# Participatory Design of Mobile Phone Software for Seniors

by

Michael Massimi

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University of Toronto

# Abstract

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We describe one of the first case studies involving older people (ages 55-86) as co-designers of software for mobile phones. A participatory design team consisting of five older women and a computer scientist met nine times over a period of six months. A software design was created and refined through a blend of group meetings and one-on-one sessions. Based on paper prototypes and participant opinions gathered from these sessions, we present *Recall* - a software customization that the team developed. We reflected on the process of participatory design with seniors and tested some usability dimensions of the software itself. We present the results of the reflection and testing as themes, integrated analyses, and guidelines for involving seniors in software design. To be successful, participatory software design with seniors requires a clear shared purpose, careful participant selection and meeting structuring, and significant investment in mutual learning activities.

# Dedication

*For my grandmother, Nancy Georgeanni.*

# Acknowledgements

*"I not only use all of the brains I have, but all I can borrow."*

*– Woodrow Wilson*

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# Chapter 1

# Introduction

Designing mobile phone systems for the elderly is a major challenge. Although the "baby boomer" generation will largely be familiar with mobile phones from their middle-aged years, the current generation of elderly people are less savvy. Designing for this population requires an understanding of their unique physical, social, and psychological circumstances.

We report on a case study of participatory design (PD) with older users. This method brings the circumstances of the elderly to the actual development environment by including seniors as co-designers of software. We hypothesized that by including seniors in the design process, we would obtain keener insight into the particular design issues that currently prevent mobile phones from serving as memory aids for seniors. Initially, we intended to design software to support memory for names and faces of people in the senior's social network. This scope broadened as the design process continued. PD not only changed the scope of our project, but also provided a way for seniors and designers to come together to share their common problems with memory and computers, to stay current on technology, and to make friends.

Inititally, we intended to develop a memory aid for seniors that would run on a mobile phone. This memory aid would assist the senior in remembering the names of people in

their social network who they might otherwise forget. We wanted to build and deploy a database of names and photographs on each phone, tailored to the individual. If we could create an elegant design that permitted fast look-ups of names (e.g., through context-sensing), we imagined the user could rely on the phone to provide information that his or her memory could not. Instead, the design goal progressed and changed throughout the PD process.

The progression in our design goals can be elucidated by first introducing Maslow's Hierarchy of Needs to frame the discussion (see Figure 1.1) [30]. Maslow proposed this hierarchy to provide an understanding of the needs that drive people to act. Our most basic physiological needs, including the need to eat and sleep, form the lowest and most important level of the hierarchy (Level 1). Level 2 needs deal with personal safety and security. The need to be free from fear and the need for shelter and warmth are examples. Level 3 includes social needs, including the need to belong to a group and the need to be loved. Level 4 includes ego needs such as the need for self-confidence and respect amongst one's peers. The highest level, Level 5, refers to self-actualization and the need to transcend or fulfill one's goals. This level includes the need to learn, express oneself, and to help others realize their potentials as well (transcendence).

This project idea attempts to satisfy social and ego needs on Levels 3 and 4 of Maslow's Hierarchy. The need for social inclusion (Level 3) prompts the desire for one to remember the names of others in a community, thus contributing to the social well-being of the individual. The need to feel self-confident and free from worry about a failing memory are representative of Level 4 needs.

However, once the PD sessions began, the seniors shared needs that extended to other areas beyond memory and social grace. When asked about problem areas, they noted items such as the need to contact emergency personnel in the event of a fall or accident, the need for medical information to be easily accessed, and the desire to call their friends or family if their cars broke down. We realized that mobile phone software

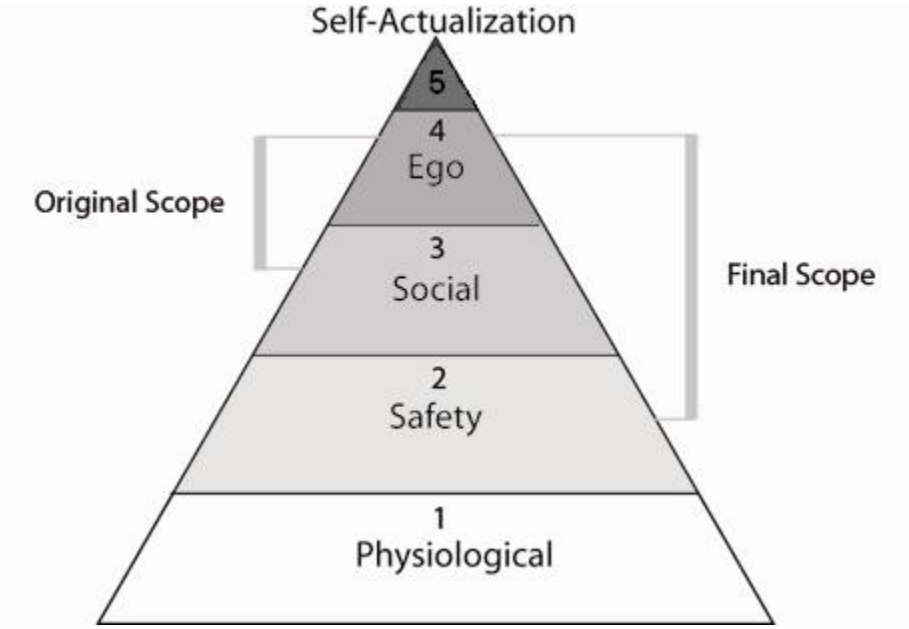


Figure 1.1: Scope of the design team's focus. Originally we intended to develop a memory aid (Levels 3 and 4), but the seniors chose to include safety needs as well (Level 2). Figure adapted from [29].

for seniors must first satisfy lower-level needs from Levels 2 and 3. In other words, the original project idea ignored safety entirely, and the scope of the social needs was too constrained. The team felt safety was important and talked about it alongside memory during each session. For this reason, the products of our design activities reflect a variety of influences that the seniors brought to the table, including: their physical and cognitive impairments, problems with accessibility, their predicted usage patterns, and their pre-existing conceptual models of how computers operate.

In this case study of PD with seniors, we aim to answer the following questions:

- What types of designs will seniors generate for mobile phones? Will they be traditional because of limited past experiences, or novel because of relative lack of experience?

- Which PD activities work well with seniors? Which activities are difficult?

- Do seniors perceive PD to be a positive experience in terms of educational, social, and personal value?
- To what extent do team dynamics in this population affect design?

The design process began by recruiting 5 seniors who volunteered for a study based on self-reports of trouble remembering names. We then conducted PD in varying forms, including group and individual meetings, for a total of 6 months (Chapter 3). The PD process yielded paper prototypes for two major components of the mobile phone software, one of which was then developed into a high-fidelity prototype and deployed onto iMate K-JAM mobile phones running Windows Mobile 5. In addition, we made a suite of adjustments to the default phone settings; these adjustments stemmed from the design team's preferences. Together, the team named the software and the suite of customizations *Recall* (Chapter 4). We then evaluated the process of design and the software that the team constructed. A deployment-based prototype evaluation ran for 4 weeks with 2 different members of the design team. We collected usage data from logs and diary forms. We gathered subjective measures of usability via interviews, diary forms, phone calls, text messages, and questionnaires. In addition to evaluating the software, we evaluated the process of participatory design from the seniors' perspective in order to help determine whether this process was a suitable method for design (Chapter 5). We share emergent themes and offer guidelines based on the PD sessions, evaluations, and observations (Chapter 6). We conclude with a summary of the work completed and its contributions (Chapter 7).

# Chapter 2

# Background and Related Work

The present study is primarily informed by four separate domains of inquiry. The first draws upon cognitive psychology and geriatric studies to assess, characterize, and understand the informational needs of seniors. The second domain focuses on mobile phones and the ways in which seniors perceive and use them. Third, we review computer systems that have been designed specifically for groups of people who, like seniors, have cognitive impairments. The final domain consists of design methods and guidelines for working with older people. This includes the rich intellectual and political history of PD and more controlled laboratory-based studies and case studies examining barriers of interaction for seniors.

## 2.1 Memory and Aging

The process of aging is understood to have negative effects on cognitive, sensory, and motor performance. Furthermore, the social lives of seniors in North America change as they grow older. Friends and family pass away. The senior may move or be moved to a retirement or assisted living community. Health problems prevent the individual from leaving the home as easily. Characteristics of the elderly population vary, and it might be argued that seniors, as a user group, are more diverse than younger users in terms of

their abilities and attitudes towards technology [37][19].

Technology can potentially meet any number of needs present in the elderly. Maciuszek, Aberg, and Shahmehri lay out a design space wherein memory is classified as one of the major needs areas, among feelings of security and social well-being [28]. In particular, prospective memory falters. Prospective memory is often called "remembering to remember" and remembering to return a phone call is a common example. Prospective memory, especially as applied to activities of daily living such as reminders to turn off the stove, or to bring items along on an outing, is an area in which many seniors need assistance. Although Maciuszek, Aberg, and Shahmehri do not explicitly mention names as a critical example, surveys of older people point to names as the most commonly forgotten information in everyday activities [4][10][25].

In the geriatric psychology community, the term "normally aging" applies to senior citizens whose memories have degraded with time, but not sharply enough to prevent them from accomplishing their activities of daily living [43]. They can live alone and manage their personal affairs efficiently. Some may still be employed, while some are retired. The term generally does not apply to people with congenital cognitive disabilities that have grown older.

Normally aging elders can, however, see behavioral improvements as a result of training in memory strategies and adhering to structured routines [46]. A holistic memory aid will include memory training exercises and support its incorporation as part of a daily, regimented routine prescribed by a geriatric psychologist or other health care professional.

Squire argues that because memory can be thought of as a number of subsystems, an individual can have perfectly functioning memory of one variety, but another variety might be very poor [47]. Because seniors in our study reported troubles with names, we examine the memory subsystems involved in recalling names. Autobiographical memory may play a role, as the individual may re-examine important moments of his or her life as they relate to the person in question. Episodic memory may also be involved as previous

encounters with the individual are summoned. It can also be argued that names are semantic pieces of information because they are static, explicit, external "world facts." Clearly this is an oversimplication of the process of remembering a name, which depends on contextual cues as well. For instance, remembering the name of a person in front of you may be accomplished differently from remembering the name when prompted with a photograph or verbal description. Rather than assuming a biological approach for the purposes of our design, we instead focus on behavioral changes that can be evidenced through interaction with a computer system.

## 2.2 Seniors and Mobile Phones

### 2.2.1 Adoption Rates

Although older people adopt mobile phones at lower rates than younger age groups, there is still considerable adoption for those over the age of 50 in the United Kingdom (Figure 2.1). The Office of Communications in the UK also notes the following about people who own mobile phones and are over 65 years of age [40]:

- Most older people with a mobile phone (82%) claim to make one or more calls per week, but just one quarter (24%) say they send any texts.
- Older people consequently spend an average of 8 pounds per month compared to 22 pounds for all UK adults with a mobile phone.
- Older people use their mobile phone for a much narrower range of services than UK adults as a whole. Two in five older people with a mobile phone make no use of it in a typical week.
- Over half of older people with a mobile phone say they are confident about locking their phone, and storing a new contact on it (58% and 51% respectively). Nearly half can listen back to voicemail messages with confidence (44%). Three in ten say they can send a text message with confidence. Nearly half of older people say they are uninterested in sending a text message, or changing the ringtone on their phone.
- Similar numbers of all adults and older adults say they have concerns about mobile phones – at around 4 in 10. The two main areas of concern for older people are risks to health and risks to society, standards or values.

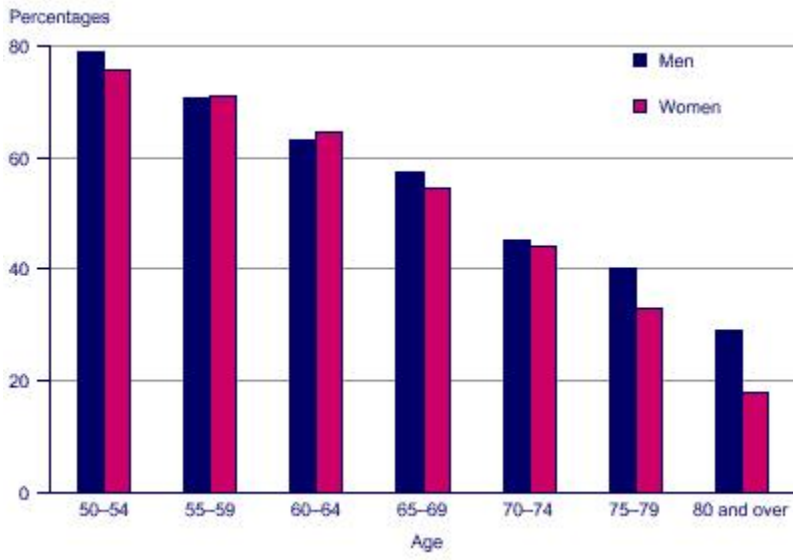


Figure 2.1: Percentage of individuals in the UK who own mobile phones, by age and gender, 2002. Figure from [49], source data from University College London English Longitudinal Study of Ageing.

The last point warrants more explanation. The study states that seniors are concerned about health and a degradation of society as a result of mobile phone use. In other words, seniors worry about radiation damage as a result of using the cell phone. They also dislike the way that mobile phones have allowed crude or impolite behaviors. For instance, Kurniawan related a story told her to her by seniors in a focus group. The seniors felt concerned after reading a newspaper article about a phenomenon called "happy slapping," where teenaged bullies would take photos of victims with their mobile phones and subsequently send them to other teenagers [22]. Seniors also felt offended by rude public displays involving mobile phones (e.g., ringing phones during movie screenings).

Detailed figures for this age group are not available for the United States or Canada. However, according to `http://www.ipsos-na.com/news/pressrelease.cfm?id=3049`, 90% of households in Eastern Asia own at least one mobile phone, compared to 80% in Western Europe, 75% in the United States, and 60% in Canada. For this reason, the numbers reported in the UK study are likely to be higher than the actual adoption rates

of seniors in North America. This indicates that not only are there cultural differences in adoption rates of mobile phones, but there exists considerable room for improvement in order to encourage North American seniors to purchase phones.

### 2.2.2 Barriers to Use

As mentioned above, the fact that only half of seniors who own mobile phones feel confident in their ability to add a new contact indicates that interface or educational improvements are necessary. Social circumstances may also influence these usage patterns and adoption rates. Phone complexity can prevent seniors from purchasing mobile phones, or from using them for situations besides emergencies once they are actually purchased. Further, the fact that a critical mass has yet to be reached in adoption among older users offers little incentive for more seniors to "opt in" (a problem endemic to many computer-supported collaborative work systems [18]). Despite the ability to place calls to landlines, some seniors in our study have cited that they have not purchased a mobile phone because they don't have anyone that they would call; none of their friends have mobile phones. We informed them that mobile phones could be used to call landlines as well, but the seniors' opinions did not seem to change.

Leonard, Jacko, and Pizzimenti also noted that older users have trouble maintaining focus on a single item on a handheld computer screen when there are several competing items also present [26]. Older users are able to use a stylus effectively, however. This is consistent with Noble's finding that older users are capable of providing input to small devices via a hardware keyboard [39].

Leonard, Jacko, and Pizzimenti conducted one of the first studies on Age-related Macular Degeneration (AMD) and mobile device usage [26]. As sight degrades, direct manipulation interfaces on small-screen mobile devices such as mobile phones can become difficult to use. In their studies, like desktop systems "contrast sensitivity (CS) systematically impacted the efficiency of the task" [26]. Not all displays are identical across

mobile phones, however, and the type of screen employed can impact the senior's ability to read its contents. Omori et al. demonstrated that as cataract cloudiness increases in older users, reading speed on mobile phones decreases and the number of reading errors increases [41]. Character height was identified as an important factor in determining the ability of the senior to read the text on the screen accurately. The distance between the viewer and the phone was also important; Omori et al. encourage seniors to select phones that they can read at distances beyond 50 cm. Darroch et al. also suggest that designers select font sizes of 8-12 point in order to provide readability for both young and old users [12].

Mobile phones may serve poorly as memory aids because the phone may be inaccessible. Patel et al. identified that even the most ardent mobile phone users keep their phone within arms' reach only 85% of the time. Many people carry their phones even less. One 61 year old participant kept his phone out of arm's reach 53% of the time. A 66 year old retired man only kept his within arm's reach 35% of the time. The data provided indicates that a memory aid may not always be useful because the phone may be too far away [42].

### 2.2.3 Previous Mobile Phone Designs

Previous mobile phone designs targeted at seniors have been proposed or commercialized. The SilverPhone Easy5 mobile phone (`http://www.silverphone.co.uk/mobilephone/easy5.php`) offers only 5 pre-programmed buttons for calling individuals and emergency services, and has been designed for easy gripping (Figure 2.2). Its lack of a screen and inability to support rich input, however, prevent it from being useful for highly-functioning seniors who wish to place calls to more than 5 people.

Samsung developed the JitterBug, a mobile phone that comes in two different models (`http://gojitterbug.com/Easy-Cell-Phones/pay-as-you-go-cellular-phones.html`). The first model has a numerical keypad while the second instead has pre-programmed


Figure 2.2: SilverPhone Easy5 mobile phone designed for seniors and individuals with vision or mobility impairments.

buttons for calling an operator, a tow truck, and 911 (Figure 2.3). The hardware physical design includes large buttons to combat motor control problems. Visual problems are addressed through the large on-screen display. The elimination of unnecessary phone features reduces cognitive load. However, the simple design limits the options for rich interaction in the development of a memory aid. The Secufone (`http://www.secufone.com/index.php?id=5&L=1`) runs on a Pocket PC form factor phone device with a touch screen and five hardware buttons (Figure 2.4). The system includes a built-in GPS receiver and operates on a GSM triband cellular network. Although the primary purpose of the Secufone is to provide caregivers with the user's location in addition to verbal assistance, the phone does not limit the user to only assistive/emergency functions like the Jitterbug A110. The Secufone can also store photo/phone number pairings for up to 24 people, 60 programmed numbers, and 200 additional non-programmed numbers. Because hearing loss is a common problem among the elderly, Motorola has developed technology to automatically adjust volume to accomodate seniors. A patent for their system was filed in April, 2006 [34]. Hearing problems existed on our team of seniors as well; one participant, was very concerned about this problem because her old rotary phone had recently broken.


Figure 2.3: Samsung A110 "Jitterbug" mobile phone designed for seniors.

Figure 2.4: The Secufone offers GPS sensing in addition to telephony functions.

## 2.3 Systems for the Cognitively Impaired

Vannevar Bush's vision of Memex, a device that was to be one of many "powerful mechanical aids" [6], foreshadowed a series of developments to increase the cognitive performance of normal information workers. Englebart also called for tools to "augment human intellect" [14], and envisioned a future where human and machine would work closely to increase the mental functioning of the human operator. Likewise, Licklider urged the need for man and computer to complement one another's abilities in order to form a more effective union [27]. The eventual devices conceived by these visionaries have been realized in many forms, including personal computers and mobile computers. These devices, however, are general purpose and do not sufficiently convey the need to augment the human intellect in a close-knit symbiosis similar to the paradigm Lamming calls "Intimate Computing" [24]. Further, their visions occurred at a time when computers filled rooms and were prohibitively expensive for a single user.

Since Bush and Englebart, computers have become embedded in mobile devices that

can easily slip into a pocket or purse. These shrinking form factors have permitted rehabilitation specialists, computer scientists, and psychologists to apply this technology in novel ways to address cognitive deficits. Emerging technologies can support individuals with normal memory functioning in many ways, from generally purposed digital tools to aids specifically crafted for memory support. Herein, however, we limit the discussion to prostheses that ameliorate cognitive problems in specific populations that exhibit a well-characterized deficit.

Cognitive prosthetics are a superset of memory prosthetics. Many of the characteristics of cognitive prosthetics apply to memory aids, so it is relevent to include a discussion of them. Cole offers a review of successes in cognitive prosthetics, and has developed a set of criteria that define them [11]:

- Uses computer technology.
- Is designed specifically for rehabilitation.
- Directly assists in ... everyday activities.
- Is highly customizable to the needs of the individual.

Although Cole argues that a cognitive prosthetic must be rehabilitative in its purpose, cognitive prothestics can also be created for normally functioning individuals. This informs an extended classification system for cognitive aids that we propose:

**Rehabilitative/Restorative** The cognitive prosthetic *trains or re-trains* the user to complete a cognitive task successfully on their own (Example: SenseCam [20], described below).

**Compensatory** The cognitive prosthetic *replaces* a damaged subset of cognitive function (Example: NeuroPage [50], described below).

**Augmentative** The cognitive prosthetic *enhances* a normal, healthy cognitive function (Example: pencil and paper).

Compensatory prosthetics aim to circumvent the problem area by "out-sourcing" it to a computer. Cole only defines compensatory and rehabilitative prosthetics as cognitive

prosthetics, and does not address augmentative prosthetics. We can only create compensatory and rehabilitative prosthetics when an understanding of the memory deficit is available and clear, and when appropriate technology to address it is available. Augmentative cognitive aids might be realized in many forms, including extremely innocuous ones such as paper and pencil. However, these technologies push the boundaries of what is humanly possible to compute. This scheme is not the only way to classify cognitive aids, however. We may also do so by examining the number and type of users. Some aids are meant to be used solely by the patient, while others involve a caregiver as a secondary or primary user.

An excellent example of a compensatory aid is NeuroPage, described by Barbara Wilson [50]. Designed for individuals with prospective memory problems as a result of an acquired brain injury (ABI), NeuroPage operates on a beeper system. A caregiver first programs the NeuroPage system to deliver reminders to the ABI patient at a given time for a series of days. Then, the ABI patient is given a beeper to wear on his or her belt. These beepers are similar to ones used by professionals who are on-call, and thus are not socially stigmatizing. In fact, Wilson reports that some users found them prestigious. At the pre-programmed times, the beeper will sound and deliver a short text message to the ABI patient. For example, it might say "Medicine" in order to remind the patient to take their pills. This study is particularly motivating because their findings indicate that for a period of time following the removal of the system, the patient benefits from improved prospective memory, as if the beeper system were still intact.

In the same vein, Hendrik Schulze [45] used a custom handheld computer for purposes of compensating for prospective memory loss as a result of ABI. Unlike NeuroPage, however, his MEMOS system permits two-way communication between the caregiver and the person with the memory impairment via a GPRS link. Like Wu's recent work [52] [53], MEMOS examines the collaborative nature of memory. Failure to complete a task due to prospective memory impairment not only affects the person with the brain injury, but also

the family members who might fear an emergency is occurring. A laboratory evaluation of succinct tasks performed with the MEMOS system indicates that, of the individuals with a motivation to use the aid, 94% completed tasks successfully, in comparison to a mobile phone or Palm Pilot (80%) or no aid at all (72%).

SenseCam is a camera that can be worn around the neck of an individual with memory difficulties [20]. SenseCam takes photographs of the wearer's surroundings approximately once every 30 seconds. Photos, stored on the camera's 1 GB internal memory, can be transferred to a desktop computer for later review. In a single user case study, a woman with encephalitis resulting in memory loss ("Mrs. B.") employed a SenseCam as a retrospective memory aid. Together with her husband, "Mr. B.," the subject would select particular events that she wanted to remember. After identifying and experiencing a set of events, the researchers split the events into 1 of 3 conditions. In the first condition, Mrs. B. refrained from using any memory aid. In the second condition, Mrs. B. reviewed the event using a detailed diary entry as recorded by her husband. In the final condition, Mrs. B. reviewed the event using the images provided from the desktop SenseCam software. Mrs. B. remembered more details about events that she reviewed with SenseCam than she was able to remember in either of the other two conditions. Further, she remembered these details for longer periods of time. Even after 3 months, Mrs. B. could remember details of events reviewed with SenseCam, whereas she could not remember events reviewed with the diary or unaided. In essence, the SenseCam system helped train her memory to remember event details on her own more effectively than other methods.

An electronic aid for anterograde amnesics has been developed by Michael Wu and his colleagues at the University of Toronto and Baycrest Centre for Geriatric Care [51]. This is another excellent example of a compensatory aid. Anterograde amnesics in their study report that they suffer from disorientation rather often. This occurs because the amnesic individual cannot encode and consolidate new memories. As a result, an amnesic cannot remember why he/she is in a particular location. In this effort, the computer scientist

worked closely with a clinical psychologist to incorporate the tool into the training and rehabilitation regiment of the amnesics. The amnesics in this study relied heavily upon scheduling functions of a standard Palm Pilot as part of a training regimen overseen by a clinical psychologist. To extend the built-in capabilities of the Palm Pilot, a participatory design team convened and created OrientingTool. This software runs on the Palm Pilot and immediately shows the amnesic where they are, who they are with, and what they are doing. The amnesic must regularly enter this information into the software in order to later retrieve it. As with NeuroPage, this compensatory system takes pieces of information that are retained in memory in individuals with normal memory, and represents it externally in a computerized device.

Individuals with cognitive impairments strive to maintain autonomy as they navigate throughout their communities. Using public transporation, however, can be a daunting task for some. Carmien et al. prototyped three systems to address this difficulty: Personal Travel Assistant, Memory Aiding Prompting System (MAPS), and Lifeline [7]. To inform their designs, they interviewed, observed, and surveyed high school students with developmental disabilities such as cerebal palsy, autism, and Down's syndrome. They also interviewed experts who manage programs designed to help these individuals live independently. The users carried mobile phones or PDAs that contained GPS (in the case of the Personal Travel Assistant) or pre-scripted directions (MAPS) in order to navigate public transporation. By approaching the problem in the context of caregiving, the MAPS program permits a parent or teacher to create scripts for the child to use. This, in turn, meant the design of dual interfaces for both the caregiver and care recipient. Laboratory testing of specific tasks on these prototypes demonstrated that both caregivers and care recipients could successfully create and follow scripts.

## 2.4 Design Methods and Guidelines

Designing systems for seniors can be difficult for numerous reasons. As Newell et al. note, seniors sometimes do not want to say anything negative about prototypes because they don't want to hurt the feelings of the designer ("good subject bias"), but at the same time harbor reservations towards adopting new technology [37]. Beyond interviewing and questionnaires, techniques to ascertain the real needs of seniors include theatre [37], ethnographic studies [33], scenario analysis [1], focus groups or group interviews [22] [21], and ideation sessions [32]. Laboratory tests of task completion on mobile phones between young and old users have also been performed [54].

In most studies, the seniors are what Carroll et al. term "practicioner-informants" [9]. In this capacity, each senior contributes by informing a design team about aspects of their lifestyles. Often times, the designers interview or observe the seniors. Ethnographic practices also attempt to inform design by "mining" information about a community through participant observation or other techniques.

Often times, however, we mistake a senior for an expert in a specific domain area, and assume we can elicit appropriate information from them for design purposes. But we note that seniors are not experts in a field of knowledge – there is no book on how to live as a senior citizen, or as a person with amnesia, or as a person living any other lifestyle. Because there exists a great deal of tacit knowledge in the everyday lives of seniors, it seems logical for them to have a more active role in the design process. Interviews and questionnaires will not elicit tacit knowledge, but by including them in cooperative design activities, they are given more opportunities to point out how design choices might affect their lives. For this reason, we have seen a shift recently towards including the cognitively impaired as "analysts" and even as fully-fledged "designers" [9].

### 2.4.1 Participatory Design

Greenbaum and Kyng describe the origin of the participatory or cooperative design paradigm; it stems from a need for individuals in an enterprise to have control over the processes that would affect their jobs [17]. The labor union of a Scandinavian printing company affirmed the need to be involved in the process of selecting and designing the computing equipment that was to be introduced into their workplace. This introduction would certainly impact the way that they worked and would change not only the steps involved in the tasks they performed each day, but would also alter the occupational environment (for example, workers being laid off because of the introduction of technology that would supercede their capabilities).

Recently, researchers have studied conducting PD with groups of people outside of the workplace. Of particular interest are the PD efforts that have been conducted with groups of people with cognitive impairments. One excellent example comes from Wu et al. who conducted PD with a team of six people with amnesia [51]. Particular steps were taken to overcome the memory deficits present in the participants, such as creating external environmental memory aids, and reviewing/previewing each session's major activities.

