure 10: Interaction Design Lifecycle –Stage 2 (Preece et al., 2002, p. 186)

The key information that contributed to the design concept included: (1) the finding that older adults frequently use more than one memory aid and these are mainly used in the home, (2) calendars, written notes, phone book and alarms were among the most popular memory aids, (3) although there were many benefits of these aids, problems were also identified. The initial concept of Multiminder was first introduced during the focus group method in the Needs Analysis chapter. The purpose of this was to investigate whether older adults would feel comfortable using a touch screen pen, recognise their handwriting from the output and their impressions of a digital calendar with memo pad, contacts and timer options. This provided feedback to progress the conceptual design using user profile and storyboarding techniques and incorporating the identified themes into this design concept.

Multiminder, as the name suggests is a reminder system that provides multiple reminder strategies to the older user, a calendar, a memo pad, a contacts diary and a timer.

Digital calendars are available commercially on devices such as mobile phones and computers. A comparison of some of these calendars, including Google, Microsoft Office and Microsoft Works, is presented in Appendix D. These applications are popular and ubiquitously available to the general population however their suitability for the older user is questionable.

The last section of this chapter outlines how the identified themes from the data-gathering methods were used in the design of Multiminder and describes how the system would support prospective memory.

4.2. User Profile

Now that the user has been identified and their requirements established, the profile a potential user can be drawn up. The chronological age markers used to categorise people into age groups is uncertain. For example, different research studies and various health organisations have referred to samples of older adults from the ages of 50, 55, 60, 65, and so on (Fisk et al., 2004). Often these differences are due to biological as well as social and cultural differences or changes. According to the American Psychology Association (APA, 2007), gerontologists traditionally focus on people aged 60 and older. Similarly, although there is no specific chronological age, the United Nations refers to people from the age of 60 up as the older population (WHO, 2007). For this reason, and to include a generation of individuals who may be more experienced using technological devices, the age of participants in this study is from 60 years.

Multiminder will be designed to accommodate minor age-related difficulties including visual and auditory decline, fine motor skills problems and PM difficulties. The older user is not required to have any technology experience to use Multiminder. Some technology experience would be of benefit to the user when learning how to use the memory aid, as some of the functions and terms would be familiar to them. The majority of older adults have experience using household devices such as televisions, washing machines and microwaves (Rogers, Mayhorn, & Fisk, 2004) and mobile phones are becoming increasingly more popular.

4.2.1. Personas

A persona is a fictitious user representative that can be used to help guide decisions about a systems features, navigation, interactions and visual design (Goodwin, 2005; Norman, 2004). A device may have a number of different user profiles, depending on the user characteristics and requirements (Preece et al., 2002). For example, a person with computer experience would have different user requirements to a novice user. Two personas will be described in this section to represent the different user types within the target demographic that might use a PM aid. The user personas are imaginative figures influenced by the characteristics and lifestyles of the interview, observation and focus group participants and used to represent the typical older adult user for the purpose of design. These particular personae were employed to represent different characters, with different cognitive, physical and social circumstances and to illustrate how Multiminder could be of benefit to both characters. The user personas will be used as a tool to focus and guide the design of Multiminder, reinforcing the issue of the user as a person with specific needs and preferences (Norman, 2004).

User scenarios are also used as a tool for design focus and communication and allow for the persona to be put into context (Norman, 2004). Scenarios were also outlined, for the purpose of this study, for each persona to describe the potential tasks and benefits of using a PM aid such as Multiminder. Scenarios are a technique used in design conceptualisation to create a fictitious story based on realistic and specific activities and to communicate to others how a person would use a proposed device (Preece et al., 2002). The scenarios described below, like the user personae, were artificial impressions inspired by the data obtained throughout the qualitative research methods.

4.2.1.1. Persona 1 – Áine Beale



Figure 11: Example Persona, Áine Beale

Background

Áine is a 76 year old widow living in Malahide (Figure 11, Personal Photograph, 2007). She studied and worked as an accountant but is now retired and volunteers two days a week fundraising for a children's hospital. She lives alone but sometimes her niece who lives in America stays with her for a few months during the summer. She suffered from tinnitus and is now partially deaf in one ear. This does not greatly affect her lifestyle but she does have trouble hearing, particularly high pitched noises.

Daily Tasks

Áine wakes up early and has a cup of coffee before getting washed and dressed. She drops into her elderly neighbour to make sure that he is okay, makes them both breakfast and finds out if he has any errands he needs her to do. The neighbour's carer usually writes any messages for her on a notepad but this regularly goes missing. She finds it difficult to remember his tasks as well as her own but he has no one else to do it. On the days that Áine is not volunteering in the hospital she visits her sister and brother-in-law, goes swimming with her friend or goes to Italian language classes. Áine always wanted to go to Italy and would like to be able to speak a bit of the language before she goes.

Technology Usage

Áine used a computer when she was working and feels confident enough using them now. Her niece keeps her updated on the new gadgets and she recently learnt how to put her photos from her digital camera onto the computer, which is very useful for taking pictures of the children in the hospital. She has heard that the web is great but doesn't feel she has any real need for it.

The biggest problem Áine has is being able to hear alarms and buzzers. She doesn't wear a hearing aid because she finds it pick up too much background noise. She likes that the volume can be increased on her phone but she can never hear her oven timer and

usually has to stay in the kitchen when she's cooking something so that she can hear it better. This can be very frustrating.

4.2.1.2. Scenario 1

Áine has been involved in a fundraising event with the hospital that is coming up in a few days time. The event is a cake sale. The children love cake sales and most of the parents get involved and bring in a few cakes to sell themselves. Some bakeries also donate cakes for the event. Áine used to keep all her event information in her diary. She needs to write things down so that she can refer to it to remind herself of the time and place where she has to go and contact numbers. She finds it annoying when the details change though and she has to scribble it off and find space for the new information. She also finds it hard to fit in peoples' phone number, work, mobile and home. These are also always changing and she has to update her diary frequently.

Recently however Áine has invested in a new memory aid called Multiminder that her friend recommended to her. She found it very easy to use and it only took her a few goes to get the hang of it. She uses the calendar, contacts and timer the most but because she lives alone she doesn't use the memo pad as much. She enters the hospital events into the calendar and sets it to remind her a few days before the event and again on the day to give her time to prepare for it. She is glad that she has this reminder because she completely forgot about the cake sale, even though she was only talking about it the day before.

Áine consults the contacts section of Multiminder to look up a colleague's mobile number to see what cake would be best to make and what time to bring them to the location. She then goes to buy her ingredients to make her own cake. When she is making the cake Áine sets the timer on Multiminder to go off after half an hour. She increases the volume on the system because she is going to go into her sitting room to watch the television.

4.2.1.3. Persona 2 – David Meyers



Figure 12: Example Persona, David Meyers

Background

David is a retired 65 year old man living with his wife in their family home in Raheny (Figure 12, Personal Photograph, 2007). He is retired from his career as a secondary school teacher and now spends his time doing activities that he enjoys, particularly gardening. He has three young grandchildren that visit him and his wife regularly and keep him active throughout their stay. David finds that he is not able to play with his grandchildren for as long as he would like.

Daily Tasks

David is an early riser and makes his wife and himself breakfast every morning. He puts his wife's blood pressure medication on her tray with her breakfast so that she remembers to take it. After breakfast he usually drives to the shop to pick up a few bits that they need in the house. Often he forgets to buy one or two items that he meant to buy and has to go back.

David found after retirement that if he didn't plan the week ahead he was left idle. Therefore he makes a weekly plan on his calendar every Sunday and consults it each morning. David likes to keep busy and frequently plays golf, meets his children for lunch and goes to events with his wife organised by the local community centre. On sunny days, he spends his time in the garden tending to his flowers.

Technology Usage

David's son bought him a laptop for Christmas but he has not learnt how to use it yet. He doesn't want to bother him by asking stupid questions. His wife told him to go to computer classes but he is afraid that he will be the oldest there. He would like to be able to use the computer so that he can use online banking and email, and also to have his finances organised. At present this seems like a far fetched goal for him.

David has a mobile phone that he uses regularly and his grandson has taught him how to text message and to use the calendar. He finds it difficult to see the days on the calendar though because the screen is so small and the background light goes out before his eyes can

focus properly. When someone sets the reminders for him however, he finds it very useful. David feels more confident about remembering to do things when he has the backup reminder.

4.2.1.4. Scenario 2

David's wife bought him an electronic calendar called Multiminder for his birthday. He was apprehensive about using it but decided to have a look at it when his wife was out. He set the system up in his kitchen and went through it with the manual. He even put in a few phone numbers into the contacts section on his first try and wrote a memo for his wife for when she came back. Now David puts all his appointments into the calendar and finds it much easier to use than the calendar on the mobile, mainly because he can see it. His wife also writes a list of what he needs to get in the shop in the morning onto the memo pad so that he can't forget anything.

Using Multiminder has helped David to grow more confident with technology and he signed up to go to beginner classes in computer skills in the local community centre. He feels that he will eventually be able to use his laptop for the things he wants to do.

4.3. Storyboarding

A storyboard is a series of drawings or images that represents how an interface would be used to accomplish a particular task (Snyder, 2003). Storyboarding is a useful strategy used in the field of HCI to convey a systems interface in its early stages and to trace progression from one part of the screen to another (Faulkner, 1998). It is a cheap effective strategy for checking the design of the system before moving into a more interactive stage.

Hand-sketched storyboards were developed as part of this study to work out the sequence of screens and general layout of the screen design (see Figure 13). The storyboards that were hand-sketched as part of this study can be seen in Appendix E. These storyboards were used to help plan the layout and structure of the prototype screens.



Figure 13: Series of Hand-Sketched Storyboards of Multiminder Screens

4.4. Incorporating Themes into Multiminder

The themes that were identified from the requirements gathering methods included, Memory Ageing, Physical Ageing, Social Network and Activity, Ageing Attitude. These themes represent the principle issues to be considered for the design of a technology mediated PM aid for older adults. The following points outline how these themes have been used in the design of Multiminder.

4.4.1. Memory Ageing

- Limited learning is required
- Help option with general help instructions and help for the page the user is on
- Introduction demonstration and manual would be available
- Step instructions to help users input information easily
- Limited input required
- Information can be entered by primary or secondary users
- Supports time and event-based prospective memory
- Supports retrospective memory (contact details)
- Provides options for pre-reminder and to postpone reminder
- Feedback is given after information is entered and saved (e.g., written memo will appear on small memo pad and timers set will appear in small timer section)
- Colour coded design to help with navigation and to help the user know where they are in the system
- Usability similar to traditional methods (writing notes on the screen rather than typing) minimising the adaptation effort to technological devices
- Cancel and Clear options if users make any usability errors

4.4.2. Physical Ageing

- Touch screen system which is interacted with using a touch sensitive pen
- Large screen
- Adjustable text size and volume
- Text and audio reminders issued
- System can be displayed at height suitable for the user
- Colour coding used for user to view separate sections easier

4.4.3. Social Network & Activity

- Allows user to organise their time efficiently
- Reminds user of appointments

- Stores contact details into personal and business sections for easier access
- User can postpone, edit or delete reminders depending on their changing social schedule
- User can leave memos for other people in the home
- Multiple reminders can be set to encourage multiple activities
- Promotes independence for activities, the user does not have to rely on others to remind them

4.4.4. Ageing Attitude

- Benefit of system is clear to the older user
- Learning is supported with manual, step instructions and Help option
- Advantages over traditional paper methods
- System is not an 'assistive device', the user will not seem incapable of remembering if they are using the system
- Used in the home so user will feel comfortable interacting with the system without the fear of making mistakes in public
- Can be used by all members of the family
- Users do not have to be computer literate to use the device
- Easy to return from errors, there is no risk of making a usability error that cannot be deleted or cancelled

4.5. Multiminder and Prospective Memory

Multiminder is a PM aid and it is therefore essential that the device supports the older user to remember to do their PM tasks. The processes and components involved in PM were described in Chapter 1, section 1.3.1 of this thesis. To summarise these points, McDaniel and Einstein (1992) claim that PM is comprised of a prospective component (remembering that something has to be done) and a retrospective component (remembering what this task is and when it needs to be carried out). PM is further broken down into time-based PM (doing a task at a specific time or after a certain amount of time had passed) and event-based PM (doing a task when prompted by an external cue).

In relation to the components of PM, Multiminder supports both the prospective and retrospective components. According to McDaniel and Einstein (1992) the processes supporting the prospective component provide the ability for individuals to recognise a cue as a stimulus that requires further action. Multiminder supports the prospective component of PM by issuing reminders or cues to the individual to inform them that there is something that they have to act upon. McDaniel and Einstein also claim that the processes supporting retrospective component allow individuals to retrieve information associated with the cue from memory, providing them with the relevant information to complete the task. To support the retrospective component, Multiminder relies on the user to input the context information into the system so that it can later be relayed to them at the appropriate time. An example of Multiminder supporting both components would be a text reminder with an accompanying audio alert issued at 10am to remind the user that they have a lunch appointment in town at 1:30pm.

Time-based PM is particularly sensitive to ageing (Driscoll et al., 2005) therefore it is necessary that Multiminder successfully supports this process. Firstly, Multiminder provides a current time display that the user can view. The user can also set a reminder in the calendar for future tasks that will be issued at a specific time. The timer also allows the user to set a reminder to be issued after a specific amount of time has passed. Multiminder supports event-based PM by providing cues in the form of text reminders to the users to prompt them to perform a particular behaviour. Examples of these cues include the written memos, calendar messages and timer labels that the user previously entered.

Dobbs and Reeves (1996) suggested that the processes involved in PM include; meta-knowledge, planning, monitoring, content recall, compliance and output monitoring. The aim of Multiminder is to act as a compensation system, supporting PM and independence in the home without the older adult becoming over-reliant on the system. Therefore Multiminder will support most but not all of the elements involved in the PM process, allowing the user to independently make changes to their schedule and decide the level of interaction they want with the system encouraging and inter-reliance between the user and Multiminder. The framework that was introduced in Chapter 1 to guide the design of Multiminder can again be displayed (see Figure 14) to show the relationships and processes involved in PM when using Multiminder as a memory aid.

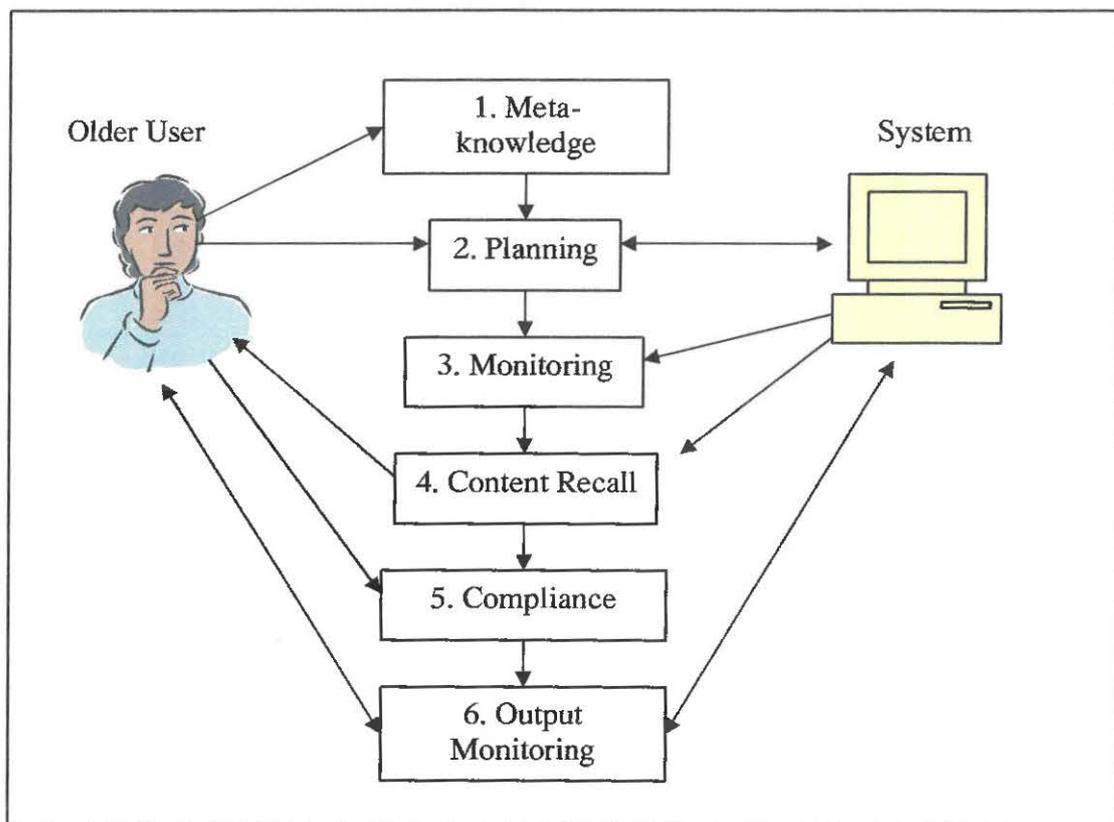


Figure 14: Model of Prospective Memory Process with System, Adapted from Dobbs and Reeves (1996)

To examine whether the processes involved in PM, according to Dobbs and Reeves, are supported by Multiminder, each step will be considered:

- 1) *Meta-knowledge (general knowledge about tasks of remembering and personal knowledge about abilities and behaviours)*: The older adults that participated in the research methods all claimed to use external aids to help them remember. This implies that older adults feel a need to support their PM with an external aid. Meta-knowledge therefore predicts whether the user feels the need to use Multiminder and to what extent. To support this element of PM, Multiminder allows the user to set different levels of reminders from passive messages on the calendar or memos, to reminders issued with an adjustable alarm and text message with a choice of font colour (e.g., black or red) depending on the task's perceived importance.
- 2) *Planning (construction and implementation of a future plan)*: Multiminder supports the older user to plan a PM task by helping them to organise their time through access to the calendar and the ability to write to-do lists on the memo pad and also by providing information in the calendar about the user's previously made appointments for future dates.
- 3) *Monitoring (remembering at the appropriate time or event that a task is to be done)*: Multiminder monitors the PM task for the individual and issues reminders and cues at specific times or after a certain amount of time has passed so that the user can perform the task at the required time. The advantage of Multiminder over traditional external strategies is its ability to monitor the PM task. For example, one problem that participants found with paper external aids was forgetting to look at it to see the reminder. Multiminder on the other hand attains the individual's attention through text and audio alerts.
- 4) *Content Recall (remembering what is to be done)*: The older adult using Multiminder is reminded about the content of the PM task through the recall of information that the user wrote into the system about the task. These are usually key words that the individual uses to remind them about the whole content of the task. For example, an individual could write the message "leave car to M @ 2" which would prompt the user's memory to leave their car to the mechanics for a service at 2 pm.

- 5) *Compliance (one's willingness to execute the task)*: Older adults, like all individuals, can choose to change or cancel their plans depending on their mood or present circumstances. Multiminder would not influence the user's willingness to execute a task, however it would support the user's ability to plan the task efficiently so that they are prepared to make a decision about its execution and it also allows the user to postpone a reminder if they feel that they would be more compliant to complete the task at a later time or date.
- 6) *Output Monitoring (remembering that the task has been executed)*: Multiminder does not monitor the user's actions and therefore does not have the ability to recognise whether the task can be completed. However, the user has the option to interact with their written message or memo after the event to make a note about the task's progress. This could be simply editing a memo by crossing off a message or putting a tick beside it to show that it is completed. This can also be done by editing a message on the calendar for the user's future reference, such as writing the results of a doctor appointment beside the previously issued reminder message to go to the doctor.

4.6. Summary of Design Concept

In this chapter the profile of a typical user of the proposed system, Multiminder, was identified. Example personas and scenarios were presented, outlining the characteristics of a potential user and the PM tasks that they might carry out that could be supported by Multiminder. It was outlined how the themes identified in the Needs Analysis chapter would be incorporated into a practical PM aid solution. Finally, the current chapter identified the components of PM that Multiminder would support and the stages of PM that it would be responsible for. The next chapter concentrates on the further development of this concept and describes in detail each memory strategy that Multiminder offers and the design features that accompany them.

CHAPTER 5: PROTOTYPE DEVELOPMENT

5.1. Introduction

This chapter describes how the design features of Multiminder were identified including the hardware and software needed and the memory strategies that were chosen to support the user. An outline of the system's visual displays is also presented. This development of an interactive version of the design represents the third stage of the interaction design (see Figure 15).

A prototype is a low level model of a design, built to test the function and feel of the design and to identify any flaws at an early stage (Preece et al., 2002). To aid the development of an interactive prototype a task analysis approach was undertaken. This process was used to investigate the rationale and purpose of the memory strategies, what the user would be trying to achieve and how they would go about achieving it.

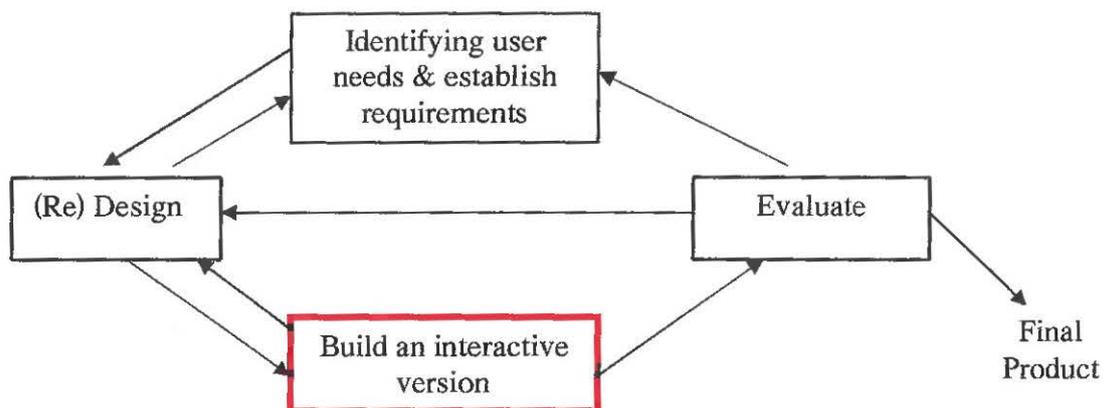


Figure 15: Interaction Design Lifecycle – Stage 3 (Preece et al., 2002, p. 186)

5.2. Hardware and Software Components of Multiminder

5.2.1. Hardware Components

The Multiminder prototype was designed for use on a Tablet PC with a touch screen pen. It was proposed that the fully developed system would be set on a bracket in the user's home and displayed as an alternative to traditional paper calendars. The user would interact with the system via the touch screen pen. Ideally future prototypes of Multiminder would

be stand alone technologies, rather than working from a PC. This would mean that it could be developed as an inexpensive and physically lighter system as it would have reduced technological specification.