The Aphasia Project at the University of British Columbia employed PD to include people with aphasia in the design of cognitive aids [31]. Each participant with aphasia was included in the creation of software for a mobile device that would allow him or her to create and communicate personal schedules. Because producing and/or comprehending words is difficult or impossible for this population, they used the multi-modal capabilities of a Pocket PC device to include audio clips and photographs of words that the user wished to convey. Because individuals with aphasia may be difficult to recruit, these researchers have also explored the possibility of using experts in the field of aphasia as "proxies" [5].

Participatory activities (PAs) have been conducted with seniors before in relatively isolated parts of the design process (e.g., for only an evaluation phase, or for only a

conceptual design phase). Previous studies included seniors in PAs such as evaluating websites [13], evaluating minimalist tutorials and designing simulation environments [44], evaluating sets of usability guidelines [23], and designing game concepts [2]. Gaver, Dunne, and Pacenti pioneered cultural probes by offering packages of cameras, postcards, maps, and other respondant devices to groups of seniors as a method of provoking seniors' responses [15]. Our study differs from these in four major ways. First, seniors in our study actually participated in every activity during the design process from the needs analysis to deployment. In most previous work, researchers included seniors for needs analysis, scenario design, or other formative design activities. Unlike these studies, we took the same team from needs analysis all the way through to paper prototyping, usability testing, and deployment. Second, we recruited five seniors together with one computer scientist to work as a group to design the interfaces; this is in contrast to the "one senior/one younger person" pairings used by previous studies. Third, we believe this is the first time seniors conducted PD targeting a mobile phone. Finally, this is among the first PD attempts to understand what types of software for mobile phones seniors envision and would like to create.

The closest work to the current study is that conducted by Ellis and Kurniawan, who offer a case study of PD with seniors [13]. In their study, seniors living in a retirement building were invited to participate in a computer training workshop for several weeks. During that time, the researchers built trust with the seniors. The researchers then invited the seniors to PD sessions, where a portal website they had previously constructed was critiqued in order to be made more accessible and usable by the seniors. Based on the seniors' feedback, the researchers would make modifications to the website in real time (such as changing the color or size of fonts) and then the group discussed the changes. The seniors were involved in the reiteration of the prototype, but not in the first draft of construction. The current study included seniors in the construction as well, through the use of paper prototyping activities.

Our work also echoes many of the same themes that Carroll et al. encountered in their Learning in Networked Communities (LiNC) program [9]. In their process, they condcuted PD with a group of teachers and other primary school administrators. One similarity between our study and theirs is the focus on the process as a developmental period for the participants, although our study (5 months in total) is much shorter than the 5 year study they undertook. Like the team in LiNC, our team composition was "loose" - the seniors did not have defined roles that are common when PD is conducted with organizations or companies. With the exception of one pre-existing friendship, none of our participants knew one another before the study.

### 2.4.2 Methods and Guidelines for Working with Seniors

A few studies have examined guidelines for developing systems for seniors. In the absence of a substantial body of empirically validated human-computer interaction studies involving the specific problems of seniors, Hawthorn reviews the psychological aspects of aging and draws design considerations from them [19]. Broadly speaking, Hawthorn predicts how the following areas might impact interface design: vision, speech and hearing, psychomotor abilities, attention and automatic responses, memory and learning, and intelligence and expertise.

Becker found that of 125 government, newspaper, and commercial websites containing health-related information pertinent to seniors, not a single one met all seven guidelines for senior accessibility available from the United States National Institute on Aging [3]. This low compliance rate present in modern websites is not due to lack of guidelines, however. Kurniawan and Ziefer compiled a list of 38 guidelines organized into 11 categories, each addressing the need to make websites more accessibile to the elderly [23]. These were drawn from the HCI literature and empirically validated through expert reviews and user evaluations. Jakob Nielsen and the Nielsen/Norman Group also offer a set of 46 guidelines based on laboratory studies of seniors using websites [38]. Both sets of guide-

lines address issues of impaired motor control (e.g., use large static targets), impaired vision (use large text with high contrast) and navigational difficulties due to memory loss (avoid pull-down menus). All of these endeavors have been focused primarily on website design.

Kurniawan studied seven older women, all of whom owned a mobile phone for at least one year, learning to use a different mobile phone [22]. Her focus group yielded requirements for mobile phones similar to the ones our seniors also echoed, such as easily gripped form factors and long-lasting backlights. Because the seniors owned phones already, they shared knowledge with one another while exploring the new phone. Kurniawan also administered online questionnaires to a larger sample of 67 older women who used mobile phones and learned that very few functions on mobile phones were stressful. Most features were considered non-problematic, and strongly worded responses were rare (i.e., at the extremes on a Likert scale).

# Chapter 3

# Participatory Design with Seniors

In recent years, participatory design (PD) has been adopted by experts who are designing systems for the cognitively impaired. With this change in user population, however, it becomes necessary to adapt the practices used in the industry-centered PD sessions. What's more, the domain has changed from explicit workplace processes influencing design to subtle, often inarticulable nuances that affect the design. It is difficult for a computer scientist to understand the problems the design team when he or she has no experience living with the deficit. For this reason, we undertook PD and report on the results of this process here.

## 3.1 Recruitment and Participants

The PD team was recruited by distributing and hanging flyers near seniors' organizations in the Greater Toronto Area (see Appendix A). We placed classified ads in newsletters targeted at seniors. In addition, we performed one blanket mailing to a mailing list that a senior's organization maintained. The specific agencies we targeted included hospitals, community outreach organizations, daytime activity centers, political groups, housing communities, and YMCAs.

These advertisements stated that participants were needed for two simultaneous stud-

ies. One study (the present work) asked for participants who had trouble remembering names. The second call for participation asked for seniors interested in designing digital autobiographical family histories. Seniors examining the advertisement were free to choose the study they preferred. The advertisements also stated that participants should be at least 60 years old. We chose this age because 65 is currently the mandatory retirement age in Ontario[1]. Choosing 60 as a lower bound allowed us the possibility of including working seniors, who may have different perspectives on a mobile memory aid than retired seniors. The advertisements also made it clear that seniors must not have a diagnosed cognitive impairment otherwise (e.g., Mild Cognitive Impairment or dementia). We enforced this limitation because University of Toronto Research Ethics Board considers these populations protected due to impairments in judgment and the informed consent process (see Appendix B for the Informed Consent document). Each participant affirmed in writing that they did not suffer from such an impairment. The advertisements also encouraged people to apply if they wanted to make new friends, learn more about memory research, and contribute to technologies to help other seniors. Finally, we included a rough outline of the time commitments for meetings. On the reverse of the flyers, we described the project in more detail, and made it clear that our research would focus on memory and mobile phones.

Participants volunteered by phoning and leaving a message on an answering machine. All volunteers were women, and we did not screen participants beyond an affirmation of good health. In other words, we did not exclude participants based on factors like poor mobility, poor hearing, etc. We were not selective about including participants because few participants volunteered. Every volunteer joined the team except for one who declined before the study began, citing health concerns and upcoming travel. We encouraged each participant to bring friends and family members to meetings as well

[1] http://www.hrsdc.gc.ca/asp/gateway.asp?hr=/en/lp/spila/wlb/aw/26retirement_legislative.shtml&hs=

because we believed that memory aids of this nature would also impact these secondary stakeholders. No participant brought family members, and one participant brought one friend, who joined the team as the fifth senior.

As Table 3.1 indicates, the ages of the seniors ranged from 55-86 years. Even though our advertisements requested seniors over the age of 60, we chose to admit a 55 year old because of her eagerness to join, and because few participants volunteered. In addition, because she cares for her elderly mother with Alzheimer's disease, she has first-hand experience with aging-related cognitive decline. All participants were women, a result similar to Kurniawan's recruitment results when creating focus groups of seniors [22]. All participants owned desktop computers. P3 owned an Apple, while the rest owned PCs. Only P1 and P2 owned mobile phones, and both reported that they were strictly for emergencies. No participant owned a PDA (omitted from table).

We report problem areas here to foreshadow their impact on design activities. P1 and P4 wear reading glasses when working with paper or computers. P2 and P5 both wore assistive hearing devices, and without these devices they had difficulty maintaining the flow of conversation. P2 often came to meetings and realized she had forgotten to "put [her] ears on." P3 suffers from familial tremors, a disorder that causes her hands and fingers to shake involuntarily. The tremors intensify when she performs fine-grained motor control tasks such as writing, grasping small pieces of paper, or pushing buttons. P5 walks slowly and requires the use of a cane to move. While we met in an elevator-accessible room, we had to attend to P5's travel accomodations and help ensure she arrived at meetings safely. This meant hiring a taxi both to and from meetings, whereas other participants took public transporation, biked, or drove their own cars. We gathered information about P1 and P2 through telephone interviews in the days leading up to the first session. Due to time constraints, formal telephone interviews could not be completed with P3 and P4, and P5 had not yet joined the project. We instead conducted entry interviews with P3 and P4 individually during the first session. There was not sufficient

| Member | Age | Gender | Education | Phone? | Computer? | Problem areas |
|---|---|---|---|---|---|---|
| P1 | 76 | F | B.A. | Yes | Yes | Eyesight |
| P2 | 71 | F | Some university | Yes | Yes | Hearing |
| P3 | 78 | F | Some high school | No | Yes | Tremors |
| P4 | 55 | F | B.A. | No | Yes | Eyesight |
| P5 | 86 | F | B.A. | No | Yes | Hearing, mobility |

Table 3.1: Seniors on the participatory design team and their characteristics.

time to conduct an entrance interview with P5. Over the course of the meetings, we learned more about each participant through conversation, visits to their homes, and so on. The profiles below synthesize information from all sources (interviews, visits, conversations, etc.).

In the first interview with P1 (age 76), she immediately told us that she has severe trouble remembering everything, and has always used memory aids extensively. This condition persisted throughout her entire life, and her condition is not simply the result of aging. She does not use a computer for important information because she fears it crashing and losing all of her data. She does, however, use the computer for email and Internet. She owns a cell phone but never uses it because she perceives them as rude to use in public. She reserves its use for emergencies only. P1's social network is extensive and she has trouble managing it. Before retiring as a journalist and technical editor, she worked with many community groups and clients. While her husband was still alive, P1 and her husband would often get together with a few close couples. Once he died, she discovered she had a lot of free time on her hands. Now, she serves the community as the secretary of the Older Women's Network (OWN), a community group/co-op. In this capacity she is responsible for recognizing the various members of OWN during meetings, so that she may accurately attribute statements to people in the meeting minutes. She

also enjoys making new friends – she will purposefully attend community group meetings alone so that she is forced to meet new people, rather than bringing a friend for company. She also visits relatives in England quite frequently. She lives with her daughter. She is outspoken, eloquent, and professional.

P2 (age 71), on the other hand, noticed her memory problems more recently. While P1 had problems throughout her whole life, P2 began having trouble recalling names only three months before participating in the project. She noted she would often go from one room to another and forget what she had meant to retrieve. She relies on other people (like her husband who lives with her) to help her remember names. She reports that her social network is small, and she is not very active in community groups. She feels that as she ages, it becomes more important for her to be socially active and less of a recluse. She is quiet, but always friendly. She and her husband own a cell phone but keep it in the glovebox of her car in case of emergencies. Her main use of the computer is for email and playing solitaire. She finds this game to be a pleasant distraction when she cannot sleep at night. She formerly worked as a secretary in an office.

P3 (age 78) is an active leader in a community group in Toronto. She is the immediate past-president of this organization and as such is widely respected and often consulted for advice about its management. Presently she is caring for her husband who now lives in an assistive living facility, and she lives alone. Her husband suffers from Alzheimer's disease and has been living in this facility for close to a decade. While she does not own a mobile phone, she owns an Apple computer and uses it to answer emails related to her community group. She has experience dealing with people and political figures from her activity in the group, and has strong moral convictions. She contributed regularly during meetings, and was pleasant and friendly at all times.

P4 (age 55), the youngest member of the group, works in the film industry. She visits her elderly mother who has Alzheimer's Disease quite frequently, and has an active circle of friends from her neighborhood. She works on political campaigns and also travels

somewhat frequently. Her daughter lives in Montreal, and she enjoys visits to her. Right now she lives alone. She does not own a mobile phone, although many of her friends and family own them and use them frequently. She talks very excitedly, and often at length. After P1, she contributed to conversation more frequently than any other team member. Because she is still working and caring for her mother, she is usually out of the house and quite active.

P1 invited P5 (age 86) to join the sessions. P1 and P5 live in the same building, and are also involved in the same Older Women's Network. They have known each other for close to 17 years. P1 invited P5 on the basis of her interest in computers. For this reason, P5 did not begin the sessions at the same time as the rest of the team. She joined at the 4th session instead. P5 walks with a cane and has trouble navigating crowded downtown areas. She also has difficulties hearing, and attends a weekly group about hearing loss for seniors at a local hospital. She is quite outspoken and competent in using computers. She uses her expertise to teach other seniors how to use computers as well. Because she understands computers, she often feels compelled to explain ideas to the other team members who know considerably less. She often leverages her knowledge to force the design team to pursue a particular direction because "that's how it's done on the computer."

We administered the Multi-factorial Memory Questionnaire (MMQ) (see Appendix C) upon our first visit with the seniors in order to have a formal characterization of their memories (Table 3.2) [48]. The MMQ is a questionnaire consisting of 3 sets of questions related to contentment, ability, and strategy; it is a self-assessment of memory designed to be used in clinical interventions. High MMQ-Contentment scores indicate that the individual is not emotionally concerned about her memory (e.g., worried about embarrassment). High MMQ-Ability scores indicate that the participant feels her memory functions well. A high score on MMQ-Strategy indicates greater use of memory aids.

It is interesting to note that P5, who was solicited to join by P1 and is the oldest

| Member | MMQ Contentment (Max 72) | MMQ Ability (Max 80) | MMQ Strategy (max 76) |
|---|---|---|---|
| P1 | 42 | 50 | 51 |
| P2 | 46 | 37 | 45 |
| P3 | 52 | 49 | 30 |
| P4 | 53 | 56 | 21 |
| P5 | 69 | 60 | 34 |

Table 3.2: MMQ Scores for participants

member of the team, feels that her memory is quite strong, and memory loss does not distress her as much as other participants. P5's self-reports of higher memory functioning, and their implications during the design process, are reported later (see Chapter 5 for a discussion). P1 relies on memory aids quite heavily already, and always carries a blue notebook that contains personal reminders and important information.

## 3.2 Environment and Logistics

Because Wu et al. found that using a conference room empowered the participants and made them feel important, we decided to use a conference room as the setting for our study as well [51] (Figure 3.1). The team met in an urban environment - an academic building on the St. George campus of the University of Toronto. None of the participants had previously visited this location, unlike Wu's team who often meet in the same building in a less urban environment. This became a source of concern, as the seniors agreed that navigating to the building was difficult. While parking was available beneath the building, only P3 drove. P1 and P5 shared a taxi after a stressful attempt to use the subway and streetcar. P4 walked from her home, and P2 biked and rode the subway. We would have preferred a location easier for the participants to get to, but

Figure 3.1: Conference room where sessions took place

since we were unable to know where they lived before they volunteered, we booked a room downtown.

The conference room (Figure 3.1) provided a large-screen Smartboard which was used for PowerPoint presentations of high-fidelity prototypes and for showing photographs. We wrote ideas and drew diagrams on a non-electronic whiteboard. We provided writing utensils, paper, snacks, and tea for all participants each week. Four of the five participants kept papers between sessions and stored them in their own folders, which they took home with them and then brought to the next session. Each week, we provided a paper agenda outlining the proposed activities for that session (see Appendix D for the agendas). We videotaped each session and subsequently transcribed the text from the video in order to review quotes or actions of interest. We reimbursed all participants for travel expenses. Participants were not, however, compensated for time. Originally, reimbursement was to occur at the end of the group meetings. However, some of the participants lived on strict pensions, and could not afford the accumulated cost of transporation. For this reason, we began to reimburse participants for travel at each meeting.

We considered asking participants to complete "homework" assignments between ses-

sions. This idea comes from other techniques that attempt to capture current conditions more accurately. Cultural probes [15] and diary studies aim to understand a user group outside of the context of an interview or group meeting. We, however, attempted to keep the number of such outside activities to a minimum because we did not want to infringe on the participants' time, especially since no compensation was offered. During the course of the PD sessions themselves, we only requested that participants complete two outside tasks: to bring in their own memory aids, and to keep a diary of people whose names they had forgotten. We detail these tasks in the appropriate session descriptions below.

## 3.3 Design Sessions

Before beginning the group PD sessions, we drew up an outline of proposed activities for each week of the process. As Table 3.3 shows, over the course of approximately 2 months, we wanted the team to move from a high-level analysis of needs related to names to concrete screen designs. First, seniors would generate needs related to memory through discussion prompted by artifact analysis and sharing scenarios. After selecting a specific need from those generated, the artifacts and scenarios would ground a conversation where we would list and prioritize requirements. These requirements, in turn, would be grouped together to form a coherent application structure. Finally, each application structure was to be developed further through the cooperative creation of paper prototypes. Because the team took hold of the process and designed several applications unassociated with the initial theme of remembering names, we present below a table of activities and whether each activity supported this original theme or not (Table 3.4). As this table shows, the team devoted a significant portion of time to working on applications they chose to design, but were not necessarily related to remembering names.

| *Session* | *Activities* |
|---|---|
| 1 | Introductions, overview of PD, discussion of memory needs |
| 2 | Needs analysis |
| 3 | Needs analysis, requirements engineering |
| 4 | Requirements engineering |
| 5 | Paper prototyping |
| 6 | Paper prototyping |
| 7 | Completion of paper prototypes, validation of prototypes |

Table 3.3: Planned activities for each PD session.

| *Session* | *Memory-Related Activities* | *Unrelated Activities* |
|---|---|---|
| 1 | Explanation of purpose | |
| 2 | Artifact analysis | Hardware demo |
| 3 | Scenario/storyboarding | Requirements engineering |
| 4 | | Requirements engineering |
| 5 | | Paper prototyping: menu, calendar |
| 6 | Paper prototyping: address book | |
| 7 | Location awareness discussion | Prototype validation, wrap-up |

Table 3.4: Activities and relation to memory

### 3.3.1 Session 1

Due to scheduling conflicts, the first set of sessions were held with either 1 or 2 participants. We met individually with P1 and P2. P3 and P4 were met together. In this session we began to establish trust (an important first step when working with seniors [13]) by introducing ourselves, explaining the PD process and principles, and explaining the consent form document. The seniors completed a calendar form that indicated their availability for future meetings. We gathered additional information about each partici-

| *Importance* | *Feature* |
|---|---|
| 1 | Large button size |
| 2 | Large screen size |
| 3 (tied) | Easy to grip and hold onto despite shakiness |
| | Ease of selecting an on-screen target |
| | Don't need to turn the phone sideways to use keyboard |
| | Phone is not heavy |

Table 3.5: Ranking of hardware features.

pant in semi-structured interviews. We learned their ages, current living situations, and interests. We also inquired about their interest in the sessions and what they hoped to gain through participation.

### 3.3.2 Session 2

In this session, all four participants met each other for the first time. We completed two major activities. First, we discussed hardware factors to keep in mind when buying a phone, and conducted a show and tell activity where participants described the memory aids they currently used.

#### Activity: Hardware Choices

We began the PD sessions with an overview of existing mobile phone hardware. From the outset of this study, we had already decided that we wanted to investigate mobile phones and their viability as memory aids for names. We limited the phone selection to mobile phone/PDA hybrids that had hardware QWERTY keyboards because Noble's previous study indicated that seniors preferred keyboards to handwriting recognition [39]. This activity came early in the timeline because sufficient time was needed to purchase

phones and develop software before deployment. If we had chosen a phone at the end of the design process, we may not have had enough time to perform a deployment. In retrospect, a technology-agnostic approach would have been more appropriate at this point; this is discussed further in Chapter 5.

We showed photographs of different mobile phones to the participants. Specific phone models included the Palm Treo 650w, the iMate K-JAM, RIM Blackberry 7780 Series, and Audiovox 6600. We described the form and function of each phone, and answered questions about the phones. Each participant responded differently to the phones; preferences were also split among the phones.

Based on the photographs and discussion, we created a list of all of the phone features that influenced which phone to choose. We then discussed each feature and why it was important, whether or not it made sense to include in the phone, and so on. After discussion concluded, we ranked each feature by importance. Each participant was given three points to distribute among the features, and the features were then ranked according to how many points they received (Table 3.5).

We also considered issues of battery life, ruggedness, and volume. Participants did not foresee problems charging the phone given an AC adapter, but noted the phone should permit at least 12 hours of continuous non-talking use. They worried about damaging the phone by dropping it; as a result, we decided the phone should be rugged enough to withstand being dropped accidently. Finally, the volume should be loud enough for the owner to hear it despite hearing loss; it should also vibrate as a backup.

### Analysis: Hardware Choices

Participants responded well to the visuals provided, and were interested to learn about the different models. This activity permitted us to teach them about mobile phones - a necessary step in the process of mutual learning. We also felt that by beginning with pictures of phones, we would encourage the seniors to begin thinking about what it would

| *Participant* | *Memory Aids Used* |
|---|---|
| P1 | Blue notebook, sticky notes, wall calendars |
| P2 | "Exit drawer," binder, internal memory strategies, physical item placement |
| P3 | Computer files, wall calendar with stickers, todo list, telephone pad, keepsake birthday book |
| P4 | Pocket calendar book, address book, sticky notes |

Table 3.6: Memory aids used by each participant

be like to carry a mobile phone with them.

Note that the seniors ranked large screens and large buttons as the most important features. Both of these deal with sensory deficits as a result of aging. Older users have trouble not only seeing information on small screens, but also have trouble reading printed characters on keyboards [39] [19]. The small button size also makes it difficult for them to acquire and activate desired buttons. The remainder of the concerns are also motivated by trouble simply accessing the information on the phone. Compare these results with a sample of young people, and the most important hardware requirements will likely be very different. As aging occurs, more concern seems to go into whether it is possible to use the hardware in the first place, and the seniors did not discuss topics such as fashion, technological advancements, or status afforded by the device.

### Activity: Memory Aids Show and Tell

For this session, we asked each participant to bring their most commonly used memory aids. These served as the focus of discussion for approximately 45 minutes. The group collectively analyzed each artifact, asking questions of the owner. A list of the memory aids, broken down by participant, can be found in Table 3.6. For each aid, the participant described what the aid was, how it was used, what they liked about it, and


Figure 3.2: Memory aids from show and tell

what they disliked. Each participant took turns describing their aids, and the pros and cons for each aid were collected on the whiteboard (see Table 3.7). Some aids possessed characteristics that were neither benefits nor drawbacks, but were important nonetheless. Two important barriers to successful use prevailed across multiple aids: writing and consulting. The seniors had all experienced difficulty writing due to tremors, arthritis, or the simple lack of a pen. Many reported forgetting to consult a memory aid as a problem; for instance, they might miss an appointment because they forgot to check their calendar. After collecting these characteristics and assigning them to categories, we discussed tradeoffs between varieties of aids (such as size versus portability).

Some common aids included notebooks, calendars, and sticky notes. P3 relies on her own hierarchy of Microsoft Word documents for her record-keeping; she prints a list of her husband's medicines each time she visits a health professional. Because of her tremors, P3 affixes stickers to her wall calendar instead of writing in it; it is difficult for her to write in such small spaces.

P2 noted three memory aids unique to her: a binder, an "exit drawer" and her brain. She maintains a binder with many different types of files, organized by day. Unlike a calendar or a notebook, the binder frees her to insert information of any size or purpose. The exit drawer is a special drawer near the exit of her home. Before leaving the house,

she opens the exit drawer and brings along its contents, which includes items like mittens, hearing aids, dental devices, glasses, money, and so on. She checks the drawer before leaving out of habit, and thinks it works well.

P2, unlike the other participants, uses her own brand of internal memory strategies in addition to external aids. She categorizes information to help her remember (e.g., her shopping list). She then recalls items on the list by remembering related items ("If I remember peas, it helps me remember the other vegetables."). She also chunks numbers by remembering them in pairs instead of single digits. Finally, she focuses her attention and imagines herself taking a mental "snapshot" of important items. She follows this with spaced retrieval of the image and internal rehearsal.

P1 is very attached to one aid in particular - a blue notebook. She carries the book everywhere, and writes down most everything in it. She stressed the importance and function of this book at almost every session. Below are some of descriptions of it in her own words:

> This is my book, and my entire life is in here. Everything. Every phone call, every anniversary, every appointment, every medical appointment, everything. If I lose this, it would be *tragic*. It would be serious.

> I use it as a diary, I use it as a telephone, I use it for appointments, everything is in here. And I also use sticky notes. I put them on the door and I don't forget to take them off, each memory jotted down. I put them for my granddaughter and I taught her to use them. I am consulting this [notebook] constantly, that is the other thing, I consult this constantly, otherwise you think you remember but you may not, so it's a process of looking things up that is very important.

### Analysis: Memory Aids Show and Tell

Critically analyzing the memory aids that the participants currently use allowed us to crystallize design tensions, and subsequently influenced the customization of the phone. Here, we describe some of these design tensions that the team identified:

| *Aid* | *Pros* | *Cons* |
|---|---|---|
| Notebooks | Portable<br>Can write dates ahead<br>Easy access to information | Limited number of dates<br>Trouble finding the "right" book<br>Can be lost, need to back it up<br>Not enough room to write |
| Sticky notes | Can communicate messages<br>Easy to associate with a place<br>Placement triggers context | Limited size |
| Computer files | Reproducible<br>Easy to edit<br>Easy to send to people | Need printer<br>Hard to find files on computer<br>Can crash |
| Wall and desk calendars | Can affix stickers for fast appointment entry<br>Visually organized<br>Always know where it is | Not private<br>Not portable |
| Todo lists | Quick access<br>Frees the mind | |
| Binders | Sorted according to preference<br>Can hold any file | |
| "Exit drawer" | Forms habit<br>Holds clothes, hearing aids, mouthplates, etc. | |
| Pocket calendar | Aesthetically pleasing, nice to use | Does not sync with other calendars<br>Too small to write in what you need |

Table 3.7: External memory aids and the team's ascribed benefits and drawbacks.

**Size vs. portability:** The seniors liked large wall calendars and notebooks with plenty of space for writing. However, they could not carry these items with them and thus limited the number of situations where they had utility.

**Portability vs. misplacement:** Because aids like wall calendars are hard to move, and are therefore rarely moved, the senior immediately knows where to find the information she needs. Items that can be easily moved can also be more easily lost.

**Context vs. portability:** Some aids compound their benefit because they exist in a context or location. For example, a sticky note attached to an object is largely informed by the nature of the object. However, the note cannot be accessed outside of that place and context. On the other hand, a portable address book has little context, but can be easily accessed anywhere.

**Number of entries vs. size:** Many of the physically smaller memory aids like pocket address books forced seniors to limit the number of entries they added. Seniors had to weigh the cost of space with the benefit of having access to the information later. In P3's case, this resulted in multiple specialized address books (e.g., one only for people she knew that passed away, one for people from work). Again, the larger size and number of aids impacts portability negatively.

**Fast understanding vs. number of entries:** Aids that are easily understood "at a glance" tend to be able to hold less information. The large number of entries means more time spent searching.

**Communicative vs. private:** Some aids like wall calendars are accessible to other people in the family, while pocket notebooks kept in a purse are considered off-limits to others. P3 also related that at sensitive meetings in her community group, she has asked people not to write anything in their notebooks because it violates the confidential nature of the meeting. Some memory aids are by nature communicative

– leaving a note on the kitchen counter, for example. Others are meant to be seen only by the creator.

**Physical vs. informational:** P2's "exit drawer" reminds her what to take with her because she physically places objects in it, unlike a sticky note attached to the door that has a list of items to remember.

**Personalized vs. mass-produced:** P1 noted that one of the reasons she loves her blue notebook so much is because it "feels right for me." She only adopted a notebook once she found one that seemed personalized for her. Personalizing a memory aid can be time-consuming, expensive, and difficult, unlike mass-produced versions. However, a personalized aid may be more readily adopted.

**Fear of loss vs. back-up overhead:** Seniors expressed fear of losing their memory aids and not having a backup. P1 related a time when she lost her blue notebook, and she spent months retrieving the information she lost. Despite this huge problem, duplicating entries requires time and effort that the team members were not willing to invest.

**Structure vs. flexibility:** P2 likes to use binders to store information because she can add any type of document to a binder. This is different from a notebook, for instance, which only stores hand-written notes and cannot neatly store loose-leaf paper, receipts, or envelopes. Since the binder lacks an inherent structure, P2 must provide her own organization schema, which incurs an overhead in remembering what the schema is.

**Passive vs. proactive:** Some memory aids only work if the senior remembers to check them. For instance, a wall calendar is only useful if the senior examines it. Other aids, like alarm clocks or egg timers, do not require the senior to remember to check them repeatedly.

Some of the positive aspects of the memory aids are clearly exhibited by mobile phones: high portability, virtually unlimited space to enter information, both private and communicative aspects, proactive and passive reminders, easy backups, structured and unstructured entry, and so on. A phone does have drawbacks that the other aids do not: it needs charging, it may be easy (and expensive) to lose, provides little contextual information, can be hard to understand, provides only information (not physical reminders), and can be difficult to access. See Table 3.7 for a detailed description of the ascribed benefits and drawbacks of each type of memory aid.

It is also encouraging to note the variety and number of aids that the participants use. Presumably there are even more aids that the participants could not bring to the session. It was also apparent that the 3 older participants used more aids than P4, who is 55. P4 said that she still relied on her own memory for many things, and only wrote down addresses just in case she forgets them in the future. This is also evidenced by the MMQ-Strategy scores (Table 3.2).

Unlike most PD efforts, no one on the team knew each other before the sessions, and thus they did not exist in an organizational context that would provide these underlying shared values. For this reason, activities like show and tell not only draw out shared understandings of use that are important for design, but also build value systems where none exist. They also offer an opportunity for mutual learning to occur between participants, a phenomenon discussed in detailed in Chapter 6. For example, when P1 showed her blue notebook, the other participants asked her questions that demonstrated they were visualizing themselves using this aid in their own lives. P3 asked P1 if anyone ever asked her to refrain from writing in the book. Because P3 often attends confidential meetings where recording into notebooks is prohibited, she became curious about P1's adamant usage of the notebook. We assume that P3 visualized herself using P1's notebook in her own life, and how she would use it differently. The artifacts thus helped the seniors learn more about how each individual organizes their memories, and allows

them to draw out similarities and differences. These similarities and differences, in turn, help the team build coherence and a shared value system that are requisites for design. As a concrete example, all seniors noted during this activity that they love the feeling of having plenty of room to write; this, in turn, can clearly influence software design by indicating the need for unlimited input in a text field.

Participants also began to compare their current aids to a mobile phone during this early stage. For instance, while P1 emphasized that losing her book would be tragic, she is equally afraid to use a phone or computer for the same purpose because it might crash and erase her information. We see that the juxtaposition of artifact analysis and hardware choices has yielded an interesting result here, because now P1 has begun to think about her memory aids as they relate to mobile phones. She has already identified potential problems with mobile phones, and affirms her preference for physical aids that do not crash. This indicates a starting point for further discussion about design, and draws into question the validity of using technology for this purpose entirely.

Choosing an aid system was a very personal and important choice for the participants; even so, they had never thought about the individual pros and cons of each aid. The following week, P3 told us that she now sees her memory aids in a different light as a result of the discussion.

### 3.3.3 Sessions 3 and 4

In Sessions 3 and 4, participants created storyboards and began requirements engineering by participating in a guided discussion based on the storyboards. P5 joined during the 4th session as requirements engineering began.

#### Activity: Scenarios and Storyboards

To better understand the current needs of the seniors, we decided to conduct a scenario creation and storyboarding activity. Specifically, we wanted to understand what con-

current actions and emotions accompanied situations where names were forgotten. For example, we wanted to know if forgetting a name was perceived as stressful or occurred in socially unpleasant situations. These factors could, in turn, affect the design. Goodman, Joy, and Syme argue that scenario development can be extremely important when designing for mobile devices because context influences the user's experience so drastically [16]. Like Goodman, Joy, and Syme, we defined scenarios in the same way that Carroll does – that is, they include actors, plots, settings, and a sequence of events [8].

In this activity, we asked participants to form pairs. We decided to form pairs in order to accomodate P3's tremors. By pairing her with P1, she could still participate in the creation and elaboration of the scenarios, but would not have to draw or write out the ideas. P2 and P4 worked together (Team A), and P1 and P3 worked together (Team B). Each participant was given a stack of storycards. Figure 3.3 shows an example of one of Team A's completed storycards. These cards were printed on 8.5 x 11 inch sheets of paper. At the top of the card, we printed three scenario options: Best, Average, and Worst. Some cards were description cards, and were used as "cover sheets" and summarized the story. We instructed both pairs to create 1 scenario of each of the 3 types, for a total of 6 scenarios. Scenarios spanned multiple cards and formed an annotated storyboard. The storycards had a box for the participant to sketch a scene from the scenario; these helped convey ideas between teammates and the rest of the group. The participants used as many cards as they liked for each scenario (see Appendix E). Team A used 3 story cards and 1 description card for their best and average scenarios. They used 2 story cards and 1 description card for their worst scenario. Team B, on the other hand, used fewer cards. Their best and worst scenarios each used 2 story cards and 1 description card. Their average scenario used only 1 story card and 1 description card.

We then explained to the participants that each scenario was to deal with a particular situation they have faced related to remembering the name of another person. Afterwards, we would discuss the scenarios as a group. As an example of a best-case

scenario, we gave the following ficticious anecdote of someone with an amazing memory: "You go to your 60th high school reunion and see an old classmate who you remember from your chemistry class. You weren't close friends, but were on speaking terms. At the reunion, you are able to remember his full name despite all these years apart, and your classmate is flattered and amazed that you could remember his name." As a worst-case scenario, we suggested that perhaps the senior would be unable to remember the name of someone very important that they had just met 30 seconds ago. By creating both positive and negative scenarios, it gave us the opportunity to later tell where the phone might help memory, and where it might hurt social relationships. The average case served as a baseline of how the seniors realistically expected their memories to perform. We asked the seniors to specifically create scenarios about their lives now, without the phone. For this reason, they did not draw or talk about phones in this activity. Team A's best scenario took place at a class reunion, where P4 meets an old classmate who is well-liked, clever, and friendly. P4 then remembers his name and they reminisce together. In Team A's average scenario, P4 meets "Mr. Wrong," an acquaintance from an old job. She does not particularly care for him or remember his name, but they make small talk for a few moments about their old boss. In the worst scenario, P2 attends a lecture with a well-known public speaker, who enthralls everyone in the room. Despite the popularity, high profile, and importance of this speaker, P2 simply cannot remember the speaker's name. She freezes up and berates herself, cursing her poor memory.

Team B chose the same setting for all three of their scenarios, and created ficticious narratives rather than drawing on their own life experiences. In the best case, two couples meet while sunning on a cruise ship. All four people enjoy the newfound company, and at the end of the cruise they exchange contact information. Two years later, they meet again on a different cruise, and everyone is overjoyed to reunite, and they certainly remember one another's names. They keep in touch in the years to come and become family friends.

In their average case, the two couples meet on the sundeck but there is no real

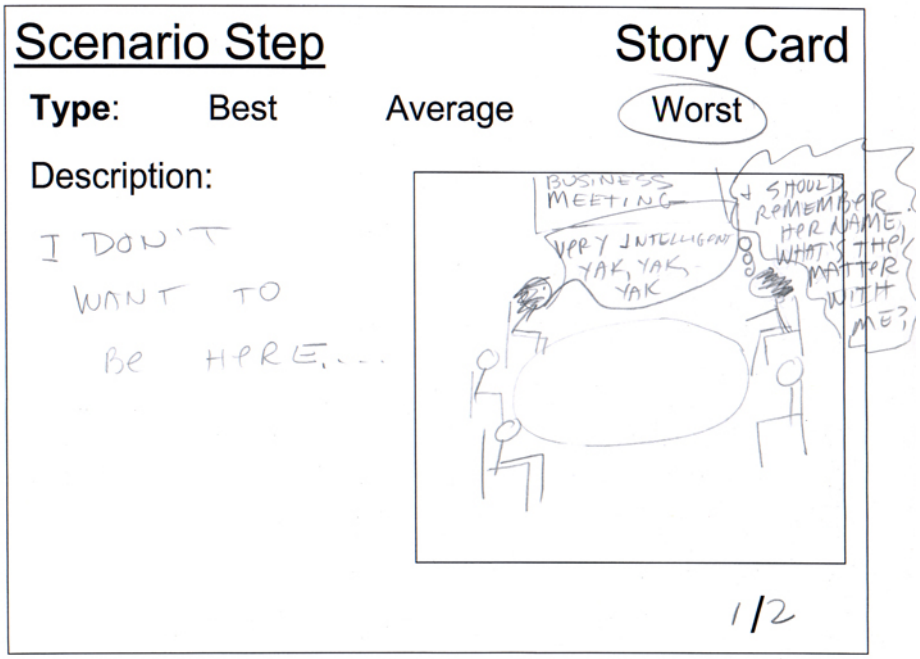


Figure 3.3: An example story card created by Team A. In this picture, P4 depicts herself forgetting the name of an important person at a meeting. On the left, the description reads "I don't want to be here." In the cartoon to the right, we see one person saying something "very interesting, yak, yak" while the other thinks to herself "I should remember her name... what is the matter with me?"

connection. They dine together that evening, and exchange pleasantries. Two years later when they meet again on the cruise, they must reintroduce themselves – "Oh, we're the So-and-so's." They have a pleasant time together but are not very concerned about remembering one another beyond the scope of the cruise.

In their worst case, couple A has an aversion to couple B because the husband of couple B flirted with the wife of couple A while on the sundeck. They are then seated together at dinner, much to the chagrin of couple A. Two years later, on another cruise, couple B recognizes couple A and invites them for a drink, assuming that A still remembers them. In fact, couple A does not remember couple B, and instead have just a gut feeling that

they dislike them. They try to avoid the other couple for the rest of the cruise.

The teams then shared their scenarios and storyboards, and used the pictures to illustrate. A group discussion followed, and flowed into the requirements engineering phase.

**Analysis: Scenarios and Storyboards**

In retrospect, most participants felt surprised by storyboarding and were not confident in completing it. It took several attempts and examples for the participants to understand how to complete the activity. Once they began, however, the participants enjoyed it. They often left out details in the cards themselves, in favor of explaining the situation verbally to the others. These details sometimes

From the storyboarding, we learned about each team member's attitudes towards memory. First, we learned that for all participants, mutual affection was important; that is, remembering a name is easy when you like someone. While creating their worst scenario, P1 said, "this is couple one, and over here is couple two, and the vibes are negative." They strongly correlated how much they liked a person with how well they remember them. P4, as she held up the storycard for the group to see, described her best case scenario in this way:

> P4: We're talking about a reunion, a class reunion ... [we're] old classmates, I haven't seen him in 55 years ... [my classmate says] ''Hi [P2], it's me Jules... I'm a doctor now.'' [I remember everything,] the recollection was dead on, the name, the associations and everything... so what do you guys think of that? Isn't that the perfect example?

Notice how in the best case, P2 talks about recalling the name of a man she admired from long ago. After he introduces himself, she remembers everything about him, and they have a lively conversation. In this best case scenario, the other person introduces himself. This relieves P2 of the burden of remembering his name. The source of pride for her in this "best case" is that she remembers his personal details and can make warm

conversation.

Second, we often imagine the name recollection takes place between two equal actors. This is not always the case. It must accomodate spouses, friends, and others nearby who are clearly part of the memory process. Further, as Team A demonstrated in their worst scenario, the person forgotten is not always a friend. They are often celebrities or politicians, people who are familiar but at the same time not personal.

Third, individual differences emerged as a result of the scenario design process – a contributing factor to a loss of focus for much of the later sessions. P2 found forgetting names to be highly stressful, and often "freezes up" when she can't remember one. P1, on the other hand, does not chastise herself for forgetting, and instead asks for the person's name again. While P4 was working with P2, they originally crafted two different scenarios. P4 said to P2, "Your worst scenario is different from my worst scenario. I don't have any of those problems" (in Figure 3.4 we see P4 and P2 sketching scenarios to share with one another to highlight their differences). This could be due to a lack of homogeneity in the group, the age difference, or simply individual differences. The scenarios helped highlight different reactions and attitudes towards memory failure among the group members. Because we suggested a sample scenario at the beginning that took place at a class reunion, we may have biased Team A into selecting a high school reunion as the setting of one of their scenarios. Their other two scenarios, however, were not related to a high school reunion.

In summary, creating scenarios and storyboards helped reveal issues that can influence design. We learned that remembering names is much more complicated than simply retrieving a piece of information from long-term memory. It also involves remembering affiliations, hobbies, and other personal data. These details help indicate to the other person that the senior cares about him or her, and in some situations, may be even more important than remembering the name of the person. Further, the tone of the event relies upon the relationship of the two actors. Are they old friends or old enemies? Do they

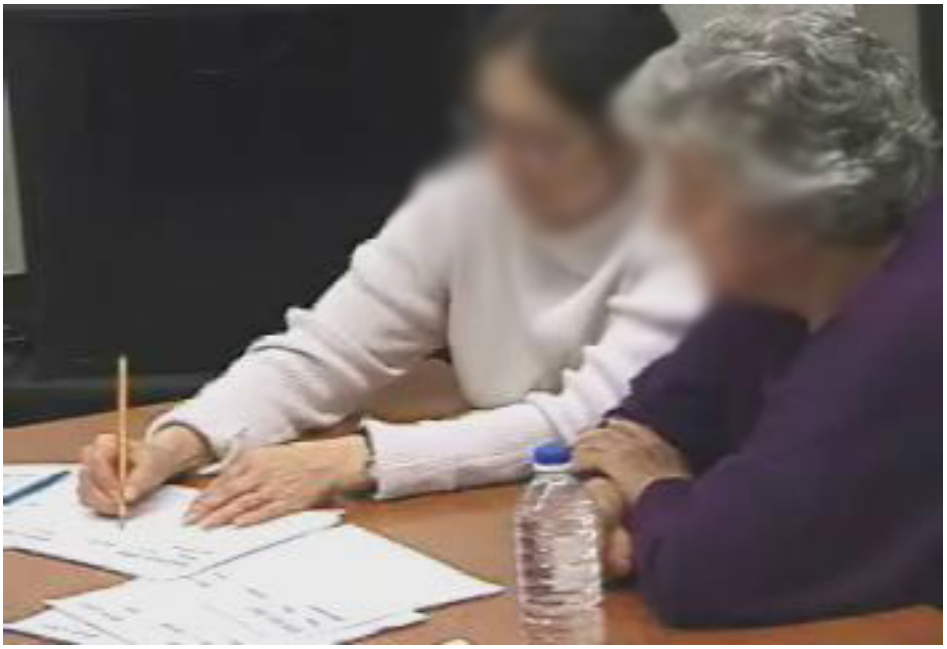

Figure 3.4: P2 and P4 draw a storycard. Differences between reactions to memory failures emerged as the participants shared scenarios.

want their relationship to grow, or are they content to simply be acquaintances? Is the relationship one-sided (e.g., remembering Tom Cruise's name) or mutual (remembering your barber's name)?

**Activity: Requirements Engineering**

Using the scenarios as a starting point and touchstone, the participants then offered their thoughts on what functions the system should possess. For purposes of talking about the system more concretely, we decided upon a name for the customized phone created by the efforts of the design team. By a vote, the team decided that the system should be named *Recall*.

We then asked the participants the question: "Now that we have shared these scenarios...what would the mobile phones do in each of those scenarios?" We urged the team to refocus on the scenarios periodically throughout the activity. The participants then brainstormed a list of features they felt the system should have. Each item was written

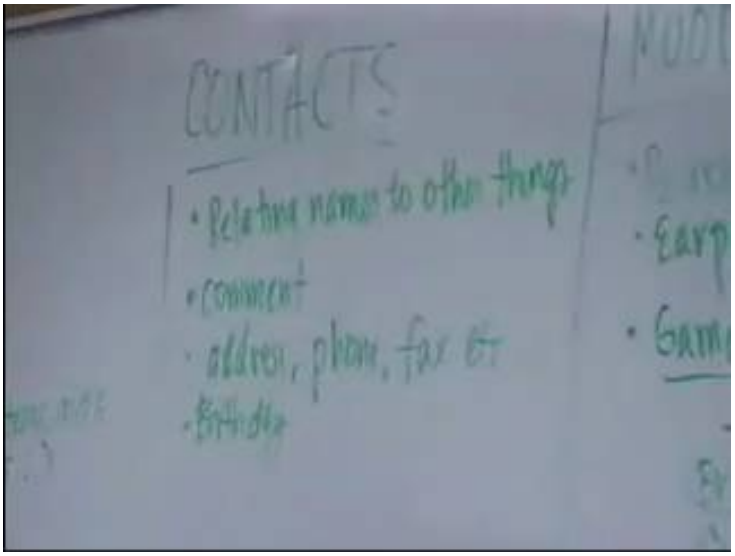


Figure 3.5: Ideas being organized on the whiteboard during requirements engineering.

on the whiteboard and loosely organized (Figure 3.5). The ideas varied greatly and were often not completely developed, but we felt it was important to simply say them and then organize them more strictly later. In the end, the three categories were "Calendar," "Address Book," and "Mood Elevators." Later, "Mood Elevators" was renamed in favor of "Games." Specific features were elaborated in the following week; the final requirements list is shown below.

### Analysis: Requirements Engineering

During this activity, the team lost its focus on memory. We attempted to guide the discussion by suggesting that we remain on the topic of memory, and to think about what sorts of features related to memory seemed to make sense from the scenarios, but the team persisted in thinking more broadly. This could be for several possible reasons.

- P5 joined the team for the first time during this exercise. Because she had not seen the scenarios or artifacts, we briefed her at the start of this session. However, her absence during the previous weeks of the PD process likely caused her to misinterpret the purpose of the study. As a result, she suggested features related to her

need for safety (such as a panic button and medical alert application) rather than memory aids.

- P1 and P5 are dominant discussants with strong personalities. P5 also has more knowledge about computers than other seniors. Because P1 and P5 are friends, other participants might have felt "out of the loop" on the discussion that P1 and P5 drove. For these reasons, other members acquiesced to their views. Further, the other participants agreed with the points that P1 and P5 made, even if they were off-topic.

- The participants considered other aspects besides memory were more important and deserving of attention.

- The seniors might have misunderstood the question and purpose of this particular activity. Instead of offering to share what they think phones *should* do to support memory for names and faces, they may have been trying to answer the question "What do phones *currently* do for memory?" Showing phone hardware to the participants during the second session may have contributed to this problem.

- The team realized the differences in memory ability that each person possessed during the scenarios and artifact analysis. Rather than attempt to reconcile these differences and move towards a singular design – which might have prompted argument or disagreement. It is possible that the team felt more comfortable sidestepping the issue.

We originally created the scenarios so that we could have a common touchstone for this discussion. The team seemed to ignore the scenarios and rarely mentioned them during the brainstorming exercise, however. We attempted to gently guide them back to the scenarios when they were off track. Instead, they brainstormed around the topic of memory more broadly. This may have been a misunderstanding between us and the

team, or the team may have felt more strongly about memory in general than the topic of names. We were also reluctant to dismiss any suggestions that the team made, no matter how unrelated to names they were, because we did not want the seniors to feel incompetent. This ultimately resulted in a break from our original intentions, and the team discussed memory more broadly throughout the remainder of the sessions.

### Calendar

The team felt that making and keeping appointments was quite important. Further, they believed they needed reminders about upcoming tasks and appointments. For example, P1 and P4 had the following dialogue:

> P1: It should have an alarm system that would go off and remind you to do something...like I get up and...remember that I should phone somebody soon and the system should ring like an alarm - ‘‘Oh shoot, it’s a quarter to three! I’m supposed to call...,’’ press the button and I should be able to see on the screen what I was supposed to do.
> P4: So a calendar?
> P1: Calendar function.
> P4: Alarm.
> P1: Reminder.
> P4: Like for meetings and stuff?
> P1: Yes. Yes. Yes. Everyday I should be able to see my events. 1 p.m. ...so that means noon I have to read the list, an alarm should go off here to remind me. It could be an alarm bell, it could wake me up in the morning, it could remind me to do things. It could tell me whose birthday it is today. All those little things on a calendar function. And then agenda function.

Below is the listing of items that were given as requirements of the “Calendar” portion. Not all of these requirements made it into the screen design in subsequent weeks. This list and the above conversation illustrate that the participants’ mental model of a calendar was conflated with other personal information management utilities such as todo lists, maps, public transit time tables, and so on.

- Daily view on startup

- Weekly, monthly, yearly views, including next year
- Spaces for notes (medications, items, aids, lists, glasses)
- Reminders/alarms
- Link with people, show relevant information about people on the calendar
- Sorted by time, priority (with a visible marker), and allow items to be underlined, crossed out, marked as complete, or transferred
- Holidays (Canadian, Jewish, etc.)
- Birthdays (as from the address book)
- Maps: Toronto, and TTC (public transit)

In general, the calendar was seen as the place where time-dependent items would be stored. Loosely interpreted, tasks to complete and reminders both have a temporal element and were therefore indicated as part of the calendar.

### Address Book

The address book contains all of the software elements that deal with people. It is also the closest application area to the initial focus on names and memory.

The whiteboard contained the following items under the "Contacts" section:

- Relating names to other things
- Comments
- Address, phone, fax, etc.
- Birthday

- Groups, making new ones

  List multiple groups

  Sort people by group, name, place, or keyword

- When they are added
- Alphabetize, sort
- Photo, capture them and also find pictures later
- TTC info (e.g., phone numbers for calling an operator)
- Emergency contact information

One particularly interesting concept revolved around the need to remember other people for purposes of amiability. P1 related a story from her days working as a journalist: "As they call I would get their...we'd get their file...this was an unbelievably important tool at work to remember everything, like their relations. And people felt, people liked me because I remembered who they were and their...any old thing about them." P1 strongly felt that this "trivia" about other people allowed her to forge and maintain relationships with community groups that were critical to her work. This need was realized in the requirements by including an area to store unorganized, disconnected bits of information about people. This area would be used for items as varied as recording allergies and dietary preferences to the name of the person's pet. Later, these bits of trivia could be consulted and incorporated into conversation or planning (e.g., "Annette, how is your beagle Rex doing?"). This idea is illustrated in the following quote from P1:

> P1: Plus, room for a little comment about that person. In other words, in addition to address, phone, fax, e-mail, business phone, there should be just a little space for comments on that person's birthday, their allergies, if I know they don't like certain things, don't phone at night, don't phone first thing in the morning, and all sorts of quirks, just a little comment to remind me who that person is.

Participants reported that they consulted their current memory aids at particular times during the day (such as when they wake up in the morning). P1 especially indicated that she would use the notes when planning events or preparing to go to a social function. They did not foresee themselves checking these notes during an encounter with another person. Rather, they would be perused and updated during free time at places such as the doctor's office or bus stop. Like the scenario activity indicated previously, personal details are more important to remember in some situations than names are.

### Mood Elevators and Games

As P2 identified during her scenario development, she often freezes up when trying to remember a name. She feels stressed, and this stress prevents her from thinking clearly and remembering well. This led to the notion of a "mood elevator" – some activity that could help reduce stress and promote better recollection. Several ideas were generated around this theme:

- Relaxation tapes, 30 min.
- Earphones, trouble hearing the phone
- Games, distractors, something to help focus

  Remember what to do by focusing on phone-based activity

  Bridge, chess, solitaire, crosswords
- Quiz game

  Who did I meet there?

  Associations

The team liked the idea of being able to relax and calm down, but they did not seem to have a clear understanding of how this calming process was to occur. For instance, was it

to occur when one forgets a name in order to calm the senior down? It was also unclear whether this feature was something the seniors actually would use. The team wanted to elevate their moods, but were not sure how to do this with a phone.

For example, participants thought of including relaxing soundtracks on the phone, such as ocean noises or yoga breathing instructions. Once participants realized they would have to wear headphones and manually activate these phone features, they decided against including these. No one foresaw themselves actually using these features during a stressful moment. They also expressed irritation at the idea of listening to music on a mobile phone via the headset because "music is used on an automatic telephone and my antipathy to the automatic telephone could fill a volume of six hundred books." Here, P5 talks about her hatred for being put on hold and listening to "muzak."

When conducting the initial telephone interviews, three participants noted they use their computers for playing Solitaire. A mobile phone seemed like a useful gaming device because these games could be played while waiting (e.g., at the doctor's office), so we suggested this notion to the team as another category of "mood elevator." These experiences with Solitaire helped introduce the idea of games and other "distractors" to help them relax and focus concentration. In fact, one participant noted that she plays Solitaire most during the middle of the night when she has trouble sleeping. Bridge, chess, and crossword puzzles were also suggested.

After prompting to refocus on the names and memory concept, the team became more creative and reinvented some more traditional games that they enjoyed. One idea the team produced was a crossword puzzle that was generated from words in the address book – names, addresses, trigger words, and so on. They also liked the idea of a quiz game, where the phone would challenge the player with a question like "Who lives at 100 Bloor Street West in Toronto?" or "Who is associated with the word 'Rex'?" and the player would have to select the correct answer. The following statement by P3 highlights their envisioned game revolving around people's relationships to one another (names

changed):

> P3: Is there anything up on there about relating the use of memory aids? I'm thinking... I met, this man, walked towards me on Sunday and I looked into his face and I realized, I said to him ''You're John Doe.'' And he said ''Yeah.'' So he introduced himself and I introduced myself and my husband, and he introduced me to his partner who was very cute and I said ''What's your name?'' and he said ''Bob,'' and I said ''Oh that's great, I'll remember that because my daughter has a new cat and she named it Bob and I won't forget that John's partner's name is Bob.''
> R1: Right.
> P3: So is there any kind of a game there that would do relationships?

Some participants favored including games more than others, and sincerely doubted that they would ever play a game on a mobile phone. P5 was especially vocal about her disdain for the games she often sees young people playing.

### Miscellaneous Features

Some items did not fit into one of the above categories. These were also collected as part of the process, in order to help validate the input of the participants. Some felt their input was not being well-received because it was very different from the memory-supportive areas that we defined during the needs analysis. We used the whiteboard as a staging area for these ideas, and agreed to return to them later. The list below demonstrates the varied, and thoughtful, ideas that the participants offered:

- Indicate to the user that they aren't damaging the phone
- Everything should be in plain, non-technical language
- Documentation should be step-by-step, in hard copy and digital formats, concise, written by an native English speaker, and in large print
- Extreme sunlight and shade should not impair the ability to see the screen, and it should be high contrast

- Losing the phone, backups, crashes

  Should be able to call the phone to find out where it is if you lose it

- Password, exclusive access

- In case of loss, contact information should be there

Clearly a number of needs were indicated here. Some of these indicate problems the participants see in current technology: incomprehensible instructions, problems viewing the screen in sunlight, and worries about breaking the system. Also, it is clear that the users need a direct method for retrieving their information and telephone in the event that they lose it. They are also concerned for their security, and some of the participant noted a password would be necessary.

One was the need for automated backups. This was identified earlier in show and tell as one of the major drawbacks of using a physical notebook – if it is lost, there is no backup. The team decided that automated backups would allow them to use the cell phone with greater confidence. If they lost it, they could pick up where they left off by simply synchronizing the phone with their home computer.