5.2.2. Software Components

Multiminder was designed using packages such as Adobe Illustrator CS and Macromedia Flash 8. These packages would be used to support database and schedule application. Recent schedulers designed using Flash includes Jason Hickner's Schedule Plus, developed for Digital Kick (Hickner, 2007) and the Conference Room Scheduler created by QSI (2005).

5.3. Multiminder Design Features

5.3.1. Vertical Navigation Menu

Multiminder is an electronic PM aid that makes use of multiple reminder strategies for older adult users. These strategies include a calendar, a memo pad, a phone book and a timer. Each strategy is one that is used regularly in older adults' homes but display problems that could be eliminated using Multiminder. Options to use these strategies can be found on the vertical navigation menu on the left-hand side of the Multiminder screen (see Figure 16). This menu is ever-present throughout the system's structure, adjacent to the main body of the page, as suggested by Nielsen and Tahir (2002).



Figure 16: Vertical Navigation Menu

5.3.1.1. Calendar

There is no doubt that calendars are a necessary external aid for all individuals to support PM. All of the older adults that participated in the interviews had at least one calendar in their home which they used and it was actively demonstrated in the observations that the calendar was needed to support the participant's memory for dates. However the participants found problems with paper calendars that they were using, such as difficulty hanging it on the wall, finding it awkward to view different months, forgetting to check it and it not being practical to store. A practical example of one of these problems

occurred while conducting the interviews in the older adult's home where it was also observed that the participant's calendar had fallen to the wrong month and the participant had consequently forgot their grandchild's birthday. These problems are essentially solved, for the average technology user, with calendar applications, such as those found on mobile phones or the internet (e.g., Google calendar). These applications are not designed with the older novice user in mind however, and it is impractical to reason that older adults should be encouraged to learn computer skills to use these applications when they feel they have no need to. These were the main reasons why a calendar was chosen as part of the Multiminder system.

The Multiminder Calendar is the systems main reminder strategy as it is the one most frequently used in the home of older adults. It was designed to combine the positive features of traditional and electronic calendars. Therefore past and future dates can be viewed ranging several years without the burden of physical storage. The users can view past and previous months by simply selecting the appropriate arrows in the Calendar section or the related text beside the arrows. The 'next' month to the month on the main display can be viewed on the left hand side of the screen so that the user can easily follow from one month to the next. A function that was available on the Microsoft Works calendar (see Appendix D) that would also be useful to older adults using Multiminder was the ability to select the month's title above the calendar dates, resulting in a drop down menu of the years twelve months. This would provide the user with easy access to any month of the year. The user can return to the present month by selecting 'Calendar' from the primary menu. It was considered whether to include a button to return to the current month on the horizontal navigation menu, however, Nielsen and Tahir (2002) advised not to have multiple navigation routes for the one function on the same screen, therefore this idea was discarded.

In order for the user to be issued a reminder, they firstly have to set the reminder. The user can do this by using the pen to select a day. A second screen appears as a result of this action. The user can change the date on this screen or cancel and start again if they realise they selected the wrong day. They can then write a handwritten message into the space provided, like they would with a paper calendar. Just by doing this and saving, the message will appear on the calendar in the appropriate day's box. To set a text and audio reminder

however, the user would have to choose a time for the reminder to be issued. The user can also choose to change the alert tone if the audio output does not suit them (some may prefer a discreet alert and others a more persistent alert). For very important reminders the user can choose to write their message using red coloured font and adjust the audio output that they are sure would gain their attention.

The user has the option to repeat reminders, such as weekly reminders to put their bin out for collection or annual reminders for their grandchild's birthday. There is also the option to set a pre-reminder, so for example, if it is their grandchild's birthday they can set the pre-reminder for a few days in advance to give them time to buy a present and then the reminder will be issued again on the day of the birthday.

There is also the option, once the reminder is issued, to postpone it for a later time. An example of where this feature would be useful would be if a reminder was issued to buy a present but the user was not going to the shops for another few hours and does not want it to slip their mind, the reminder can be postponed and issued again closer to when they are going out. Once reminders are set the user has the option to view it (if they need to see it bigger), edit the details of the reminder or delete it altogether.

5.3.1.2. Memos

The Memos section is designed as a temporary reminder aid to be used by users as notes to themselves or for other people in the home. The traditional equivalent would be sticking memo notes to the fridge or writing a note and putting it on the table or another conspicuous place. Problems that participants found with this method were that the notes looked untidy, were lost and failed to remind the intended person or fell from their displayed position and failed to remind them. The advantage of the electronic memos is that messages can be written and viewed in the one position, does not look untidy and cannot be lost unless intentionally deleted.

To use the Memos section the user selects memos from the vertical navigation menu. Previously written memos can be viewed in the main section of the screen. Memos are listed with the most recent at the top of the screen and each memo can be edited and deleted separately or collectively deleted. When the memos are not displayed on the main section of Multiminder, they can be viewed from the small Memos section on the left-hand side of

the screen. Users may want to keep the memos on the main screen if the message is important.

To add a new memo the user only has to select the 'Add a Memo' button, write their message and select 'Save'. It is intended that memos are deleted when they are not needed and would not be stored in the system as this reminder strategy is usually used for reminders that are only relevant for that time and stored memos would potentially create a build up of unnecessary information.

5.3.1.3. Phonebook

The third memory strategy in the Multiminder system is the phonebook. Electronic and paper phonebooks are widely available to the general public in the form of mobile phones, digital house phones and paper contact diaries. The interviews with older adults showed that these participants were most likely to use paper diaries to store contact details. Some of the participants felt that automatically selecting a contact to ring without looking at the number "*makes memory lazy*" and there is also the risk of losing the numbers that are stored in a phone or book. The Multiminder phonebook was designed with traditional public phonebooks in mind, where the user can find a number by going to the relevant letter in the alphabet and the contacts are divided into personal and business numbers. Participants in the interview method said that they were more likely to look in their contact diaries to remind them of irregular numbers such as people who provide services for them (e.g., gardener). Dividing personal and business contacts means that the user's business contacts would be easier to retrieve compared to other electronic phonebooks or paper contact diaries, in that the user simply selects the letter that the contact is stored under (e.g., relevant to their name or trade). Users can add a number through the appropriate section and write in the contact details using the touch sensitive pen and saving the information. This information can then be edited or deleted when needed.

The advantage of the Multiminder phonebook over a paper method is that the numbers can be entered through a simple step-by-step system and any mistakes that are made can be undone. They can also be edited or deleted without the messy scribbles of paper contact diaries. There is less risk of losing contact information as the system is stationary in the home and the user has to view the number in order to dial it into the phone,

therefore making use of their working memory skills that some participants were afraid of losing and a large number of contacts can be stored into the system. The contact details can additionally be accessed by simple selecting the letter the contact is stored under in either the personal or business section.

5.3.1.4. Timer

A timer is a reminder strategy that may not be used as frequently as other strategies, but is invaluable when it is needed. In the qualitative research methods it was observed that older adults most likely used a timer for cooking in their home. It was also revealed that older adults sometimes have difficulties learning how to use their oven timer and learn through "*trial and error*". Other problems that were observed related to the physical aspects of oven timers, where a participant who already had hip problems had to bend over to see the oven timer as her oven was positioned at a low level. This is an example of the restrictions of current timers.

The Multiminder timer was designed as an easy to use and easy to access timer for older adults. The user simply keys in the amount of time they need before reminding in the Timer section and selects 'Set Timer'. An added advantage of this timer is that the user can adjust the volume of the audio output to accommodate any hearing difficulties they may have or to allow them freedom to move around the house without the fear of missing the alarm. Timers can be deleted or edited from the Timer section.

There are often instances, as observed from the multiple tasks that the participants were involved in throughout the observations, where several timers may be needed. For example, a person could be cooking chicken for 20 minutes and pasta for 15 minutes on the hob and have bread in the oven for 60 minutes. Multiminder allows the user to set multiple reminders to accommodate for situations where more than one thing needs to be timed. If multiple reminders are being issued however, the user might get confused about what alarm is going off for what item. Therefore, the user has the option to write a label along with the timer before they set it. Once a timer is set, feedback is displayed in the left-hand side of the screen in the small Timer section. The Timer section can also be accessed from this area. The timer alarm is issued in the form of a text alert using the appropriate blue colour coding along with an accompanying audio alert.

5.3.2. Horizontal Navigation Menu

The horizontal navigation menu (see Figure 17) is also a constant display in Multiminder with optional functions depending on the user's requirements. This menu can essentially be broken down into three categories; reminder summaries, help information, and sensory control. The self explanatory option button 'Today's Reminders' allows the user to view a list of the reminders that were preset for the current day. This means that the user can easily see what they have planned and what reminders to expect. It also allows the user to see more clearly their reminders if there were too many to fit in the calendar space provided. Memos and timers that are relevant for the current day will also be displayed on this screen.



Figure 17: Horizontal Navigation Menu

The button 'View Reminder List' provides the user with the option to view reminders from any past or future date. The user can select the date, month or year that they want to view to see what notes they had made. This function means that the user can compactly store past calendar years without taking up the physical space of paper calendars. From the interviews it was found that older adults sometimes like to store past calendars to keep a record of medical appointments, therefore it is predicted that this function would be found useful, *"I keep them for a while after the year is gone and I can look back to see what I did at that time. It keeps a record"*.

The Help option is also available on this navigation menu where is it clear and easy to see if the user gets into any difficulty using the system. The Help option is very important to older adults, as discovered with the focus group sessions. When the user selects 'Help' they would have the option to (1) view the introduction demonstration which would give them a summary of the systems functions and how to use them, (2) help for the screen that the user is on, or (3) select what section they would like help for.

The third category is for the user's sensory functions. These buttons allow the user to increase or decrease the systems text size and volume output. The ability to change the text size means that the user can interact with the system without being restrained by visual difficulties. The user can adjust the text size to their needs. Similarly, the user can change the volume of the audio output depending on their hearing abilities. There is also the option for the user to temporarily increase the volume if a timer is set and they are not staying in the room when a timer alert is issued so that it can be clearly heard.

5.3.3. Primary Display

The primary display takes up the majority of the screen space (see Figure 18). It is intended that the Calendar section be displayed on Multiminder while the user is not interacting with the system, or has not chosen to display a memo on the main display. Features that are also present include the current time and date.



Figure 18: Multiminder with Primary Display

5.3.4. Secondary Display

The secondary display can be found on the left-hand side of the Multiminder screen. This section is comprised of three parts, a calendar displaying the next month to the current month, a memo pad displaying the memos that were entered into the main memos section and a timer display showing the timers that were set and are currently active along with the optional accompanying timer label.

As the information is entered, deleted or edited, the information of the secondary displays will also be updated. The purpose of the secondary display is so that the user has the option of seeing what reminders they have set within the system, while also being able to view the calendar on the larger display similar to traditional paper aids.

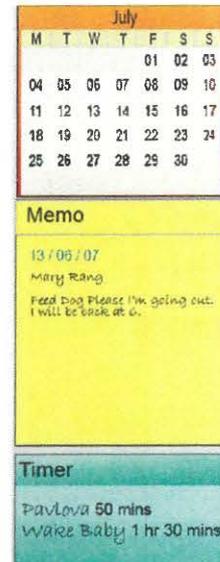


Figure 19:
Secondary Display
of Multiminder

5.4. Task Analysis

Task analysis can be defined as the study of what an operator is required to do, in terms of actions and/or cognitive processes, to achieve a system goal (Kirwin & Ainsworth, 1999). According to Kirwin and Ainsworth, task analysis is used when designing a system, evaluating a system design or if a particular human-machine system performance problem has been targeted to be analysed and resolved. A task analysis explores what the users do to achieve their task goals, what personal, social and cultural characteristics the user brings to the task, how the users are influenced by their physical environment and how previous knowledge and experience influence how they think about the task. It also uncovers the workflow the user follows to perform a task and what users value most in a system, such as speed, accuracy and ability to recover from errors (Hackos & Redish, 1998).

A task analysis was carried out to gain a further understanding of how potential users would perform their PM tasks using Multiminder. This was an iterative process where initial information obtained earlier in the research such as the interview, observation and focus group sessions was incorporated into the analysis, and then information obtained from the prototype testing further contributed to a more precise idea of the user task process.

The approach used was hierarchical tasks analysis (HTA), an approach which encourages the establishment of the user goals, tasks and sub-tasks through hierarchical

operations (Preece et al., 2002). The tasks that were identified and studied were: (1) setting a reminder on the calendar, (2) writing a memo, (3) adding or editing a phone number, and (4) setting a timer (see Figures 20, 21, 22 & 23). A tabular format of these HTAs can also be found in Appendix F. These tasks were chosen because they are the primary tasks for each memory strategy within the Multiminder system that requires a higher level of interaction between the user and the system compared to other tasks such as viewing reminders.

The task flow diagrams assisted in providing a clear understanding of the actions and processes required of Multiminder to help users achieve their task goals and to ensure that there was a valid use for each interface task option and a follow up screen for each option.

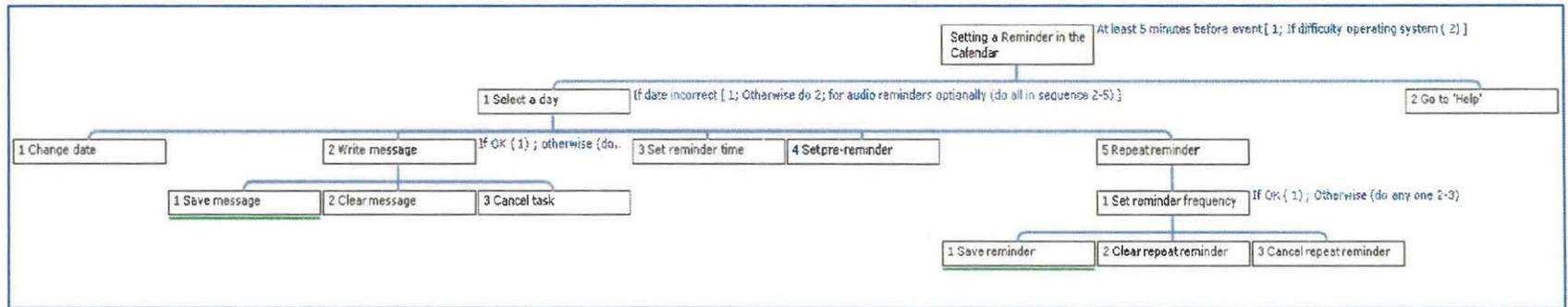


Figure 20: Hierarchical Task Analysis for Writing a Reminder into the Calendar

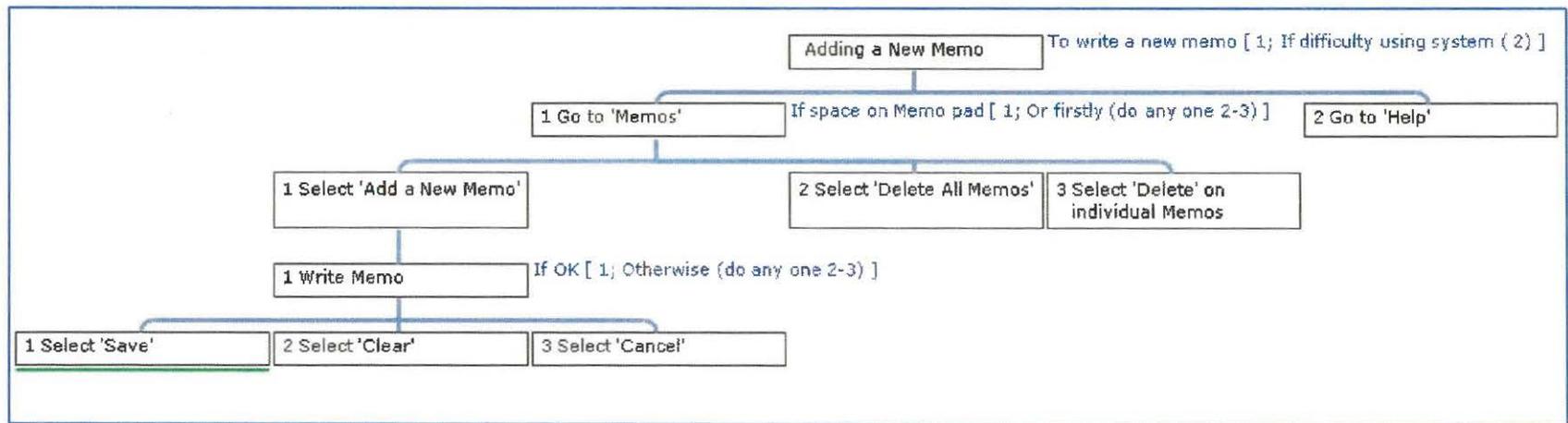


Figure 21: Hierarchical Task Analysis for Writing a New Memo

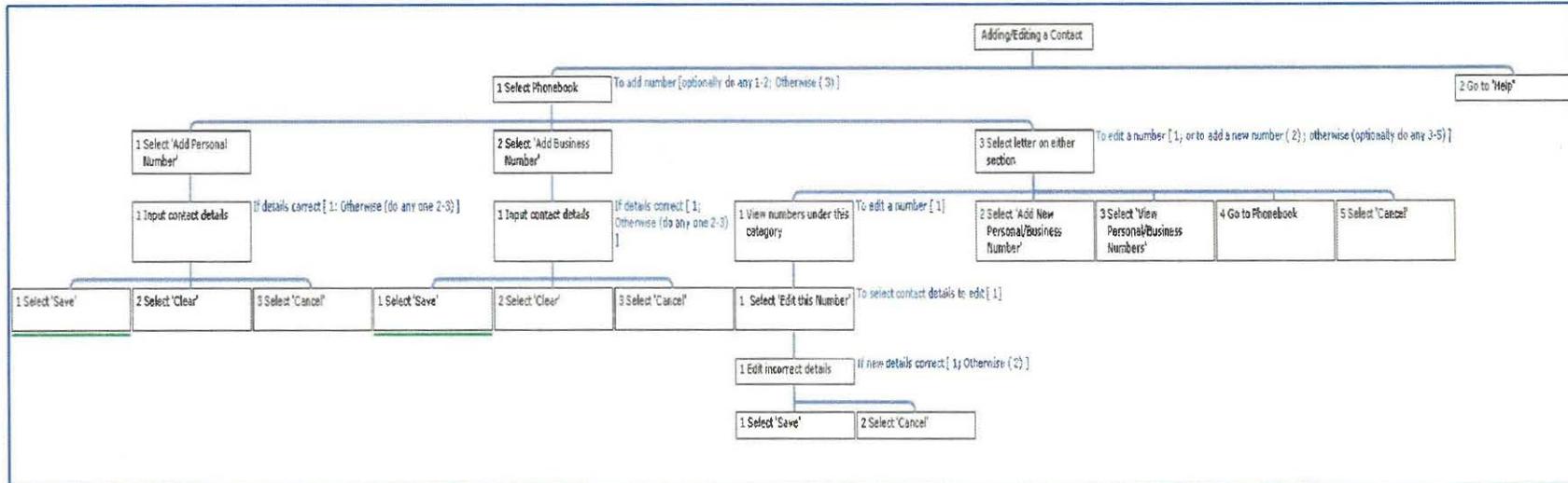


Figure 22: Hierarchical Task Analysis for Adding and Editing a Phone Number

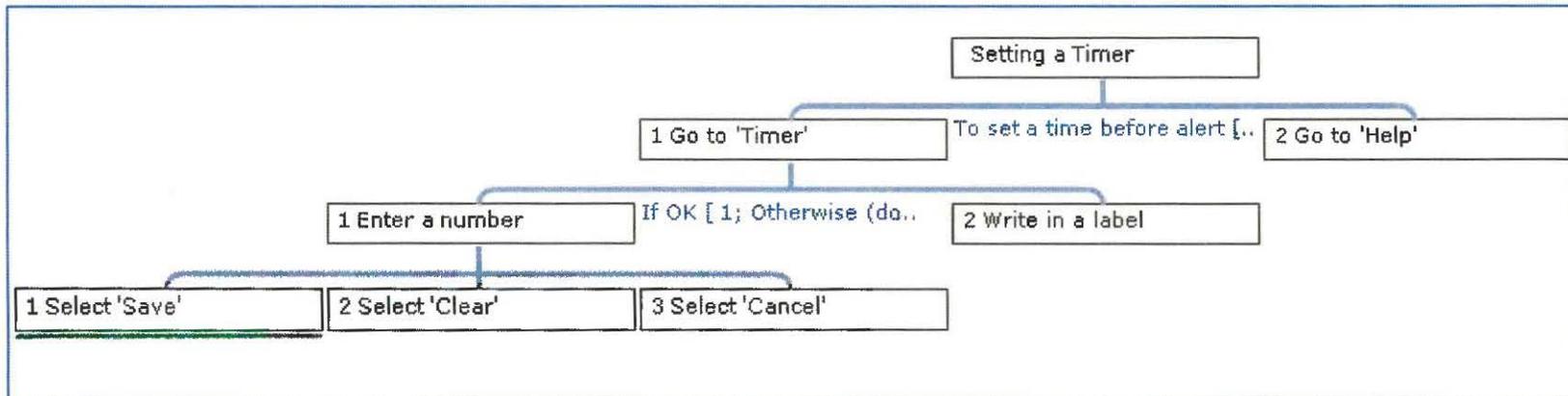


Figure 23: Hierarchical Task Analysis for Setting a Timer

5.5. Summary of Prototype Development

The purpose of this chapter was to provide an illustration of the design features and tasks associated with the Multiminder prototype. The memory strategies that were chosen to be included in the system were a calendar, a memo pad, a contacts section and a timer. These memory strategies were included based on the findings from past research (Brown et al., 2004; Cohen-Mansfield et al., 2005) and the present research (interviews, observations and focus group methods). The system's design features were also included taking into consideration past and the present research, from the use of text as opposed to icon links (Nielsen & Tahir, 2002) to the use of text size and volume options (Foos & Clark, 2003), supporting the abilities and limitations of the older user.

These design features were used for the development of interactive versions of Multiminder. The first version was a paper prototype which was introduced to a sample of older adults, tested and evaluated. This information was used to modify the design and to build a second version of Multiminder which was tested and evaluated with another sample of older adults. The prototype test procedure will be discussed in the next chapter.