Another point of real concern was the inclusion of a 911 feature. On several occasions, the seniors compared the cell phone to "pendants" currently available on the market; these pendants have a single button and can be worn around the neck. In the event that the senior falls down or has an accident, they can push this button and summon emergency personnel. The mobile phone, in the eyes of P5 especially, was a version of this device with extra features. These emergency pendant systems cost about the same amount as a mobile phone does per month. As a result, seniors would be more likely to purchase a phone if it had the benefits of an emergency system on top of the communication/organizer features that are commonly pre-installed. The seniors also wanted the phone to automatically dial a family member in the event that 911 is dialed on the phone.

In the Address Book and Calendar, the participants wanted places to write lists of medicines and the ability to specify emergency information. They also considered including a space to write other important, but sensitive, information. P5 started this idea: "I think I've got an important thing. Might be a little dangerous but there should be in your computer you always have or should have recorded your Visa number, your [medical insurance] number, and so on and so forth because if you lose that information and haven't got the numbers it's really difficult." P3 responded by noting "I don't know if that's a safe place to put it because if anyone should pick it up." The idea was dismissed based on the security threat it posed.

### 3.3.4 Sessions 4 and 5

In session four, the team as a whole created paper prototypes for the main menu for their system. This helped solidify the requirements engineering conducted earlier in session four. In session five, the team proceeded to do so for the Address Book and Calendar. We selected these two applications because the entire team agreed upon their importance (as opposed to Games, for instance, which was contested by some participants). Throughout the paper prototyping, we saw evidence of continued refinement of requirements. Creating the main menu of the system especially helped the seniors determine what the functional requirements would be.

We used a modified PICTIVE process to conduct paper prototyping [35]. We began by gathering around a table with numerous supplies for constructing mock user interfaces (Figure 3.6). We prepared cut-out interface elements in the style of a mobile phone buttons (OK, Cancel), icons, text fields of varying lengths, etc (Appendix F). We also provided markers, highlighters, pencils, pens, paperclips, glue, sticky notes of varying colors and shapes, and tape. Since we were working on designs for a phone, we could actually fit an entire picture of a phone onto a piece of paper, so we then cut out the display area on the phone, and participants could slide their design beneath the cutout

Figure 3.6: The PD team creates a paper prototype using the PICTIVE technique.

in order to see what it would like "on the phone." To help make the activity more focused, we approached the paper prototyping process for each application as a question of "What comes next?" rather than "What should it do?". Instead of asking the team to start designing the application without context, we instead asked the seniors to say what would happen when they turned on the phone and continued from there. While this helped them generate ideas, their previous experiences with computers interfered with novel designs. Instead of creating new ideas, they seemed to "fill in the blanks" of what happens on their home computers. We suspect that because the seniors use the Start Menu on their home computers to launch each program, this became the focus of their first paper prototype.

**Activity: Paper Prototyping - Main Menu**

The seniors opted to begin by designing what P5 called "the main menu" (what was eventually understood to be the Start Menu). By defining what would go on the menu, the team effectively determined what the entire system should do. The groups under-

standing of the system suddenly became grounded and written in concrete terms that the team could visualize. Unlike the requirements engineering phase, where ideas remained abstract and uncategorized, the seniors vigorously negotiated over what would go on the menu, how many entries there should be, and what each item should be named:

> P5: [suggesting a function area] There should be someplace to put a note...
> P1: [suggesting a name for the menu entry for this function] Pending?
> P5: Well, whatever. In the computer, its called Notes...
> P2: What about Reminders?
> P1: To Do List.
> P5: Notes are not necessarily things to do, theyre notes of other issues, like your medicine for example.
> P2: What about Special Notes?...

At the following session, P3 (who is quiet through the above debate) suggests it be renamed to Notes because Special Notes has a negative connotation for her, and this becomes the final name on the design. The number of functions that the phone should perform (and the corresponding number of icons on the main menu) was also a topic of debate:

> P4: I think we're all in agreement, we don't want 99 icons, we do want to keep it simple. Eight is fine.
> P5: But I do, I have, I think I have at least 40 icons on the desktop. Well, it depends what.
> P4: Yeah I know, but for this, I'd keep it to a minimum.

The final menu design that the team created is depicted in Figure 3.7. Note that the team used pencil and erased the design in places before drawing over it. In addition, the team has written "alpha order" at the bottom of the menu to indicate that in the final design, items should be placed in alphabetical order.

**Activity: Paper Prototyping - Address Book**

P5 wanted a different interface for her phone than the rest of the team. P5, with her expertise in computers, quickly drew what she thought was the "right" interface because

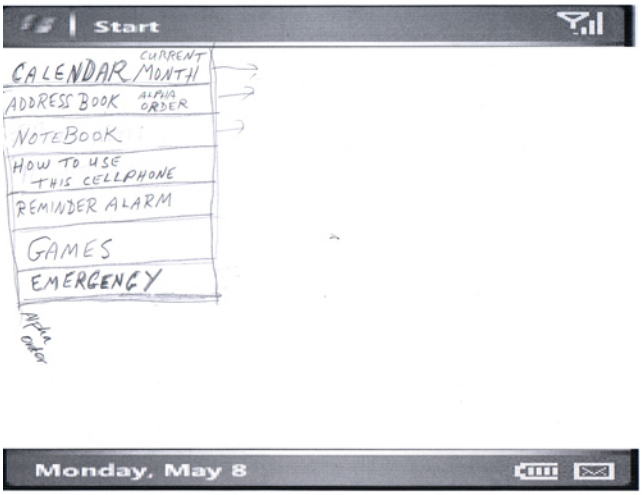


Figure 3.7: Paper prototype of the main menu. Entries (from top to bottom) are: Calendar (Current Month), Address Book (Alpha Order), Notebook, How to Use This Cellphone, Reminder Alarm, Games, Emergency. At the bottom, the team placed a note to organize these entries in "alpha order."

it was familiar from her desktop computer. When the rest of the team failed to respond to her drawing, she became agitated. Unlike the rest of the team, she disliked extended contact information being stored on the phone; she insisted she would only use a mobile phone for phone calls. Therefore, she wanted to remove street addresses, email addresses, and photographs from the screen layout. The rest of the team liked these elements, though, so they continued to work on a shared paper prototype while P5 drew her own and eventually withdrew from constructing prototypes. Instead, she would offer her opinion about the prototype the rest of the team constructed, or turn to an unrelated topic of conversation. We repeatedly encouraged the seniors to create an interface that they believed would be suitable for *most* older adults, not simply themselves. This challenged the team, however, as they tended to design the phone to such a personalized degree that many obvious features went missing from the prototypes. For instance, P1 and P4 wanted to include text messaging because they imagined other, more tech-savvy, seniors would want access to it. P2, P3, and P5 all agreed they personally would never

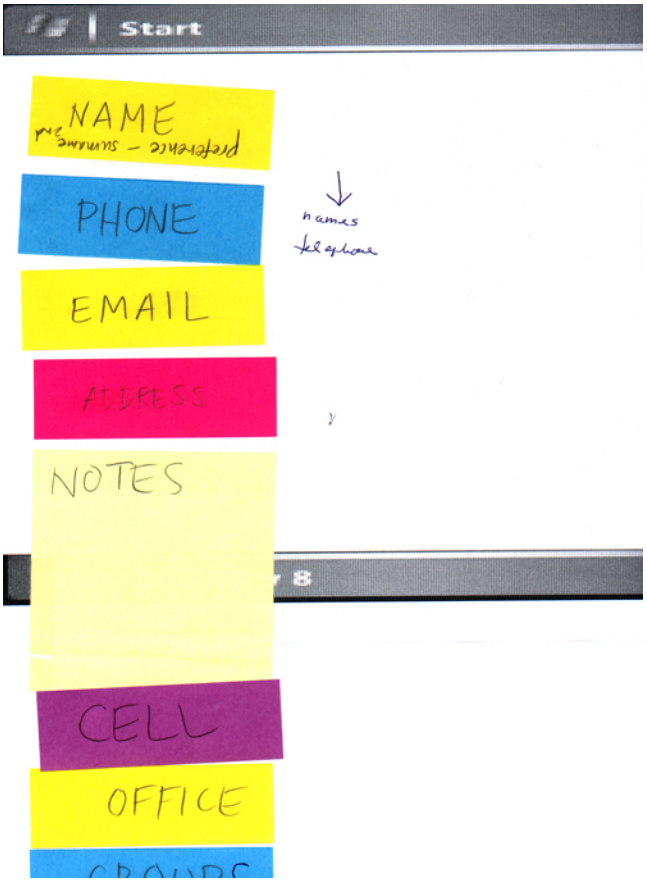


Figure 3.8: The team's paper prototype for the address book. From the top to bottom, each sticky note says: name (prefrence - surname 2nd), phone, email, address, notes, cell, office, groups. P1 wrote "names, telephone" with a down arrow next to the sticky notes.

use such a tool, and on this basis chose to remove it from the design. The final design agreed upon by the team is shown in Figure 3.8.

### Activity: Paper Prototyping - Calendar

Many of the characteristics of the design process of the Calendar application mirrored the dynamics from the Address Book. Their design emulated the characteristics of traditional wall calendars, with similar visualizations. For example, the team created a grid-like monthly view, a 7-column weekly view, and an hourly daily view. The transitions between views also emulated those found on desktop systems (e.g., tapping on a day in the month

would open the daily view for the selected day).

In addition to the lack of novelty of the design, the seniors were held back by a lack of understanding of the technology's capabilities. For example, P1 was surprised to learn that the phone could store appointments for many years into the future, unlike her current planner, and that she could enter as many appointments as she pleased.

### Analysis: Paper Prototyping

The seniors were initially very hesitant to start paper prototyping and instead asked the author general questions about how the phone would work. We encouraged them to think about how they would like it to work, or what would come next logically, but in general they were more interested in learning about existing designs rather than creating their own. Conversation sometimes diverged during these sessions; for example, participants asked about recharging the phone and the logistics of who was funding the sessions. We repeatedly encouraged the team to stay on task in order to progress through the activity.

Although there were many sticky notes and pre-made cut-outs of screen elements that could have been used to represent widgets, and we encouraged their use so they could be rearranged, the seniors preferred drawing with paper and pencil. When they later decided to change the arrangement of items they simply started over and copied the items from the old paper. We also noticed that the seniors preferred to simply use blank sheets of paper to express their ideas rather than any of the cut-outs or mock-ups.

As the quote above illustrates, P5 has worked with her desktop computer extensively and has developed routines in order to operate it (such as including 40+ icons on her desktop). These routines often informed her contributions to the paper prototyping, and conflicted with the limited experiences that other seniors had. She also used her knowledge to "correct" some of the other participant's suggestions, such as the point above where P1 suggests that the Notes section be named "Pending," only to be corrected by P5 that it is in fact called "Notes" on the PC. P5's prior experience with her computer

is evident in the design itself; it looks and operates quite similarly to Microsoft Outlook software on the PC.

To help manage roles and group dynamics, the team decided to assign P2 the job of managing the ideas, acting as a gatekeeper to the paper prototype. Because P4 has a background in the fine arts, she enjoyed the job of sketching and was appointed "drawer." The team did not maintain these roles strictly, however, and P1 and P5 both offered strong opinions and would sketch out their own interfaces away from the common prototype. P3, on the other hand, remained quiet throughout most of the paper prototyping process. We later learned this was because she did not want to stir conflict with the strong opinions of P1 and P5. Combined with her tremors, she played a small role in the paper prototyping process.

The end design contained fewer fields than most built-in address books. This was a design choice by the seniors; P1 said "I get very annoyed when they put diaries with all the lists of, you know, cell phone and mobile...I don't need that. I find it very annoying."

### 3.3.5 Session 6

Session 6 focused on two main items: foreseeing how the seniors would use the phone, and a discussion of location-awareness. We also handed out small notebooks to all participants. The seniors were instructed to record the names and locations of all people that they met during the upcoming week. The purpose of this exercise was to understand how many people they encountered on a weekly basis and how this potentially could impact design. We anticipated they would find many people whose names they did not know, and perhaps prompt them to think about how a phone might help. We hoped this would refocus the group to some extent as well.

**Discussion about Foreseeing Phone Usage**

In the first discussion about conducting tasks on the phone, the discussion became rather broad. The first major topic of conversation was about how mobile phones might become a sort of pared-down computer that seniors can take with them into retirement homes. They cited how wonderful it would be to stay in touch without needing to be in front of the computer, which tires them. P1 described it as a "mini-computer with just the essentials" such as email, contact information, appointments, and so on. She affirmed, "I could see myself in an old folks' home using this... It could be a wonderful tool when I am downsizing." P3 also agreed, "[Someone] asked me if I wanted to go into a home the other day. I don't want to take a computer, but the cell phone could be a replacement... You could also use it to remember the nurses' names." This suggests that the seniors in the group rely on computers for communication already (P1, P3, P4, and P5 all use email) and can foresee themselves using a mobile phone instead of their bulkier home computers.

This led into a broader discussion of how useful the seniors perceived the phone's communications functions to be. P5 said that the only reasons she could see for using a mobile phone is for the camera or emergencies. For her, the phone is only another place that she must keep updated, and it is a hassle to coordinate a phone with a desktop computer, a telephone, and a handwritten address book. P4 agreed that the phone would not be useful at home because she has a landline telephone, her computer, and her address book already. Any benefit the mobile phone would offer would be obviated by these pre-existing and more familiar artifacts.

The next area of discussion revolved around remembering names and how the mobile phone could be used for this activity. We again tried to refocus the group onto this topic, but the team indicated that the phone would not be very useful. We were surprised that they chose this time to point out this problem, as opposed to earlier in the design process. Even so, the previous activities seemed to clarify the doubts that the team had

and allow them to express them pointedly. P4 noted that "[i]t's the context whether or not I remember, like if they remember me or not." P5 also pointed out that the cell phone simply cannot help her with the names that she needs help with most – those of people she has not seen in 50 years. The only people she can imagine storing in the cell phone are those who she has interacted with recently. The team could not think of a way to "get people in the phone" that they had not seen in years.

The logistics of actually using the phone in a social situation were also deigned inappropriate. As P1 notes, "[i]f the phone is in my purse, I am not going to just pull it out and push a few buttons to remember a name in a conversation. I'm much more likely to just ask for their name." P3 agreed, but added that the phone "would be something I'd use after the conversation." All seniors expressed irritation at other people who talk on mobile phones in public, who they perceive as rude and negligent. If they were to use mobile phones, they would try to avoid acting like the brash individuals they often see. This largely meant that they would not use the phone during conversations or while completing another task (such as using an ATM or riding the streetcar).

The conversation concluded with a brief discussion of where exactly the phone would be stored on the person. Most agreed that storing the phone in the purse or on a shoulder-strap would be the best option.

### Discussion of Location-Awareness

In the location-awareness discussion, we tried to describe possibilities that location information could provide to the user. We suggested that we could imagine a future where we track phones through using GPS or other technologies such as GSM fingerprinting. This, in turn, could be used to support memory in particular ways. We challenged the seniors to think of ways in which this location tracking could be used to bolster their own memories. Originally, we anticipated that we might use location as a lens to focus queries into the database of people, in order to promote the software as a compensatory

prosthetic.

This notion was met with skepticism and worry. P1 quickly reacted "Why, if I needed this, I'd be in a nursing home!" and felt that location tracking was technology reserved for dementia patients who experience bouts of wandering. She said the only time location tracking would be permissible is "if it's an emergency thing." P5 made the point that "I am looking for ways to practice my memory; this doesn't help." She felt that by using a compensatory aid she would not be exercising her own memory as much as she should be. They also envisioned that having the names of people nearby would be problematic in social situations. P3 pointed out that "I wouldn't want the names of people being displayed if I just had my phone on the table there" and P4 also agreed with her. P5 told us that when someone gives her a business card, she immediately writes the location and occasion where she met the person on the back as a memory aid. Storing this location information automatically might be useful, she noted, but overall, location information was not perceived as useful. Remembering names, for the team, depended more heavily upon contextual factors like the sort of event and relationship rather than location.

There are several possible reasons why the seniors reacted negatively to the notion of location-tracking. First, we may not have educated them sufficiently about the technology and its proposed uses. Their pre-existing notions of location tracking were limited to GPS navigation systems in cars, and only for the purposes of obtaining driving directions. The team could not understand the point of appropriating the technology for other purposes, such as to assist with memory problems.

### 3.3.6 Session 7

In the final group session, we completed several activities. First, we intended to collect the notebooks that were previously distributed to the seniors in Session 6. However, P4 and P5 chose to keep the notebooks, while P1, P2, and P3 submitted a list of names. The seniors reported that keeping the notebook was not difficult. P4 found keeping it

to be a useful personal tool because it gave her the opportunity to collect the names of shopkeepers and other acquaintances that she has known for years but whose names she did not know. When we visited her 3 months later, she had accumulated approximately 50 names. Of the three participants that did submit lists of names, P1 included 15 entries on paper; P2 submitted 10 entries on paper, and P3 emailed a list of 15 entries.

During the previous session, we asked the seniors to collect a list of people that they met in the next week. However, P1 and P3 both submitted entries copied verbatim from their own home address books. These included not only people, but phone numbers for organizations, restaurants, and couples. We speculate that the reason this occurred was due to a miscommunication or misunderstanding about the activity's purpose with these two participants. It may also have been because these two seniors did not want to spend the time collecting names throughout the week, and preferred to simply complete the task in one sitting. The participants very rarely specified the locations where they encountered the people they listed.

Next, the final design was presented in the form of a PowerPoint mockup (one slide of the Address Book mockup is shown in Figure 3.9, while the remainder are in Appendix G). This allowed the seniors to point out additional changes that should be made to the design. At this stage they suggested changing the ordering of some menu items, and to include the time at the top of every screen. The address form was made to prompt for each individual field (e.g., street, province, postal code) but they liked that the address was condensed into a single line such as the kind they might see on an envelope. They were also confused about the utility of including a photo. Overall, participants seemed proud of the design and did not make dramatic changes at this time. The team reflected on the experience and shared their perceptions of the process thus far. A 1 hour group interview took place (Appendix H), and the results of this interview are summarized in Chapter 5. Because P2 could not attend this meeting, the same interview questions were asked later during an individual interview.

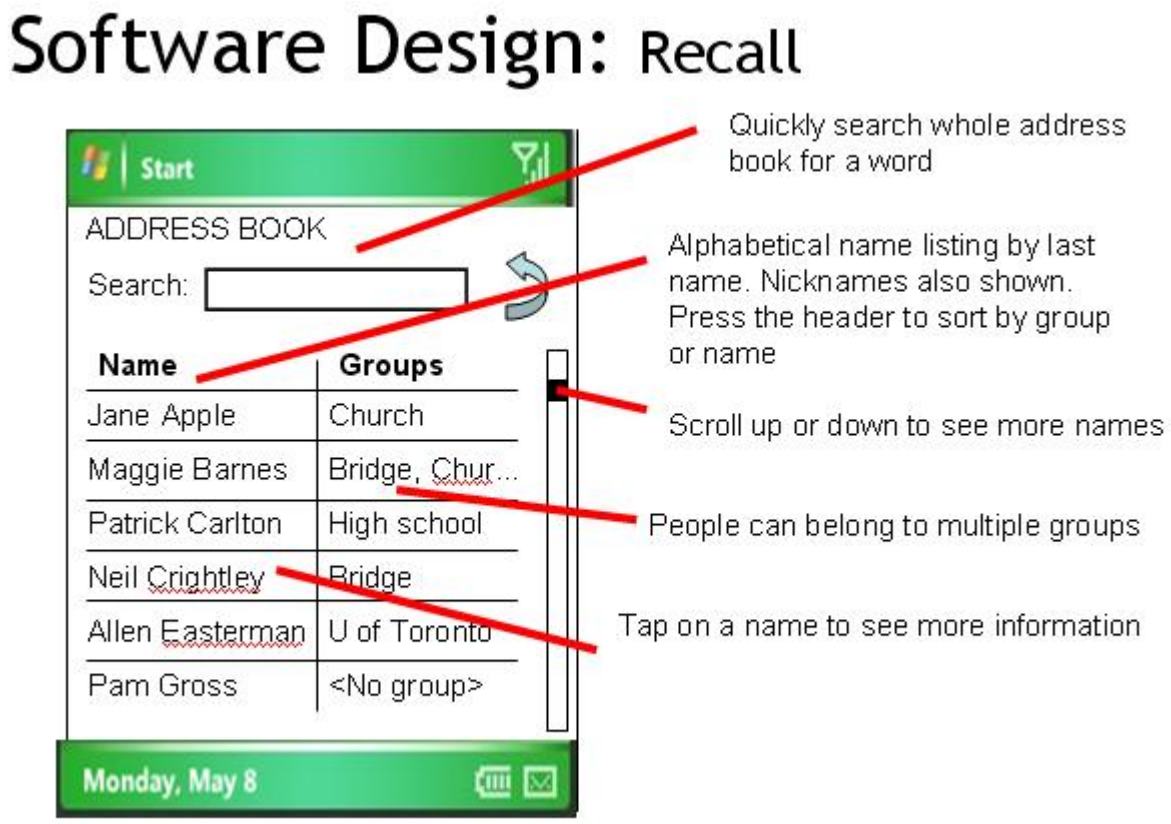


Figure 3.9: Address Book mockup created in PowerPoint and shown during Session 7.

We concluded the meeting by setting up appointments for future evaluation and design refinements. Because we wanted to better understand the places and contexts in which the seniors would use the phone to help their memories, we asked each senior for permission to visit them at a place of their choosing. We asked only that this place be representative of the sort of place where they imagine themselves using the phone. We collected permission to visit P1 at the Older Women's Network. P2, P3, and P4 invited us to their homes. P5 invited us to attend a weekly meeting she attends at a local geriatric hospital, where the focus is on helping seniors with hearing problems.

# Chapter 4

# *Recall*: PD Team's Redesign of Mobile Phone Software

## 4.1 Introducing Recall

Recall is the name chosen by the seniors in the PD team for the software that they designed. Originally, we intended for Recall to be a single process that could be launched on the mobile phone. In the end, however, the functional requirements called for multiple applications that are better represented as re-designed replacements for software normally pre-installed on a Windows Mobile 5 Pocket PC Smartphone edition device. The individual components are listed in Table 4.1. We selectively developed the Recall system in the following way (see Table 4.2 for a comparison of the DEFAULT and CUSTOM configurations). First, we rearranged the Start Menu structure to resemble the paper prototype version as best as we could, given limitations of the operating system interface. Second, we either assigned items on this menu to a pre-existing program on the phone, or wrote an application if no close match existed. We could not code all applications the team desired due to time restrictions. As a result, we coded the applications that the PD team had conceptually developed most during the sessions. For this

| *Component* | *Paper Prototype?* | *New application?* | *Deployed?* |
|---|---|---|---|
| Address Book | Yes | Yes | Yes |
| Calendar | Yes | No | Yes |
| Emergency and Medical | No | Yes | Yes |
| Reminders | No | Yes | Yes |
| Games | No | No | No |
| How to Use This | No | No | No |
| Notes | No | No | Yes |

Table 4.1: Specific components of the final Recall design, whether they were paper prototyped by the team, if they were custom-coded, and if they were deployed during evaluation.

reason, we removed Games and How to Use This. Instead, we substituted a pre-existing selection of two games (Bubble Breaker and Solitaire) and the pre-existing Help menu.

The PD team designed paper prototypes for two applications: Address Book and Calendar. Because the pre-existing Contacts software differed from the Address Book paper prototype significantly, we recoded this application to better match the paper prototype. The Calendar paper prototype mirrored the pre-existing Calendar application quite closely, so we used the pre-existing application instead.

We coded two applications based on the concepts conveyed to us by the design team: Emergency and Medical and Reminders. The themes of medical attention and short-term reminders resurfaced several times during the discussion, and for this reason, we implemented these two straightforward applications.

The first iteration of Recall software prototypes followed the paper prototypes that the design team created quite strictly. In cases where spoken assertions were in direct conflict with the paper prototype, the paper prototype was favored. For example, most of the seniors in the group did not feel that email addresses were important to store on

| *Number* | *DEFAULT* | *CUSTOM* |
|---|---|---|
| 1 | Today Screen | Today Screen (modified) |
| 2 | Start Menu | Start Menu (modified) |
| 3 | Contact Manager | Address Book (new) |
| 4 | Calendar | Calendar (same) |
| 5 | Notes | Notes (same) |
| 6 | Help | Help (same) |
| 7 | N/A | Reminders (new) |
| 8 | N/A | Emergency/Medical (new) |

Table 4.2: DEFAULT software and corresponding CUSTOM software.

the phone. Despite this, their final design included displaying the email address of a contact quite prominently. The paper prototypes were first transformed into mockups in PowerPoint and shown to the users during the final group PD session (see Chapter 3). Then, these designs were translated into high-fidelity prototypes running directly on the phone.

The pre-existing Notes application launches when the user selects this item from the menu. We favored the pre-existing version because there existed considerable confusion over precisely what a note entails, and what sorts of notes might be created here (see Chapter 3). Because of mixed reactions towards including games at all, we included the pre-existing Games selection rather than customized games. We believe games related to memory would be the most interesting remaining application to develop.

## 4.2 System Design

In total, we coded 3 main applications – Address Book, Emergency and Medical, and Reminders. Two applications that the seniors included – Calendar and Notes – came

Figure 4.1: Phone hardware keyboard in use.

pre-installed with the Windows Mobile 5 device. For the Calendar application, it was almost identical to the paper prototype that the seniors designed. Since the team did not design a Notes section on paper, the built-in equivalent was chosen after an examination of its complexity, and to determine if it was in the spirit of the designs that the seniors had drawn on paper. The remainder of the applications – Games and How to Use This – were not deployed.

All applications were created using the .NET Compact Framework 2.0 for Windows Mobile 5. All code was written in C#. Personal information management was handled by the Pocket Outlook Object Model (POOM) API. Using the POOM API permitted us to transfer personal information between applications more easily (e.g., between the customized Address Book and the pre-installed Phone software). Contact information was stored and transferred via Microsoft ActiveSync and Microsoft Outlook 2003. The phone itself is a rebranded iMATE K-JAM, licensed by T-Mobile as the MDA Vario. It is also known as an HTC Wizard, and supports a hardware slide-out keyboard that can be used when the device is turned horizontally (Figure 4.1). A stylus is also included and can be accessed by pulling it from a back panel. System preferences and features

were extensively modified from the factory installation in order to more closely align with the design preferences expressed by the team. A list of these changes, along with the rationale for each change, is given in Table 4.2. Customizations were accomplished through options available in the Settings feature of the operating system, and through manual modifications made to the system registry. As Table 4.2 indicates, the actual contribution of this work is not a singular program embodying a novel design concept. Rather, it is the integration of several smaller components in order to create a system that most closely matches the spirit of the design that the seniors generated during the PD sessions. The customizations above, therefore, are incidental to the design that the seniors created; they are not directly targeted at supporting memory or any other task-based need. For this reason, it was difficult to evaluate any single component (e.g., the Address Book or the font legibility) in isolation from other aspects.

## 4.3 Comparisons between DEFAULT and CUSTOM Applications

We present a comparative look at the Contact Manager (DEFAULT) versus the Address Book (CUSTOM), and the two Today Screens and Start Menu configurations. The discussion in this section correspondings to the first three entries in Table 4.2. Screen captures of the DEFAULT software are from `http://www.coolsmartphone.com/article479.html`.

### 4.3.1 Today Screen

The Today screen (Figure 4.2) is the default screen shown when the phone powers on for the first time. When no applications are running, the Today screen is shown, and after a timeout period, the phone automatically returns to the Today screen, closing any open windows. A number of improvements to the Today screen have been made in order to

| *No.* | *Customization* | *Rationale* |
|---|---|---|
| 1 | Adjust displayed Today Screen items: date, calendar, tasks | Other options confusing/not applicable |
| 2 | Today Screen timeout: 1 hour | Moves the focus back to the home "overview" often |
| 3 | Reprogram default Contact Manager to customized Address Book | Pre-installed contact manager too complicated for use; seniors designed a new version |
| 4 | Increase system text size to largest possible | Improved legibility |
| 5 | Disable phone auto-locking | Confusing mode for seniors, requires fine-grained target selection to unlock |
| 6 | Backlight timeout increased to 5 minutes | Allows the user more time to think without screen dimming |
| 7 | Power: auto-sleep after 5 minutes (max) | Allows the user more time to think without phone powering off |
| 8 | Make the current time visible in all applications | Design team decision |

Table 4.3: A list of customizations applied to the Windows Mobile 5 software in order to accomodate the needs and preferences expressed by the design team.

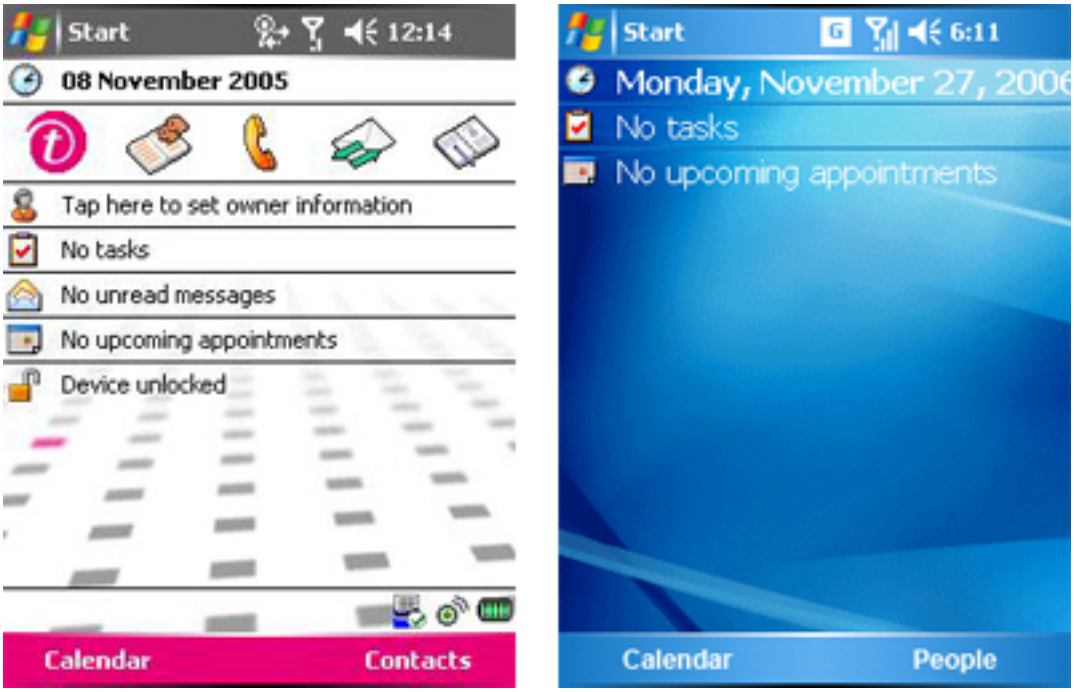


Figure 4.2: A comparison of the Today screens between the DEFAULT (left) and the CUSTOM (right).

accomodate the needs of the senior. First, the font size has been increased in order to allow easier reading. The number of items on the Today screen has also been decreased in order to eliminate distractors targeted at business users. For example, the Today screen of the DEFAULT version contains buttons for email and proprietary services from T-Mobile (the provider for this particular phone). Also note that the right and left softkeys have been reprogrammed from "Calendar" (on the left) and "Contacts" (on the right) to "Calendar" and "People" in order to support the two applications that the seniors felt were most important, as these were the ones that they themselves designed on paper. The seniors originally chose the term "Address Book" as the name for the software that was to manage the listing of people, but this term would not fit on the buttons on the Today Screen. For this reason, the term "People" was chosen by the author instead.

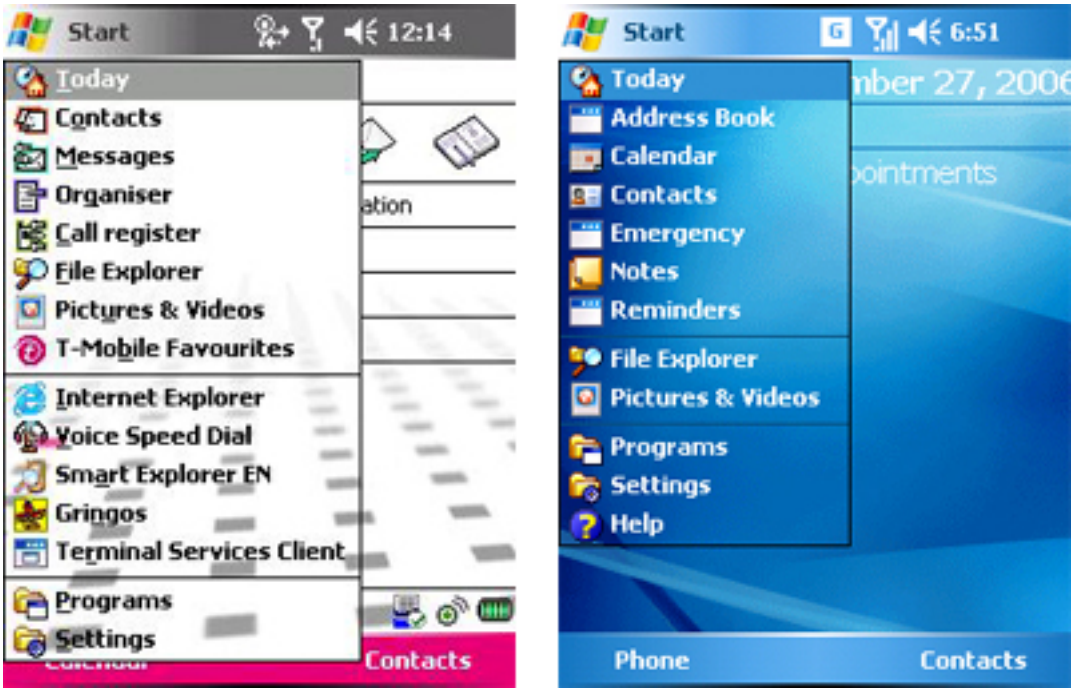


Figure 4.3: Start Menus for a DEFAULT phone, and for the CUSTOM phone.

### 4.3.2 Start Menu

The Start Menu is the main launching point for all programs on the phone. As the design team created a version of this menu during paper prototyping, it was followed as closely as possible. As is clear from Figure 4.3, the number of items on the menu has been decreased and entries for three new programs that have been designed for seniors have been added (Address Book, Emergency, and Reminders). Because the Start Menu expands its middle section with a list of recently used programs, the size can vary depending on programs used recently. For example, in Figure 4.3, 5 programs have been recently used in the DEFAULT version, compared to 2 in the CUSTOM version. Even so, the static menu entries (above the first horizontal bar in the menu) remain fewer in number in the CUSTOM version.

### 4.3.3 Contacts and Address Book

The Address Book is the CUSTOM equivalent of the Contact Manager in the DEFAULT installation. The Address Book is a custom application designed by the team in paper prototypes. Several changes have been made from the built-in Contact Manager for the senior's version.

The most obvious difference is in the number of available options on the main program menu - 12 in the DEFAULT, and 3 in the CUSTOM, not including submenu options (Figure 4.4). The seniors noted they needed a very limited subset of commands related to contacts. The Sort menu item in the CUSTOM version allows the user to sort by First Name, Last Name, or Group. It was clear from our meetings that seniors the seniors have little use for business-focused commands such as beaming contacts, sending vCards, or distinguishing between SIM and phone memory contacts. These evidences of software bloat directly compete with the commands that the seniors did feel were important: creating, editing, deleting, and sorting. The search bar has also been made more prominent and uses a larger font size. Photo previews of each individual are automatically generated to assist with name/face matching, and associated groups are shown beneath the selected individual's name.

## 4.4 New Applications

We included two new applications that the PD team suggested: Emergency and Medical, and Reminders. We describe the design of these two applications here. These are related to entries 7 and 8 in Table 4.2.

### 4.4.1 Emergency and Medical

The team desired the a way to store medical information easily, and to communicate the list of medications they took to an emergency responder (Figure 4.5). They also

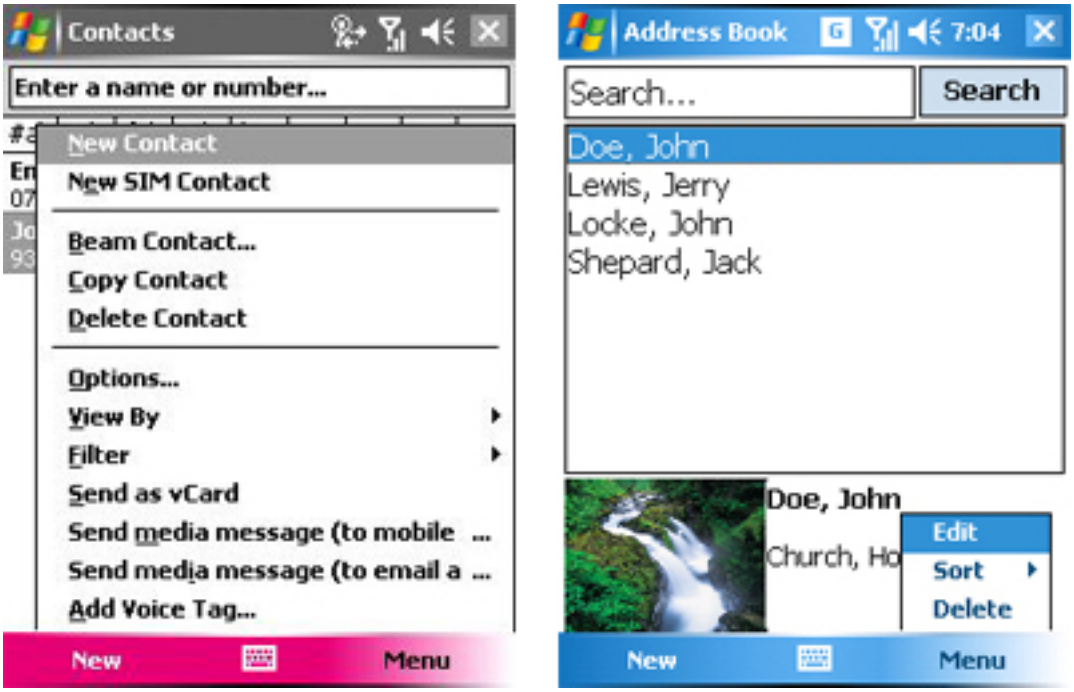


Figure 4.4: Comparison of menu items for each contact in the Address Book.

wanted to phone an emergency contact if they were hurt. These clear statements allowed us to develop an interface that permits the senior to store a list of medicines and an emergency contact's name and phone number. The user can also lock the data stored in the fields of this application in order to prevent accidental modification, a possible problem when an emergency responder handles the phone. Originally, the team wanted the emergency dialer to be "one-touch." We decided to implement a two-touch system to avert undesired false calls placed to 911 or an emergency contact.

### 4.4.2 Reminders

The Reminders application grew out of a shared need for a fast way to set reminders for chores around the house. P1, for instance, wanted reminders to make a phone call later in the afternoon, but thought that writing this in the Calendar application (and thus producing an alarm) did not make sense. The Reminders application allows the user to create a delayed alarm more quickly and with less necessary information than the

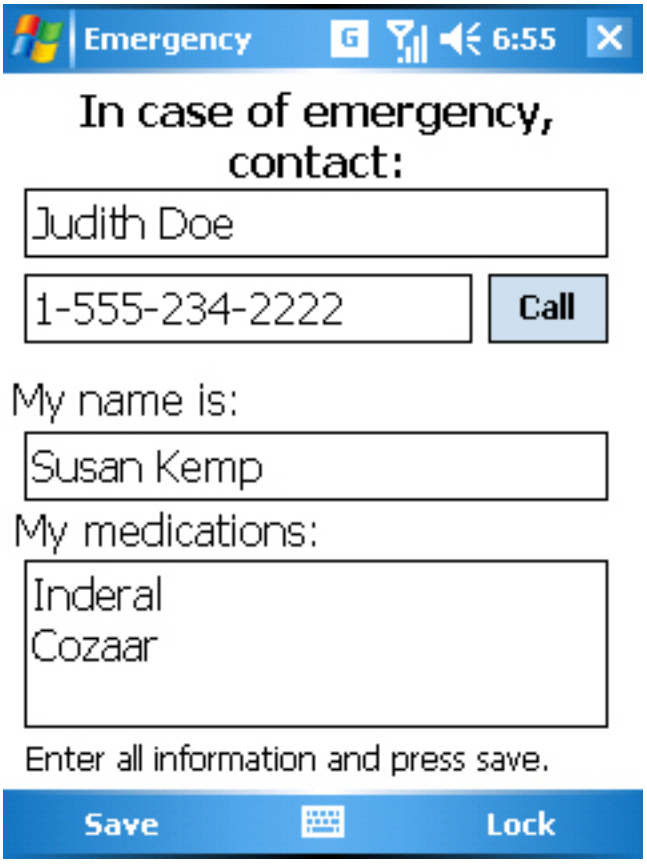


Figure 4.5: The Emergency and Medical application.

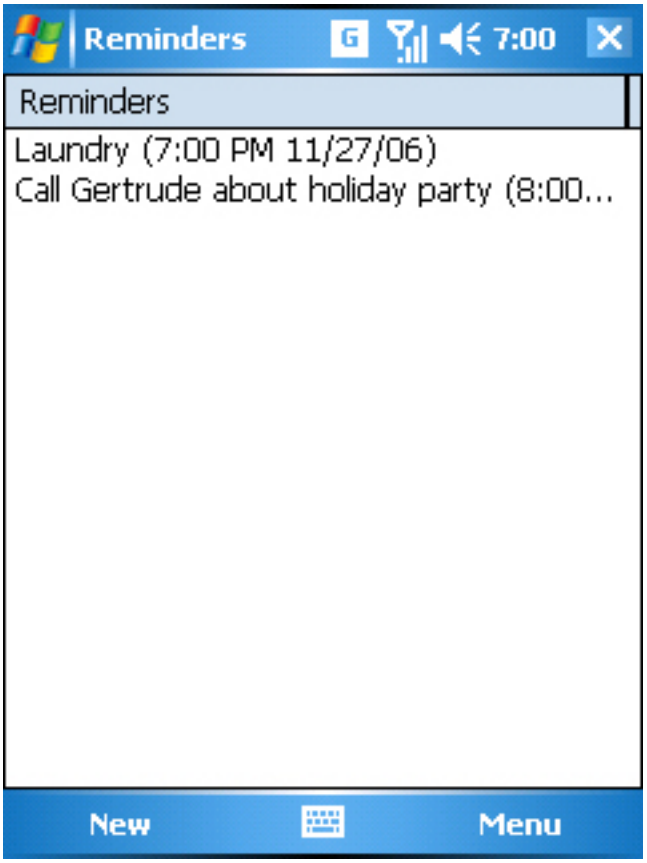


Figure 4.6: The custom Reminders application.

pre-existing Calendar. From the first screen shown upon launch (Figure 4.6), the user can view, create, delete, and edit these alarms. We also note the large font employed in order to address the visual problems the seniors encounter. Once the user selects the "New" menu item, she can add a new reminder to the system (Figure 4.7). The default time for the reminder is in 15 minutes from the current time, and the user can add an optional note to be displayed when the appropriate time arrives. For fear of the senior missing the alarm, we activate every notification method when the alarm sounds. This includes a loud tone, a flashing LED at the top of the device, a text notification that appears on the screen, and vibration of the entire device.

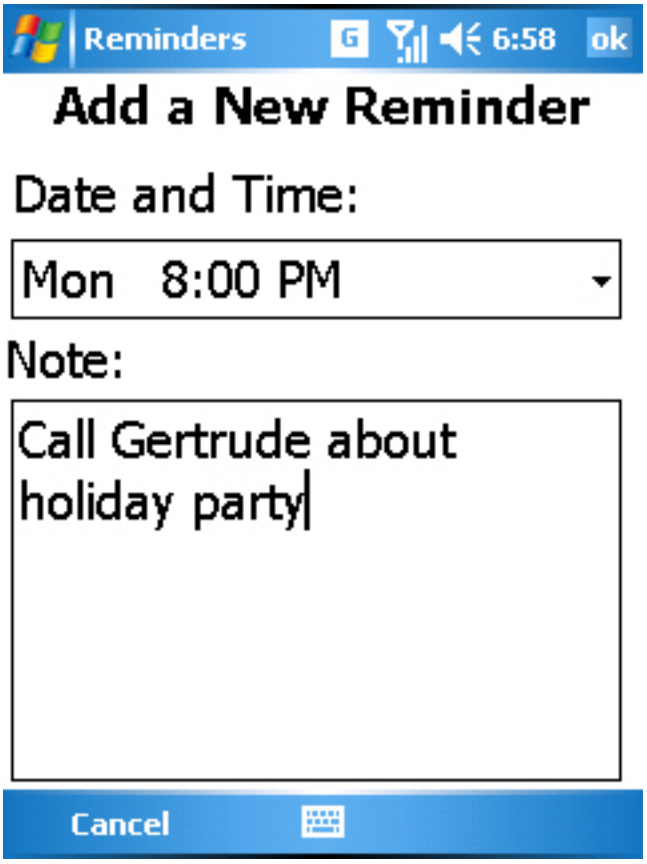


Figure 4.7: Adding a new reminder.

## 4.5 Additional Hardware and Operating System Modifications

The system designed by the PD team is one portion of a more comprehensive endeavor. During the tenure of the design period, the seniors expressed desires for several other features or phone alterations beyond those associated with names or memory. These alterations require knowledge or resources outside the realistic limitations of this work, so they are instead listed here as starting points for those interested in creating an integrated and well-designed "senior-friendly" phone system. Some of these items refer to customized hardware or circuit designs, while others would be realized through system-wide operating system support or documentation.

**Large buttons:** Mobile phones need to include large hardware buttons. The large form factor is vital in order for those with conditions such as arthritis or tremors to acquire and activate buttons. Button labels should be in a high contrast font and size in order for them to be read easily by those with macular degeneration or similar aging-related vision problems.

**Large, bright screens:** Like the buttons, large screens are essential for those with vision impairments. Of concern here is suitable space for text size to be increased (participants noted at least 14 point fonts should be used at a minimum).

**Zoomable text:** Operating systems need to provide built-in support for users to adjust the default and relative size of text displayed on the screen. This should be possible regardless of application, and extend to images as well.

**High-quality instructions:** Step-by-step instructions must be provided for the phone's hardware and operating system. Participants emphasized that these instructions must be written by a native English speaker with a firm grasp of the system function. Instructions must include related actions and contingency plans. The team

stressed concise phrasing and the availability of instructions in both online and printed forms.

**One-touch emergency button:** Seniors in this group reported the fear of falling or becoming immobilized quite often. Currently, this problem is addressed by installing specialized equipment for fall-monitoring in the home. Usually these are pendant buttons that are worn by the elderly person and able to be pushed in the event of an emergency. These are proprietary, prohibitively expense for the limited incomes of the seniors, and alert a stranger in a call center only that the button has been pushed. Phones can make drastic improvements in this sense, allowing relatives or caregivers to be summoned in addition to emergency personnel. The other functionality of the phone makes it a more worthwhile investment for the senior, and the two-way communication between the user and the emergency phone line operator may help better address the particulars of the incident.

**Loud, adjustable speaker volume:** Despite the prevalence of hearing loss in older populations, the participants on the team reported that mobile phones address this problem very poorly. The sound level is often not loud enough for them to hear, and the volume adjustment is often hidden away from easy manipulation. In-ear hearing aids only work with particular types of phones, and participants reported that today's mobile phones are not amenable to use in coordination with some hearing aids. Circuit and hardware design should allow sound levels that are higher than those currently found in most mobile phones.

# Chapter 5

# Evaluation

## 5.1 Seniors' Evaluation of the PD Process

The PD process was a novel experience for all of the seniors involved. None had ever designed software before, and most had only a minimal understanding of the organization and use of computer software. To assess how the seniors felt about the process, we administered questionnaires to all 5 participants, conducted a group interview with 4 participants, and individually interviewed 4 participants.

### 5.1.1 Questionnaire Results

The questionnaire contained 20 Likert scale items (Strongly agree = 5; Strongly disagree = 1) organized into 6 topics: confidence in computer systems, confidence in memory, team dynamics, perceived education about computer systems, perceived education about memory, and enjoyment of meetings (Appendix I). All 5 participants completed the questionnaire. Four participants completed it during the final PD group session, while P2 completed it in her home 2 weeks later. In the results we present here, each measure corresponds to a single item on the questionnaire. One of our predictions regarding PD was that the process would increase the participants' confidence in their ability to use

| No. | Item | M | SD | Topic |
|---|---|---|---|---|
| 1 | I learned about computer systems. | 3.25 | 0.95 | Ed. (tech) |
| 2 | I learned about mobile phones. | 4.5 | 0.57 | Ed. (tech) |
| 3 | I learned about how software is designed. | 4.25 | 0.95 | Ed. (tech) |
| 4 | I am confident in my ability to use new technology. | 3.75 | 0.5 | Conf. (tech) |
| 5 | We worked well as a team. | 3.75 | 0.95 | Team dyn. |
| 6 | I am proud of our team accomplishments. | 4.25 | 0.5 | Team dyn. |
| 7 | I fit in with the other teammates. | 3.75 | 0.5 | Team dyn. |
| 8 | I was able to express my ideas to the team. | 4 | 0.81 | Team dyn. |
| 9 | I am more confident in my ability to remember names than I was at the beginning. | 3.75 | 1.25 | Conf. (mem) |
| 10 | I learned about memory strategies. | 4.5 | 0.57 | Ed. (mem) |
| 11 | I learned about how memory works in general. | 3.25 | 1.70 | Ed. (mem) |
| 12 | I learned about how my memory works. | 3.25 | 1.70 | Ed. (mem) |
| 13 | Meetings were too structured. | 2.25 | 0.5 | Mtg. enjoyment |
| 14 | I would recommend this kind of study to my friends. | 4.5 | 0.57 | Mtg. enjoyment |
| 15 | I looked forward to coming to meetings each week. | 4.5 | 0.57 | Mtg. enjoyment |
| 16 | The meetings were fun. | 4.5 | 0.57 | Mtg. enjoyment |
| 17 | The meetings would have been better if the team members knew each other beforehand. | 1.75 | 0.5 | Team dyn. |
| 18 | The meetings helped me cope with my memory problems. | 3 | 0.81 | Conf. (mem) |
| 19 | The meetings helped me feel more in control of my memory. | 3 | 0.81 | Conf. (mem) |
| 20 | I understood the direction and purpose of the meetings. | 4.5 | 0.57 | Mtg. enjoyment |

Table 5.1: PD Questionnaire Items

technology. Another prediciton was that the process would help the seniors feel more control over and confident in their memories. These levels of improvement are subjective; a questionnaire was administered only at the end of the study. The individual items listed on the questionnaire asked the seniors to say whether they agreed that there was an improvement. The seniors felt they improved slightly in two areas: confidence in ability to use new technology (M = 3.75, SD = 0.50), confidence in ability to remember names compared to beginning (M = 3.75, SD = 1.25). There was no evidence to suggest that the meetings helped the seniors cope with memory problems (M = 3.00, SD = 0.81) or feel more in control of their memories (M = 3.00, SD = 0.81).

Team dynamics arose as an important issue as the meetings progressed. The seniors indicated a slight agreement that they worked well as a team (M = 3.75, SD = 0.95), and disagreed that the meetings would have been better if everyone knew each other before the start of the sessions (M = 1.75, SD = 0.50). They were quite proud of what they accomplished in the sessions (M = 4.25, SD = 0.50). They also felt that they fit in with the team (M = 3.75, SD = 0.50) and that they were able to express ideas to the team (M = 4, SD = 0.81).

We anticipated that the meetings would be educational for the participants. The questionnaire results support this to some extent, as the seniors believed they learned about mobile phones (M = 4.5, SD = 0.57) and about how software is designed (M = 4.25, SD = 0.95). However, they were rather neutral on how much they learned about computer systems (M = 3.25, SD = 0.95).

With regards to memory education, the seniors agreed that they learned about memory strategies (M = 4.5, SD = 0.57). On the other hand, they did not learn quite as much about how memory works in general (M = 3.25, SD = 1.70) or how their own memories work (M = 3.25, SD = 1.70). These results seem reasonable, especially since the sessions were quite applied, and the mobile phone was seen as a tool in supporting memory strategies by the team. More theoretical or general aspects did not have the

opportunity to arise quite as often as particular strategies did.

Finally, enjoyment of meetings was important for us to understand whether seniors would be amenable to this sort of process in the future, or if it was too technical and hands-on for their liking. The questionnaire indicates that the seniors did enjoy the meetings very much. They thought that meetings were fun (M = 4.5, SD = 0.57) and would recommend them to their friends (M = 4.5, SD = 0.57). Further, they looked forward to coming to meetings each week (M = 4.5, SD = 0.57) and understood the direction and purpose of the meetings (M = 4.5, SD = 0.57). They did not feel that the meetings were overly structured (M = 2.25, SD = 0.50).

The seniors were given the opportunity to write down any additional thoughts about the project. They noted several positive aspects. P1 wrote "I enjoyed participating in the creation of a program from the beginning. This made the final Recall program simple to understand. I now feel more confident about using new technology of any type." P3 wrote "I am thrilled at the possibilities for this project, and it is fun too!" P4 noted "I learned lots about memory (seniors and others) and technology issues. I appreciate the opportunity to meet and hear others' opinions on these issues. Mike's knowledge about latest technology, particularly computer design and cell phones, coupled with his excellent and sensitive facilitator skills made these sessions quite informative and enjoyable."

There were some negative aspects regarding the meetings that the seniors also shared. P1 added "Initial instructions on venue and room were inadequate and misleading. It took several meetings to find the meeting room with ease. Suggest you send participant a map and detailed directions in future." P5, who joined the meetings halfway through, noted "[t]here are here in this questionnaire several references to knowing about memory. I do not think this is possible from these meetings." This supports our intuition that P5 harbored different expectations from the PD process in comparison to the other participants.

### 5.1.2 Group Interview Results

At the end of the group meetings, we engaged the seniors in a semi-structured group interview to reflect on the design experience (P2 was absent from this meeting). We first asked the seniors about accessibility of the room, as this seemed to be a problem for some of them in the earlier sessions. They noted that they had trouble finding the room, and that coming downtown (most lived on the outskirts of Toronto) was stressful. Maps should be mailed to all participants ahead of time, and signs should be clearly posted throughout the building. They liked having the meetings in a conference room at a large table; P1 agreed, "When I want to have a good conversation, I sit someone down at my kitchen table, not the living room!" They appreciated being made to feel welcome, especially since we provided food and tried to include all people in the conversation.

We next asked what portion of the process was the most interesting or valuable for them. P3 liked the idea of the entire project. P1 felt that being involved from the beginning was a great asset for her. She explained that by being included from the very start, it gave her better understanding of the way that the software works and was created. She extends this notion to include a better understanding of computer software in general. P4 felt that the most valuable portion of the process was the education she received about cell phones. She enjoyed learning about technologies "coming down the pipeline." As a result, she was able to see the "big picture of technology" and understands the capabilities of modern mobile phones better. P1 added that she not only learned about technical matters, but has increased self confidence: "It was educational – helped me understand how computers work. I will be able to teach myself, and I'm not afraid to experiment and ask what buttons do."

We then asked what the most confusing or worst part of the sessions was. P3 immediately noted that she had trouble hearing and sharing her thoughts. She observed that "sometimes I think we needed a talking stick" in order to help determine who was talking and who was listening. Crosstalk and side conversations distracted her from the

main discussion, and she said that she often felt unable to "get a word in" because other participants could not hear her trying to share her idea. P4 also agreed that group dynamics and process were "tough." The conversation then turned towards the pace of the meetings. There were mixed feelings towards the speed of progress made through the sessions. P1 and P3 both felt the meetings progressed far too slowly, while P4 felt that the slow speed helped to ensure that everyone had shared understanding. In her later individual interview, however, P4 noted that she too felt the meetings were too slow. P3 suggested increasing the frequency of meetings: "I often found myself midweek wishing it were time for another meeting – I thought it would be better to have 2 meetings per week." P1 disagreed with this suggestion, citing her busy schedule.