CHAPTER 6: PROTOTYPE TESTING

6.1. Introduction

The previous three stages of the interaction design process focused on reviewing past research, using qualitative methods to investigate older adults' needs and preferences and developing the design concept of Multiminder. The fourth stage of the process is evaluating the designs (see Figure 24). The user-centred approach is iterative and therefore the design to be evaluated depends on the stage of development. This chapter describes the prototype testing of Multiminder. Initial paper prototype testing led to the redesign of the system and the development of a higher fidelity touch screen prototype which was tested again, yielding further design recommendations. Jacob Nielsen (2003), usability expert, states that “the benefits from early usability studies are so vastly superior that you should definitely use paper prototyping, even if you don't think the prototype will be as good as testing a fully developed design” (Why Paper Prototypes Save Money section, para. 4). Further iterations of these three stages would eventually lead to a fully working design that could be used by the public older adult population.

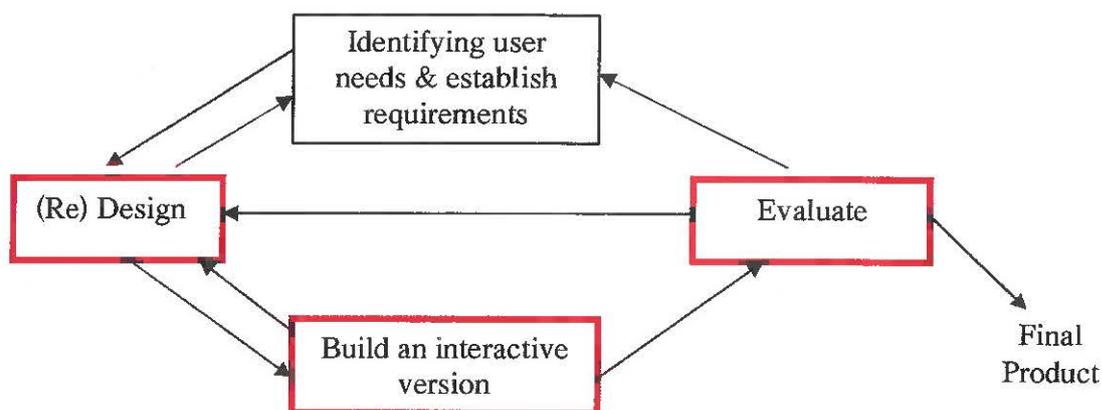


Figure 24: Interaction Design Lifecycle – Iteration of Stages (Preece et al., 2002, p. 186)

6.1.1. Prototype Testing Participants

The participants involved in the prototype testing were a sample of older adults aged between 60 and 89 years. The majority of the participants recruited had already participated in the previous interview method. There were five participants (average age of 75 years) in

the paper prototype test session and seven participants (average age of 70 years) in the working prototype testing (three single user tests and two double user tests). Supporting these user test numbers, Nielsen (1994) recommends using between three to five subjects per testing group for user testing to simplify the testing while providing the same benefits of a more elaborate test with large test groups.

To ensure that the participants' rights and safety were protected, the prototype testing methods were examined and approved by the Psychology Applied to Information Technology Ethics Committee (PAITEC) of the Department of Learning Sciences at IADT Dún Laoghaire. It was important that the participants were aware that they could discontinue the testing at any point particularly for inexperienced technology users who may be anxious using new devices.

6.1.2. Prototype Testing Tasks

The prototype test procedure involved giving the participants a set of tasks to do using paper screens followed by a series of feedback questions (see Appendices H2 & H3). The participants were given a ballpoint pen to act as the touch screen pen, which they were told could be used to interact with the paper prototype screens (see Appendix G4), for selecting options and writing in notes. A task-based think-aloud protocol was employed, where the participants were asked to vocalise their thought processes while carrying out the tasks. They were also asked to vocalise what click pattern (the series of buttons selected) they were taking to navigate the system and what they found surprising or confusing. The tasks included scenarios which required the use of each of the system's main sections, and also additional functions such as changing the text size and using the Help option. These tasks were a progression from the tasks analysis presented in the previous chapter, representing the primary tasks and goals that the user might use the system for (testing documents were adapted from UTexas, 2007, sample documents). The task scenarios were as follows:

- Task 1 - You need to set a reminder so that you will be reminded to put your bin out every Wednesday. What steps do you think you would take to do this?
- Task 2 – You are going out and want to leave a message or memo for someone in case they call in to say where you are. What steps would you take to complete this task?

- Task 3: You have difficulty reading the text. What button would you press to change the size of the text?
- Task 4: You can not remember how to look at stored reminders that were made in the past. How would you find information about how to do this?
- Task 5: You have just employed a new house cleaner and want to store her number so that you will not forget it. What steps would you take to complete this task?
- Task 6: You are cooking a roast chicken that will not be ready for another hour. How would you go about setting a timer to alert you after this time had passed?

The test facilitator was responsible for issuing these questions and changing the sequence of the screens appropriate to the participant selections. The follow-up interview included questions referring to the systems layout and navigation, best and worst features and whether people would have problems using it.

6.2. Phase 1: Paper Prototype Testing

6.2.1. Paper Prototype Test Procedure

The paper prototype testing, like previous methods in this study, was conducted in the participants' homes. A pilot test session was carried out prior to this and no problems were found with the materials and questions. The pilot test also indicated that the test session would take approximately 20 minutes to carry out.

Before beginning the prototype testing the participants were asked to read and sign a consent form (see Appendix G1). It was then explained to them what the concept of Multiminder is, how they can interact with it and the purpose and procedure of paper prototyping. The observations and verbal comments were recorded using note-based materials. A voice recorder was also used as a reference (i.e. the test sessions were not transcribed) to ensure that key points were not missed.

The participants were brought through the prototype test procedure consisting of the tasks scenarios and the follow up interview. The paper screens were placed in front of the user and the user was asked what actions they would take for each task scenario. The test facilitator manually changed the paper screen to the next screen as the participant indicated their selections.

6.2.2. Results of Paper Prototype Testing

The purpose of the paper prototype testing was to record the user's observation click stream (the series of buttons that were selected), their verbal comments, any suggestions to make the task easier and how difficult the task was for the user on a scale of 0 to 3 (0 referring to the user having no difficulty to complete the tasks, 1 for the user having minor problems, 2 for the user completing the task but requiring more time/effort than expected, and 3 referring to the user not completing the task; UTexas, 2007).

The results from this rating may not represent the users' true difficulty however. For example, tasks 1 and 2 were rated overall as being the most difficult but observations and user comments show that the participants found more problems with task 5. This could be that the user had learnt the layout of the system throughout the testing period.

The observations from the task-based testing exhibited more reliable results and the participants readily offered opinions concerning the areas they did not like or found confusing. The information gathered was very useful and generally consistent with each participant. Although a number of problems were found with the design, the overall feedback about Multiminder was very positive.

6.2.2.1. Computer Terms

The participants had various levels of technology experience which meant that some of the terms that were used in the design of the system or in the test procedure were ambiguous to those who had little experience, participants stating "*I'm stupid about these things*", and "*I don't understand computers*". Some of these terms included 'Select', 'Contacts' and 'Save'. The usability terms were explained to the users and were readily accepted, however it was decided that an alternative term would be used in place of 'Contacts', as more than one participant stated that "*Contacts doesn't mean anything to me in that sense*" (older participant, personal communication, September 12, 2007).

6.2.2.2. Calendar

The task to set a reminder on the calendar was the first task in the paper prototype testing. Therefore there were some hesitations and confusion observed that was not present in the later tasks, such as knowing to save all the inputted information. The users were not

told to do specific tasks, such as asking them to set the reminder to go off at a specific time. Therefore, most of the participants did not show that they would enter a time for the alert, but this is not necessary for the completion of the task. The participant was more likely to (pretend to) write the time for the alert in with their task message. They did select the option to be reminded before the event though. When asked to repeat the reminder, some of the users spent some time looking for the option and one looked outside the pop-up screen to the primary screen. It was decided that these issues may be rectified by simply using numbered steps at each input stage.

6.2.2.3. Memos

The Memos section posed the same problem for most of the participants when asked to add a memo. The participant was asked to demonstrate how they would write a new memo using Multiminder. The problem that they experienced was that they simply did not see the button to 'Add a Memo', and were more likely to go to write on the screen that displayed the previously written memos. It was suggested that the button be displayed in a more prominent position, "*I think if it was bigger and down here (on the memo pad) it would be clearer*" (older participant, personal communication, September 17, 2007).

6.2.2.4. Contacts

The Contacts section probably caused the most confusion for the participants when they were asked to add a contact as part of the testing. Firstly, two of the participants said that they would not know what the term 'contacts' meant in the context of adding a phone number, "*No 'contacts' wouldn't be obvious. 'Phonebook' would though*" (older participant, personal communication, September 12, 2007). The term 'contacts' is used to label the phonebook in applications such as mobile phones or email services, however it is now evident that this term is not used ubiquitously in this context. Another area that was vague to the participants was the use of the term 'Services' to describe the Contacts section for storing numbers for people who provide them with a service (e.g., hairdresser or gardener).

The participants were asked as part of task 5 what actions they would take for entering a new contact's details into Multiminder. Some of the problems that were revealed

from the Contacts section were 1) that the users tried to use the displayed alphabet to type in contact name (meant for viewing contact details stored under particular letter), 2) did not see the button for adding a contact, or 3) looked directly for a space to add in a number. In the case of the last problem, it can be seen how prior learning can interfere with using other applications, as this participant claimed to be used to regularly using the quick option on a mobile for adding a contact where you can type in the number, save and then add in the contact name.

When on the 'Add a Contact' page the users were likely to be confused by the first step or skip to the second step. This problem will be discussed in more detail in the 'Buttons and Labels' paragraph below. Also regarding this screen the participants thought that there were too many items on display, *"That's too much, information overload there. If you're confronted with too much you would get confused"* (older participant, personal communication, September 17, 2007). It was decided that many of these items could be removed.

6.2.2.5. Timer

There were no problems observed during the task designed to set a timer in the Timer section. None of the participants used the label option during the task, which is not mandatory to the task completion anyway. It was later explained to the participants that the label would be used with the timer alert to help notify them as to what they are being alerted to. All of the participants apart from one said that they would find this very useful because, as one noted, *"You can have more than one thing in the oven"* (older participant, personal communication, September 11, 2007). It was also observed that the button 'Set another Timer' was a redundant item and unnecessarily cluttered the page.

6.2.2.6. Buttons and Layout

It was observed throughout the testing that the participants, especially those who claimed to have never used computers, spent some time looking around the page to see what buttons they thought were appropriate to select. Although experience may have helped the participants to find the options quicker, the feedback from the think-aloud

protocol and end questions helped to establish that the button size and button colour was a major factor.

The vertical navigation menu containing the options 'New', 'View', 'Today', 'Delete', 'Help' and text and volume controls were coloured using a darker shade of grey to the background colour. Although the participants found the options on this section quite quickly, some of the comments made were, "*These aren't coloured at all here*", and "*My eyes didn't focus on them*" (older participant, personal communication, September 17, 2007). The participants also thought that the 'Help' and 'Save' buttons should be made more prominent as they would be important options for them, "*I wonder should you have 'Save' as the one colour throughout the whole thing because it would be very important*". It was also suggested, with some humour, by two participants that the 'Help' button be displayed using a red colour so that it is clear to see in case of technology emergencies.

The participants were asked in task 3 what button they would press to change the text size. Although all of the participants pressed the correct button on the paper prototype, they said that they were confused about whether it was to increase or decrease the size. It was suggested that a plus and minus option be included on the button.

It became obvious throughout the testing that some of the buttons that initially were thought to give the user an extra option for doing a task (allowing them more than one way to set a reminder, for example) were only confusing the users and were not needed. These included the buttons 'New', and 'Delete', "*I didn't know what 'Today' meant. What does 'New' on the calendar mean?*" (older participant, personal communication, September 12, 2007). The terms 'View' and 'Today' also proved to be vague, however when it was discussed with the users as to their intended purpose it was decided that they would be useful but a new name would be needed for them.

Other problems that were observed were that the users did not input information (observed by the user selecting the area on the paper screen) in the sequence that was laid out on the screen. This issue was discussed with the participants and it was suggested that numbering the steps would help them to do the task in the correct order. Also in the case of the Contacts section, it was suggested that the order of the steps be changed, putting the written information to be entered first as this was the section all the participants jumped to. One of the participants also mistakenly thought that step 1 was needed to input information

into step 2 (using the alphabet option which the contact is supposed to be stored under to type out the contact name, rather than using the pen to write the name). Therefore changing the sequence of these steps could eliminate numerous problems.

6.2.2.6. Positive Feedback

The feedback that was obtained from the participants was very encouraging and reinforced the idea that Multiminder would be welcomed and of benefit to the user's lifestyle and PM. Some of the reasons that the participants gave for liking Multiminder were that it provided multiple services in the one system and could be easily accessed in their home, *"I think it's marvellous that its all there for you"*, *"It's very compact and it does the important things"* and *"It's wonderful. I think it would be wonderful because you could have it here where you would use it"* (personal communication, September 11, 2007).

The participants also found it easy to use and navigate, despite the problems described above, *"It's very straightforward. I think it would be good if you were shown how to use it first"* (older participant, personal communication, September 11, 2007), *"I think it's easy enough when you understand it, its quite easy, if you were shown at the start how to use it"* (older participant, personal communication, September 17, 2007), *"I think its useful and I think if it was cheap enough it would be great, I'd buy it"* (older participant, personal communication, September 12, 2007). It can be seen from these comments that issues such as learning how to use the system initially and the cost of the system are important factors for older adults when using new technologies, information that was also found in the qualitative data-gathering methods.

The participants claimed that they would find different sections of Multiminder most useful, *"As far as I'm concerned it would all be very useful. Maybe the calendar would be the best"* (older participant, personal communication, September 11, 2007); *"I'd use the timer the most"* (older participant, personal communication, September 17, 2007). This shows that it would appeal to different peoples' individual lifestyles and preference of memory aid strategies. The participants also stated that they would find Multiminder useful because it would *"Remind [them] to do things"* (older participant, personal communication, September 11, 2007). This is the most important feature of Multiminder as it is designed to compensate for PM decline.

The advantages of conducting the prototype testing in the participants' home were that the participant felt comfortable to spend time on the tasks and to talk about their own experiences. For example, one participant was impressed that Multiminder would allow the user to store calendar information from past months and years as she stored paper calendars from past years and found that they took up too much space and were difficult to look through. She said, *"The calendar would be great to look at notes from a few years back because it would save you holding onto previous calendars. I've had calendars and it was only the other day that I was rooting through them because my husband needed it for the tax, and I'm the one who has to do all that. It was information from 2005 he needed. But you could have everything on this calendar"* (older participant, personal communication, September 17, 2007).

Another advantage of testing in the home is that the researcher can observe problems that occur naturally that would not be observed in a testing room. For example, when entering the home of one of the participants. It was obvious that there was an oven timer alarm going off in another room, presumably the kitchen, but the participant did not show any reaction to this. She simply could not hear it. This is an example of how a volume option would be useful with a timer for individuals that are hard of hearing or may be at a distance from where the timer is based.

6.2.3. Modifications to Paper Prototype

6.2.3.1. Calendar

- Included instructional steps for each task
- Used a background colour behind the days of the week to make them stand out from the other sections of the calendar

6.2.3.2. Memos

- Repositioned and resized 'Add a Memo' button
- Made small memo pad a link to Memos section

6.2.3.3. Contacts

- Changed the title 'Contacts' to 'Phonebook'

- Removed 'Edit' and 'Delete' buttons from Phonebook
- Resized 'Add a Personal/Business Number' buttons
- Removed alternative section from 'Add a Number' screen to only show working section (i.e. only shows personal options if adding a personal number)
- Removed alternative section when viewing a number (was previously a smaller section to the side)

6.2.3.4. Timer

- Included instructional steps for each task
- Removed 'Add Another Timer' button
- Resized 'Set Timer' buttons to make it more prominent
- Changes title 'Current Timers' to 'Active Timers'

6.2.3.5. Buttons & Layout

- Resized and used colour for 'Save' button
- Used separate colour for 'Help' button
- Changed the colour of buttons on horizontal navigation menu to stand out more from background
- Changed shape of text size and volume buttons to resemble those on remote controls and to make the increase and decrease functions clearer
- Changed the titles of buttons 'Today' to 'Today's Reminders' and 'View' to 'View Reminder List' so that their purpose is clearer.
- Coloured the word on title bar according to the colour coded section (orange for calendar etc.)

6.2.4. Summary of Paper Prototype Testing

The think-aloud protocol together with the observations of the paper prototype test participants carrying out the required tasks allowed the test facilitator to distinguish between the design features (including the layout, colours and navigation options) that the older users found easy to use and the features that caused confusion or frustration. The

follow up interview was then used to confirm these observations and to gain an insight into the participant's opinion about the system and whether they would use it.

The main problems that were experienced by the participants were caused by poor colour design, ambiguous button labels and too much information on the screen. These problems were examined and the Multiminder screens were redesigned with the modifications in place (see Figure 25 for example screenshot). This new design was also modified so that it could be used on a Tablet PC, allowing the participant to interact with it in a similar manner to how they would interact with the finished product.

Overall, the paper prototype participants displayed enthusiastic responses to the concept of Multiminder and despite experiencing some problems with the design said that they would find it very useful to have in their home.



Figure 25: Screenshot of Modified Calendar Section

6.3. Phase 2: Working Prototype Testing

6.3.1. Working Prototype Test Procedure

A second testing session was set up with the modifications from the paper prototype testing in place (see Appendix G5). The phase 2 prototype in this test session consisted of the Multiminder screens displayed on a Tablet PC (see Figure 26, Personal Photograph, 2007). The screens were exported from Adobe Illustrator into Flash and certain buttons, such as those needed to carry out the testing tasks, were made interactive. This working prototype was of higher fidelity compared to the paper prototype however it was considered low fidelity in that actions, such as writing in a message, were not possible.

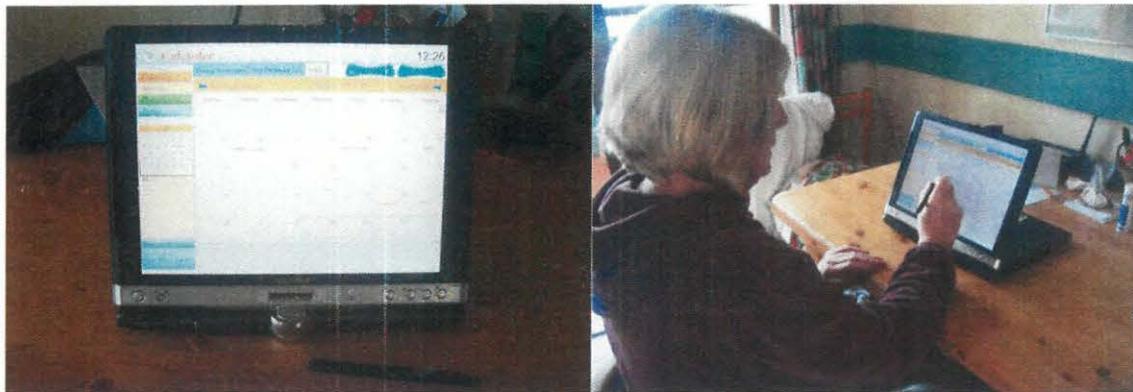


Figure 26: Multiminder Prototype and Prototype Testing

The Tablet PC was adjusted so that the monitor rotated covering the keyboard. The test user interacted with the system using the touch screen pen. The features that were interactive allowed the user to get a feel for how the system would work, how they interact with the system and how to navigate the system.

The test procedure was equivalent to the paper prototype testing in that the test users were given a consent form, an introduction to Multiminder and the test procedure, a series of task scenarios and finished with user feedback questions. The testing was recorded using a voice recorder and written notes were taken. The voice recording was used as a secondary source to verify the written notes. It was necessary on some occasions during the testing to repeat or rephrase the questions for the participants, particularly with the oldest participant.

6.3.2. Results of Working Prototype Testing

Throughout the second series of prototype testing (after three test sessions) it became apparent that the participants were less forthcoming with their opinions about the design; what was confusing them and what they thought should be changed. The feedback from the first three prototype tests was considerably less than the feedback obtained from the paper prototype tests. Various reasons for this were considered, those being that the participants did not feel confident enough to say what they thought, or they genuinely could not think of any problems or suggestions at the time. To ensure that these results were not due to the participant's lack of confidence using computers, two more test sessions were arranged using a co-discovery technique.

Co-discovery testing is a method that uses two participants in the one prototype testing session. In this method, participants are more likely to work on the tasks together, and discuss them with each other (Snyder, 2003; Weimer, 1995). According to Snyder the benefits of using co-discovery testing are that it is more comfortable for the users and more data is obtained from one test session. Therefore it was decided that the co-discovery method be implemented into the second prototype testing phase to ensure that the results from the first three working prototype tests were valid and reliable. As it is thought that co-discovery allows the users to feel more comfortable and more likely to discuss the tasks with the other user, it was interesting to see whether the feedback from the first three users was any different from the co-discovery users. Therefore in the second prototype test group there were five user tests, with three individual tests and two co-discovery tests.

As expected the test users in the co-discovery testing appeared to be more relaxed throughout the session and more vocal compared to the individual test users, discussing the tasks between each other and asking questions about the system and its capabilities that were not covered through the tasks. This said, although minor problems were met, there were not any more or less compared to the previous three tests.

Although the participants were not asked about their technology experience, those who had never used, or rarely used technology, readily offered the information, "*I'm not used to computers*" (older participant, personal communication, September 21, 2007). Following this it was not surprising that the participants said that they would like to have a user manual to learn how to use Multiminder or an introduction demonstration, "*You'd*

have to get used to it, read up about and that. We'd have a great time with it really"; "If I was shown first it would definitely help" (older participant, personal communication, September 26, 2007). The main findings that were as follows:

6.3.2.1. Calendar

The participants were asked to set a reminder into the system to repeat every Wednesday. There were some problems understanding the purpose of the 'Repeat Reminder' function for four of the participants. This is not surprising as they would not be familiar with using devices that would offer this function, such as mobile phones, and would therefore not be aware of the benefits of the technologies, *"I don't know why I didn't see it. I think because I'm not used to computers it would just take a bit longer to find things"* (older participant, personal communication, September 21, 2007).

6.3.2.2. Memos

Like in the paper prototype testing when asked to write a new memo, some of the participants did not see the 'Add a Memo' button in the Memos section and wrote directly onto the memo pad. It is possible that the participants carried out this action because there were no messages on the pad and there was space to write a message. Possibly if previously written messages were displayed on the memo pad, the user would look for an alternative option. It also became obvious that the 'Clear' function was redundant on the memo display screen.

6.3.2.3. Phonebook

The Phonebook section caused the most difficulty for the task requiring the participants to add a new contact. Like in the paper prototype section, some participants tried to use the alphabet to type in the contact name, however this problem was less common (it would also not be possible if the system was fully working as pressing a letter would bring you to the phone numbers stored under that letter) and in one case the user pressed the 'Add a Number' button after typing in the name. This suggests that the layout is clearer compared to the paper test layout. It was later explained to the users that the

Phonebook section is similar to a public phonebook, in that the numbers are stored and viewed under personal and business sections and alphabetically.