Because we perceived hesitation in building paper prototypes, we asked the seniors what their thoughts were on that process. P3 said that she had no prior experience with storyboarding or building interfaces from paper, so she was confused about how to proceed. P2 reiterated this concern during her later individual interviews, but was more focused on groupwork dynamics, and noted:

> I was reluctant with drawing pictures at first of feelings of events or something, I forget now, that was, I was resistant for two minutes and I got into it and it was okay, it was actually fun! I didn't want to be with this person that I was with [referring to her partner during the scenario task] and then I started talking to myself: ''This is just craziness, everyone has their own quirks.'' I got over it and I actually liked this person after a while. And then we got into it, it was okay! I actually liked being with her. She asks a lot of questions but gee, once you get past some of the stuff you get something.

P1 would have preferred to have all participants build their own interfaces individually: "It would be better if everyone could just draw their own and then we could see where there is overlap." Overall, the seniors preferred working in pairs or alone instead of as a group of 4 or 5.

With regards to the structure of meetings, the seniors enjoyed the flexibility provided. They believed that by being flexible, more ideas were able to emerge. They noted that

the paper agendas provided at the start of the meetings helped them organize their thoughts, and allowed them to save comments for appropriate times in the session. They often wrote notes on the agendas in order to help them remember to bring them up later. Most seniors kept file folders with the agendas from past weeks and other paperwork related to the project, and they brought these with them to the meetings. They were used to review concepts from previous weeks before the session began.

We asked the seniors what suggestions they would make to improve future PD sessions. Their responses were primarily administrative rather than concerned with the process or content of the meetings. P1 wanted meetings to start and end on time more often, although P4 disagreed because she was the one who was usually late. P1 also would have liked name tags provided to all participants. P5 disliked the way that transporation reimbursement was handled. Because she was living on a pension, P5 was forced to plan her travel expenses ahead of time, and would have liked to have known how much money was available to her for coming to meetings. P2 felt the process was well-handled:

> I have to compliment you on your way of handling the group, and I recognized some professionalism there. The patience you had and the, I dunno, I felt you were an expert there in communication in a group setting. You haven't let me down, you've always been on time, and when I met you down there it was also the same way. You call back. That kind of thing is invaluable. Activities were very interesting, that's where your expertise lies.

### 5.1.3 Individual Interview Results

The individual interviews were conducted in the places that the seniors chose in the final session, and allowed for two occurrences that were not possible during the group interview (see Appendix J for this interview protocol). First, participants could comment privately on aspects of the process that they did not want to bring up during the group interview. Second, because individual interviews occurred 1 month after the final PD group session, the participant could comment with some keener hindsight about their

experience. Interviews were conducted with all participants except P5. Below are a list of some ideas the seniors expressed about their time conducting design:

**P1**

- She noted that perhaps bringing along P5 to the meetings was not the best idea, because it disrupted the flow that the rest of the team had already established.
- P1 felt that the phone was too small for her to use properly and could not conceive that young people are able to text message smoothly using one.

**P2**

- She liked the teamwork aspects involved in the PD sessions. She cited the PICTIVE sessions especially, when she was given responsibility for organizing concepts, while P4 was given responsibility for drawing.
- She remembered creating the scenarios with P4, and how this "opened [her] eyes." She learned that she doesn't have to worry just about her own memory; other people have memory failings too.
- She showed me a small inspirational poster she owns, and related the experience in the design sessions with the precepts of the poster. The poster contains a number of phrases such as "Life is a challenge; meet it."
- She did not participate a great deal because she felt other people on the team knew more than she did.
- She didn't feel like it was important to "chime in" since she usually agreed with the ideas that other people had.
- She learned a great deal from P1 and P5. She says that she sees P5 as a role model now because she is 86, and has learned a great deal about computers despite her

age.

- She thought that some people dominated conversation, but tried not to judge them.
- She prefers the personal nature of one-on-one interviews to the group discussions. She wishes there were individual interviews occurring in addition to the group meetings throughout the entire process.
- She was amazed by the number of ideas generated and how we were able to organize them all.
- At first she was very resistant to location tracking, but now she is a little more open to the idea, but she is still not enthusiastic about it.
- She liked keeping the book of names, and filled it primarily with people in her building that she meets. She most wrote first names and suite numbers down, with the occasional phone number.
- She believes it will take her at least 3 months to learn to use the phone.
- She suggested that she and another member of the design team should partner up to learn the phone together.
- Having food and drink at the meetings was pleasant and important for her, but wishes the space were more accessible. Traveling downtown was somewhat of a bother.
- She wasn't always sure of the direction of the meetings or how they fit into the purpose of the project.
- She thought that five people was a good size for the design team.

**P3**

- P3 wishes she had known more about cell phones before starting.
- She thought that the sessions were far too repetitive, and she didn't feel like the team made as much progress as they might have.
- Now that she has participated in the study, she thinks of names differently. She gave an example where she had recently forgotten the name of a man at church. She felt much more aware of the fact that she had forgotten the name, whereas before she would have ignored it.
- She demonstrated her computer and noted she has a large amount of sensitive information on it. She isn't sure what to do with it once she dies.

**P4**

- Six weeks later, she is still keeping the book of people who she comes into contact with. She finds it to be a useful exercise and has helped her to reflect on the people she meets each day.
- She gave gave us a newspaper clipping she had been saving. The clipping related to memory and computer games for helping to improve mental acuity.
- She showed us her home, community garden, and neighborhood restaurants.
- She introduced us to her friend at the cafe, who was curious about the phone too.
- She liked the design process very much, and appreciated the patience and tolerance we exhibited during it.
- She felt the sessions were open and transparent, and liked that about them.
- She gave the impression she was frustrated with the repetition of material that other group members favored. She would have liked to move at a faster pace.

- Compared to the other members of the design team, she felt that she did not have strong opinions about what the actual design ended up being.

- She felt that other participants were more cautious than she was about trying new technology. This seemed to be attributed to their older ages and awareness of their own limits.

## 5.2 Usability Studies of Team's Address Book and Outlook Contact Manager

In the second round of individual sessions, we conducted usability tests with each senior. These tests occurred approximately 1-1.5 months after the first round of interviews. The major goal here was to determine whether the seniors expressed a preference for their own Address Book design, or for the Microsoft Pocket Outlook (Windows Mobile 5, Pocket PC Phone edition) Contact Manager. We counterbalanced task presentation order, alternating A-B or B-A for each participant. Each session lasted 1 hour.

Participants completed the same task set on both address books. The task set involved adding a new contact, taking a picture, saving the contact, sorting the list of contacts, editing an existing contact, and finally deleting a contact. These functions were selected because they were the features that the seniors included in the paper prototype. With the exception of search, the task was a comprehensive tour of the custom Address Book software. We only ran this study with the Address Book software; other customizations were excluded from observation.

Table 3 displays the results of a questionnaire (Appendix K) given at the end of the session, after completing tasks with both prototypes (n = 4). Our results may be affected because a separate questionnaire was not administered after each prototype. For items 1-4, Likert responses ranged from 1 (Strongly Disagree) to 7 (Strongly Agree). For

| *Item* | *P1* | *P2* | *P3* | *P4* | *M* | *SD* |
|---|---|---|---|---|---|---|
| Recognize custom? | Y | N | N | Y | | |
| Liked custom | 4 | 4 | 6 | 6 | 5.00 | 1.15 |
| Liked built-in | 3 | 5 | 3 | 5 | 4.00 | 1.15 |
| Likely to use custom again | 6 | 4 | 6 | 6 | 5.50 | 1.00 |
| Likely to use built-in again | 2 | 5 | 6 | 5 | 4.50 | 1.73 |

Table 5.2: This table indicates how each participant responded to the questionnaire administered upon completion of the set of tasks for both the Outlook Contact Manager and the team's Address Book. The first line indicates whether the participant recognized the design that the team created, when confronted with the choice between the two systems that they had used.

items 5-8, a score of -1 means the participant chose the built-in address book, +1 means the participant chose the custom address book, and 0 means no preference. After the questionnaire, we asked each participant to identify the design that they helped create. Of the 4 participants, 2 could not identify the design that they helped to create 3 months earlier. Even so, all 4 confirmed that the designs they saw were what they had envisioned during the design process.

## 5.3 Evaluation and Refinement Based on Deployment of Outlook and Recall

We conducted a qualitative deployment-based evaluation wherein 2 seniors (P2 and P4) from the design team were given mobile phones for a period of one month in total. We were only able to evaluate the software with 2 participants because P1 had scheduling difficulties, P3's tremors prevented effective usage, and we chose not to contact P5 due to

her differences with the purpose of the project. We employed two different customizations of the mobile phone. The first included the customizations that the seniors designed in the PD sessions (CUSTOM). The second included no customizations whatsoever to the default factory installation of Windows Mobile 5 on the phone (DEFAULT).

### 5.3.1 Method

To prime the phone's database of contacts, we first met with P2 and P4 to elicit their social networks. We asked both participants to gather photographs so we could include photos with the names on the phone, but P2 did not want to do so. For P2, we used her home address book and the notebook we distributed on Session 6 to develop a list of 81 names. We then entered these names into the phone for her. P2 provided telephone numbers and addresses for most of these names. P4 did bring photographs, however. We used these photographs to compile a list of 16 people who were likewise entered into the phone. We also entered phone numbers and email addresses for these contacts.

P2 and P4 used both the CUSTOM and DEFAULT phone designs for a period of two weeks each (Table 5.3.1). Data was gathered through face-to-face interviews, phone conversations, text messages, system logs, and daily diary forms. We engaged each of the two participants in individual semi-structured interviews at 0 weeks, 2 weeks, and 4 weeks. P2 also arranged one additional meeting with us in order to obtain instructions on unclear portions of the phone. Participants were encouraged to phone us whenever they had an issue that they wanted to discuss, or when they had a suggestion for a change to the software. All phone conversations were noted and summarized. Text messages were also accepted a substitute for phone calls. System logs were used to measure how frequently particular functions within the custom software were used. No system logs were kept for built-in software. Finally, each participant completed a daily diary form (Appendix L) that prompted them for any and all information about the phone usage for that day, including feelings towards the phone. This form also asked them to record

| *Weeks* | *P2* | *P4* |
|---|---|---|
| 1-2 | CUSTOM | DEFAULT |
| 3-4 | DEFAULT | CUSTOM |

Table 5.3: P2 first used the CUSTOM phone for two weeks, followed by the DEFAULT. P4 was given the opposite presentation order.

approximately how many minutes they spent using the phone on that day. Diary forms were collected at the end of the month. Each participant received a phone, a carrying case, a replacement stylus, a wall charger, a USB cable for connection to their home PC, and the manuals that accompanied the phone. Each phone was preloaded with 200 minutes of airtime available for the month, and was given a unique phone number and SIM card. ActiveSync and Microsoft Outlook were installed on P2's home computer in order to allow her to add her own contacts to the phone via Outlook. We offered to do the same for P4, who declined.

### 5.3.2 Results

P2 called us 6 times to discuss problems with the phone or offer suggestions. P4 called us 7 times and text messaged us 1 time for similar reasons. P4 completed a diary form 25 of the 27 days she used the phone. P2 completed a diary form for 6 out of 37 days she used the phone. P2 and P4 both participated in interviews at the start, middle, and end of the deployment. P2 scheduled a fourth session with us to ask questions about the phone.

We obtained two major pieces of information from the daily diary forms. First, the participant estimated the number of minutes that they used the phone at all (Figure 5.1). This includes, for instance, playing games and adding calendar appointments. This means that the usage numbers do not correspond to the airtime minutes used. We also

collected the major application areas each participant used through these diary forms (Figure 5.2). Application areas omitted from the figure indicate the participant did not use the application at all.

### 5.3.3 Discussion

It should first be noted that this deployment is not an experiment, and results certainly cannot be generalized (even across conditions within subjects). Instead, we report on issues that the seniors brought up throughout the process. The majority of the problems were not necessarily with the software that the seniors designed, but with issues of accessing other functions involved in phone usage. These included charging the phone, turning it on and off, adjusting the volume, pressing the intended buttons, and using the stylus. They also had trouble making and receiving calls, text messages, and voice mails.

#### Experiences with the Phone and Software

P2 was enthusiastic about the phone at first, but stopped using it a few days after receiving it. She told us in a phone interview: "I get feelings of frustration, that just arise within me when I remember how frustrating it is, and it stops me from using it, so I used it for a few days and then stopped." With respect to the frequency of use of custom software, logs collected from the device show that P2 engaged in non-trivial interaction with the address book in the first 3 of the 14 days only. She did not use the "Emergency" or "Reminders" software at all. Her self reports confirm substantial, but decreasing, activity in the first 5 days, with little or no engagement with the phone thereafter (Figure 5.1). She did not use the phone at all during the last 2 weeks of the deployment.

Even when we swapped P2's CUSTOM software for the DEFAULT software, she still did not use the phone. In fact, P2 did not use the phone at all during the time she had the DEFAULT software. We do not believe P2's lack of interest is the result of

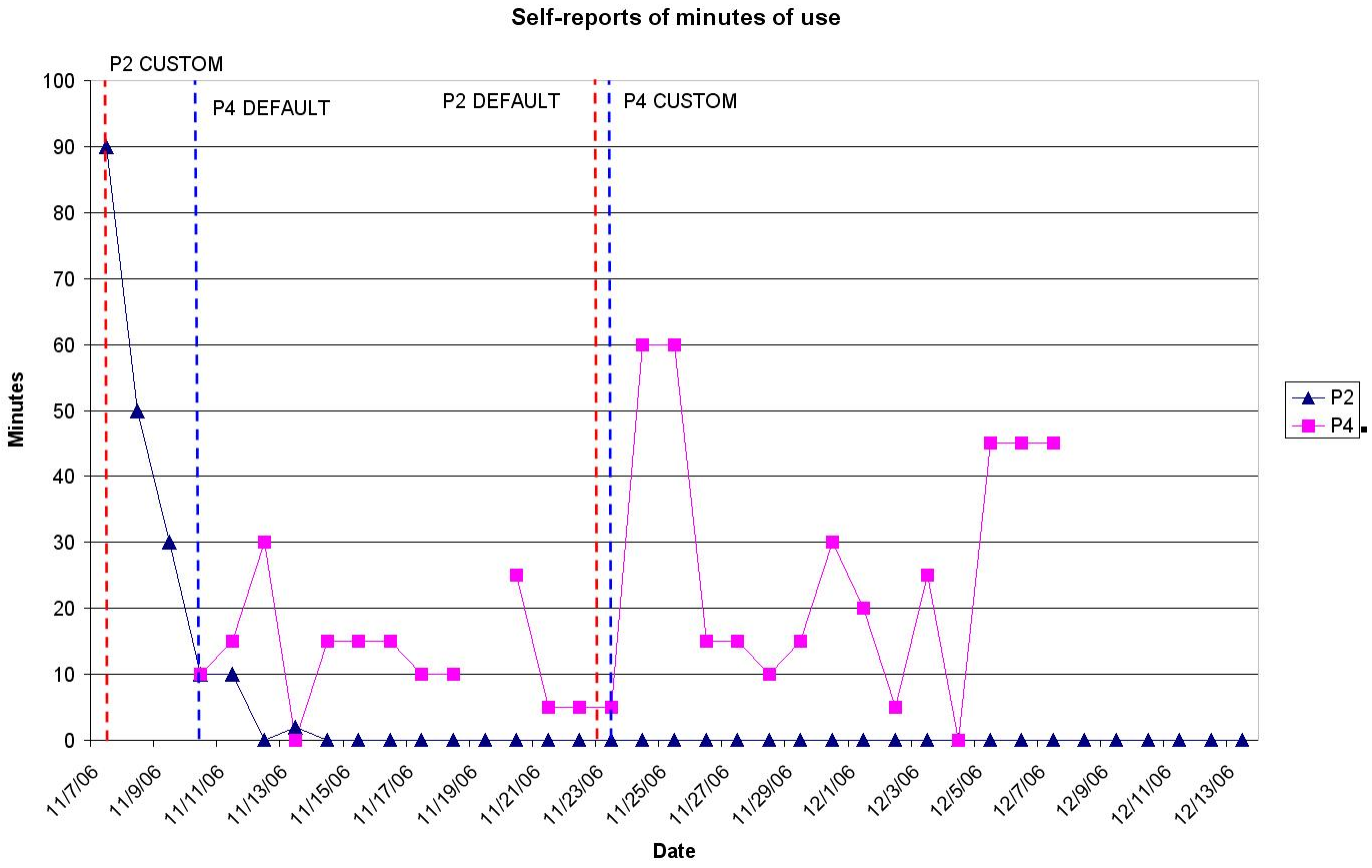


Figure 5.1: Self reports of the number of minutes of interaction with the phone software per day, as collected from daily diary forms. P2 stopped using the phone entirely after 11/14/06.

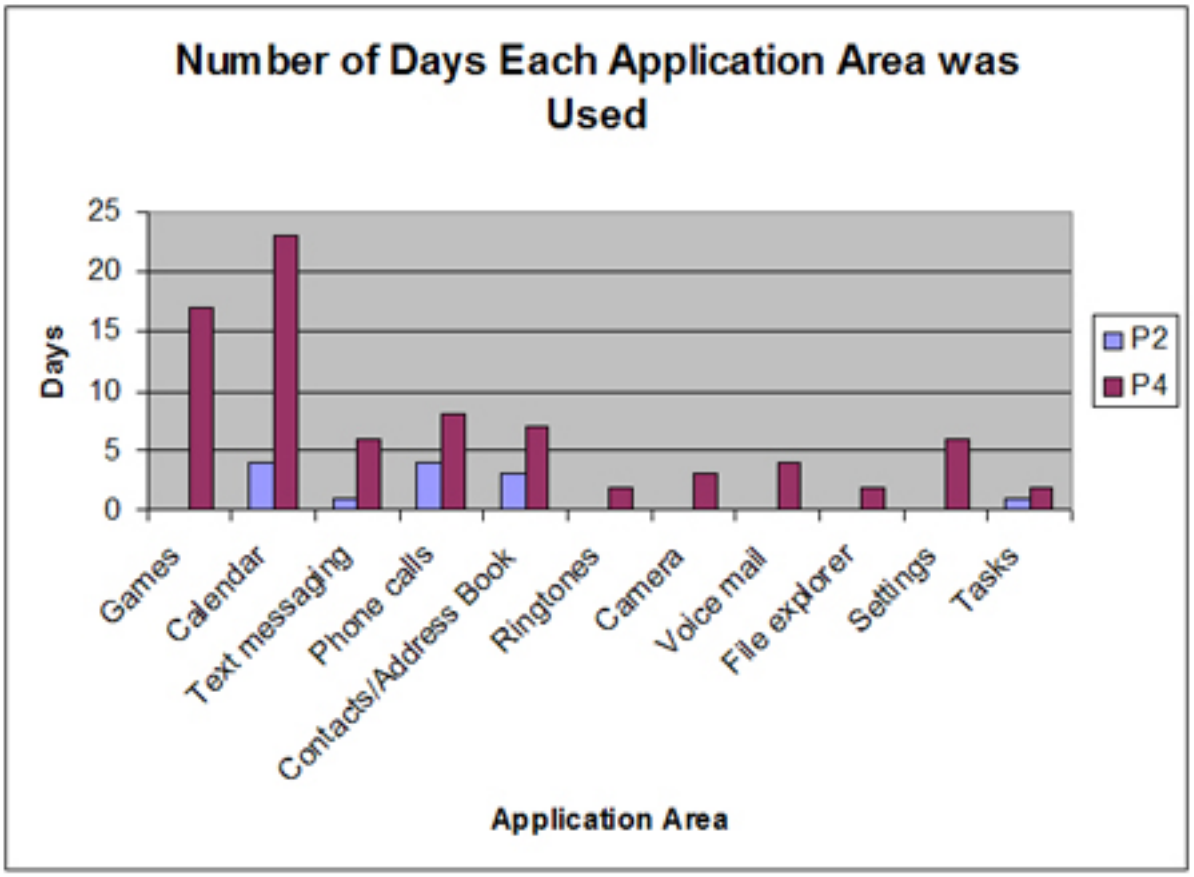


Figure 5.2: The number of days each application area was used by the participants as collected from daily diary forms. The Today Screen and Start Menu are excluded.

the software that the team designed, but rather the result of phone hardware, lack of instructions and fear of calling for help, fear of radiation from the phone, and confusion about placing and receiving calls. Her interviews confirmed this:

> P2: I didn't use the phone. I was not focused. Once I interrupt something it seems to me, to get back to it requires an awful lot of willpower which I could not focus to get there. It's a shame because it was a good opportunity for me to, but you know, life has a habit of counting in on me and I get so sidetracked and this was so unfortunate that I didn't pay attention. I haven't looked at it, I didn't even open this box until today, and you went to that bother of fixing up that phone for me.
>
> I think my idea of having a buddy... I was afraid to call you, and if I call you about negative stuff I thought ''who wants to hear that?'' and I thought a buddy would keep me at it because I wouldn't want to let them down. I know you gave me permission to call and I was appreciative and it was a good resource but...
>
> I didn't get past the fear of the radiation though, and that was also a stopping thing. You know, as I get older, I go to have x-rays a lot and I'm just adding to all this radiation that I have, and I just lost a dear friend who died of too much radiation, she had cancer but the way they were treating it was through radiation and she had too much of it so it kind of disturbed me, and I lost her and it was such a tragic thing...

P4's initial reaction to the phone was more positive than P2's. P4 maintained interest and placed many more calls than P2. Over the course of the month, P4 used 133 minutes of airtime, while P2 used only 5 minutes. This may be in part due to P4's friends and family. Unlike P2, P4 has many friends who have cell phones, and they were glad that she finally had one too. They also assisted her with troubleshooting and other technical problems. Both participants hesitated to call us despite our assurances that we would try to help as best we could at any time. When they did call, they had trouble articulating the problems they were experiencing over the phone. During one phone call, P2 said "Remember, I don't have the computer language so just bear with me."

Overall, it was unclear whether the customization offered any benefit. Because com-

parisons between participants are unavailable due to P2's low usage rate, we can only note P4's activity with the phone. She noted that she liked particular aspects of the customization during her interviews:

> That little one [CUSTOM], I checked the settings and profiles, I noticed there were some things that were different. Calling, the people list, it was okay. I was mostly making appointments and taking pictures and games and I did like it. I liked it more than the other one [DEFAULT] even though some of the functions I wasn't sure where to find. I like the larger font but that's no big deal. So I wouldn't be able to speak to it, I wasn't on it enough, this one and the other one, but I'd say I liked that one [DEFAULT] better for its functionality. In terms of visibly, the clarity of the functions, and I know part of the other, more than half the time with the other I'd change the screen graphics a couple of times and the contrast was too light but the font and the font size, I like bigger clearer simpler fonts. I can't speak to the programming stuff [Reminders and Emergency and Medical] because I didn't get into it.

Our results from interviews indicated that feelings towards the phone were mixed. P2 and P4 both liked the idea of the phone but found the actual incorporation of its use into their lives to be a burden. The particular interfaces factored into the adoption very little. P4 felt comfortable with the DEFAULT system as much as she did with the CUSTOM one, and often went beyond the minimalistic design of the CUSTOM system to access features purposefully hidden to reduce complexity. For instance, she tried using all the programs on the phone, not simply the ones on the main menu. She also customized the wallpapers and fonts to her liking, and changed her ringtones. She actually enjoyed text messaging and taking photos, two activities the design team disliked overall and chose to exclude from the design. With regards to text messaging, she said "I originally thought I'd spend more time with the text messaging thing but I only have one friend who uses it so I didn't use it too much. I would have liked to explore [it] but I was prevented because I don't have a lot of contacts who use it. I get the point, I'm on email, I get the drill. It's just one more way of doing that."

When we asked if the phone helped support memory, P4 gave the following explana-

tion of how she saw the phone as a memory aid (names changed):

> In terms of your contacts ... I think of my mom and see her picture and I go right into her sphere. It's different from phoning her. The picture does evoke, for everyone, my partner that died and all these people, it's Bob's picture, not the dead guy but his partner, but we do have this... it's not just memory stuff, but it's the feeling, when you have a list of your close friends and it's deeper than just going into my phone book to get Sue's phone number. It's much more visceral than say just old style address books because it's more tactile. I think it's very useful in terms of memory; it's not too heavy or breakable but it is more... I wouldn't say human, but it's more... closer to our memory banks of our friends and relatives depending on who we load it with than just a piece of paper. [It's] visible, and I'm very much a visual aids person, but that's a good trigger I think and it is useful, very relevant in terms of a memory aid.
>
> But I wouldn't forget who these people are, like that one woman who couldn't remember her son's name said she'd be off the window ledge, but at the end of the day, maybe people forget who these people are and how these puzzle pieces would fit into my sense of why I think these cell phones are closer to our hearts with our contacts because I'm sort of, my memory is okay and I kid around ... but my mom who has AD ...I can see how people forget things as they age, and I don't know how this will work, but I think ...it's a good backup for who and what we are by who we associate with and know. Down the road when people lose touch or cognitive functions this would be, the contact list and photos (which should be a bit larger), could be quite helpful although I didn't show it to my mother. She would have trouble.

In this quote, P4 admits she does not yet have the need for this technology in her life. She instead "can see how people forget things as they age," especially by relating to her mother with Alzheimer's disease. In a sense, she is saying that she does not need the technology that she and the other teammates designed. Indeed, with regards to cell phones, she "[doesn't] know how this will work," indicating that even if she did have the need for this technology, she would not have any ideas about what kind of technology is even available or what it should do. She even says this despite using the mobile phone for the previous 4 weeks and helping design software for it for almost 8 months. It is possible

that the structure imposed on the team forced the seniors to think of each activity as a discrete unit and not as part of a larger process. Even further, they may not be interested in the technology *or* the need, despite the entire experience.

### Design Refinements

The following usability issues emerged from the data we collected in interviews, phone calls, and daily diary forms.

- Telephone numbers should be listed alongside contacts on the main Address Book screen so that the user can copy the number down to paper, or call from a home phone line.

- It should be possible to call a contact from the overview screen in addition to the contact's details screen. Opening the detailed view for a contact seemed unnecessary.

- Large numbers of images (one for each person in the address book) caused forms to be drawn slowly, and the time delay between invoking the Address Book and the completion of its painting was deigned too long.

# Chapter 6

# Discussion and Analysis of the Process

In this case study we have opted not to analyze results using nonparametric statistics due to the small sample size and flexible nature of the process. Instead, we present a series of themes and guidelines that materialized from two sources: our impressions of the process, and the feedback from the seniors.

## 6.1 Focus on Mobile Phones

From the recruitment phase onward, we made it clear that the process was to focus on mobile phones, and that we would design software targeting these mobile devices. We believed that mobile phones would be an appropriate technology for several reasons. Some seniors already own mobile phones, so designing for this platform can leverage pre-existing adoption. Furthermore, future generations of seniors (such as the baby boomers) will enter this phase of life with considerable experience in mobile phone usage from their middle-aged years. There also exists a substantial body of literature about how older people approach websites, interactive television, and desktop interfaces, but relatively little in terms of how older people approach mobile devices.

In retrospect, however, a technology-agnostic approach may have been more appropriate. This conclusion grows primarily out of observation of the paper prototyping phase. In earlier sessions, we showed the team photos of phones and demonstrated the interaction modes these models employed. During PICTIVE, we printed out cut-outs of the phone itself and framed the drawing area with status bars similar to those found on the phone we selected. We therefore should not have been surprised to find that the seniors developed applications that closesly followed existing designs of address books and calendars on desktop computers.

If a technology-agnostic approach were adopted, we might have developed a completely different system. These designs might have been more original or appropriate for handling the needs expressed by the PD team during our sessions.

## 6.2 Physical and Cognitive Challenges of Designing with Seniors

Muller [36] points out that "universal participation" remains an elusive goal for design he notes that almost all PAs "are strongly visual and require hands-on manipulation of materials." This was especially true in our study. P3's tremors meant that she could not grab the carefully arranged paper prototype pieces:

> P3: I'm not putting my hands into that paper because it could...I don't think it will help. I find, just, yeah, I'll try to digest the information.
> P1: I don't think we all need to do the drawing; we'll just cooperate.

We paired P3 with a partner for drawing scenarios, and during the PICTIVE sessions, the team decided upon an "ideas person" and a "drawing person" so that despite P3's tremors, she could still participate. These roles were not strictly enforced, however, and soon, 3 seniors were drawing, and ideas came from all directions.

Because we targeted memory as a needs area, we expected some memory problems to surface. Even so, memory was not as poor as we had anticipated. Sometimes, participants forgot what happened from week to week. This resulted in repetition of ideas and slow progress in some portions. To combat this, we conducted a review/preview in each session (similar to Wu et al. [51]). Participants also wrote ideas on their agendas to prevent forgetting them. As we mentioned previously, P3 and P4 did not remember the name of the system and did not recognize the design that they helped to create. Since our study, P3 has visited a doctor regarding her memory. Due to hearing impairments, participants sometimes could not hear one another even though they were at the same table and wearing hearing aids. This caused P5 to lose interest at times; she interrupted other participants without realizing that they were talking. In this passage, P3 is sharing an idea when P5 cuts in on an unrelated topic:

```
P3 [continues]:  What about ‘‘information?’’
P5:  [cuts in] Which kind of really relieves the tension in the...
P3:  [continues despite P5’s interruption] But what about the information
you give 911...
P5:  [cuts in] I’m sorry, I didn’t hear.  It doesn’t matter if you
repeat it.  I can’t hear you.
```

## 6.3 Social Challenges - Conflict and Community

In organizational settings, PD involves varying viewpoints because each participant has a different role in the organization (e.g., management and labor). Muller [36] notes that this “combination of different people’s ideas into unified concepts” is one of the strengths of workshop activities in PD. However, our participants come from a demographic, not an organization. Because of this, there is no underlying goal (e.g., to earn a living) or culture (e.g., everyone works for the same company) to tie members of the team together. This, in turn, can sometimes lead to conflict.

Goodman, Dickinson, and Syme review the literature on focus groups to determine characteristics of focus groups that are appropriate for seniors [16]. Pre-existing groups

(such as from a common hospital, workplace, interest group, etc.) help ensure cohension between the team members because of the homogeneity of the individuals. Understanding the context of use also indicates how one should recruit. For example, if a system is to be placed in the homes of the senior, then all residents should be included in the discussion, rather than simply the head of the household. Sometimes, creating pre-established profiles to fulfill will help create more useful focus groups by ensuring a diversity of opinions.

P5 provided us with some excellent proof of this. She originally joined at the behest of her friend, P1, because P5 is interested in computers. As her MMQ scores in Table 3.2 indicate, however, she does not have the same concerns about her memory that the rest of the team has. Because of this, she brought a completely different set of goals and ideas to the design meetings. P1-P4 were interested in designing systems to help their memories; P5 was more concerned with including a panic button (for calling 911 rapidly) and with the volume of the headset (a persistent problem for her). This lead to some arguments between the seniors  while P1-P4 chose to prototype the address book, P5 seemed indignant and upset that the rest of the team did not focus on the issues important to her, and often used her position as the most computer-literate senior to have her way. In the end, she saw the phone as a safety and emergency device; the rest of the team saw it as a communication and memory device. For this reason, she did not continue on to the individual sessions like the rest of the team, and we were reminded that it is more important for members of the team to have a shared interest in an area (such as memory) than a shared age group.

Despite their varied backgrounds and reasons for joining, the team transformed from a team of strangers to a design team over the course of these two months. Relations at first were quite formal. But, despite the conflicting goals design members brought to the table, they did not feel that meetings would have been better if they had known each other beforehand (M = 1.75, SD = 0.5, as reported in a questionnaire completed

at the end of the group meetings). In fact, meeting new people has been beneficial to the participants; P2 has begun to take computer lessons from P5. By the end of the process, most participants were friendly and warm (some participants exchanged hugs upon meeting and leaving).

## 6.4 Meeting Structure

In most studies with cognitively impaired individuals, strong leadership and meeting structure are necessary for the design to take place because the participants are unable to take on the onus of guiding sessions. In these cases, the initiator or researcher prepares agendas, focuses the task, and gives concrete exercises to the participants.

This practice, however, seems at odds with the principles of PD – namely, that egalitarian access is crucial, and that all participants should have equal stake and ownership of the design. If the researcher runs the sessions, then a clear hierarchy of power emerges, and this principle is destroyed. In this spirit, and because the seniors in this study are intact cognitively and simply have trouble with names, the meetings were somewhat open-ended, and provided opportunity for the participants to guide discussion, suggest activities to the group, or draw the interface.

At the end of the study, participants were asked if meetings were too structured. All of them disagreed, and suggested that the design sessions move at an even faster and more structured pace. This surprising result suggests that PD sessions should be highly structured regardless of the capabilities of the design team. With seniors, the lack of familiarity with the technology necessitates, to some degree, that they are led through the process rather than driving it.

## 6.5 Designing Next-Generation Technologies

Participatory design worked well for some portions of the phone customization, such as the calendar and address book. The process broke down, however, when discussing more unfamiliar features. In particular, we were unable to collaboratively design location-aware features. Some participants understood the power of location-awareness, while others misinterpreted the purpose and assumed that they would be tracked because we thought they were "out of it" or demented. Even once the misconceptions were gone and mutual education about the feature occurred, the seniors could not provide feedback because it was simply not concrete enough.

In reflection, this problem is representative of one of the major problems with design. As experts in technology and design, we must teach our users about what new technological advances can do for them. For instance, participants in the current study were stunned to learn that they could receive email on the phone. Only 1 participant understood what text messaging was.

Designers should be aware that they have a responsibility to educate their participants, and like a good teacher, must bring the material to life. This is even more important when the technology is abstract or hard to visualize. Movies and theatre, for example, seem to be promising methods to permit non-technical participants to see and hear the technology in a more vivid way [37]. Had we shown videos of location sensing and its applications, participants might have been more responsive. We also did not have sufficient time to properly build trust by perhaps running a workshop or other educational program.

## 6.6 PD as an Intergenerational Social Event

Any PD team meeting is an opportunity for socialization, regardless of age. But because of the age of the researcher (23) and the "newness" of mobile phones, participation in this

study helped the seniors feel more connected to younger, technology-centric generations. As one of the participants noted, "older people tend to live in the past." Our older users expressed a preference for the technologies they with which they were familiar. P5 related an experience where her old analog telephone broke, and she simply could not find a replacement that was loud enough for her to use. We were lucky to work with seniors who take the time to learn about new technology in an effort to remain young themselves. Participants enjoyed meeting with the researcher and commented on several occasions that they appreciated meeting new people.

Reflecting on this, we would propose that some older people feel it is important to not only maintain contact with people of other generations, but also with the emblematic technology of that generation. The seniors told us that they had seen a wide range of technological advancements since their births, including the introduction of the microwave, vacuum cleaner, and telephone. Their participation in the current project demonstrated their need to stay "connected." Both P1 and P5 noted that if they did not continue to learn about technology, they would be left behind. While they understand why other older people do not keep up with new technology, they feel that they cannot afford to miss out because learning keeps them cognitively healthy. Similarly, the participants pointed out that some of the problems they have now will be even worse for future generations; for example, based on observations of many young people with headphones, P5 affirmed "for the coming generation they are going to have a lot more hearing problems!" The seniors felt that by offering their help, they weren't just helping their peers; they were helping future generations by preparing the technology ahead of time.

Working with mobile phones helped the seniors understand their own children and grandchildrens activities to some degree. For instance, P5 noted "my granddaughter has one of these sorts of diaries, the automatic kind. I meant to look at it when I was with her. If you look at these things, if you play with these things, then you have some idea what you're talking about." P2 echoed this idea: "I must ask my grandchildren how they

use their diaries and maybe come up with some variations on that. [They] use diaries all the time, because their telephones have diaries too. We can see if there are variations that the senior could use, based on what they're doing."

## 6.7 Mutual Learning

One exciting result of this study concerns the educational process. In most PD sessions, the goal is for technologists to inform workers and vice versa. During design sessions, workers usually do not substantially learn from other workers, nor do technologists learn from other technologists. In our case, however, we found that everyone learned from everyone else. In other words, the seniors on the team taught each other while they taught us.

An excellent and obvious example comes from the fact that P5 now tutors P2 on computer usage in their spare time. The learning, however, was not limited to computers. P3 noted that she liked to learn about how the other participants structured their lives to accomodate their memory loss. During the scenario and storyboarding exercise, P2 and P4 seemed to be an uneasy match at first. P2 later recounted in an interview that she was worried about working with P4 because she seemed to have different outlooks on memory than she did. While this was the case, P2 noted that by the end of the exercise, she realized that P4's outlook was not as foreign as she first imagined. They both grappled with similar problems of forgetting names, but their reactions and reasons for reacting in a particular way were quite different. P1 and P3, likewise, found that they shared a common friend from the past and excitedly talked about the latest news in that social circle.

Every participant informed us that they learned a great deal about mobile phones during the sessions, and have come to understand the allure that phones hold for younger people. Because we had the opportunity to work alongside the seniors for an extended

period of time, we learned about the lifestyles, attitudes, and compensatory strategies of seniors with mild memory loss.

## 6.8 Participatory Design Guidelines

We present a series of guidelines that may be useful to others who choose to co-design with seniors. These guidelines stem from the interview results above, our own subjective experiences, and observations during the sessions.

**Provide structure:** We originally allowed seniors to dictate their own course throughout the PD process, and gave them freedom to change the agenda. The seniors, however, wanted the organizers to provide the structure. In the questionnaire, they disagreed that meetings were too structured (M = 2.25, SD = 0.5) and preferred to be given a PA to try rather than to define their own course.

**Minimize crosstalk:** Hearing problems exacerbated difficulties understanding streams of conversation, and also led to people talking at the same time. The facilitator must make sure that one person speaks at a time, and that this person can be heard by all other participants.

**Speed up or down to suit the group:** We originally thought we could complete in 5 weeks, but during the process, the seniors seemed to need more time. At the end, however, most participants felt that we proceeded too slowly through the design process. One even wished that meetings were twice a week, as she would often have new ideas during the week and wanted to act on them quickly. Individual and group sessions together may help address this (see next guideline).

**Blend individual and group sessions:** Individual sessions allow participants to confidentially share their thoughts about the group meetings. Participants who want to "speed up" can use this time to elaborate and share, while participants who

want to "slow down" can use this time as a review and opportunity for mutual understanding. Finally, individual sessions allow more opportunities for prototype evaluation, and may lead to more productive group meetings.

**Reimburse early and often:** Some of our participants lived off of pensions and had extremely fixed incomes. Be prepared to provide reimbursement from a petty cash account at all sessions.

**Select an accessible and visible space:** Almost all of the seniors were lost trying to find the meeting room in an urban academic building. P5 has trouble walking, so it was difficult for her to get to the meetings. Ensure that seniors are capable of finding the meeting room and that it is wheelchair accessible. Post signs in the building, and mail maps to all participants before the first session.

**Make them feel welcome:** Older people who choose to participate in a process of this nature may be hesitant, curious, and doubtful of their ability to contribute. Be sure to show appreciation of their contributions often (e.g., praise, snacks, thanking them, asking about their lives).

**Provide alternative activities:** When conducting activities that require the seniors to draw, sketch, or move about, ensure that there is are alternative ways to incorporate people whose disabilities might prevent them from participating fully. For instance, while some people create a paper interface, ask participants with arthritis or tremors to instead debate which parts of pre-existing interfaces they like best and why. Some people also simply prefer to work alone or in a pair as opposed to a larger group.

**Be sensitive to impairments:** Seniors may have a number of motor, cognitive, or sensory impairments that can impact all aspects of the process. Ask each participant what can be done to make the sessions more accessible. Take the time to implement these suggestions – doing so will also help to build trust. The previous three

guidelines serve as corollaries to this one.

**Remain flexible:** When working with populations that have special needs, it is important to remain as flexible as possible. As examples of flexibility in our study, we changed the schedule to accommodate individual needs and moved from group meetings to individual meetings due to the hot weather and team preferences.

**Foster group cohesion and stability:** When we introduced a new participant to the group halfway through the sessions, she upset the direction and pre-existing understanding that the group developed. In retrospect, it would be better to select a team with strong pre-existing ties, and to prohibit people from joining once the process is underway.

## 6.9 Supporting Deployments

Our software deployment faced difficulties despite the fact that we only deployed two systems. We highlight these difficulties in order to prepare the community to handle these problems in other future work.

**Technical support:** Both of the seniors in our study had extensive questions regarding phone usage, including aspects unrelated to our design. When conducting an experimental deployment, one must decide what approach will be taken regarding providing technical support. We opted to help as much as possible regardless of the area of concern, be it related to our software or the operating system. Other more rigorous studies may choose to provide no support due to confounds regarding researcher attention; however, this may result in trouble using the software and result in few results from that participant.

**Anticipating exploration:** Despite the fact that the seniors never mentioned particular features during the design sessions, they discovered phone features we did not

anticipate. For instance, P2 set her phone to "Flight Mode" at one point – a mode made for use on airplanes which prevents phone operation but leaves PDA features intact. We could not understand why the phone was not working as we troubleshooted the problem over the phone. Researchers deploying systems should either eliminate all features irrelevant to the study at hand, or be forewarned that users will likely try features that are not directly under consideration. This may seem obvious, but problems resulting from exploration caused considerable frustration for the seniors in the study.

**Maintaining motivation:** The two participants in our study had trouble integrating the technology into their lifestyles. P4 used her phone only at home in her spare time, and P2 did not use the phone at all for 3 of the 4 weeks of the deployment. When we asked the seniors about why this occurred, P2 responded that she was simply too frustrated to use the software. She would have liked to be paired with another senior who was also participating in the study so they they could consult one another for help and to talk about their phone problems. Despite the fact that we encouraged her to call us at any time for help, she did not feel comfortable doing so because she did not want to burden us with calls and complaints. This, in turn, discouraged her from using the phone at all.

P4 also did not want to burden us by calling, but had another reason for her lack of adoption. She was not motivated because she felt 1 month of time was not long enough to warrant learning how to use the phone. She declined to add new contacts and appointments to the phone for similar reasons. She did not carry the phone with her either: "It's such a time limited project that I didn't want to bring it with me places...if it was permanent I would have probably used it at holiday parties and such." Future deployments should consider that hardware must be given to individual participants for periods of time substantial enough to warrant their

effort in learning the system. Another option is to integrate the deployed software with pre-existing systems that the participant owns already such as a computer or mobile phone.

# Chapter 7

# Summary, Contributions, and Conclusion

Conducting PD with seniors can be a challenging task. We have reported one case study about the design of software for mobile phones oriented towards assisting seniors with memory. A group of 5 seniors actually co-designed the applications from needs analysis to paper prototyping. We used a blend of individual and group meetings, along with modified participatory activities, to engage and understand each senior on the team.

We have further presented a qualitative evaluation of the process of PD with seniors by integrating our own observations with opinions solicited from the team during group and individual interviews. After we developed high-fidelity prototype software, we conducted a usability test of the Address Book, a key component relevant to supporting memory. We found that overall, seniors slightly preferred their own software to the default software that came pre-installed on the phone. However, only 2 of the 4 seniors in the test could actually recognize the software that they helped to create. To further explore the designs resulting from the PD team's labor, we conducted a limited deployment of the software with 2 available members of the design team. Neither subject engaged with the phone intensively. This provides evidence that despite extensive customization to the

team's standards, hardware and operating system-wide barriers exist in the hardware and operating system we selected. Redesigning a subset of the phone features will not suffice, and instead it is necessary to take a holistic approach and consider hardware, software, and support together.

Our study informs the current trend in PD to include the cognitively impaired or elderly in the design process. Our results indicated that this group, while able to generate interesting scenarios and application ideas, had trouble creating novel interfaces and instead preferred interfaces they had previously encountered on desktop computers. Related to the process, we identified representative issues of conflict, community, intergenerational/mutual learning, and physical/cognitive challenges. We also report on deployment problems we faced and may be useful for others considering real-world deployments with this population.

However, this work has contributed a new viewpoint to the ongoing discussion regarding design for seniors. We have shown that a team of seniors who do not know one another can come together to perform a variety of activities related to software design, even if they have little to no experience with mobile phones. Although they were not comfortable with all portions of the design process, they were enthusiastic and expressed a desire to create software to help future generations of seniors. By taking the seniors through the entire design process instead of only the early stages, we have shed light on the experience of including seniors in late-stage design. We also believe that we have shared enough of the experience so that others can refine the late-stage activities, perhaps yielding more novel and exciting methods and applications than we were able to obtain during this first try.

We learned that careful attention must be paid to the order and relationship of design activities. Seniors in our team felt unsure of their abilities and attempted to "go with the flow" rather than offer their true opinions. Therefore, when we started activities around the mobile phone, none of the seniors explicitly said that this was a poor idea. Instead,

they kept this to themselves and later evidenced this distaste for the phone through a lack of enthusiasm for screen designs and poor performance on the usability test and deployment aspects. Likewise, we may have been too focused on using mobile phones to have detected this. We also should have related each activity to the overaching purpose of the meetings more frequently. By the end, the participants did not seem to connect the activities together towards a single end. Rather, they saw each new activity as another isolated "thing to do" and did not carry knowledge of previous activities into the next one.

We originally wanted meetings to be open and democratic in the spirit of PD. For this reason, we imposed only a moderate amount of structure on the meetings, and changed course when the team decided to pursue a discussion topic. This later resulted in a disconnected software design, with additional areas (like the Calendar) that had little to do with names. If we had the opportunity to conduct PD with seniors again, we would create much more structure with each activity, and at the same time relate each activity to the larger (pre-defined) goal. In interviews and questionnaires, the team members indicated they too would have preferred that they were guided through the process more closely.

We also had a team comprised entirely of women. A team of men may have approached the tasks in a different way. Many retired engineers, mechanics, or scientists from this age group are male. Due to social norms present in the culture of 1940s-1960s North America, women were not given opportunities to become comfortable with technology. The women on our team came from the fine arts, journalism, administration and clerical positions instead.

Overall, the process taught us a great deal about the needs of this population and highlighted both barriers to use and misconceptions that seniors presently hold with regard to mobile phones. Future work remains in the employment of alternative technologies to assist those with difficulties remembering names.

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# Appendix A

# Recruitment Flyer

# Opportunity for Participation in Research

**Do any of the following apply to you or a loved one?**

- Over 60 years of age
- Having difficulty remembering names and faces of friends, colleagues and family as a result of normal aging **OR** interested in documenting your family's history
- Not diagnosed with a cognitive disorder
- Interested in current memory research
- Like to learn new things and meet new people
- Keen to contribute to research that could benefit seniors

If so, you may qualify to participate in a new study! This study will focus on using mobile phones to help people remember names and faces more accurately. We are looking for people who meet some of the above characteristics to help us design this product in a productive, social environment. You will be part of a design team that will meet for 1 hour weekly for 2 months, biweekly for the next 2 months, and then 2 more times at 3 and 6 months afterwards. Please note that you need not be a techno whiz to participate!

If you are interested in obtaining more information or would like to inquire about how to participate, please contact:

Ron Baecker
Professor of Computer Science
University of Toronto
Email: memoryaids@kmdi.toronto.edu
Voice: 1-416-978-6983
Fax: 1-416-978-5634

*This project is supported by:*

Regional Geriatric Program of Toronto
*Affiliated with the University of Toronto*

*Please see reverse side for more information.*

# Additional Information

A more detailed description of the research program follows.

### A Mobile Phone for Remembering Names and Faces

Older adults report problems forgetting names more frequently than any other item. The growing capabilities of mobile computers and mobile phones may help provide a solution. These devices provide a way for us to offer a memory support tool to those who have difficulty remembering names.

The project will last approximately 4 months, and you will meet with a psychologist and a computer scientist about once per week, along with several other participants. You will get to try out a new mobile phone, learn about computers, and have the opportunity to actively support your memory.

If you are having trouble remembering the names of your friends and family, and would like to help design an experimental product that will help you do so, you are encouraged to join this project!

**If you are interested in participating in this project, please call 1-416-978-6983 or email memoryaids@kmdi.toronto.edu.**

# Appendix B

# Consent Form

**DEPARTMENT OF COMPUTER SCIENCE**
**UNIVERSITY OF TORONTO**

**Researchers:**
Dr. David Ryan
*Regional Geriatric Program of Ontario*
*Sunnybrook & Women's Health Centre*

Michael Massimi, B.S., and Dr. Ron Baecker, Ph.D.
*Department of Computer Science*
*University of Toronto*

## INVITATION TO PARTICIPATE

Are you 60 years of age or older? Have you ever forgotten someone's name? Have you ever felt like you recognized someone but avoided using their name because you were afraid you'd be wrong? If so, we invite you to join a design team that will use current technology to help people remember. This project will bring together 6 senior citizens who have difficulty remembering names and faces. We will then work together to make new software for a mobile telephone, which is anticipated to help you remember. After we have created the new software, you'll get to try it out in your daily life to see whether it's helpful or not.

## CONSENT FORM

I agree to take part in a study that is intended to aid in the creation and evaluation of a mobile phone device for remembering names and faces. **I affirm that I am at least 60 years old, and have NOT been diagnosed with Mild Cognitive Impairment or Alzheimer's Disease**. I also understand that I am free to withdraw from the study (in part or in whole) at any time without any consequence. I am not required to answer any question I do not feel comfortable answering, and I am not required to complete any task I do not feel comfortable completing.

I understand the following:

- The purpose of the study is to help design computer software that will help me remember names and faces of my friends and family more accurately.
- I will be part of a design team of approximately 8 people. This team will include other participants, a computer scientist, and a geriatric psychologist.
- I will attend between 6 and 8 design meetings on a weekly basis. The time, date, and location of these meetings will be provided to me in advance. The meetings will last approximately 1-2 hours each. At these meetings, I will be asked to give my opinion on computer software and hardware designed to help me remember names and faces.

- I may be asked to use the mobile phone and software on a daily basis for duration of up to 6 months. I may also be asked to record times and situations where I forget names and faces.
- The study will run for a period of approximately 12-15 months in total. I may be asked to attend weekly meetings for the first 2 months, attend meetings biweekly for the next 2 months, and then 2 more meetings at 3 and 6 months afterwards.
- The researchers do not foresee any risks or stresses beyond what one might experience in day-to-day living.
- I will receive the following benefits: the free use of a mobile phone for a period of up to 6 months (with some restrictions on usage); a feeling of contribution; the opportunity to learn more about new mobile phone technology.
- I **may** receive monetary compensation for participating in meetings (**pending the availability of funds**) at the rate of $10/hour. Travel expenses (up to $30 total for the duration of the study) will be reimbursed.
- All data collected about me will be kept secure. In all data files, my name and identifying features will be removed and replaced with a number in order to preserve my anonymity. Only the researchers involved in this study will have access to the information I provide. The data collected will be destroyed at the end of the study.
- Data collected may be used in research journal, conferences, or other scholarly activities. In these cases, my name will not be used and will be replaced with an identifier (e.g., Participant 1) and no identifying information will be provided to the audience.
- I may be video-recorded during the study. If I am being video-recorded, the researchers will inform me and allow me the opportunity to be removed from the recording entirely or have my face blurred to preserve my anonymity.
- I am free to ask questions about the process at any time. I can ask questions in person, or by contacting Ron Baecker via email at rmb@kmdi.toronto.edu or by telephone at 416-978-6983. I may also contact Michael Massimi at mikem@dgp.toronto.edu or by telephone at 416-946-8874. If you feel you are under undue stress or are being hurt in any way by this research, **please** contact us so that we can help you receive treatment.
- I will receive a copy of this form for my records.
- I have a right to receive any results or publications that arise from this study, and will be notified of publications by the researchers.

Participant's Printed Name

_____

Participant's Signature

_____

Date_____ Participant Number _____ Experimenter's Initials _____

# Appendix C

# Multi-factorial Memory Questionnaire

Name: _____ Date: _____

# How I feel about my memory

Below are statements about feelings that people may have about their memory. Read each statement and decide whether you agree. Think about how you have been feeling over the past *two weeks*. Then, place a check in the appropriate column.

| | Strongly agree | Agree | Undecided | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| 1 I am generally pleased with my memory ability. | | | | | |
| 2 There is something seriously wrong with my memory. | | | | | |
| 3 If something is important, I will probably remember it. | | | | | |
| 4 When I forget something, I fear that I may have a serious memory problem, like Alzheimer's disease. | | | | | |
| 5 My memory is worse than most other people my age. | | | | | |
| 6 I have confidence in my ability to remember things. | | | | | |
| 7 I feel unhappy when I think about my memory ability. | | | | | |
| 8 I worry that others will notice that my memory is not very good. | | | | | |
| 9 When I have trouble remembering something, I'm not too hard on myself. | | | | | |
| 10 I am concerned about my memory. | | | | | |
| 11 My memory is really going downhill lately. | | | | | |
| 12 I am generally satisfied with my memory ability. | | | | | |
| 13 I don't get upset when I have trouble remembering something. | | | | | |
| 14 I worry that I will forget something important. | | | | | |
| 15 I am embarrassed about my memory ability. | | | | | |
| 16 I get annoyed or irritated with myself when I am forgetful. | | | | | |
| 17 My memory is good for my age. | | | | | |
| 18 I worry about my memory ability. | | | | | |

Name: _____ Date: _____

# Memory Mistakes

Below is a list of common memory mistakes that people make. Decide how often you have done each one in the *last two weeks,* then place a check mark in the appropriate column.

| | All the time | Often | Sometimes | Rarely | Never |
|---|---|---|---|---|---|
| 1 Forget to pay a bill on time. | | | | | |
| 2 Misplace something you use daily, like your keys or glasses. | | | | | |
| 3 Have trouble remembering a telephone number you just looked up. | | | | | |
| 4 Not recall the name of someone you just met. | | | | | |
| 5 Leave something behind when you meant to bring it with you. | | | | | |
| 6 Forget an appointment. | | | | | |
| 7 Forget what you were just about to do; for example, walk into a room and forget what you went there to do. | | | | | |
| 8 Forget to run an errand. | | | | | |
| 9 In conversation, have difficulty coming up with a specific word that you want. | | | | | |
| 10 Have trouble remembering details from a newspaper or magazine article you read earlier that day. | | | | | |
| 11 Forget to take medication. | | | | | |
| 12 Not recall the name of someone you have known for some time. | | | | | |
| 13 Forget to pass on a message. | | | | | |
| 14 Forget what you were going to say in conversation. | | | | | |
| 15 Forget a birthday or anniversary that you used to know well. | | | | | |
| 16 Forget a telephone number you use frequently. | | | | | |
| 17 Retell a story or joke to the same person because you forgot that you had already told him or her. | | | | | |
| 18 Misplace something that you put away a few days ago. | | | | | |
| 19 Forget to buy something you intended to buy. | | | | | |
| 20 Forget details about a recent conversation. | | | | | |

Name: _____ Date: _____

# Memory Strategies

People often use different tricks or strategies to help them remember things. Several strategies are listed below. Decide how often you used each one in the *last two weeks*. Then, place a check mark in the appropriate column.

| | All the time | Often | Sometimes | Rarely | Never |
|---|---|---|---|---|---|
| 1 Use a timer or alarm to remind you when to do something. | | | | | |
| 2 Ask someone to help you remember something or to remind you to do something. | | | | | |
| 3 Create a rhyme out of what you want to remember. | | | | | |
| 4 In your mind, create a visual image of something you want to remember, like a name and a face. | | | | | |
| 5 Write things on a calendar, such as appointments or things you need to do. | | | | | |
| 6 Go through the alphabet one letter at a time to see if it sparks a memory for a name or word. | | | | | |
| 7 Organize information you want to remember; for example, organize your grocery list according to food groups. | | | | | |
| 8 Say something out loud in order to remember it, such as a telephone number you just looked up. | | | | | |
| 9 Use a routine to remember important things, like checking that you have your wallet and keys when you leave home. | | | | | |
| 10 Make a list, such as a grocery list or a list of things to do. | | | | | |
| 11 Mentally elaborate on something you want to remember; for example, focus on a lot of the details. | | | | | |
| 12 Put something in a prominent place to remind you to do something, like putting your umbrella by the front door so that you will remember to take it with you. | | | | | |
| 13 Repeat something to yourself at increasingly longer and longer intervals so that you will remember it. | | | | | |
| 14 Create a story to link together information you want to remember. | | | | | |
| 15 Write down in a notebook things that you want to remember. | | | | | |
| 16 Create an acronym out of the first letters in a list of things to remember, such as carrots, apples, and bread (cab). | | | | | |
| 17 Intentionally concentrate hard on something so that you will remember it. | | | | | |
| 18 Write a note or reminder for yourself (other than on a calendar or in a notebook). | | | | | |
| 19 Mentally retrace your steps in order to remember something, such as the location of a misplaced item. | | | | | |

# Appendix D

# PD Weekly Agendas

# Participatory Design Agendas
## Session 1

Participants: Michael Massimi, David Ryan, [P1]

**Welcome & Introductions**

**What is participatory design?**

- Participatory design is a process where we, as computer scientists and psychologists, invite other people (especially people who are going to use the things that we design), to help us do the design. In this instance we will be designing software for the cell phone that helps people to deal with some of the frustrating things about memory. Participatory design is just a fancy term for having meetings where we will all work together to make the software. It sounds complicated at first, but the only thing we ask is that you give us your opinion as honestly as possible. In these meetings, you are the expert on what it is like to have a memory concern.
- Generally speaking, we are going to make software for a mobile phone that can help you remember names. This could take many forms, depending on what happens in these meetings, but this is a starting point.
- Participatory design will take several weeks as we go through different parts of the creation of the software. A lot of what we will do is prototyping – that is, we will come up with ideas for software to help with names and memory problems. We will talk about what the problems are to get a better idea of what is important and what is not. We will make drawings of what we think the software should look like. We will talk about how it will work and how we would use it.
- So, how much you know about computers isn't important -- you can still very actively contribute. This is a group activity, and we're all in this together. This project is just as much your project as it is ours, and we hope to learn a great deal from each other about computers, about memory problems, and about how we can work to overcome them.