The modifications from the prototype testing meant that some of the buttons were removed from sections and repositioned or deleted altogether if redundant. Throughout the testing, it became obvious that an error was made with these modifications. The 'Edit' and 'Delete' buttons were removed from the main page, where they were not needed but were not repositioned to the screen where they would be needed. Therefore these functions were replaced into the 'Viewing Contact Details' screen.

6.3.2.4. Timer

There was no observed difficulty in the timer task with any of the participants for entering in the time and setting the timer. However, like in the paper prototyping, the participants were not familiar with the use of the timer label. When this function was explained to them, the majority of the participants thought that it would be very useful to them, *"That would be handy. If you had a cake and something else cooking it would be very useful"* (older participant, personal communication, September 22, 2007). Other participants thought that the timer label may have been more useful to them when they were younger and had a young family, *"Time was we would have loads on at the same time, I think [the system] would have relevance for all age groups"* (older participant, personal communication, September 25, 2007).

6.3.2.5. Buttons and Layout

In this testing session all of the participants saved the information they had 'inputted'. Even those who had never used computers selected 'Save'. This is a vast improvement from the first paper prototype test group, and may be due to the change in the button's size and colour. Another positive outcome from the previous modifications was the inclusion of the step instructions in each section that required user input. It was observed that the users read through these steps before making any decisions and ultimately used the system in the way that it was designed to be used.

It was suggested by one of the participants that the last few date numbers of the previous month be included into the current month's display, *"I think I would like to have*

more of the previous month, you know, like the 30th of the last month. I forget which months have 31 days or 30” (older participant, personal communication, September 25, 2007). This seemed like a valid and useful point and was therefore included in the modifications. It was also suggested by another participant to have a backlight on the system screen to make it easier to see, particularly if the room lighting was low, *“Does that light up at all, the screen itself. Does it glow, like a mobile?”* (older participant, personal communication, September 26, 2007). Although this is a good suggestion, the function would be part of the development of the system hardware which is not covered within the current studies limits.

6.3.2.6. Positive Feedback

The feedback from the end test questions all revealed very positive and encouraging results. The participants all said that they would find Multiminder useful for reminding them to do things, *“It would be great to remind you, I’d like to have one”* (older participant, personal communication, September 26, 2007). All of the participants stated that the colour coding throughout the system helped them to navigate and to know where they were within the system, *“I think the colours help to make it easy, having orange for the calendar here [button] and here [horizontal navigation menu]”* (older participant, personal communication, September 21, 2007).

From the focus groups it was established that older adults were frustrated by technology that does not offer a backup option. Therefore it was important to include this option in Multiminder and user testing shows that the participants appreciated this option, *“When you’re using something for the first time your afraid or pressing something wrong but you can get out of it with this. There is a ‘cancel’ button so that’s very good”* (older participant, personal communication, September 26, 2007).

6.3.3. Modifications to Working Prototype

6.3.3.1. Calendar

- The last dates of the previous month was included onto the main calendar month

6.3.3.2. Memos

- 'Add a Memo' button was repositioned to the bottom of the memo pad in keeping with the phonebook section
- 'Clear' button was removed from the memo display screen

6.3.3.3. Phonebook

- 'Edit' and 'Delete' functions were included in the stored numbers section

These modifications can be seen in Figure 27.



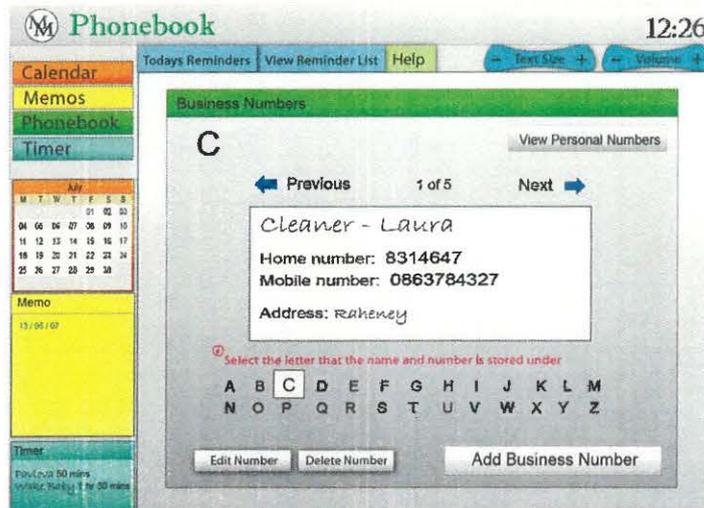


Figure 27: Modifications of Multiminder Screens

6.3.4. Summary of Working Prototype Testing

The results throughout the user testing of the phase 2 working prototype suggested that the modifications made after the paper prototyping significantly improved the usability of the design. Very few problems were experienced by the participants throughout the working prototype testing and the verbal feedback was generally positive. Co-discovery testing (testing in a group of two) was introduced to investigate whether participants would display different opinions in the comfort of a group. Although the participants in these test groups were more verbal compared to those tested individually, the results of the testing did not differ greatly. The main problems that were noted related to the position and inclusion of the buttons. Modifications were made based on these problems and also on the suggestions of the participants. Overall the participants showed a high level of enthusiasm towards Multiminder suggesting that the finished product would be a marketable PM aid for the older adult population.

CHAPTER 7: DISCUSSION & FUTURE DIRECTIONS

7.1. Introduction

This research focuses on the design of a PM aid for healthy older adults. The objective of the research study was to design a system that would be easily accepted by the older user, supporting their capabilities and limitations. This was achieved through user-centred design techniques, which involved doing background research (discussed in Chapters 1 and 2), conducting a needs analysis (outlined in Chapter 3), generating a conceptual and physical design of the system (presented in Chapters 4 and 5) and testing the system (outlined in Chapter 6). The present chapter will discuss the information that was found through these techniques, how Multiminder compares to previously designed devices and also the possible future directions for the development of Multiminder.

It was suggested at the beginning of this research study that if the needs and preferences of older adults were investigated through qualitative data-gathering and analysis methods, then a prototype of a PM aid could be designed that older users would find useful and easy to use. The results of the prototype testing supported this belief. Through needs analysis methods, the needs and preferences of older adults were determined, particularly regarding memory ageing, physical ageing, ageing attitude, and social network and activities. A prototype for a PM aid which focuses on the older user's abilities and limitations was designed. Overall, the test participants had little difficulty carrying out the tasks that were put to them and quickly picked up how to navigate through the system and how to input and interact with the memory strategies provided by the Multiminder prototype. Additionally, the participants said that they would enjoy using the system, would find it useful as a reminder and could see the benefits of it over traditional paper memory aids.

Although digital calendars are commercially available, a digital PM aid with multiple reminder strategies to be used by older individuals is a novel concept. The acceptance of this system by older adults into their home would provide them with the same benefits that younger people experience from mobile phone and computer applications. This research

also provides a framework that could be used for the design of other technology devices supporting older users.

7.2. Research Overview

7.2.1. Background Research

The review of literature concerning ageing and PM suggests that there is an age-related decline in PM functioning (Einstein et al., 1997; Kidder et al., 1997; Maylor, 1993b; Maylor et al., 2002; McDaniel et al., 2003). It was shown that external aids can be used to support PM and have been shown to improve both young and older adults' PM (Einstein & McDaniel, 1990; Kapur et al., 2002). Electronic PM aids, such as Neuropage (Wilson et al., 1997) and Memojog (Szymkowiak et al., 2004), have several benefits over traditional external aids. The primary benefits being the monitoring and alert functions of the devices to remind the user at the appropriate time. To support the development of Multiminder as a successful PM aid, Dobbs and Reeves' (1996) theory of PM was adopted. It was believed, from reading the literature about previously designed PM aids, that it was important that the user would not become over-reliant on the technology to remind them of tasks (Pollack et al., 2003). Therefore it was felt that the proposed system should be responsible for some processes of PM but not all of them. Dobbs and Reeves believed that the processes of PM include (1) meta-knowledge, (2) planning, (3) monitoring (4) content recall, (5) compliance, (6) output monitoring. The processes which Multiminder supported were (1) planning, (2) monitoring, and (3) content recall. If the user provided information about the task after the event, then the system could also support the output monitoring process. The user is then responsible for the remaining processes thus maintaining their PM skills. The purpose of Multiminder is to support the user's PM abilities rather than acting as a substitute for them.

7.2.2. Needs Analysis

The background research into PM and ageing together with the literature describing the design and evaluation of PM aids for memory impaired individuals provided the basis for the design of a new PM aid for healthy older adults. It was evident from past research that older adults are critical users of technology and that any new technology would have to

accommodate both their needs and preferences (Cohen-Mansfield et al., 2005; Melenhorst et al., 2007). A needs analysis approach was adopted to investigate the lifestyle of older adults, how they would benefit from a new technology and how a new technology would fit in with their lifestyle. This included methodological triangulation of interviews, observation and focus groups. Extensive information was gathered from these methods concerning the lifestyle of older adults and their use of memory aids. Overall, these findings showed that older adults frequently use memory strategies, such as writing notes or using a calendar, to help them to remember to do future tasks and both positive and negative aspects of these memory strategies were described by the participants. For example, participants reported that although they found alarms useful for waking them up in the morning, easily accessible and good reminders, problems that were noted about alarms were that they might not be heard, you have to learn how to use them and you can rely too much on it. This research also showed that older adults were, in general, open to new technology provided it suited their needs and lifestyle. The focus group participants said that they used a wide range of devices including mobile phones, digital television and digital cameras.

7.2.3. Concept Development

From the needs analysis four themes were identified as important factors in an older adults daily life: *Memory Ageing* (the memory changes that people experience as they get older, particularly PM), *Physical Ageing* (the physical changes that are experienced with ageing including sensory and motor abilities), *Social Network and Activity* (the activities that older adults are involved in and the network that they socialise with) and *Ageing Attitude* (the attitude of the individual towards ageing). These themes were used to shape the development of a new PM aid device - Multiminder. The incorporation of the themes identifies Multiminder as a system designed specifically to accommodate the capabilities and limitations of older users. Whether these themes were true and valid was further examined through the testing of Multiminder prototypes.

7.2.4. Development of Multiminder

Multiminder is a touch screen device that supports PM through multiple electronic memory strategies, including a calendar, a memo pad, a phonebook and a timer. The objective of the research was to design a system that was modified to suit the older user, rather than modifying the older adult (through extensive training) to be able to use the system. This was achieved by using technology, such as a Tablet PC with a touch sensitive pen, so that the older adult could interact with the memory aid in the same way that they would use traditional paper aids (i.e. writing on the screen with the output of their handwritten note). The memory strategies were also designed in a style similar to their traditional paper counterparts, so that the user could easily become accustomed to the digital method. For example, the phonebook was divided into personal and business sections similar to a public phonebook and for the memos the user simply writes on the memo pad and the message is displayed. Multiminder has the advantage over traditional aids in that the reminders are automatically issued to the user at the appropriate time without the older adult monitoring the task. The user can choose to set an audio alert to attain their attention to the reminder. These audio alerts, along with the visual output can be adjusted to suit the user's sensory needs. Additionally, the use of a stationary digital reminder system means that information is less likely to be lost compared to portable diaries or loose paper notes, while also allowing reminders and information to be compactly stored in the one system.

7.2.5. Prototype Testing of Multiminder

One observation from the prototype testing was the difference between the participants' interactivity levels. For example, some older participants were very particular about the information that they were inputting and others skipped over options that they felt were not needed. These behaviours may have been influenced by the different levels of technology experience but it highlighted the importance of having a flexible system to accommodate for varying skills and preferences. With Multiminder the user has the option of inputting as much or as little information as they like. For example, the user can choose to set the time they would like to be reminded with an audio alert or they can simply write a note on the day and use the visual cue as a reminder. Similarly, the older user can use

Multiminder as frequently or infrequently as they feel is necessary. In other words, the user has control over the system rather than being controlled by it, maintaining their independence. This is an important factor because it reduces the risk of the older adult becoming over-reliant on the system. Rogers et al. (2004) claim that if technology is developed to support independence in older adults, it should be reliable and the person should be willing to rely on the technology. This statement was supported in the focus groups when the older adults said they would want a system to do what it is supposed to do in a few simple steps. Over-reliance on a system can negate its purpose if the user loses their independence to the system. However it is believed that Multiminder successfully promotes the user's independence, supporting their cognitive, physical and psychosocial needs and preferences.

Prototype testing with older adults was carried out as an iterative process to improve the design and functionality of Multiminder and also to gather some feedback from potential users about the system as a PM aid. The results were very encouraging, eleven out of the twelve test participants said that they would find Multiminder very useful as a reminder system in their home and that they would purchase it if it was available. Throughout the testing the participants pointed out the features that they found confusing and suggested alternative ways to design these features. Participants with no technology experience indicated the terms and features that were not familiar to them. Although no participant had major difficulties using the prototype, the majority of the older adults said that they would be more confident using it if they were shown how to use it first or if they had access to a manual that they could read when using Multiminder for the first few times. This supports previous research that found that older adults are more accepting of new technologies if they are provided with training and the benefits are clear to them (Rogers et al., 2004). Overall, the participants found Multiminder to be a useful device for reminding them to do future tasks and each had a preference for the type of memory strategy they would find most useful, emphasising older adults' individual differences.

7.2.6. Reflecting on the Research

A number of methods contributed to the final prototype design of Multiminder. Interviews, observations and focus groups were used as part of the needs analysis and the

findings that were produced were implemented into the design. It was believed that these methods complemented each other, both supporting and opposing findings from the other methods and ultimately producing reliable information. Conducting the research in the participant's home also contributed to the data being 'true' or valid. This allowed the participants to feel comfortable, encouraging natural behaviour and also allowing the researcher to take note of the participant's home environment and how they interact with memory aids within this environment. The validity of these results was displayed through the feedback from prototype test participants. The responses from the older adults indicate that the needs and preferences relating to memory ageing, physical ageing, social network and activity and ageing attitude were met.

A method that was used as part of the prototype testing was to rate the difficulty level of the tasks. This measurement was dependant on how long the user took to complete a task, if at all, and the degree of frustration or confusion that was displayed. It was decided that this method did not accurately reflect the actual difficulty of each task. For example, participants had problems in the first task that they did not have in later tasks. It was ambiguous from the rating method whether this was due to learning on the participant's part or whether the first task was actually more difficult. Therefore the results of this method did not contribute to the development of Multiminder.

A method that was found to be useful and to benefit the research was the co-discovery technique (i.e. paired testing). This method was brought into the second stage of prototype testing to ensure that the responses and feedback from the participants were reliable. Using this method, it was observed that the participants were more relaxed and appeared to be more confident, asking more questions about the system and interacting with it more compared to individual testing. Given the opportunity to repeat the prototype testing or for future testing, it is recommended that the co-discovery method would be used.

7.3. Comparing Results to Past Research

Several memory aids have been reviewed and compared as part of this thesis, namely Neuropage, Memos, Memojog, Autominder, COACH and Cook's Collage. These memory aids were designed to support the successful completion of PM tasks for older adults and also individuals with cognitive impairments. Although these devices have been shown to

increase task completion, some problems were revealed through their evaluations, for example devices displaying reminder errors, interaction difficulties, coverage problems for updating schedules for devices which relied on a wireless network and features that were too small for older adults with sensory difficulties (Mihailidis et al., 2000; Pollock et al., 2003; Szymkowiak et al., 2004; Tran & Mynatt, 2003; Walther et al., 2004; Wilson et al., 1997). In the evaluation of Memojog the older adults not only had difficulty reading the text but they also had difficulty figuring out how to change the size of the text (Szymkowiak et al., 2004).

The three memory aids that are most comparable to Multiminder are Neuropage, Memos and Memojog as these devices' main purpose was to remind the user of their scheduled tasks. Table 5 demonstrates the differences of these four PM aids in relation to the cognitive, physical and psychosocial needs of the user. These three headings were used, as opposed to using the identified themes, because they were the headings that originally were used to review the existing memory aids and to shape the design of the qualitative study. In terms of the *cognitive* needs it can be noted that all four memory aid devices support PM through the issuing of text and audio reminders. The main difference between Multiminder and the previous aids is that it was designed for cognitively healthy older adults. Therefore the user can independently input their information and monitor their own task progress. The user can input and interact with Multiminder as frequently or in as much detail as they please or feel is necessary to sufficiently remind them. Unlike Neuropage, MEMOS and Memojog, Multiminder does not rely on a paging company, a central server or wireless network to issue successful reminders. It is proposed that older adults can use Multiminder in a similar manner as they do traditional aids by writing notes and reminders onto the screen with a touch screen pen and viewing the written note as a reminder, while also maintaining the benefits that technology offers (automatic and audio alerts, saving past and future reminders etc.).

The most obvious advantage of Multiminder is that it offers the user multiple reminder strategy options. These were reminder strategies that were found to be the most commonly used in the older adult's home throughout the needs analysis.

Table 5: Comparison of Multiminder Functions with Previously Designed Memory Aids

Memory Aid	Neuropage	MEMOS	Memojog	Multiminder
Cognitive	<ul style="list-style-type: none"> • PM aid for cognitively impaired. • Requires little user input. • Input dependent on paging company which may act as limitation but useful for inexperienced tech user. • No way for user to confirm action completed or delay reminder. 	<ul style="list-style-type: none"> • PM aid for cognitively impaired. • Input entered by user via handheld computer or carer/professional carer via central server. • Task confirmation function and reminder delay function. • Emergency contact function. • Little learning involved. 	<ul style="list-style-type: none"> • PM aid for older adults and cognitively impaired. • Requires schedule input from user or carer. • Task confirmation function, carers contacted if task not confirmed. • Minimal action steps. • Coverage problems reported when modifying diary. • May cause confusion to cognitively impaired users. 	<ul style="list-style-type: none"> • PM aid for healthy older adults. • Requires schedule input from user. • Minimal learning and action steps. • Reminder delay function & pre-reminder function. • Provides access to multiple reminder strategies.

Table 5 (Continued): Comparison of Multiminder Functions with Previously Designed Memory Aids

Memory Aid	Neuropage	MEMOS	Memojog	Multiminder
Physical	<ul style="list-style-type: none"> • Small and portable. • Alarm/vibrator alert, with text: multimodal. • Large button to control, easy to use even for motor impaired. • Small screen. 	<ul style="list-style-type: none"> • Portable, lightweight device. • Users can leave voice messages if they want to input data which is then decoded from central server. • Quite a large screen for visual display with a few clearly labelled soft buttons. • Alarm can be adapted for user. 	<ul style="list-style-type: none"> • Small portable device. • Quite a large visual display. • Adaptable alarm. • Keyboard integrated into hardware caused problems when inputting information. 	<ul style="list-style-type: none"> • Lightweight touch screen device. • Large screen size. • Stationary in users home. Interacted via touch screen pen. • Suitable for age-related fine motor skills problems. • Adjustable audio and text alert output.
Psychosocial	<ul style="list-style-type: none"> • Very small device, therefore easily concealed. • Promotes independence for activities of daily living. 	<ul style="list-style-type: none"> • Small portable ubiquitous device. Promotes independence for user. • Assists as contact device in crisis situations (user confused or disorientated). 	<ul style="list-style-type: none"> • Small portable device. • Holds personal information (family details). • Carers not reliant on others to input data as device easy to use. • Promotes independence for both user and carer. 	<ul style="list-style-type: none"> • Promotes independence for user. • Holds personal information (contact details). • Reminds user of social events. • Designed for older users with no technology experience, promotes confidence in technology use. • Low cost, does not require much system memory or internet access.

While digital reminder strategies are available to individuals with mobile phone calendar applications and computer applications, these strategies do not accommodate all of the needs and preferences of older adults (see Appendix D). Problems with these applications include the need for expensive computer equipment, internet access, the system being too small for the older user and the design features being too complicated.

In relation to the *physical* needs of the user the main difference, which consequently contributes to its advantage, is that Multiminder is a stationary memory aid with a relatively large touch screen. Neuropage, Memos, and Memojog on the other hand are all portable memory aid devices. During the focus groups that were carried out as part of this study, the participants were asked whether they would prefer a portable or stationary device as a memory aid. The response was that a portable device would be impractical taking into consideration the items that they also carried when they went out, such as their mobile phones, keys and wallet. Therefore, it was decided that a stationary system would be of most use. The benefits of a stationary PM device in the home are that it reduces the risk of losing stored information (e.g., leaving your diary on the bus) and having the information to hand when it is needed (interview participants said that they mostly used PM strategies in their home, such as alarm clocks and diaries). Other benefits of a stationary device are that the screen size can afford to be larger, subsequently making interaction and display easier and clearer. The literature describing the evaluation of Memojog observed that the participants showed difficulty using the touch screen on the PDA device as the screen was not sensitive enough (Szymkowiak et al., 2004). As MEMOS was also built to be used on PDA it can be supposed that this problem was also an issue for the usability of the design, however it was not noted in the literature reviewed (Thöne-Otto & Schulze, 2003; Thöne-Otto & Walther, 2003; Walther et al., 2004). The larger screen size of Multiminder would allow a greater space for the user to select items on the screen using the touch screen pen while also reducing the likelihood of interaction errors such as selecting an incorrect button. Although Multiminder is a larger device than the smaller portable PM aids, it would be a lightweight device that could be easily transported by an older adult throughout the house if they wished.

Neuropage, Memojog and MEMOS all cater for the *psychosocial* needs of the intended users. For example, MEMOS assists as a contact device for memory impaired

users in crisis situations. These devices are also small and easily concealed for those who may feel uncomfortable using a PM aid in public. However, Multiminder was designed for cognitively healthy older adults. The purpose of Multiminder was to support the user's psychosocial needs by focusing on ways to enhance their social network and activities through the organisation of their time, by reminding them of events they had planned and by providing them with a way to store contacts' details, both personal and business.

It was important that the concept of Multiminder was attractive to older users as many older adults have relatively little technology experience compared to younger adults who have learnt how to use computers in school and working environments, and could easily be put off by a complicated design. Therefore, Multiminder includes visual displays and elements such as large buttons, colour coding, help and cancel options and features designed to look like everyday items (e.g., volume and text size button based on a remote control volume button and a yellow memo pad) among others. It was proposed that the inclusion of these details would help older users to feel comfortable and confident using the system. Furthermore, one participant in the prototype testing stated that although she had no computer experience, after interacting with Multiminder she felt confident and curious enough to observe her niece using her computer, which she previously avoided. This individual event supports the belief that the findings gathered from the qualitative study which consequently led to the emergence of the themes memory ageing, physical ageing, social network and activity and ageing attitude, were successfully implemented into the design of Multiminder.

7.4. Future Developments and Directions

Multiminder was designed and tested using low-fidelity prototypes. The test participants were purposely not shown the prototype design before they were asked to carry out the testing tasks so that it could be observed what features were obvious to a novice user and what were problematic. Further iterations could allow test users some time before the test period to interact and navigate the system on their own terms. This would provide a realistic insight into how older users would approach a new system. Additionally, the users could have the option to use an instruction manual before and throughout the test period to investigate how much support the older adults would need to use the system and what areas the older user studies in the manual.

Future progressions of this research would extend to the development of a high-fidelity interactive prototype to be evaluated by older users in their home. A fully working prototype would allow the older user to obtain a more realistic view of the system and its usability, allowing them to navigate freely throughout the system, input information and experience the output. An evaluation of Multiminder would consist of training older adults to use the system, and asking them to use and assess it over a specific time period. The success of Multiminder would be based on whether it reminded the user to carry out future tasks and whether they found it more useful compared to other PM strategies. The current study displays the potential for the development of Multiminder however further research and development is needed.

This research concentrated on the development of a prototype supporting PM in healthy older adults. Future research could expand the concept of Multiminder to include a broader range of users. For example, during the co-discovery prototype testing, participants said that they would have found Multiminder very useful when they were younger and had a young family. They said that this was because it was a busy period for them and they frequently had to use PM aids to remind themselves and to remind other members of the family to carry out tasks. As Multiminder is a stationary device that would be used on a day-to-day basis in the home, a family could use it individually or to interact with other members of the family who may not be present at the time. Future research for instance could investigate family use with Multiminder and whether individuals would like to have additional features such as their own reminder profile (e.g., an issued reminder would be

accompanied by the individual's name). This is just one example of how Multiminder could be used by a greater audience than it was designed for. The user-friendly design of Multiminder suggests that both younger and older individuals could benefit from its use.

7.5. Research Conclusions

The design of Multiminder highlights the potential for the development of a fully interactive device. Through qualitative data-gathering methods, concept and physical prototype design and iterative testing with older adults, a prototype of Multiminder was developed that older users found easy to use and enjoyable. Throughout the needs analysis methods it was found that older adults experienced problems with traditional PM strategies, and that digital counterparts were not available that accommodated their needs and preferences. The present research study aimed to fill this need by designing Multiminder, a PM aid that supported older adults' PM through multiple reminder strategies. These reminder strategies (calendar, memo pad, phonebook and timer) were ones that were familiar to the older user and ones that were used most frequently by older adults in their home as determined through the interviews and observations. Multiminder would support PM with the advantages that technology provides (e.g., automatically issuing reminders or saving past information compactly) while also eliminating any problems that were found by the older adults using traditional paper aids (e.g., losing notes or not hearing a timer alert).

Having Multiminder in the home would allow older adults the same benefits that younger computer users have with applications such as Google Calendar and mobile phone organiser applications. Providing older adults with the access to a PM aid preceding any significant need for it, increases the likelihood that the system will be accepted when it is needed to support age-related decline. Overall, it is hoped that Multiminder will be a useful PM aid for older adults that would not only accommodate their cognitive needs, but also their physical and psychosocial needs and preferences.

CHAPTER 8: REFERENCES

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	<ul style="list-style-type: none"> • If they don't have either a network or a job then its devastating, this social isolation 	
Age Attitude	<ul style="list-style-type: none"> • Expect problems with ageing • Want to appear more able than they are 	<ul style="list-style-type: none"> • Attitude of older adults to ageing
Finance LC	<ul style="list-style-type: none"> • Financial problems 	<ul style="list-style-type: none"> • Finance problems after retirement
-M	<ul style="list-style-type: none"> • Prospective memory problems due to depression • Very old showing signs of senility (forgetting who you were) • Problems in cognitively normal older adults may be due to lack of stimulation, stress or illness such as depression • Dementia most common diagnosis for ongoing memory problems • Memory on the whole should be preserved with age 	<ul style="list-style-type: none"> • Memory problems with ageing
MS	<ul style="list-style-type: none"> • Older adults confined to their home used strategies such as routines, calendars, contact books, shopping lists, alarms, putting objects in conspicuous places and asking someone to remind them • Employ strategies to accommodate for memory • Encouraged to prevent memory problems early on by doing mind engaging tasks, exercising and eating the right foods. 	<ul style="list-style-type: none"> • Strategies used to help memory

A.4

Worked Example

Interview Transcripts

PARTICIPANT 4

GENDER - FEMALE
AGE - 76
INTERVIEW LENGTH - 31 M

LIFESTYLE CHANGES

I - What age are you?

P - I'm 76

I - Do you live alone, with a spouse, or with family or friends?

P - I live alone

I - How do you travel, car, public transport, walk, or take lift?

P - I gave up my car last year and I thought about it for a while and I thought I would. And I must say I don't miss it. I walk. I was always a good walker, used to walking, so that didn't make much difference. They only thing I miss it now for is going to a garden centre when I want to, without troubling anyone. You know to get compost and heavy bags but I'm going to enquire about them delivering stuff. I'm sure they would if you spent so much, you know, I'll arrange something.

does not want to burden family

I - Are you a member of an association, club, voluntary or social group that meets regularly? Can you tell me what this is and what is involved?

P - Yes, I'm in the ladies club in Clontarf. And I always liked cooking so I'd do anything that I'm asked to do. The priest often asks me to do things in that line. Catering. I go swimming on a Thursday morning to the CRC. I also do art classes on Fridays.

part of numerous social groups & activities

I - And how often do you meet?

P - That would happen a few times in the year. What else do I do? I might go out with my grandchildren and that or bring the dog for a walk.

- combines socializing with activities regularly.

I - Do you regularly, occasional or seldom leave your house?

P - I go out pretty often yes. I go out with friends. I go out every Wednesday anyway and then I might go out other times. There's a friend that calls ad lib and tells me what she's doing and would I like to join her.

I - What type of work did you do before you retired?

P - I did office work. I always liked cooking so it just happened that I was in the ladies club and I won two fish cookery competitions and then [redacted] in the supermarket asked me if I was interested in taking on...they were starting up the salad bar in Nolans. I said I'd love that. So I was there for 11 years in the morning time and I trained in a good few people and I enjoyed it very much. So when [redacted] died I left. I had given in my notice the day before he passed away so that I could be there with him. So that was unfortunate. But that's what I did after the office work. Oh I was also asked to give cookery classes so I did for a few years. It got more difficult because the same people would come year after year so I would have to think of new recipes each time but I loved that.

LC - death of spouse related to retirement

I - What are the main lifestyle differences between before and after retirement?

Interview Transcripts

P - I like doing things and I'd say it's good, you know. I'm always active. I love the garden and I do it myself. I loved cooking so I always enjoyed working. I go out more now so that's good. I go into town more often too. There aren't a great lot of differences. LC

Act

I - Do you do all daily tasks yourself or does someone help you? How do they help?

P - No I do it myself. Act

Feels she was active before retirement and has stayed active

provides support to neighbours

I - Do you help someone else with their daily tasks?

P - Yeah I do if I can. For instance [redacted] across the road comes to me if she's in distress. If she locks herself out or breaks something and she's afraid to tell Helens she comes to me. So at the moment her washing machine is out of order and I'm doing her washing for her. Like things like that I'd help her out.

F+F/Supp.

I - And would you baby-sit your grandchildren much?

P - They don't trouble me a lot but I'm there for them if they need me. And they come over to me. P+F - provides support to family

PHYSICAL CHANGES

I - Do you have any physical difficulties related to ageing?

P - I don't except the knees are a bit stiffer than they were in the morning but thank god I don't have arthritis. PP - minor physical difficulties

I - Does this affect how you carry out daily tasks?

P - No

I - Do you use any object that assists you to do these tasks?

P - No, except a little rubber thing for opening jars. And I wear glasses. AT - visual difficulties - fine motor strength

I - Are there any daily tasks that you don't like doing for any other reason?

P - I really don't like taking out the Hoover but I have to. PP

I - And why don't you like it?

P - Pushing and pulling the thing around. Lifting it out and putting it back, going around and lifting it up ever step. I did have a woman once and I liked it but I prefer not. She moved to the country and I never bothered after that.

heavy household tasks are struggle. My actions causing problems.

MEMORY CHANGES

I - Do you think your memory abilities have changed as you age?

P - No but I call my grandchildren by each other names but I did that with my own M children. But memory changes...no not really thank God.

provides no major memory change

I - Do you find any differences in your ability to remember to do things in the future?

P - Just if I've had a late night I might forget that I have to start something

tiredness affecting PM.

I - Have there been any significant positive or negative changes in your lifestyle in recent years? How has this affected your daily routine?

P - I don't think so. Perhaps I've got tidier. I have places for everything around the house to make life easier. Before I'd be ages looking for things. I'm trying to think of other changes. My grandchild in America was in a car accident at Halloween and it was awful. And I was doing stupid things because I was thinking of her all the time. She's physically

LC/F+F

Friends and family affecting lifestyle and memory.

Interview Transcripts

wonderful but short term memory is going to take a long time. I'm hoping she'll come over in the summer. You worry about them all. You're the same about them as your children.

I - Do you have any problems remembering the following:

I - Birthdays ?

P - No I have them all written down. I have 17 grandchildren. MS - large number requires use of memory strategy?

I - addresses and phone numbers?

P - No I'm very good at phone numbers M

I - Appointments ?

P - No

I - Taking medication?

P - I don't take any

I - Chores or errands?

P - I could forget an errand easy enough -M

I - Travel routes?

P - No

I - Names of familiar faces?

P - No I would say not

MEMORY STRATEGIES

I - Are there any memory strategies that you use to help you remember to do daily tasks?

P - Yeah I'd leave a thing where I'd walk over it to remind me. MS - put items in conspicuous places.

I - Do you use any of the following:

I - Taking paper notes?

P - Oh I would yes

I - Making shopping lists?

P - I do but they say its better for you memory not to. But I do write notes...constantly. MS - write the note in first place would reinforce memory. But do you know what I do, I write a note and forget to bring it...regularly. -MS

I - Tick off completed tasks?

P - I do. I've done that a good few times MS

I - Use a daily routine or "ritual"?

P - No I like everyday to be different -MS - importance of variety in participants lifestyle. Also says she likes when 'friend calls ad lib' to invite her out.

I - Entering appointments in a diary or calendar?

P - I do. I have a calendar on the wall MS

I - Entering addresses or phone numbers into a diary?

P - I have a little diary in my bag

I - Writing a memo? MS - portable memory aid

P - Yeah MS

Interview Transcripts

I - Writing on the back of your hand?

P - No. All the young people do. The grandchildren

I - Taking photographs?

P - No

I - Using a clock, oven timer, alarm?

P - I do I use an oven timer. I have a new oven now and I have yet to master the timer.

Every time ^{MS} comes over I mean her to show me because she has one. There is a

manual but you really have to use them. I read it up and can't make it out. They're great though because the buzzer goes and then you know.

I - Putting objects in conspicuous places?

P - Yes MS

I - Asking someone to remind you?

P - Often MS

I - Text reminders on mobile phone?

P - I have only learnt how to text now. I'll advance. MS/LAN

I - What benefits are there to using paper notes?

P - Reminders, yeah. I just think of them as reminding me to do things. They're handy and then you can throw them out. +MS - paper note as memory aid

I - Do you experience any problems with this strategy?

P - No if I wrote it I would put it where I would see it or where I wouldn't miss it

I - What benefits are there to using shopping lists?

P - So you remember the things. Say you wanted a light bulb or battery or something that you could easily forget because you're not getting them regularly. And you can bring it around the supermarket with you.

I - Do you experience any problems with this strategy?

P - No

I - What benefits are there to using ticking completed tasks?

P - Good discipline. Keeps you on the ball and you get satisfaction out of it. I've made out programs for myself to get more done in the day. I get great satisfaction about getting things done. +MS - use gets personal & practical use

I - Do you experience any problems with this strategy?

P - No

I - What benefits are there to using a calendar or diary?

P - I find them very good. I have it up on my wall in the kitchen. It's good for the green bin and the bin day. The green bin in particular because it only comes once a month. It's easy to organise your time

I - Do you experience any problems with this strategy?

P - No

I - What benefits are there to using address and phone books?

Set up on daughter to show her how to use it

Fit

oven timer as memory aid

-MS finds it hard to learn to use

- willing to learn a new memory strategy

+MS shopping list as way to reinforce memory

+MS - calendar good for regular reminders & weekly etc.

Interview Transcripts

P - Usually builder, plumber or anyone you want, I have them all in a diary.

I - *Do you experience any problems with this strategy?*

P - No, all good

I - *What benefits are there to writing a memo?*

P - They're very handy and you can put them anywhere. I use them more as notes, not so much as putting them on the wall. +MS

I - *Do you experience any problems with this strategy?*

P - No

I - *What benefits are there to using a clock, oven timer or alarm?*

P - good for cooking. Different things take different times to cook so you can time them. You don't burn what you're cooking. +MS

I - *Do you experience any problems with this strategy?*

P - just that you have to learn how to use them -MS

I - *What benefits are there to putting objects in conspicuous places?*

P - I have a place for everything now so that I know where they are when I go to look. Putting something out reminds you that you have to do something with it. +MS

I - *Do you experience any problems with this strategy?*

P - No I don't think so

I - *What benefits are there to asking someone to remind you?*

P - yes I would ask someone to remind me. Just as a backup really. +MS

I - *Do you experience any problems with this strategy?*

P - No, I don't think people mind when you ask them. Sometimes they forget as well though. -MS

A.4

Worked Example

Step 1 – Listing Themes

- 1. Activities
- 2. Friends and Family
- 3. Support
- 4. Physical Problems
- 5. Assistive Technology
- 6. Assistive Technology Problems
- 7. Positive Lifestyle Changes
- 8. Negative Lifestyle Change
- 9. No Lifestyle Change
- 10. Financial Changes
- 11. Ageing Change
- 12. Negative Memory Issues
- 13. Positive Memory Issues
- 14. Memory Strategies

Step 2 – Collapsing themes

- Physical Problems
 - 1, 3, 4, 5, 6
- Lifestyle Change
 - 1, 2, 7, 8, 9, 10
- Memory Issues
 - 11, 12, 13, 14
- Social Network
 - 1, 2, 3,
- Ageing Attitude
 - 2, 3, 4, 11, 12, 13, 14
- Support
 - 2, 3, 4, 5, 14

Step 3 – Collapsing Themes Again

- Physical Problems
 - 1, 3, 4, 5, 6
- Memory Ageing
 - 11, 12, 13, 14
- Social Network & Activity
 - 1, 2, 3, 7, 8, 9, 10
- Ageing Attitude
 - 2, 3, 4, 11, 12, 13, 14

APPENDIX B

Observations

1. Consent Form
2. Coding & Memoing

B.1 Consent to Participate in Research – Observations

You are invited to participate in a research study conducted by the researcher Niamh Caprani, from the Institute of Art, Design and Technology Dún Laoghaire. The results from this observation will contribute to the design of a reminder system for older adults as part of a postgraduate research project.

The purpose of this study is to observe the natural behaviour of people in their home environment. The study will involve the observation of your behaviour while carrying out your normal everyday activities. The observer will not interrupt you while you are doing these tasks.

Your decision to participate in this study is entirely voluntary and you may decide at any time to withdraw. The observed actions of all participants will be completely confidential. Only the researchers working on this project will have access to the information provided. Any information that is published or used publicly will maintain participant anonymity. There are no foreseeable risks to participating in this study.

This study has been approved by the Psychology Applied to Information Technology Ethics Committee of the Department of Learning Sciences at IADT Dún Laoghaire. If you have any further questions or would like to know more about this research project you can contact the researcher Niamh Caprani at the contact details below:

Mail Address: School of Creative Technologies, IADT, Kill Avenue, Dún Laoghaire, Co. Dublin.

Email: niamh.caprani@iadt.ie

Phone: 085 721 6601.

Research Supervisors: Nicola Porter and John Greaney

Participant Consent

I have read about and understand the nature and purpose of the study and my rights as a participant. I agree to participate in this study.

Participants Signature

Participants Name (printed)

Date

B.2

Observation Coding and Memoing

Code	Key Observation	Memo
Site	<ul style="list-style-type: none"> • Kitchen, bathroom, utility room, garage, garden, bank, chemist, conservatory 	<ul style="list-style-type: none"> • Places participants went to. Kitchen area used mostly
ExMemAid	<ul style="list-style-type: none"> • Clock, oven timer, watch, paper sign, calendar, diary, ticks off items from list, address book 	<ul style="list-style-type: none"> • External memory aids that were used or handled
Remem	<ul style="list-style-type: none"> • Took page back and folded • Checks bread • Reminded researcher about phone call over hour later • Asks is she to fold page • Asks what date it is • Reminded researcher • Put tray into oven • Checks scones 	<ul style="list-style-type: none"> • Things that the participants remembered to do or reminded themselves to do
MemStrat	<ul style="list-style-type: none"> • Medication before breakfast • Put cheque and prescription closer to edge of table • Verbally lists items she needs, touches item to verify having it (pats bag) • Must ring friend to ask for lift • Scones will be ready in 10 minutes • Bread will take 45 minutes • I took my tablet at 10 so I can eat at half • Puts medication on table, other medication in press • Moves scones closer to oven • Puts letter to side of table 	<ul style="list-style-type: none"> • Strategies participants used to help them remember to do things. Includes verbally rehearsing task or verbally listing items, having a routine, putting objects in conspicuous places

Clean	<ul style="list-style-type: none"> Rinses, bleaches, empties, sweeps, wipes, washes, dries, mops 	<ul style="list-style-type: none"> Cleaning was a big part of participants daily tasks
Cook	<ul style="list-style-type: none"> Brown bread, scones, marinate meat, soup, prepares potatoes, toast 	<ul style="list-style-type: none"> Participants cooked and baked food to consume and prepared food for later that day
Eat	<ul style="list-style-type: none"> Toast, jam and tea, scones and coffee, soup 	<ul style="list-style-type: none"> Participants consumed what they were cooking
ItemReplace	<ul style="list-style-type: none"> Replaces sieve, puts flour back, hangs on hook, puts pen in holder 	<ul style="list-style-type: none"> Participants all replaced items as they were finished with them. Items were located where they were needed (tea towel beside sink)
FamilyMem	<ul style="list-style-type: none"> Husband, daughter, friend, son-in-law, wife, dog 	<ul style="list-style-type: none"> All participants interacted with or talked about people from their social network
PhysActi	<ul style="list-style-type: none"> Bends down, kicks ball, hangs out clothes, carry basket, carried bowls 	<ul style="list-style-type: none"> Some activities required physical effort
Tech	<ul style="list-style-type: none"> Digital cooker, portable phone, TV, radio, oven timer, mobile phone 	<ul style="list-style-type: none"> Technology was present in all of the participant homes, some more obvious than others
Cogprob	<ul style="list-style-type: none"> Mixed up what he was doing when wife was talking Writes address on wrong envelope 	<ul style="list-style-type: none"> Participant confused what he was doing when faced with too many tasks
Assistive Tech	<ul style="list-style-type: none"> Reading glasses, crutch, reaching claw 	<ul style="list-style-type: none"> Devices that were used or present in the participant home
PhysProb	<ul style="list-style-type: none"> Holds measuring jug away to read Leans on counter to take pressure off hip Effort to turn cooker knob Can't carry wash basket with crutch 	<ul style="list-style-type: none"> Physical problems that were observed while tasks were being carried out

APPENDIX C

Focus Groups

1. Consent Form
2. Schedule
3. Coding & Memoing

C.1 Consent to Participate in Research – Focus Group

You are invited to participate in a research study conducted by the researcher Niamh Caprani, from the Institute of Art, Design and Technology Dún Laoghaire. The results from this focus group will contribute to the design of a reminder system for older adults as part of a postgraduate research project.

The purpose of this study is to discuss the preferences and opinions that you hold about technology. You do not have to know anything about computers or other modern technologies to attend.

Your decision to participate in this study is entirely voluntary and you may decide at any time to withdraw. The responses of all participants will be completely confidential. Only the researchers working on this project will have access to the information provided. Any information that is published or used publicly will maintain participant anonymity. There are no foreseeable risks to participating in this study.

This study has been approved by the Psychology Applied to Information Technology Ethics Committee of the Department of Learning Sciences at IADT Dún Laoghaire. If you have any further questions or would like to know more about this research project you can contact the researcher Niamh Caprani at the contact details below:

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Phone: 085 721 6601.

Research Supervisors: Nicola Porter and John Greaney

Participant Consent

I have read about and understand the nature and purpose of the study and my rights as a participant. I agree to participate in this study.

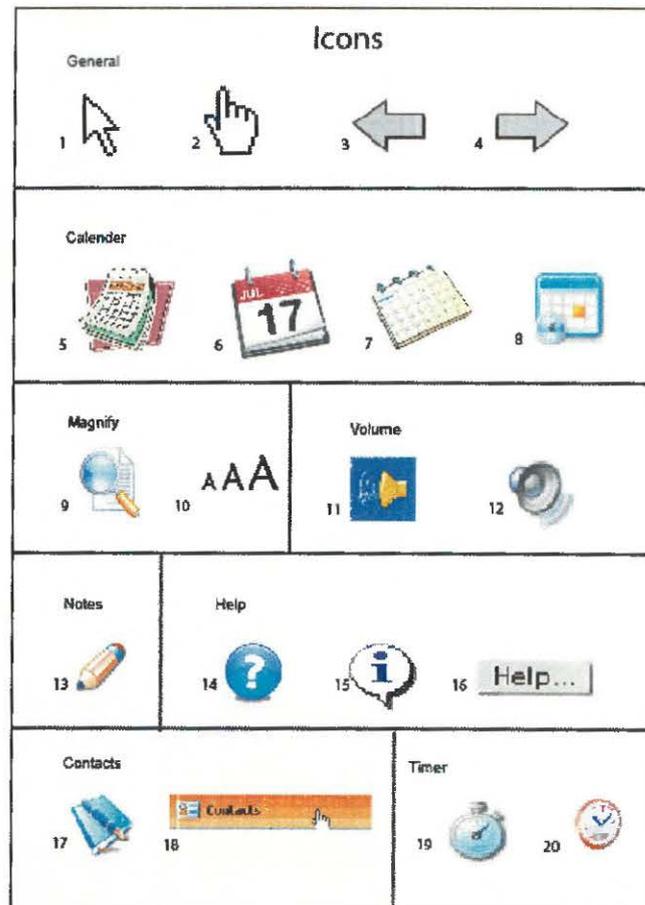
Printed Name	Signature	Date
1		
2		
3		
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6		

C.2

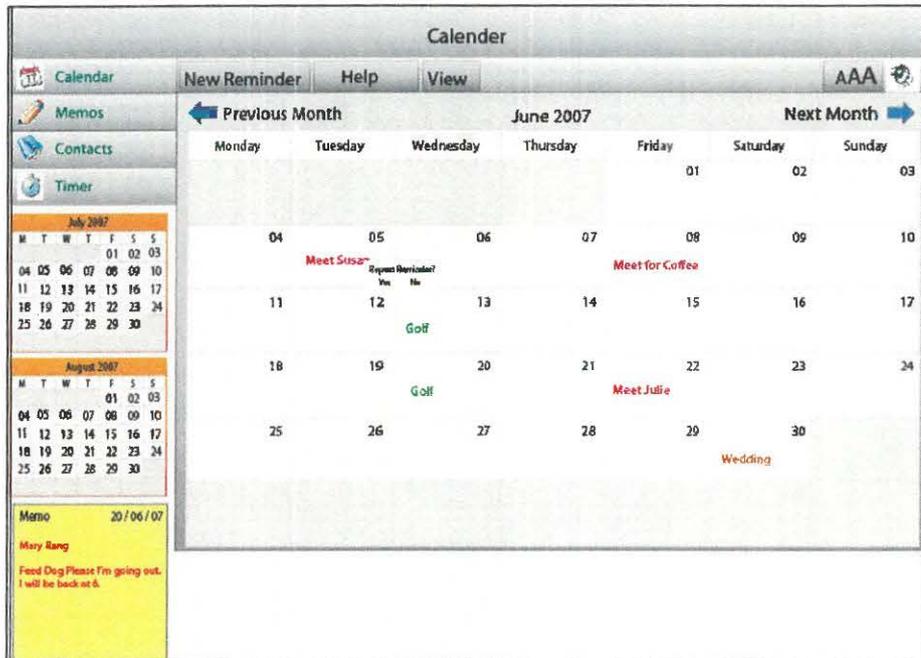
Focus Group Schedule

Questions

- 1) What is your name and where do you live?
- 2) Can you think of any devices or technology that you use?
- 3) Are there any typical problems that you have come across when using technology. This could range from your oven timer to PC (e.g., hard to learn to use, too many options, unclear text).
- 4) What devices do you have in your home that you find really easy to use? What features do these have that you like?
- 5) If you were buying a device such as a phone, what features would you look for?
- 6) Have you ever used a touch screen system before, such as an ATM machine, Dart ticket system, or flight tickets system? How did you find them to use?
- 7) I'm going to show you a tablet PC that will display the memory aid and ask you what you think of its usability and display features.
- 8) I am going to show you some general computer icons and images and I would like you to tell me whether or not you know what they are for and which ones you prefer.



- 9) This is a paper mock up of the design I am proposing to develop. Does anyone have any feedback about this design, either positive or negative?



- 10) Do you think a portable device that issued reminders from the main screen would make you use it more?
- 11) Can you recommend any way for this design to be improved?

C.3

Focus Group Codes, Key Points and Memoing

Code	Key Point/Quote	Memo
LRN	<ul style="list-style-type: none"> Having to read the instructions, you know it but we're slower than a 25 year old would be at grasping the essentials of it. 	<ul style="list-style-type: none"> Learning and practice, age differences
LRN	<ul style="list-style-type: none"> I'd meticulously follow the manuals and forget it and go over them again. Whereas a person accustomed to technology doesn't have to. 	<ul style="list-style-type: none"> Learning and practice. Environment affecting use
LRN	<ul style="list-style-type: none"> The mobile phone when we first got it, it took me a lot longer to learn to use. 	<ul style="list-style-type: none"> Learning and practice, age differences
LRN	<ul style="list-style-type: none"> You learn the oven timer by trial and error. 	<ul style="list-style-type: none"> Learning and practice
LRN	<ul style="list-style-type: none"> Instruction manuals will tell you how to do do do... but they never tell you how to correct a mistake. 	<ul style="list-style-type: none"> Learning. Bad instructions.
LRN	<ul style="list-style-type: none"> Keep working at it and working at it and you get it 	<ul style="list-style-type: none"> Learning and practice
LRN	<ul style="list-style-type: none"> If there's no interest in it you won't learn it. 	<ul style="list-style-type: none"> Learning and attitude
LRN	<ul style="list-style-type: none"> If you live with it you learn how to use it, once you read the instructions. 	<ul style="list-style-type: none"> Environment and learning
LRN	<ul style="list-style-type: none"> If you read the manual, bring it to the device and go through it step by step you can get it. 	<ul style="list-style-type: none"> Learning and practice
LRN-AGEATT	<ul style="list-style-type: none"> We find it easy enough to do the essential things but anything complicated you can forget about it. We were brought up in a different era. 	<ul style="list-style-type: none"> Age and learning. Complexity of technology
AGEATT	<ul style="list-style-type: none"> I have grandchildren and they're not able to walk but they can use a computer. 	<ul style="list-style-type: none"> Age difference and environment
AGEATT	<ul style="list-style-type: none"> I think I'm gone beyond that now. 	<ul style="list-style-type: none"> Feeling of being too old to learn technology
AGEATT	<ul style="list-style-type: none"> You always leave it to your family to do things but then you don't know how to do it yourself. 	<ul style="list-style-type: none"> Social network and learning
AGEATT	<ul style="list-style-type: none"> Some people aren't bothered with technology, they depend on other people. If it's not their younger family its neighbours or friends. 	<ul style="list-style-type: none"> Social network and learning. Dependence on others
AGEATT	<ul style="list-style-type: none"> I feel a little too old for this 	<ul style="list-style-type: none"> Negative age attitude
POSTECH/AGEATT	<ul style="list-style-type: none"> I don't think I would now but I would have before this. I have enough to cope with. 	<ul style="list-style-type: none"> Positive feedback for Multiminder. Feeling of being too old

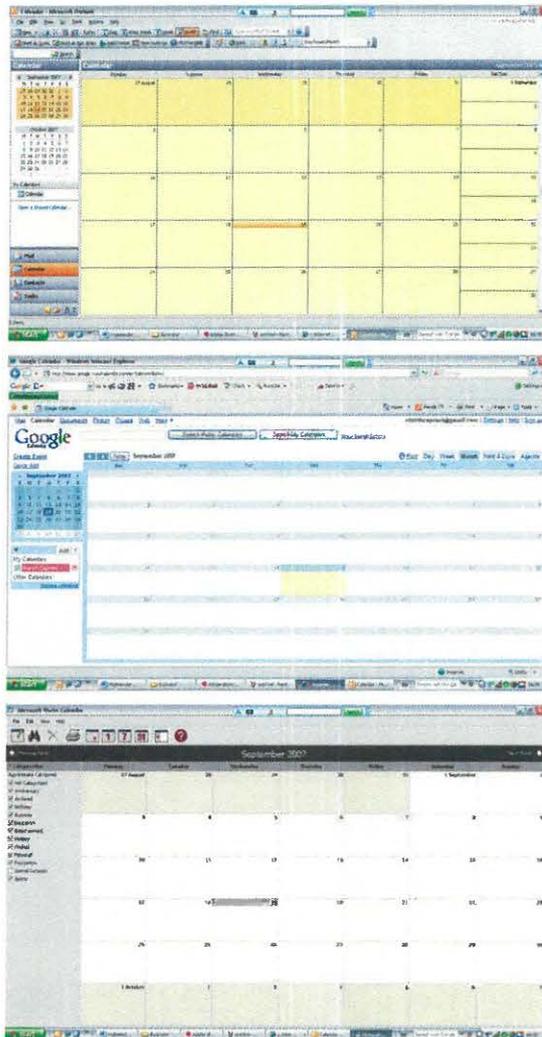
		to learn.
POSTECH	<ul style="list-style-type: none"> • [Touch screens are] lovely. Terribly easy to use. They're usually straightforward and if you do something wrong you can cancel it. 	<ul style="list-style-type: none"> • Touch screen features. • Self explanatory
POSTECH	<ul style="list-style-type: none"> • I think there are people who would find it useful. To have one gadget rather than a whole lot of things. The other idea to make the technology simpler would be very useful 	<ul style="list-style-type: none"> • Positive feedback for Multiminder
POSTECH	<ul style="list-style-type: none"> • I think I'll buy it. 	<ul style="list-style-type: none"> • Positive feedback for Multiminder
POSTECH	<ul style="list-style-type: none"> • I had to learn, it was the need to use it that makes you learn 	<ul style="list-style-type: none"> • Usefulness of technology. Necessity of learning when need to.
POSTECH	<ul style="list-style-type: none"> • My grandson showed me and I can text anyone now. I text Australia 	<ul style="list-style-type: none"> • Social network affecting learning
POSTECH	<ul style="list-style-type: none"> • I'd love that on the wall because I'd lose my diary 	<ul style="list-style-type: none"> • Positive feedback for Multiminder
NEGTECH	<ul style="list-style-type: none"> • Does that make you stop using your brain? 	<ul style="list-style-type: none"> • Over dependence
NEGTECH	<ul style="list-style-type: none"> • [Calendar synch with phone] I think that's a bit too much. I don't use the calendar on the phone. • I just use my phone to take calls • I like to carry a diary in my bag 	<ul style="list-style-type: none"> • Negative feedback for synchronizing mobile technology with stationary technology
NEGTECH	<ul style="list-style-type: none"> • Not more technology 	<ul style="list-style-type: none"> • Negative attitude to technology
NEGTECH	<ul style="list-style-type: none"> • I just can't text, I haven't tried 	<ul style="list-style-type: none"> • Negative attitude to technology
NEGTECH	<ul style="list-style-type: none"> • I got a newer phone and its harder to use than the older one. 	<ul style="list-style-type: none"> • Complexity of technology
NEGTECH	<ul style="list-style-type: none"> • There's a lot of change and its hard to keep up all the time 	<ul style="list-style-type: none"> • Complexity of technology and rapid development
AGEATT	<ul style="list-style-type: none"> • I'm too old. Younger people are brought up with it. 	<ul style="list-style-type: none"> • Feeling of being to old to learn technology. Age differences
NEGTECH	<ul style="list-style-type: none"> • I look at the computer but never go near it 	<ul style="list-style-type: none"> • Wariness of technology
POSFEAT	<ul style="list-style-type: none"> • If there was some sort of automatic switch that you could press and it would give you what you want it would be brilliant. 	<ul style="list-style-type: none"> • Simple features, shallow layered design
POSFEAT	<ul style="list-style-type: none"> • Big numbers for my eyesight. 	<ul style="list-style-type: none"> • Large features

APPENDIX D

Review of Existing Digital Calendars by Themes

Current Digital Calendars

To understand how Multiminder would be of more benefit to older users compared to pre-existing reminder systems, three digital calendars were described. These calendars were Google Calendar, Microsoft Office 2003 Calendar, and Microsoft Works Calendar. These calendars were chosen because they are widely used and easily available to computer users.



Microsoft Outlook Calendar

Google Calendar

Microsoft Works Calendar

Figure Appendix D: Screenshots of popular interactive calendars

It has been established that the themes identified from the needs analysis highlight important issues for older adults that if considered in the design, can help older adults incorporate the technology into their current lifestyles. The calendars, therefore, will be

examined under the heading; Memory Ageing, Physical Ageing, Social Network & Activity, and Ageing Attitude.

Memory Ageing

The purpose of the digital calendars is to remind users of appointments they have made. All three of the calendars allow the user to type in their appointments and appointment time, with the option of entering additional notes such as appointment location and description of appointment. There is also the option to be alerted a certain amount of time before the appointment is set. These features show that the all of the calendars support both the prospective component of PM (reminding the user at a specific time) and the retrospective component of PM (displaying the message back to the user).

Dobbs and Reeves (1996) claim that the PM process occurs over six stages, as described in Chapter 2. Google, Office and Works Calendars successfully processes three of these stages through assisting in the planning of task (showing the user what days they are available and what days they are not), monitoring (alerting the user to remember to do the task at a specified time), and content recall (displaying to the user the inputted message, such as the location of the task). The remaining steps (step (1) meta-knowledge, step (5) compliance, and step (6) output monitoring) are not met. Where step 1 and 5 rely on the individual's abilities, knowledge and attitude, step 6 could possibly be processed through the applications but it would require the user to give feedback into the calendar about whether the task was completed.

Another benefit that these calendars have to an older user is that they provide the option to remind the user before the event. This would give the user time to prepare for the appointment, such as buying a card for a friend's birthday. Microsoft Outlook also gives the user, upon receiving the reminder, the option to 'snooze' or postpone the reminder for a certain amount of time. This is a useful feature for people who are busy with another task at the time they are alerted and are likely to forget the appointment. The reminders for all calendars are pop-up reminders with a short audio alert. Users can also repeat reminders daily, weekly, monthly or yearly. This option saves users from manually inputting reminders into the system that occur on a routine basis.

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APPENDICES

APPENDIX A

Interviews

1. Consent Form
2. Interview Schedule
3. Coding & Memoing
4. Worked Example

A.1

Consent to Participate in Research - Interview

You are invited to participate in a research study conducted by the researcher Niamh Caprani, from the Institute of Art, Design and Technology Dún Laoghaire. The results from this interview will contribute to the design of a reminder system for older adults as part of a postgraduate research project.

The purpose of this interview is to gain further knowledge concerning the lifestyles of older adults, the problems they experience with daily tasks and the strategies they use in order to carry out tasks involving memory use.

Your decision to participate in this study is entirely voluntary and you may decide at any time to withdraw. The responses of all participants will be completely confidential. Only the researchers working on this project will have access to the information provided. Any information that is published or used publicly will maintain participant anonymity. The interview may also be audio recorded using a Dictaphone with participant consent. Access to these recordings will also only be available to researchers working on the project.

There are no foreseeable risks to participating in this study. You should know however that some items will relate to issues of memory changes, physical changes and lifestyle changes associated with ageing. Some participants may find these questions personal or distressing. We would like to remind you that you do not have to answer these questions if you do not wish to do so, or continue participating in the study if these issues upset you. If you choose not to complete the interview for this reason please let the researcher know at the time, so that we can have your feedback to improve future research.

This study has been approved by the Psychology Applied to Information Technology Ethics Committee of the Department of Learning Sciences at IADT Dún Laoghaire. If you have any further questions or would like to know more about this research project you can contact the researcher Niamh Caprani at the contact details below:

Mail Address: School of Creative Technologies, IADT, Kill Avenue, Dún Laoghaire, Co. Dublin.

Email: niamh.caprani@iadt.ie

Phone: 0857216601.

Research Supervisors: Nicola Porter and John Greaney

Participant Consent

I have read about and understand the nature and purpose of the study and my rights as a participant. I agree to participate in this study.

I am willing for the interview to be audio recorded **Yes/No**

Participants Signature

Participants Name (printed)

Date

A.2.1 Interview Schedule (Geriatrician)

SECTION 1

- What is your main role as a geriatrician?

SECTION 2

- From what age would you refer to a person as being an 'older adult'?
- What are the main lifestyle problems that older adults come to you with?
- What are the main behavioural or emotional problems that older adults come to you with?

SECTION 3

- What memory related problems do you find older adults experience?
- What factors do you think could have an affect on memory performance?
- Do you find many older adults experience prospective memory problems?
- How does this affect them?
- What suggestions would you make to try to improve memory performance?
- What suggestions would you make to try to improve prospective memory performance?

SECTION 4

- What are the main lifestyle changes that older adults experience? Retirement etc?
- How does this affect their daily lifestyle?
- Do you know of any daily tasks that older adults find particularly difficult to do? Why?
- Are older adults usually willing to try assistive devices to compensate for any problems?

A.2.2

Interview Schedule (Counsellor)

SECTION 1

- What are the main issues that people have problems with regarding ageing?
- How do you help them cope with these issues?

SECTION 2

- From what age would you refer to a person as being an 'older adult'?
- Do you think people young or old feel that ageing is a mostly positive or negative process?

SECTION 3

- What are the main life changes that occur, as people grow older? For example, retirement, death of spouse, children leaving home?
- What are the main problems experienced after these events, in relation to the change in lifestyle?
- Do most people, following their retirement or other significant events, eventually develop alternative lifestyles that keep them as active as they were before retirement?
- Do you think people who fail to develop a social lifestyle after retirement or other significant life changes, experience the affects of ageing more quickly than those who do develop an active lifestyle?

SECTION 4

- Would people ever voice concern over their ability to organise their day or to plan ahead?
- Do you find that individuals find it difficult to carry out or remember to carry out tasks in the home that they may not have had to do while working?
- Do you know whether or not such individuals use memory strategies to cope with this problem?

A.2.3

Interview Schedule (Care Worker)

SECTION 1

- What is your main role as a care worker when you are working with older adults?
- What age range do you work with?
- Typically, what type of social network do older adults have? Such as friends, family, voluntary work, member of clubs?

SECTION 2

- What are the main physical problems that older adults show?
- How does this affect how they manage everyday tasks?
- What are the main memory problems that older adults show?
- How does this affect them?
- Do you know of any daily tasks that older adults find particularly difficult to do?

SECTION 3

- Have you noticed whether older adults show prospective memory problems? For example, forgetting that you are calling over to their house, burning food etc?
- Would people ever voice concern over their ability to organise their day or to plan ahead?
- Have you noticed whether older adults use memory strategies to help them remember? For example,
 - taking paper notes
 - making shopping lists
 - Tick off completed tasks
 - Use a daily routine or “ritual”
 - entering appointments in a diary or calendar
 - entering addresses or phone numbers into a diary
 - writing a memo
 - writing on the back of your hand
 - taking photographs
 - using a clock, oven timer, alarm
 - putting objects in conspicuous places

- asking someone to remind you
- text reminders on mobile phone

- Do older adults use assistive devices to help them perform tasks that they might find difficult?
- Do you think that older adult's perceived ability to carry out tasks is different to what you perceive their ability to be?

A.2.4

Interview Schedule (Older Adult)

LIFESTYLE CHANGES

- What age category do you fall into: 60 – 70, 70 – 80, 80 – 90+?
- Do you live alone, with a spouse, or with family or friends?
- How do you travel, car, public transport, walk, or take lift?
- Are you a member of an association, club, voluntary or social group that meets regularly? Can you tell me what this is and what is involved? How often do you meet?
- Do you regularly, occasional or seldom leave your house?
- What type of work did you do before you retired?
- What are the main lifestyle differences between before and after retirement?
- Do you do all daily tasks yourself or does someone help you? How do they help?
- Do you help someone else with their daily tasks?

PHYSICAL CHANGES

- Do you have any physical difficulties related to ageing? Does this affect how you carry out daily tasks? Do you use any object that assists you to do these tasks?
- Are there any daily tasks that you don't like doing for any other reason?

MEMORY CHANGES

- Do you think your memory abilities have changed as you age?
- Do you find any differences in your ability to remember to do things in the future?
- Have there been any significant positive or negative changes in your lifestyle in recent years? How has this affected your daily routine?
- Do you have any problems remembering the following:
 - birthdays
 - addresses and phone numbers
 - appointments
 - taking medication
 - chores or errands
 - travel routes
 - names of familiar faces

MEMORY STRATEGIES

- Are there any memory strategies that you use to help you remember to do daily tasks?
- Do you use any of the following:
 - taking paper notes
 - making shopping lists
 - Tick off completed tasks
 - Use a daily routine or “ritual”
 - entering appointments in a diary or calendar
 - entering addresses or phone numbers into a diary
 - writing a memo
 - writing on the back of your hand
 - taking photographs
 - using a clock, oven timer, alarm
 - putting objects in conspicuous places
 - asking someone to remind you
 - text reminders on mobile phone
- Do you experience any problems with these strategies?
- What benefits are there to these strategies?

A.3.1

Interview Coding & Memoing

Older Adult Coded and Categorised Data

Code	Key Point	Memo
Activities (Act)	<ul style="list-style-type: none"> I'm always active. I love the garden and I love cooking. I did like gardening, we have a fair big garden. 	<ul style="list-style-type: none"> Active interests, hobbies
Act	<ul style="list-style-type: none"> I play golf. I don't like walking but I have to. 	<ul style="list-style-type: none"> Interest and mandatory activities
Act	<ul style="list-style-type: none"> I go to the bridge club and active retirement Book club, yoga club, art group, walking group, philosophy group. I'm belonging to every group there is. I'm in the ladies club, I do catering. I go swimming and art classes 	<ul style="list-style-type: none"> Social activities
Act	<ul style="list-style-type: none"> We are in the bridge club and the active retirement when it suits. Pitch and put and gardening I walk for pleasure. I go to history of art, music appreciation and German classes once a week. 	<ul style="list-style-type: none"> Social and interest activities
Friends & Family/Act	<ul style="list-style-type: none"> I go out with my friends. I might go out with the grandchildren or bring the dog for a walk 	<ul style="list-style-type: none"> Social activities
Family and Friends (F& F)	<ul style="list-style-type: none"> We live alone 	<ul style="list-style-type: none"> Husband and wife living together
F& F	<ul style="list-style-type: none"> I live with my husband and my son is still living here 	<ul style="list-style-type: none"> Spouses and children living together
F& F	<ul style="list-style-type: none"> We live together and our daughter is beside us 	<ul style="list-style-type: none"> Spouses living together with children nearby
F& F	<ul style="list-style-type: none"> The priest comes every month to visit 	<ul style="list-style-type: none"> Social visits
F&F/Support (Supp)	<ul style="list-style-type: none"> Our daughter drives us in the car. I'd have to have somebody with me 	<ul style="list-style-type: none"> Dependence on family for outside activity

	going out	
F&F/ Supp	<ul style="list-style-type: none"> • A chap up the road comes down and does any heavy digging 	<ul style="list-style-type: none"> • Support from neighbours for heavy duty tasks
F&F/ Supp	<ul style="list-style-type: none"> • The only thing I miss the car now for is going to the garden centre when I want without troubling someone. 	<ul style="list-style-type: none"> • Reluctance to depend on others
F&F/ Supp	<ul style="list-style-type: none"> • My neighbour across the road comes to me when she is in distress 	<ul style="list-style-type: none"> • Providing support to neighbours
F&F/ Supp	<ul style="list-style-type: none"> • [The children] don't trouble me a lot but I'm there for them if they need me • We collect the grandchildren from school • I help my sister-in-law on a weekly basis. I occasionally baby-sit the grandchildren 	<ul style="list-style-type: none"> • Providing support to family
F&F/ Supp	<ul style="list-style-type: none"> • I used to help a neighbour but she's dead now. I've always been involved in the area. I have an aunt as well who I help 	<ul style="list-style-type: none"> • Providing support to neighbours and family
Physical problems (PP)	<ul style="list-style-type: none"> • Deaf • Arthritis • Bad eyesight • Stiffness of the bones • I'm a bit slow getting around • The knees are a bit stiffer 	<ul style="list-style-type: none"> • Age-related physical problems
PP	<ul style="list-style-type: none"> • I slipped and had my knee replaced • I had a bypass • I had breast cancer • I fell and fractured my hip 	<ul style="list-style-type: none"> • Non age-related physical problems
PP	<ul style="list-style-type: none"> • I try not to lift heavy things • I don't like hoovering, pushing, pulling it, lifting it up every step and putting it back 	<ul style="list-style-type: none"> • Affected areas due to physical problems
Assistive	<ul style="list-style-type: none"> • Glasses 	<ul style="list-style-type: none"> • Devices used to aid

Technology (AT)	<ul style="list-style-type: none"> • Walking stick • Hearing aid • Furniture • Jar opener • Medication dispensers 	physical problems
AT problems	<ul style="list-style-type: none"> • I don't like using the hearing aid because it picks up background noises and distorts noises 	<ul style="list-style-type: none"> • Devices not used or replaced if problems found
Lifestyle changes with retirement (+LC)	<ul style="list-style-type: none"> • I did the things I wanted to do. I have time to do the things now. • More time on your hands. • We moved down from Portmarnock to Wicklow • Being able to meet friends more • We travelled further abroad • I'm enjoying retirement even though I enjoyed work • We bought a house in Dingle and it has given us a new impetus for life 	<ul style="list-style-type: none"> • Positive lifestyle changes with retirement
=LC	<ul style="list-style-type: none"> • I don't see any difference really • There aren't a great lot of differences 	<ul style="list-style-type: none"> • No lifestyle difference found
-LC	<ul style="list-style-type: none"> • Having a lot of time on your hands. I couldn't get used to it to begin with. I felt guilty. 	<ul style="list-style-type: none"> • Negative aspects of retirement
Financial LC	<ul style="list-style-type: none"> • No money • Reduction in salary. Living off half your salary 	<ul style="list-style-type: none"> • Financial aspect of retirement
Ageing change	<ul style="list-style-type: none"> • You know that you are getting older • Family are getting older • There's less to worry about 	<ul style="list-style-type: none"> • Lifestyle changes with ageing
Negative Memory Issues (-M)	<ul style="list-style-type: none"> • Sometimes forgetting names and that • Since mobile phones I don't remember anyone's phone number 	<ul style="list-style-type: none"> • Negative perception of memory abilities

	<ul style="list-style-type: none"> • My memory has changes drastically. I cant remember names. Names puzzle me. The faces I know, the names I can't. I'd have to go round the alphabet 40 times a day • I was great with phone numbers until they brought in that automatic phone. • I would have said, "God, I can't remember your name now". 	
Positive Memory issues (+M)	<ul style="list-style-type: none"> • I'm pretty good at remembering future things • I remember the ones I have to remember, the ones I use all the time • I have a very good memory. I can remember telephone numbers and younger people don't know how I can retain all these numbers • My memory is good. 	<ul style="list-style-type: none"> • Positive perception of memory abilities
Memory strategies (MS)	<ul style="list-style-type: none"> • We have all our phone numbers in a book • I have all the birthdays written down • What I probably do more now is write everything in a diary or calendar • I would have problems if I hadn't them written down. • I'm very methodical about remembering to do things. I'd write them on the calendar or pin them on the wall. 	<ul style="list-style-type: none"> • Strategies used to remember

A.3.2

Professional Coded and Categorised Data

Code	Key Points	Memo
Act	<ul style="list-style-type: none"> Encouraged to organise days and plan ahead 	<ul style="list-style-type: none"> Benefit of planning
Act prob	<ul style="list-style-type: none"> Despair or regret over things they didn't do Security and nervousness affecting social and physical lifestyle Fear of going out if out of public for long period Environment affecting social activity (transport, crime) 	<ul style="list-style-type: none"> Factors affecting social activity
PP	<ul style="list-style-type: none"> Unsteady on their feet Falling is common problem Sensory problems 	<ul style="list-style-type: none"> Physical problems related to ageing
PP	<ul style="list-style-type: none"> Affects how they carry out tasks 	<ul style="list-style-type: none"> Areas affected by physical problems
AT	<ul style="list-style-type: none"> Use household furniture to move about house Use assistive devices for major problems Don't mind using assistive devices in home 	<ul style="list-style-type: none"> Devices used to assist physical problems
AT Prob	<ul style="list-style-type: none"> Embarrassment using assistive devices in public Standing out, being seen using aids that mark you as old or helpless 	<ul style="list-style-type: none"> Problems with assistive devices
F&F	<ul style="list-style-type: none"> Important to have family or social network Good network needed to help with life changes 	<ul style="list-style-type: none"> Social network
F&F Supp	<ul style="list-style-type: none"> Older adults providing support to others 	<ul style="list-style-type: none"> Support to family and friends
F & F prob	<ul style="list-style-type: none"> Isolation due to bereavement or retirement 	<ul style="list-style-type: none"> Problems related to lack of social network

A small detail but one which may cause frustration to the user is the fact that the Microsoft Works calendar neglects to display the current date or highlight the current day on the calendar. It would be thought that being able to identify the current date would be a benefit of user a digital calendar compared to the traditional calendar.

One feature which was of particular importance to the participants in the focus group method was for a system to provide a clear and simple Help option and to allow the user to return from errors made. The Google calendar displays a text link Help option in the right hand corner of the screen. This link is clear but does not particularly stand out against the other link options. The Help centre is well displayed with the main menu on the left hand side column, submenus in the centre of the page and the top 5 questions on the right hand side column. This calendar is also very good to recover from any errors made with cancel options, a back button and an option to return to the calendar. Most of the links are displayed as text (with the exception of previous and next arrows), and their purposes are quite clear to the user.

The Microsoft Outlook calendar is not as user friendly to the older adult user however. The icon buttons are very small, which means that the Help option is not very clear to the user who might need it. The Help appears as a question mark, the purpose of which may not be very obvious on its own. However, rollover hints are displayed explaining this. When the user selects the Help option they can either search for a topic or choose to look at the table of contents. The table of contents then displays a long list of subjects, one of which is related to the calendar. Once this is selected, a further 32 options are displayed to the user. This many options in one long list is likely to discourage the inexperienced older user. Another help option is available in the main toolbar which also has options to contact the support team and view outlook online.

The Microsoft Office calendar also allows the user to cancel or edit actions and has a link for the user to return to 'Today's' calendar. A cancel option does not appear on every pop-up window, such as when entering a new event, however the experienced user would know to use the X button on the top right hand side of the screen.

Microsoft Works calendar similarly has a text and a Help icon option. There are significantly less icons on this screen compared to the Office calendar and it is therefore very clear to the older user. When the Help option is selected only 5 links are displayed for

the user to choose from. This is significantly less daunting for the inexperienced user compared to the other two calendars. The Works calendar also provides cancel and edit options but does not have a back button, a feature which would be useful for the older user. All three calendars display a message asking the user if they are sure they want to delete an appointment reminder. This ensures that information is not deleted accidentally.

To conclude this section, it seems that current digital calendars are relatively well designed to accommodate Memory Ageing. Areas that could be improved include an easily identified and easy to use Help option and options to cancel, edit and go back to a previous section. The ability to postpone a reminder (only available with the Outlook calendar), and highlighting the current date would also be useful to the older user.

Physical Ageing

All three of the calendars are available on computer systems and therefore require information to be entered with a computer keyboard and mouse or laptop touchpad. Although the keyboard and mouse have been found to be the best input device for experienced older users, it was shown to be difficult to use by inexperienced older users (Wood, Willoughby, Rushing, Bechtel, & Gilbert, 2005). All of the calendars take up the whole of the computer screen, which means that the display is large, especially compared to calendars used on mobile phones or organisers. The text which is displayed is standard text size however it may be too small for users with visual problems. This particularly applies to the appointment messages displayed on the calendar. Google and Outlook calendars offer the user to choose the appointments to be displayed in colour, which makes the message stand out more. None of the calendars allow the user to change the text size. Outlook does offer the user to type an additional message about the appointment which can be the text size and colour of the user's choice. This message is only visible if the user clicks on the displayed appointment.

Microsoft Works offers the user to display the icons either in a small or large version. This feature, although it would be useful for other areas of the calendar also, shows that the design has taken into consideration different physical abilities. This option would be useful for Microsoft Outlook, which contains very small icon displays. In terms of auditory ability, all of the digital calendars post reminders with a short alert sound. The Microsoft

calendars also allow the user to change this audio alert by browsing through the users folders and choosing a sound file if one is present. It would be easier for the user if sample alerts sounds were available for the user to choose from.

Social Network & Activity

The ability for the user to organise their time, to see what appointments they have made on what days and to be reminded to do tasks or go to appointments is a clear benefit of digital calendars in terms of organising the users social lifestyle.

A further benefit of the Google calendar is the ability for the user to share their calendar with a friend, a public calendar such as a sports team calendar and to create calendars for multiple persons so that each person or calendar's information is coded to their own colour. Google also provides the user with the option to synchronise their calendar with their mobile phone, so that reminders are also issued to them when they are away from their computer. Although these features are impressive and useful for socially active users, the older user (as found from the focus group method) is more inclined to use the main functions of a device to do a task, disregarding additional features.

Ageing Attitude

It is the attitude of the user which determines whether they will use a device. This attitude is usually defined for a technology mediated device by the usefulness of the system, the cost and the visual display. The usefulness of the system can be measured through the difference between the benefit of the device over the user's current method (digital versus traditional calendars), the amount of effort needed to use the device compared to the benefit of the output (whether the user needs reminder alerts) and whether the device does what it is supposed to do.

The cost of the device is also of importance to the user. From the interviews it was found that older adults have a significant loss of income after retirement. Therefore, as expected, they may be less likely to buy technology that they are not familiar with or that is expensive to purchase. All of the calendars discussed here require the user to have a computer. As computers are expensive pieces of equipment it is unlikely that an older user would buy one just to use a digital calendar. Google and Microsoft Outlook also require the

user to have an internet connection. Again, it would be impractical for the older user to purchase an internet connection for a digital calendar if one is not already installed. Ideally, a reminder system would be a stand alone piece of technology that could be made and purchased at a low cost.

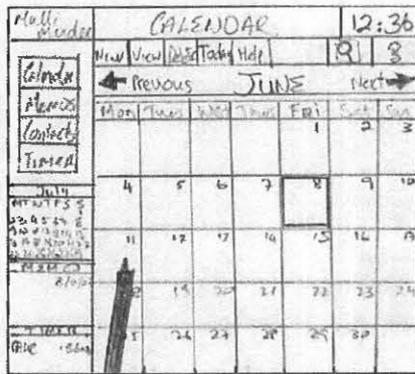
The visual display of the calendar is also important when predicting the attitude of the older user. From the focus groups, it was discovered that many older adults initially feel that they are unable to use technology and are too old to learn how to use it. It was later found that the majority of the participants used multiple technology systems including digital television, mobile phones, microwaves, house alarms and digital cameras. It can be concluded then that if the display appears uncomplicated and easy to use with clear display options, the user will be less likely to be daunted by it.

Conclusion

There is no doubt that the digital calendars described above are examples of good design and the worldwide use of all three calendars is proof of their success. It is also obvious that these calendars were not designed with the older adult as its primary target user. Multiminder, on the other hand, will be designed for older users, taking into consideration the information about older adult needs and preferences that were obtained from the data-gathering methodologies and past research literature.

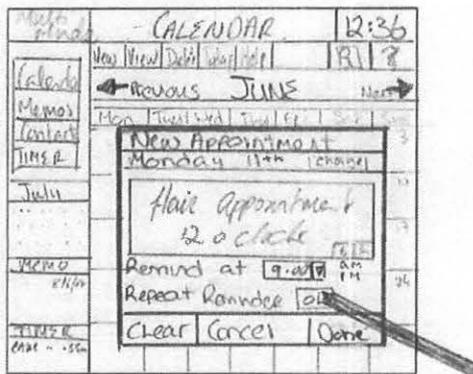
APPENDIX E

Storyboards



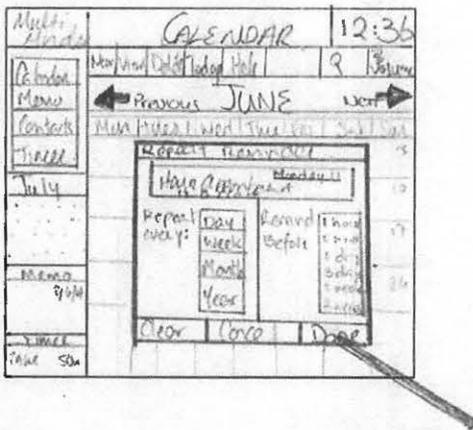
Main Screen

- 1) Multi-Window will display the current month as its main screen. The user can navigate to any section from here.
- 2) To create a new appointment the user can double click a day or click 'New'.



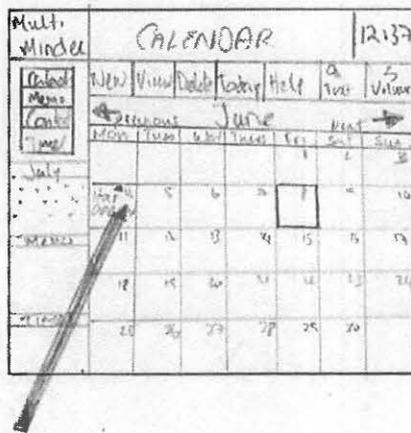
New Appointment

- 3) If the user double clicks a day a new screen appears. The user can write in their message, choose a time to be reminded and click 'Done'. The user can also choose to repeat the reminder.



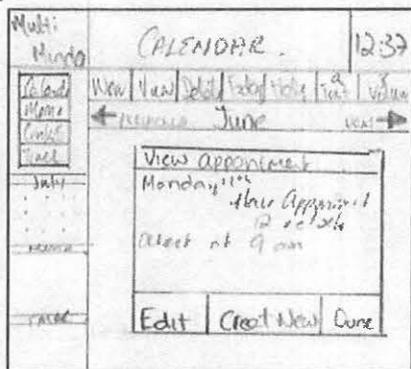
Repeat Reminder

- 3) If the user chooses to repeat the reminder, the message is displayed to them. They can choose the frequency of the reminder and whether they want to be alerted about the appointment.



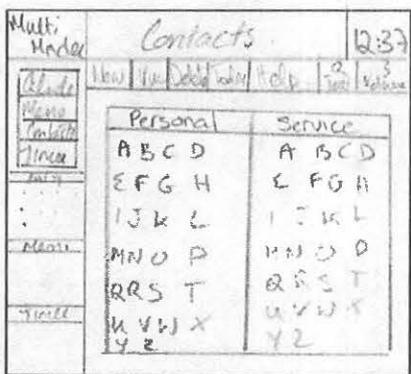
Main Screen

4) When the user is finished creating the appointment, the main screen is again displayed. The message can be seen in the space for the day with an bell icon showing if the user selected a time.



View Appointment

5) The user can view the message and its details by rolling over the text. The message can be edited by double tapping on the day.



Contacts

6) Users can view contact details of people; either personal or servicemen. A contact can be viewed by tapping the letter they are stored under.

Multi-Window	Contacts	12:40																					
Contacts	New	View	Delete	Labels	Help	Test	or	Volume															
Contacts	<table border="1"> <tr> <td colspan="2">New contact</td> </tr> <tr> <td>Category</td> <td>Personal Service</td> </tr> <tr> <td>Name</td> <td><input type="text"/></td> </tr> <tr> <td>Type of service</td> <td><input type="text"/></td> </tr> <tr> <td>Phone number 1</td> <td><input type="text"/></td> </tr> <tr> <td>Save order letters</td> <td><input checked="" type="checkbox"/> <input type="checkbox"/></td> </tr> <tr> <td>Clear</td> <td>Cancel</td> <td>Save</td> </tr> </table>								New contact		Category	Personal Service	Name	<input type="text"/>	Type of service	<input type="text"/>	Phone number 1	<input type="text"/>	Save order letters	<input checked="" type="checkbox"/> <input type="checkbox"/>	Clear	Cancel	Save
New contact																							
Category	Personal Service																						
Name	<input type="text"/>																						
Type of service	<input type="text"/>																						
Phone number 1	<input type="text"/>																						
Save order letters	<input checked="" type="checkbox"/> <input type="checkbox"/>																						
Clear	Cancel	Save																					
Time																							

Adding Contacts

f) A new contact can be entered either by selecting new or by selecting a letter and selecting new from there.

Multi-Window	Memo	12:40															
Memo	New	View	Delete	Labels	Help	Test	Volume										
Memo	<table border="1"> <tr> <td colspan="2">New memo</td> </tr> <tr> <td colspan="2">Home to Pauline's Dog is fed</td> </tr> <tr> <td>Display</td> <td>Large</td> <td>Small</td> </tr> <tr> <td>Clear</td> <td>Cancel</td> <td>Save</td> </tr> </table>							New memo		Home to Pauline's Dog is fed		Display	Large	Small	Clear	Cancel	Save
New memo																	
Home to Pauline's Dog is fed																	
Display	Large	Small															
Clear	Cancel	Save															
Time																	

Memo

g) A new memo can be selected by entering the 'memo' section and selecting 'new'. The memo can be display full screen or in the bottom left. Memos are temporary notes

	Timer	12:41																							
Timer	New	View	Delete	Labels	Help	Test	Volume																		
Timer	<table border="1"> <tr> <td colspan="2">New timer</td> </tr> <tr> <td>Label</td> <td><input type="text"/></td> </tr> <tr> <td>Unit</td> <td>hrs</td> <td>mins</td> <td>secs</td> </tr> <tr> <td>Set</td> <td><input type="text"/></td> <td>mins</td> <td>secs</td> </tr> <tr> <td>Predefined</td> <td>Potatoes</td> <td>50 mins</td> </tr> <tr> <td>Clear</td> <td>Cancel</td> <td>OK</td> </tr> </table>							New timer		Label	<input type="text"/>	Unit	hrs	mins	secs	Set	<input type="text"/>	mins	secs	Predefined	Potatoes	50 mins	Clear	Cancel	OK
New timer																									
Label	<input type="text"/>																								
Unit	hrs	mins	secs																						
Set	<input type="text"/>	mins	secs																						
Predefined	Potatoes	50 mins																							
Clear	Cancel	OK																							
Time																									

Timer

g) The timer is a count down timer. A label can be attached to the timer. These are displayed in the bottom left corner of the screen

APPENDIX F

Task Analysis

Task Analysis - Tabular Format

Goal 1 – 0 Setting a Reminder in the Calendar plan 0: at least 5 mins before event (1); if difficulty using system (2)
1 Select a day plan 1: If date incorrect (1), otherwise (2), for audio reminders optionally (do all in sequence 2-5)
1 Change date
2 Write message plan 1.2: If OK (1), otherwise (do any one 2-3)
1 Save message
2 Clear message
3 Cancel task
3 Set reminder time
4 Set pre-reminder
5 Repeat reminder
1 Set reminder frequency plan 1.5.1: If OK (1), otherwise (do any one 2-3)
1 Save reminder
2 Clear repeat reminder
3 Cancel repeat reminder
2 Go to 'Help'

Goal 2 - 0 Adding a New Memo plan 0: to write new memo (1), if difficulty using system (2)
1 Go to 'Memos' plan 1: If space on memo memo pad (1), otherwise firstly (do in any order 2-3)
1 Select 'Add a New Memo'
1 Write Memo plan 1.1.1: If OK (1), otherwise (do any one 2-3)
1. Select 'Save'
2 Select 'Clear'
3 Select 'Cancel'
2 Select 'Delete All Memos'
3 Select 'Delete' on individual Memos
2 Go to 'Help'

Goal 3 - 0 Adding/Editing a Contact
1 Select Phonebook plan 1: to add number [optionally do any 1-2; otherwise (3)]
1 Select 'Add Personal Number'
1 Input contact details plan 1.1.1: If OK (1), otherwise (do any one 2-3)
1 Select 'Save'
2 Select 'Clear'

3 Select 'Cancel'
2 Select 'Add Business Number'
1 Input contact details plan 1.2.1: If OK (1), otherwise (do any one 2-3)
1 Select 'Save'
2 Select 'Clear'
3 Select 'Cancel'
3 Select letter on either section plan 3: to edit number (1), to add number (2), otherwise (do any one 3-5)
1 View numbers under this category
1.3.1.1 Select 'Edit'
2 Select 'Add New Personal/Business Number'
3 Select 'View Personal/Business Numbers'
4 Go to Phonebook
5 Select 'Cancel'
2 Go to 'Help'

Goal 3 – 0 Setting a Timer
1 Go to 'Timer' plan 1: to set a time before alert (1), to label what is to be timed to appear on alert (2)
1 Enter a number plan 1.1: If OK (1), otherwise (do any one 2-3)
1 Select 'Save'
2 Select 'Clear'
3 Select 'Cancel'
2 Write in a label
2 Go to 'Help'

APPENDIX G

Prototype Testing

1. Consent Form
2. Prototype Testing Tasks
3. Participant Feedback End Test Questions
4. Paper Prototype Screens
5. Interactive Prototype Screens

G.1 Consent to Participate in Research – Prototype Testing

You are invited to participate in a research study conducted by the researcher Niamh Caprani, from the Institute of Art, Design and Technology Dún Laoghaire. The results from this prototype testing will contribute to the design of a reminder system for older adults as part of a postgraduate research project.

The purpose of prototype testing is to obtain feedback from the potential users of the reminder system in relation to the visual design, the layout and the design features. You will be shown several screens and asked to point to areas of the page that you think would allow you to do a specific task. The testing will be followed by a short interview where you will be asked your opinion about the design.

Your decision to participate in this study is entirely voluntary. The responses of all participants will be completely confidential. Only the researchers working on this project will have access to the information provided. Any information that is published or used publicly will maintain participant anonymity. There are no foreseeable risks to participating in this study. You do not have to answer any questions that you are not comfortable with and you may withdraw from the study at any time.

This study has been approved by the Psychology Applied to Information Technology Ethics Committee of the Department of Learning Sciences at IADT Dún Laoghaire. If you have any further questions or would like to know more about this research project you can contact the researcher Niamh Caprani at the contact details below:

Mail Address: School of Creative Technologies, IADT, Kill Avenue, Dún Laoghaire, Co. Dublin.

Email: niamh.caprani@iadt.ie

Phone: 0857216601.

Research Supervisors: Dr. Nicola Porter and Dr. John Greaney

Participant Consent

I have read about and understand the nature and purpose of the study and my rights as a participant. I agree to participate in this study.

I am willing for the interview to be audio recorded Yes/No

Participants Signature

Participants Name (printed)

Date

G.2

Prototype Testing Tasks

Task 1 - You need to set a reminder so that you will be reminded to put your bin out every Wednesday. What steps do you think you would take to do this?

Task 2 – You are going out and what to leave a message or memo for someone in case they call in to say where you are. What steps would you take to complete this task?

Task 3: You have difficulty reading the text. What button would you press to change the size of the text?

Task 4: You can not remember how to look at stored reminders that were made in the past. How would you find information to about how to do this?

Task 5: You have just taken on a new house cleaner and want to store her number so that you will not forget it. What steps would you take to complete this task?

Task 6: You are cooking a roast chicken that will not be ready for another hour. How would you go about setting a timer to alert you after this time had passed?

For each task make a note of the following:

Observation of click stream:

Verbal Comments

Any suggestions to make the task easier

Difficulty rate of this task:

0 1 2 3

-
- 0 – User completed task with zero difficulty (zero frustration)
 - 1 – User completed task with minor problems (little frustration)
 - 2 – User completed task but required more effort/time/dead-ends than expected (medium/high frustration)
 - 3 – User did not complete task (point of failure)

G.3

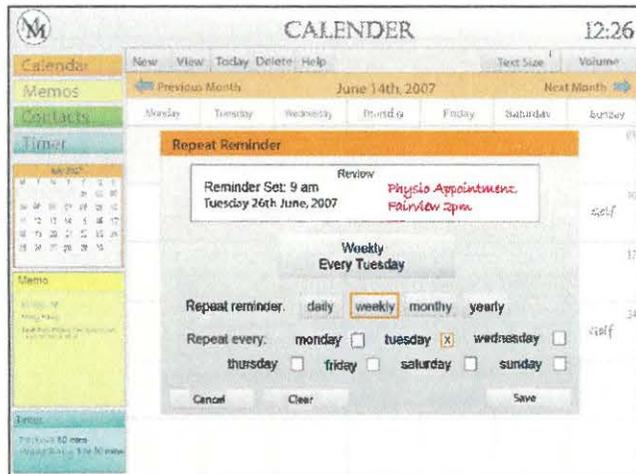
Participant Feedback End Test Questions

1. What features of Multiminder were vague or confusing to you, if any?
2. What is your impression about navigating Multiminder? Does it seem easy or difficult? What makes it that way?
3. Do you think that the colour coding helps you to know where you are in the system?
4. Is there anything you would change about the layout of the screens or buttons?
5. What else should be included in the system?
6. What do you like best about Multiminder?
7. What do you like least?
8. Do you think some people would have problems using Multiminder? What kind of people? What kind of problems?
9. If Multiminder was available to purchase would you be interested in it?
10. Would you like to make any other comments about the system?

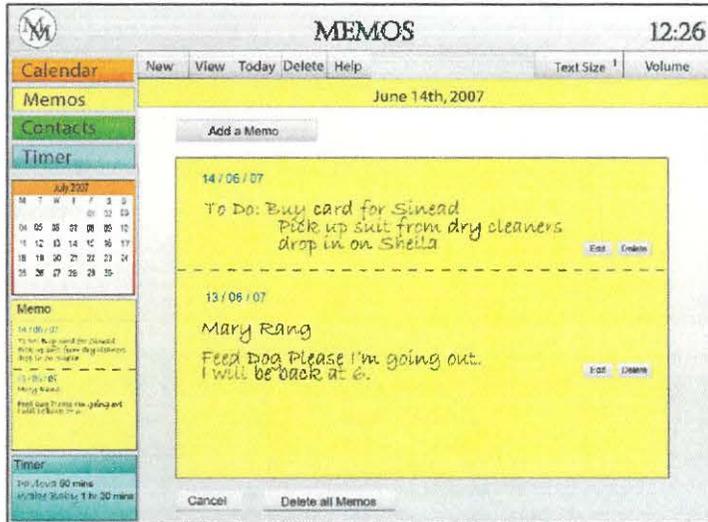
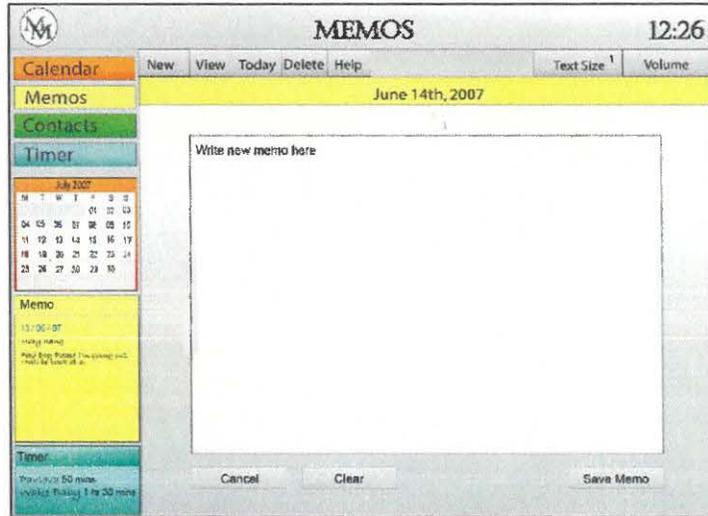
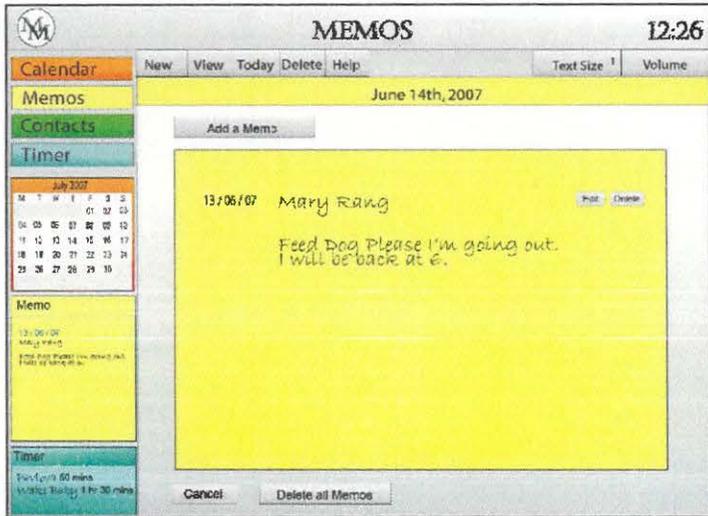
G.4

Paper Prototype Screens

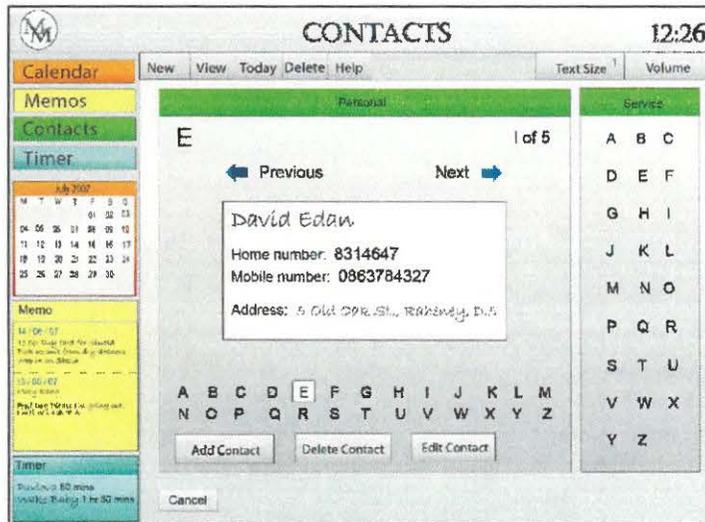
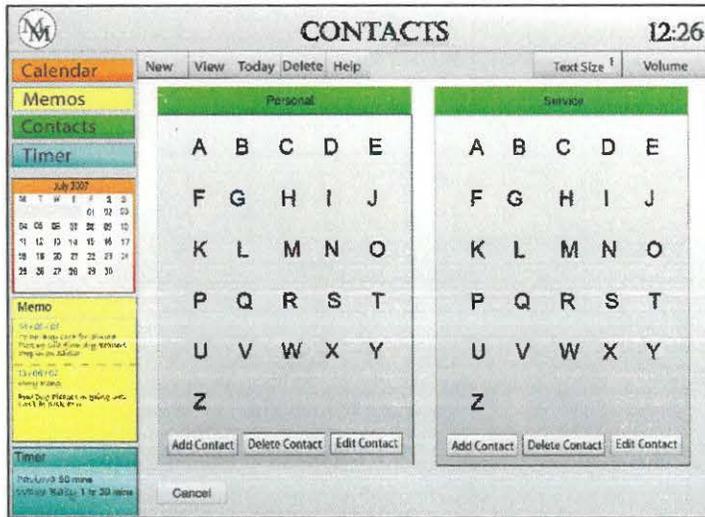
Calendar Section



Memos Section



Contacts Section



Timer Section

Text & Volume Functions

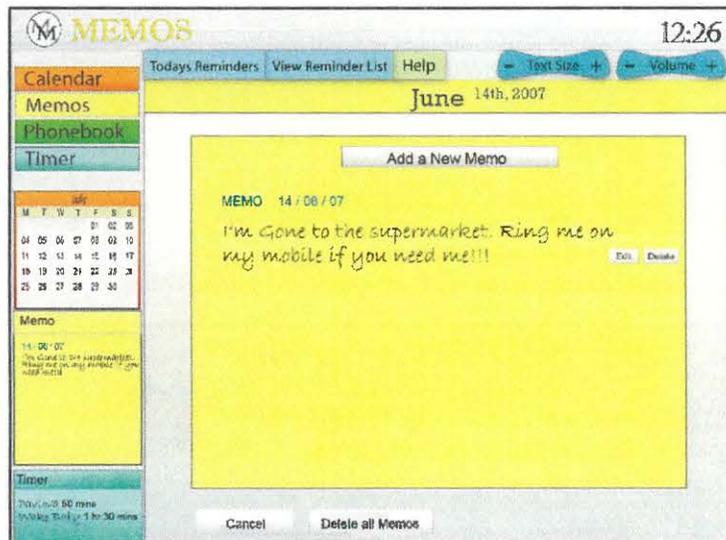
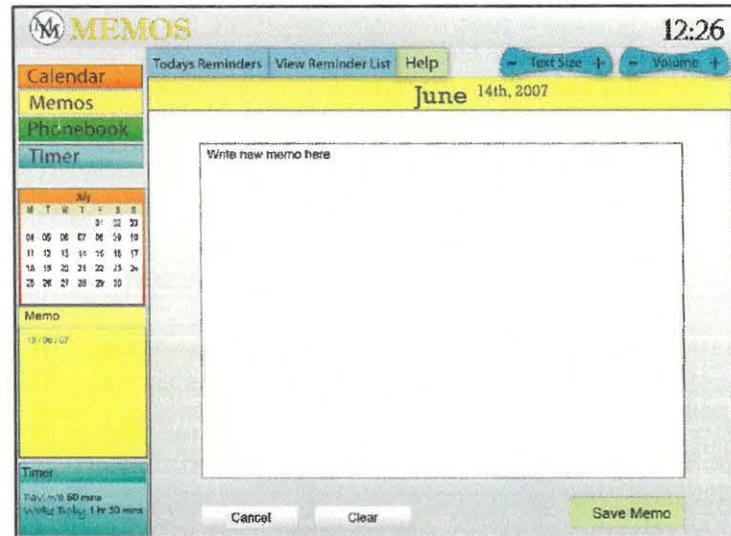
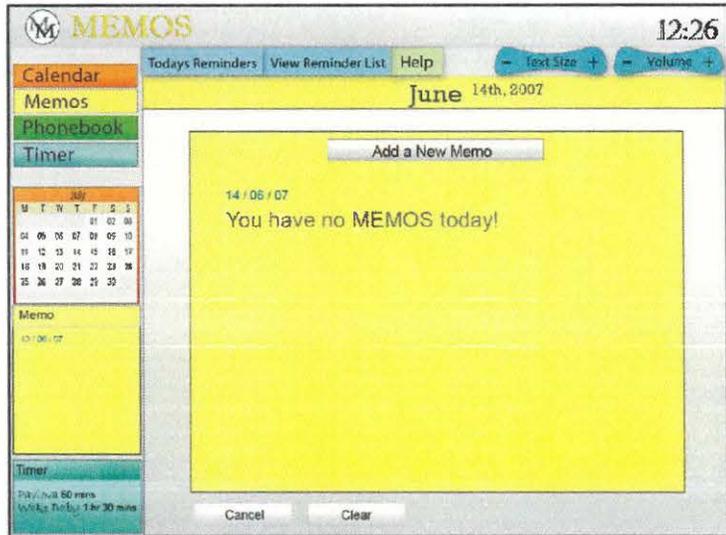
H.5

Interactive Prototype Testing Screens

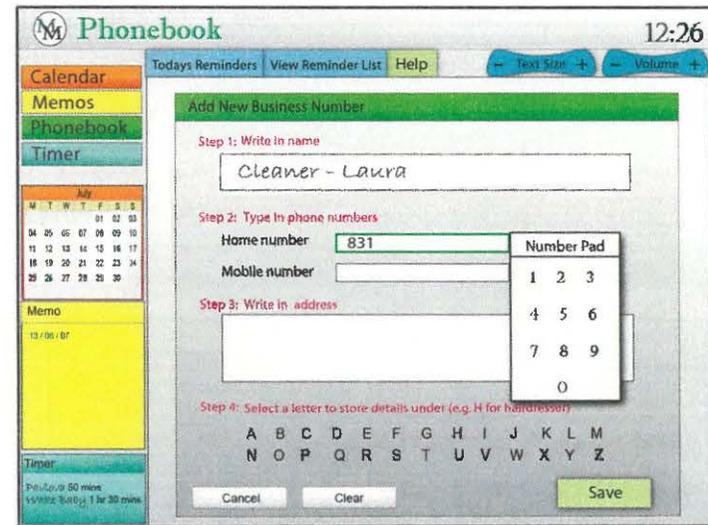
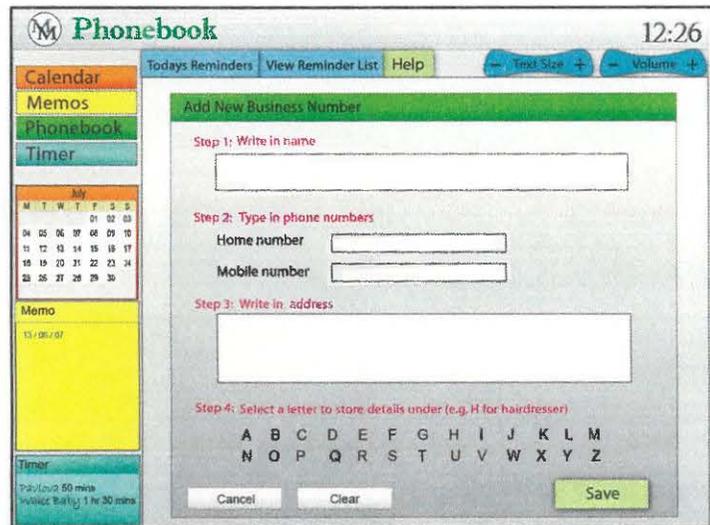
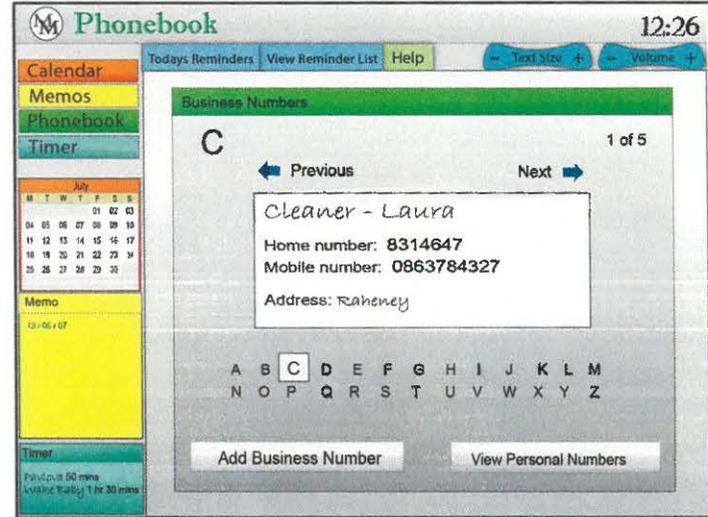
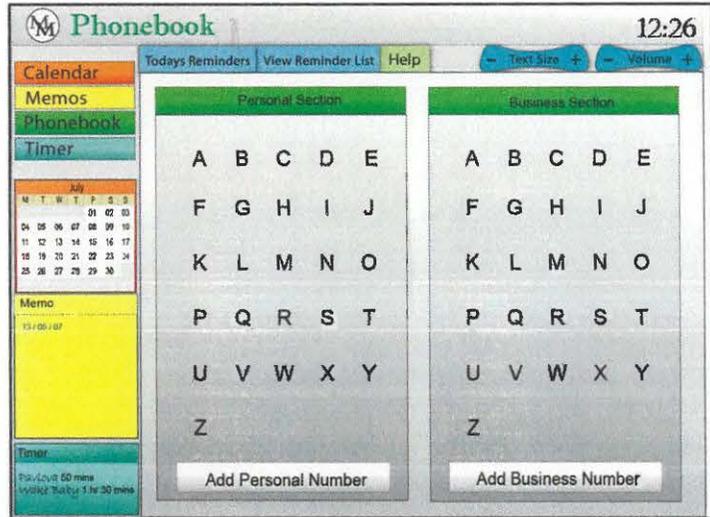
Calendar Section



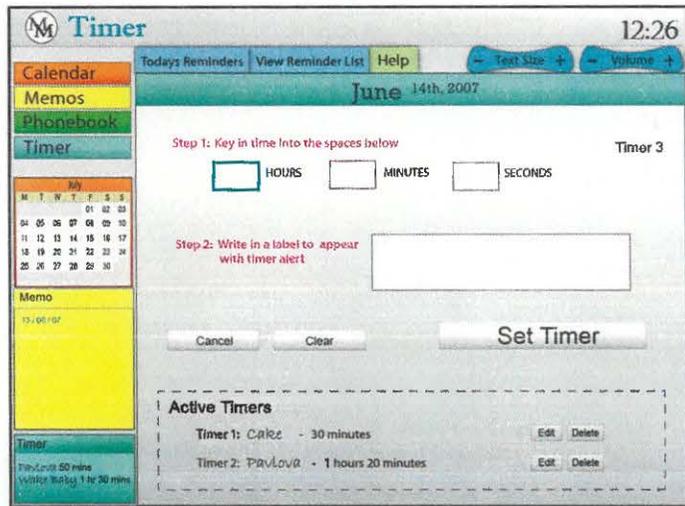
Memos Section



Contacts Section



Timer Section



Text Function

Calendar 12:26

Today's Reminders | View Reminder List | Help | Text Size + | Volume +

← Previous Month **June** 14th, 2007 Next Month →

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
				01	02	03
04	05 Meet Susan	06	07	08 Meet for coffee	09	10 Golf
11	12	13	14	15	16	17
18	19	20	21	22	23 Wedding	24 Golf
25	26	27	28	29	30	

July
M T W T F S S
01 02 03
04 05 06 07 08 09 10
11 12 13 14 15 16 17
18 19 20 21 22 23 24
25 26 27 28 29 30

Memo
13 / 06 / 07
Marry Marry
Pret Day Please I'm gonna out
I will be back at 6.

Timer
Pavlova 50 mins
Wakes Baby 1 hr 30 mins

Calendar 12:26

Today's Reminders | View Reminder List | Help | Text Size + | Volume +

← Previous Month **June** 14th, 2007 Next Month →

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
				01	02	03
04	05 Meet Susan	06	07	08 Meet for coffee	09	10 Golf
11	12	13	14	15	16	17
18	19	20	21	22	23 Wedding	24 Golf
25	26	27	28	29	30	

July
M T W T F S S
01 02 03
04 05 06 07 08 09 10
11 12 13 14 15 16 17
18 19 20 21 22 23 24
25 26 27 28 29 30

Memo
13 / 06 / 07
Marry Marry
Pret Day Please I'm gonna out
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Timer
Pavlova 50 mins
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Calendar 12:26

Today's Reminders | View Reminder List | Help | Text Size + | Volume +

← Previous Month **June** 14th, 2007 Next Month →

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18	19	20	21	22	23 Wedding	24 Golf
25	26	27	28	29	30	

July
M T W T F S S
01 02 03
04 05 06 07 08 09 10
11 12 13 14 15 16 17
18 19 20 21 22 23 24
25 26 27 28 29 30

Memo
13 / 06 / 07
Marry Marry
Pret Day Please I'm gonna out
I will be back at 6.

Timer
Pavlova 50 mins
Wakes Baby 1 hr 30 mins

PUBLICATIONS AND PRESENTATIONS

Portions of this thesis have previously been presented and published in the following peer-reviewed outlets:

Abstract (Peer-Reviewed)

University of Wales, Bangor 7-9 September 2006

Caprani, N., Greaney, J., & Porter, N. (2006). The development of a technology mediated Memory aid for older adults with early AD. *Proceedings of The Ageing Jigsaw: Interdisciplinary Approached to Understanding Old Age*. Bangor, Wales (p. 46).

Short Papers (Peer-Reviewed)

University of Sussex 11-12 September 2006

Caprani, N., Porter, N., & Greaney, J. (2006). Designing a prospective memory aid for cognitively impaired elderly individuals. *Proceedings of Human Centred Technology Workshop 2006: Designing for Collaborative as well as Individualised Environments*. Sussex (pp. 38-40).
<ftp://ftp.informatics.sussex.ac.uk/pub/reports/csrp/csrp585.pdf>

University of Lancaster 4th September 2007

Caprani, N., Porter, N., & Greaney, J. (2007). Methods used to predict older adult use of technology mediated memory aids. *Proceedings of MEMOS Workshop: Supporting Human Memory with Interactive Systems, HCI Conference*. Lancaster, UK (pp. 17-20).
<http://diuf.unifr.ch/people/lalanned/MeMos07/files/MeMos07.pdf>

Long Paper (Refereed Journal)

PsychNology Journal

Caprani, N., Greaney, J., & Porter, N. (2006). A review of memory aid devices for an ageing population. *PsychNology Journal*, 4(3), 205 – 243.
[http://psychology.org/File/PNJ4\(3\)/PSYCHNOLOGY_JOURNAL_4_3_COVER_TOC_EDITORIAL.pdf](http://psychology.org/File/PNJ4(3)/PSYCHNOLOGY_JOURNAL_4_3_COVER_TOC_EDITORIAL.pdf)