**Administrative and scheduling things**

- We'd like to tell you a little bit more about the administrative and timekeeping side of things now.
- We would like to have a meeting every week at the same time. The meetings will be about 1-2 hours long. Some new people may join in later in the program.
- Depending on how things go, we will continue meeting each week until the end of July at the latest.

- Another session will also be running on Tuesdays in parallel to this one. Each week we'll talk about what the other session learned and shared.
- Because this is a substantial time investment for you, we'd like to show our appreciation by offering to provide lunch each week. We will also reimburse you for travel expenses.
- If you can't make it on a particular week, that's not a problem at all. Please just let us know if you will not be coming. We anticipate people will be unable to attend from time to time, and that's perfectly fine.
- At the end of the meetings we might ask you to try out the new software in your everyday life. We will determine the length and nature of this part at a later date.

**Consent forms and calendars**

Now that we've explained a bit about what participatory design is, and what these sessions will be like, we'd like to see if you have any questions at all.

As part of your participation, we'd like to ask that you please read this informed consent form carefully and sign it. It will detail the benefits and risks of participating. If you have any questions, please feel free to ask. I will give you some time to read it over. You do not have to sign it now, and can instead bring it to the next session. I will also give you my card in case you would like to contact me at any time.
<Offer consent form and card>

We'd also like to get an idea of what people's schedules are like. If you could please indicate on this form the times that you are unable to attend, that'd be great. Please also indicate alternative times that you might be able to attend. Please complete this during the week and bring it with you to next week's session.
<Offer calendar form>

**MMQ**

There is just one more form to go over today. This is a questionnaire that will help us understand how you feel about your memory. If you could please fill this out, that'd be very helpful. Filling it out should take about 10 minutes.
<Hand out MMQ>

**What gives us problems?**

For the remainder of today's meeting we'd like to go over some of the problems that we are currently facing with regards to memory. Let's go around and talk about the kinds of things that are bothering us about our memories.
<Open Discussion>

**For next week…**

Next week we'll continue to talk about those frustrating things about memory.

We'd like to talk a bit about what we currently use to overcome those frustrations, such as post it notes, name tags, datebooks, and so on. For the next session, we'd like to ask you to bring some of the most important things you use everyday to help you remember. We will talk about what's good about them and what could be improved. Please also do not forget to bring your consent form and your calendar form. If you like, I can call or email you sometime this week to give you a reminder.

# Session 2

## April 18, 2006

## AGENDA

1. Review of last meeting
    a) Why we are here
    b) How we perceive our memories

2. Technology comfort questionnaire

3. Show & tell about memory aids
   For each aid, please say:
    a) What it is
    b) How you use it
    c) What you like about it
    d) What you dislike about it

4. Names & faces memory problems
    a) What are the problems with remembering names?
    b) What are the consequences?
    c) Who is involved?
    d) What gives rise to forgetting?

5. Ranking the problems

6. Summary of today's meeting

7. Preview of next meeting (May 2nd)
    a) Storyboarding
    b) System requirements

8. (Optional) Meet with Dr. Baecker

# Session 3

## May 2, 2006

## AGENDA

1. Review of last meeting and introductions (5 min)
    a) What we use to remember
    b) The best and worst parts of each

2. Scenario creation in teams (10 min)
    Think of 3 scenarios...
        1. Best situation
        2. Average situation
        3. Worst situation

3. Storyboarding (30 min)
    a) Sketch a storyboard of each scenario

4. Break (10 min)

5. Discussion (45 min)
    a) Name the system!

b) Share our scenarios & storyboards
c) In general, what should the system do?

6. Summary of today's meeting (5 min)

7. Preview of next meeting (May 9th) (2 min)
   i. Ideas → Screen design

# Session 4

## May 9, 2006

## AGENDA

1. Review of last meeting (5 min)
   a) Storyboards (best, worst, average)
   b) Recall: calendar, names, mood elevators

2. Major features breakdown – parts and actions
   a) Calendar (15 min)
   b) Names and faces (15 min)
   c) Mood elevators (15 min)

3. Break (10 min)

4. Screen design (50 min)
   a) Calendar
   b) Names and faces
   c) Mood elevators

5. Summary of today's meeting (5 min)

6. Preview of next meeting (May 16th) (2 min)
   a) More screen design
   b) Phone demo

# Session 5

## May 16, 2006

## AGENDA

1. Review of last meeting (5 min)
   a. Features of Recall
   b. Paper screen designs

2. Screen design – Calendar (50 min)

3. Break (10 min)

4. Screen design – Address Book (50 min)

5. Summary of today's meeting (5 min)

6. Preview of next meeting (May 23rd) (2 min)
   a. Phone demo
   b. Your social networks

# Session 6

## May 23, 2006

## AGENDA

1. Review of last meeting (5 min)
   a. Screen designs

2. Travel reimbursement (10 min)

3. Social networks (35 min)
   a. How to enter a name?
   b. How to recall a name?

4. Break (10 min)

5. Screen design – location features (50 min)

6. Putting it all together (10 min)

7. Preview of next meeting (May 30) (2 min)
   a. Wrap up and future scheduling

# Session 7

## May 30, 2006

## AGENDA

1. Review of last meeting (5 min)
   a. Considerations when using the phone

2. Final travel reimbursement and summer interview scheduling (10 min)

3. Design recap and feedback (30 min)

4. Break (10 min)

5. Software demo and feedback (30 min)

6. Questionnaires, group interview, open-ended discussion (20 min)

7. Wrap-up and thank you!

# Appendix E

# Cards for Scenarios and Storyboarding

## Scenario Idea — Story Card

**Type**: Best Average Worst

**Description**:

## Scenario Step — Story Card

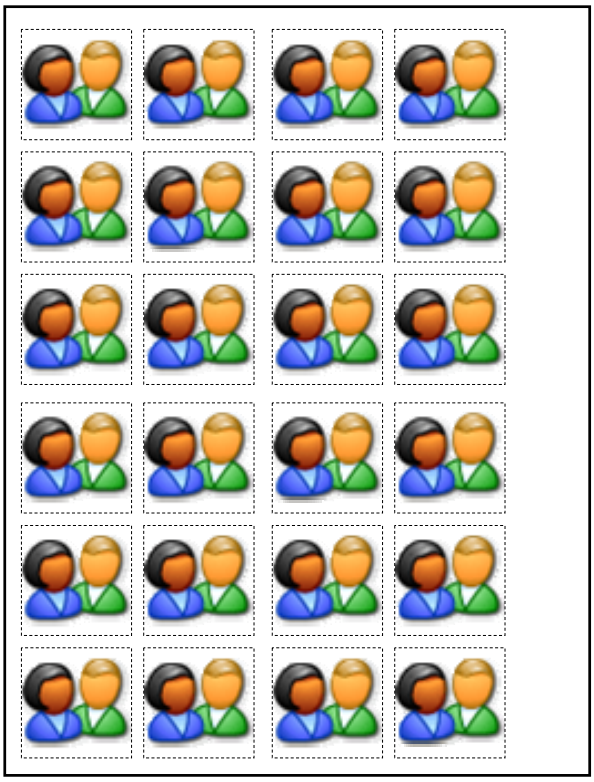
**Type**: Best Average Worst

Description:

/

# Appendix F

# PICTIVE Elements

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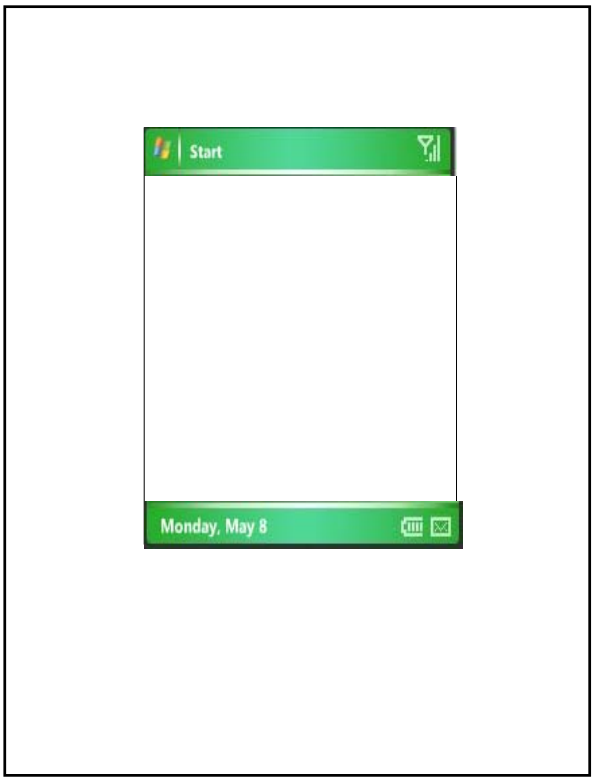
i-mate
K-JAM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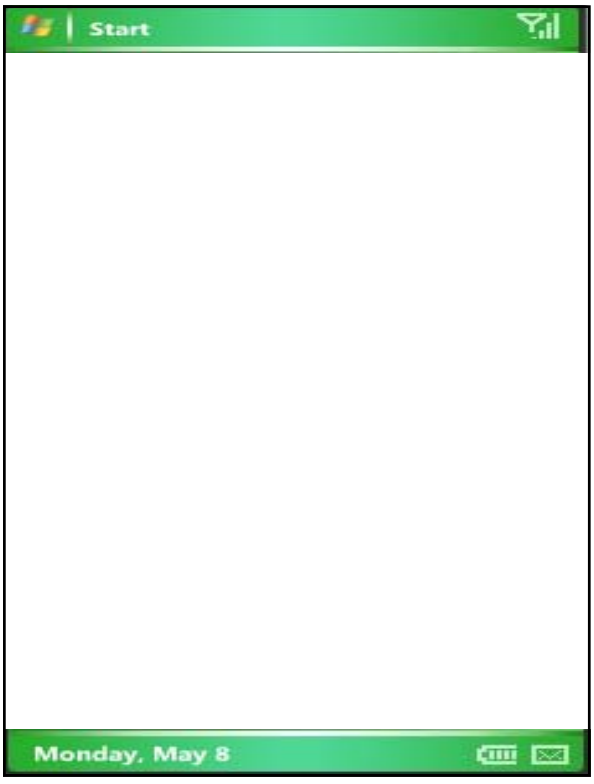
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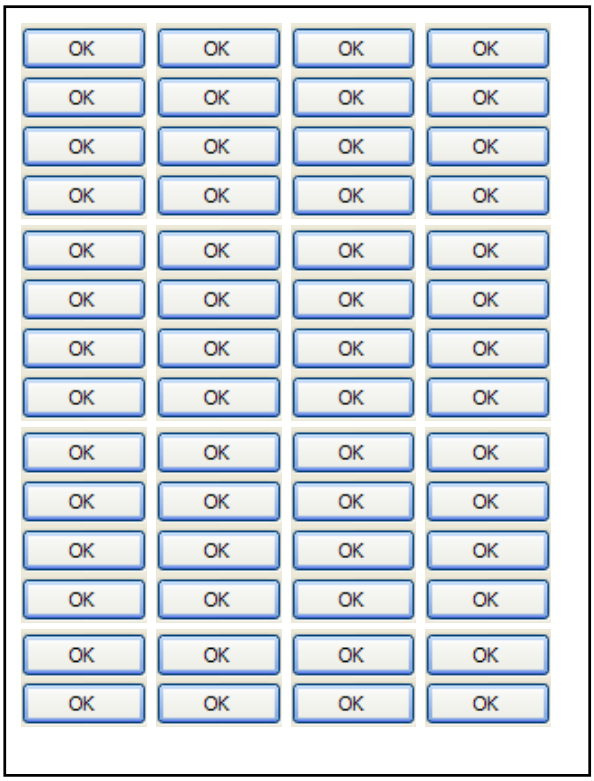
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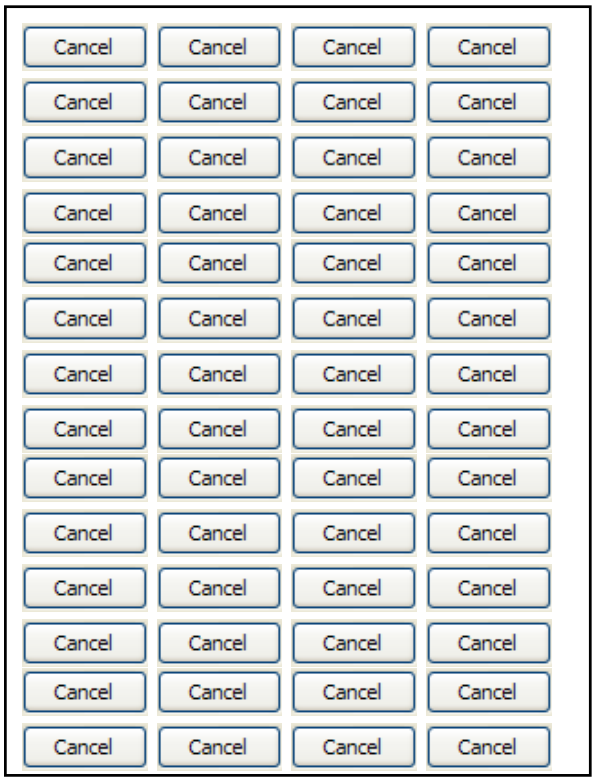
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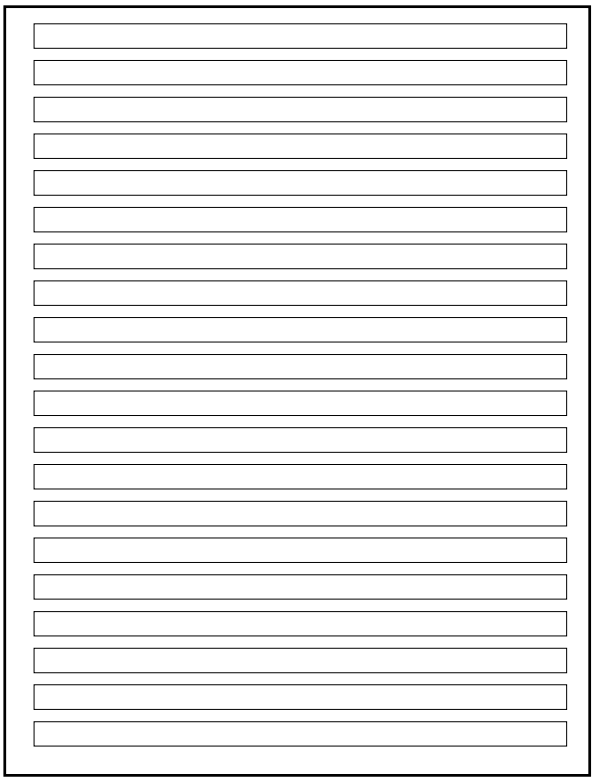

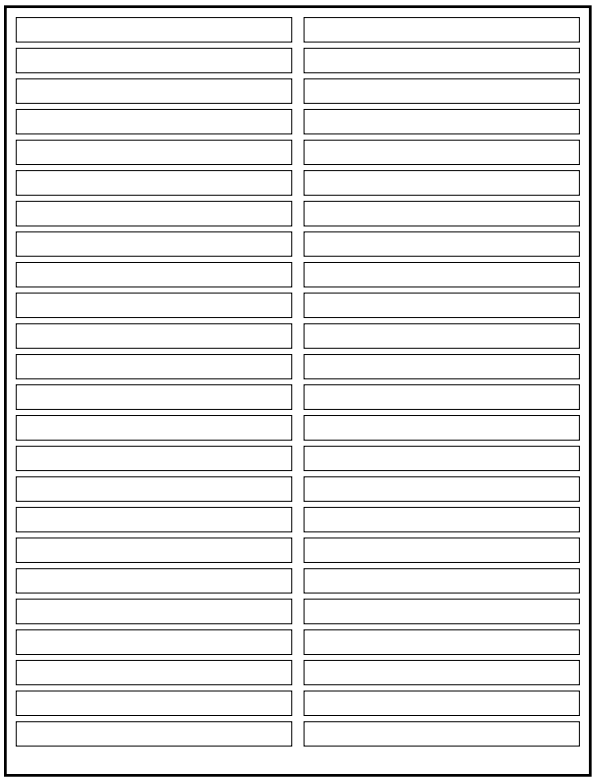


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Monday, May 8
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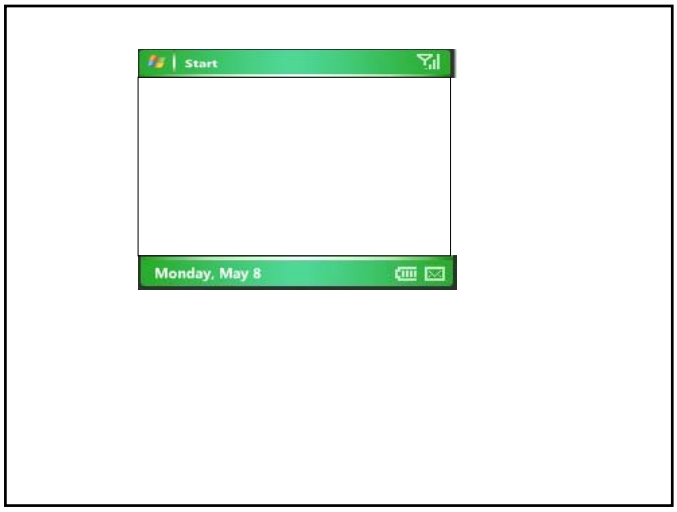
Space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Monday, May 8


Start
Monday, May 8

# Appendix G

# Design Review from Session 7

# Hardware Selection: i-Mate K-JAM


QWERTY hardware keyboard with large, light-up buttons

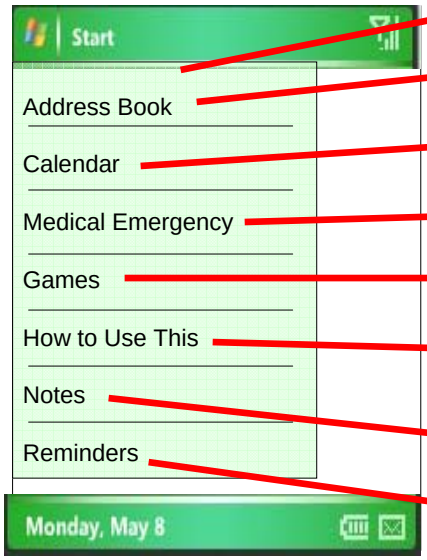
Email, phone, and text messages

Adjustable speaker volume

Large, bright touchscreen

Programmable one-touch buttons to access Recall or emergency services

# Software Design: Recall




• Alphabetized menu items

Contains information and reminders about people

Daily, weekly, monthly, and yearly calendars

911 & contact information

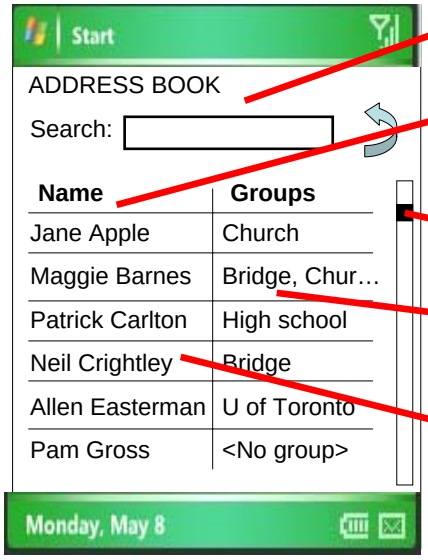
Name-related crosswords and trivia games to help train memory

Clear, detailed, step-by-step instructions for how to use Recall

Shopping lists, scratch pad, and other information not related to people

Easy-to-set alarms

# Software Design: Recall




Quickly search whole address book for a word

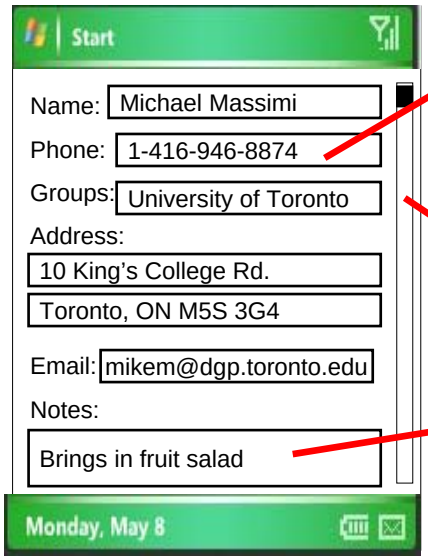
Alphabetical name listing by last name. Nicknames also shown. Press the header to sort by group or name

Scroll up or down to see more names

People can belong to multiple groups

Tap on a name to see more information

# Software Design: Recall

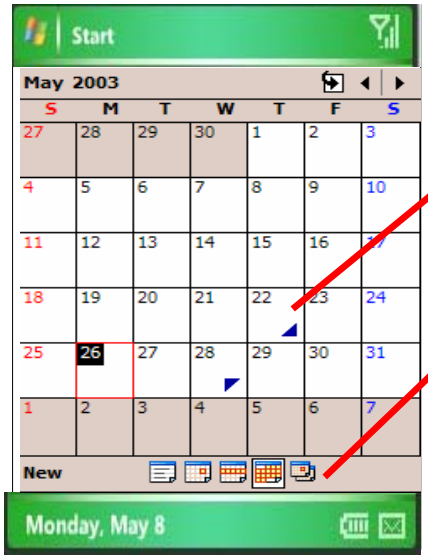



Pressing the Call hardware button dials this person's phone number.

Scroll up or down to see more information about this person, including a photo

Notes to help trigger memory

# Software Design: Recall




Built-in Microsoft calendar with triangles indicating appointments or holidays

Able to change to a daily, weekly, monthly, or yearly view

# Appendix H

# Final Group Interview Protocol

1. Was the meeting space suitable for our purposes?
2. What could we do to make it better?
3. What did you think of the paper design parts?
4. What could we do to improve the actual design process?
5. Would you have preferred more structure in the meetings, with me running more of the show?
6. What advice would you give in order to improve these sorts of sessions in the future?
7. What was the most interesting part?
8. What was the most confusing part?

# Appendix I

# Questionnaire about PD Process

| | Name:<br><br>_____<br><br>Please reflect on the meetings we have had since April as you read the following items. Please place a mark in the box under the best response. | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|---|
| 1 | I learned about computer systems. | | | | | |
| 2 | I learned about mobile phones. | | | | | |
| 3 | I learned about how software is designed. | | | | | |
| 4 | I am confident in my ability to use new technology. | | | | | |
| 5 | We worked well as a team. | | | | | |
| 6 | I am proud of our team accomplishments. | | | | | |
| 7 | I fit in with the other teammates. | | | | | |
| 8 | I was able to express my ideas to the team. | | | | | |
| 9 | I am more confident in my ability to remember names than I was at the beginning. | | | | | |
| 10 | I learned about memory strategies. | | | | | |
| 11 | I learned about how memory works in general. | | | | | |
| 12 | I learned about how my memory works. | | | | | |
| 13 | Meetings were too structured. | | | | | |
| 14 | I would recommend this kind of study to my friends. | | | | | |
| 15 | I looked forward to coming to meetings each week. | | | | | |
| 16 | The meetings were fun. | | | | | |
| 17 | The meetings would have been better if the team members knew each other beforehand. | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 18 | The meetings helped me cope with my memory problems. | | | | | |
| 19 | The meetings helped me feel more in control of my memory. | | | | | |
| 20 | I understood the direction and purpose of the meetings. | | | | | |

21. In the space below, please comment on any aspect of the entire design experience that you like. Please be honest and provide as much feedback as you like.

# Appendix J

# Interview Protocol from First Individual Session

Interview protocol, Round #1
Thursday, June 15, 2006

Demonstrate the phone

1. What are your first impressions of the phone?
2. What here is most interesting to you?
3. What else is interesting?
4. What seems the most confusing?
5. What else is confusing?
6. Would you feel comfortable carrying a phone like this?
7. Does the keyboard work well?
8. Do you like the form factor?
9. Is the screen bright and large enough to read?
10. Can you hear the phone well enough?
11. Do you feel like you can grip it well?
12. Is it heavy?
13. Do you have any questions about it?
14. Do you like the phone overall?
15. What would you worry about while using it?
16. What do you think should change?
17. Do you think you will use it to make calls? Email? Text message? Camera?

Demonstrate some software: calendar, notes, reminders

1. Do this part make sense to you? Are you able to figure it out?
2. What changes would you make to them?
3. Do you think you would use this?
4. Try creating a new {reminder, appointment, note}.

# Appendix K

# Usability Study Questionnaire

You just saw two different ways of keeping people's addresses and phone numbers: Address Book A and Address Book B. Please circle the number that you feel is the best response.

1. I liked using Address Book **A**.

| Not at all | | | | | | Very much |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

2. I liked using Address Book **B**.

| Not at all | | | | | | Very much |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

3. If given the choice, I would use Address Book **A** again.

| Definitely not | | | | | | Definitely yes |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

4. If given the choice, I would use Address Book **B** again.

| Not at all | | | | | | Very much |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

| | | |
|---|---|---|
| 5. Which was easier to add a new person to? | A | B |
| 6. Which was easier to delete a person from? | A | B |
| 7. Which was easier to sort? | A | B |
| 8. Which one was easier to update a person's information? | A | B |

Thank you!

Participant number _____

Date _____

# Appendix L

# Deployment Daily Diary Forms

Phone Experience Diary

Participant: _____

Date: _____

How many minutes today did you use the phone? _____

What parts of the phone did you use (list as many as you can remember)?

Please share any and all thoughts you have about anything related to the phone: