Chapter 14
Fostering Social Engagement and Self-Efficacy in Later Life: Studies with Ubiquitous Computing

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Abstract This chapter describes a multiyear project with a team of social scientists and engineers at Intel focused on emerging technologies and successful aging. Theories of behavioral change are linked to the capabilities of emerging technologies for capturing and reflecting variability in activity and health status. The technologies described in this chapter reflect an attempt to integrate psychological theory and ethnographic research with ubiquitous computing. Ethnographic research that we conducted at the outset of this project consistently underscored the value of social engagement for successful aging. It also pointed out the significant social barriers encountered by many older adults. These barriers – which include changes in lifestyle, mobility, and cognitive functioning – are compounded by a perceived inability to change isolating circumstances. To address these social needs and barriers, we developed a set of prototypes involving sensor networks and feedback displays. This chapter describes the social health technologies that we developed, reactions of the older adults and family caregivers who participated in in-home trials, and implications for future development. We also describe the need for tools to encourage self-awareness and self-efficacy for a broad range of health concerns.

14.1 Introduction

Social engagement is increasingly recognized as a critical element of health within social science and medicine. Longitudinal studies have demonstrated the protective and therapeutic value of social engagement for illnesses ranging from the common cold to dementia (Berkman et al., 2000; Fratiglioni et al., 2000; Sarason et al., 1998). Recent research has extended the analysis of social networks on health from cognitive aging to cross generational concerns such as obesity

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(e.g., Tamburlini et al., 2007). Recent research, widely covered in the popular press, has extended this analysis of social networks from cognitive aging to cross generational public health concerns such as obesity (e.g., Tamburlini et al., 2007). An extensive ethnographic study of aging, conducted by an interdisciplinary team at Intel, underscored the value of social capital for successful aging (Morris et al., 2003). One man's statement, "I'm a rich man, I have three daughters," conveyed the dependence of life satisfaction on interrelatedness. Our research focused on cognitive aging and the role of social engagement in preventing the onset and progression of dementia. The value of social engagement for cognitive functioning and other aspects of health appears to stem from emotional and instrumental support, the continuation of meaningful life activities, and the feeling of having a positive impact on others. The cognitive stimulation inherent in social interaction is probably also at play in the prevention of dementia: the mental orchestration required to plan an interaction may not be so different from that involved in puzzle solving or tasks involving executive functioning that are undertaken to preserve cognitive health. Moreover, social interaction often goes hand in hand with other cognitively stimulating activities: conversation, perspective shifting, critical questioning, planning events for the future, and physical activity. The following sections describe barriers to social engagement that emerged from our ethnographic research and opportunities to facilitate satisfying interaction.

Significant barriers to social engagement exist for many older adults. Retirement, the death of a spouse, and a diminishing network of surviving peers radically decrease social opportunities. Vision impairments and other physical problems that limit mobility and driving can leave people virtually locked in their homes. Some participants in our ethnography described themselves as "shut-ins." Others compared later life to a deserted island. Elders expressed a longing for the spontaneous contact and occasions for making new friends that they enjoyed in earlier stages of life. Many lost contact with an already diminishing peer group after relocating to live with or near their children. Dissonant feelings about losing contact with friends were sometimes resolved by reorienting energy around families. This focusing of social energy on children and grandchildren may be more compelling than contact with distant friends or recently made acquaintances (Frederickson and Carstensen, 1990), but we observed significant downsides of this reliance on family for social contact: Elders often felt lonely and powerless with regard to initiating interactions, and the daughter or son with the most caregiving responsibility often experienced burnout and frustration.

Cognitive changes may present the strongest barrier to communication for older adults. Some cognitive abilities persist and strengthen throughout life, but normative decreases in processing speed make it hard for many elders to participate in rapidly moving conversations. Alzheimer's disease, estimated to afflict approximately 50% of people over the age of 85, brings about far more severe communication challenges. Difficulty in identifying people, recalling previous conversations, and recalling other socially relevant information add awkwardness and anxiety to interactions (Morris et al., 2003). Our participants expressed anguish when unable to recall a name and embarrassment as they stood apart from a conversation they simply could not follow. "I don't say anything . . . I'll ask her (my wife) about it after," explained

one man. In addition to memory and planning, domains such as spatial orientation, motor control, and judgment are frequently affected in dementia. As a result, spouses often become 24-hour caregivers; they too lose social contact and are therefore at increased risk for a range of health problems.

Cognitive changes threaten social identity. The inability to communicate confidently and clearly is especially problematic with regard to a critical aspect of social engagement – the feeling of influencing and helping others. We observed painful identity threats, for example, a man who was asked to stop teaching because he repeatedly lost focus during lectures, another whose perceptual and motor impairments prevent him from making repairs to a house that he designed and built, and a woman who now struggles for a week to plan the type of family dinners that she used to execute on the spur of the moment. These shifts were sometimes denied for long periods of time, either by the elder or by their families, who did not welcome the change in responsibilities. There are endless examples of these role losses, and they are experienced across gender, race, and socioeconomic lines. Shame about these role losses, the fear of burdening others, and the ongoing stigma associated with dementia push these individuals even further away from social support.

A perceived inability to change social circumstances was expressed by many participants in our ethnography of cognitive aging. The statement of one man in his eighties, "Loneliness is part of old age and there ain't a damn thing you can do about it," exemplifies this hopelessness. The belief that there is nothing one can do to increase contact perpetuates isolation. Such cycles of pain and perceived loss of control, described as "learned helplessness" by psychologist Martin Seligman (Seligman and Seligman, 1989), can seriously impair mental and physical health. Seligman's research on attributional style – our quick inferences about causality in everyday life – suggests that it would be more adaptive for individuals to perceive isolation as a temporary and changeable situation rather than a permanent condition. Attuning to the variability in negative states is also a component of mindfulness practices. Awareness of variability has been encouraged in the treatment of extreme physical pain (e.g., in burn units) and depression but not yet in the way we address isolation.

14.2 Tools for Social Self-Efficacy

Self-efficacy, a confidence in one's ability to bring about change, is a productive lens for health technology innovation. Albert Bandura (1977) demonstrated self-efficacy as a critical dimension of psychological development, well-being, and professional success. Those with a high degree of self-efficacy are more likely to take risks to pursue goals and more likely to feel that they have succeeded. Social self-efficacy is the belief that one can effectively negotiate interpersonal situations and develop positive relationships. The predominantly negative societal attitudes about aging in the West may undermine social self-efficacy in later life. The elderly are defined

largely in terms of impairments, and cast into understimulating environments and roles with limited influence. Consequently, older adults themselves may focus less on their accumulation of wisdom than on cognitive limitations, such as memory loss or delayed information processing, and therefore suffer further insecurity about their ability to effectively connect with others.

Self-efficacy principles align with capabilities of ubiquitous computing. The four strategies outlined by Bandura for increasing self-efficacy – mastering a goal, observing success by similar people, being reminded of one's strengths and abilities by others, and inferring readiness to achieve a goal on the basis of one's physical and emotional states – are supportable by sensing and feedback technologies. Wearable and environmental sensors offer increasingly meaningful data about activities and health states in the contexts of daily life. And, ambient displays, whether on a computer, television, watch, phone, or clothing, can present these data in terms of instructions and motivating feedback. To support self-efficacy, displays should present role modeling visualizations, trending of one's own behaviors and abilities, and feedback to increase awareness of one's emotional and physical states.

Fostering self-awareness of behavioral, cognitive, and emotional patterns related to social interaction was the goal of the current project. To foster this self-awareness and ultimately encourage social interaction, feedback displays need to highlight variability and opportunities for change. This general principle of illustrating variability is central to biofeedback, which has helped patients become more aware of and able to control muscle contractions related to pain. Historically practiced in clinical or laboratory settings, biofeedback is slowly migrating into everyday life: for example, games have been developed to help kids with diabetes understand glucose dynamics (Kumar et al., 2004). Behavioral feedback is similarly shifting outside the clinic: for example, digital photography has been studied to help diabetic patients and dieters reflect on the physiological effects of their food selections (Frost and Smith, 2003). These and other examples present contextually rich data and invite individuals to reflect on the biological and behavioral relationships and invite experimentation with new health strategies.

The next step is to broaden the focus of dynamic feedback from physical to social and emotional conditions. To date, innovative feedback has focused on biological metrics (e.g., blood glucose) and some simple behavioral indices (e.g., steps per day) to motivate diet and exercise changes. Little has been developed to help people track the factors associated with interpersonal and mood changes. Concept feedback studies have revealed interest among many people in tracking multivariate mind–body relationships over time (Beaudin et al., 2006). To facilitate behavioral change, such feedback systems need to be highly personalized and tailored to an individual's short- and long-term goals. The displays also need to be sufficiently compelling – aesthetically and psychologically – to override resistance to self-examination and difficult behavioral change. Given the protective effects of social engagement, it makes sense to explore creative monitoring and feedback tools to help people overcome isolation as a starting point for emotional health feedback systems.

14.3 Prototypes Developed to Foster Social Engagement

We developed a prototype system to motivate social engagement. Our goals were to help people see dynamics in their behaviors, highlight others' availability, and provide contextual prompts to facilitate conversation. The central component of the platform was a social network feedback display continuously updated with sensor and self-reported data. Two additional prototypes were presence lamps that provided information about others' availability and contextual cues to facilitate phone interactions. In the spirit of fostering self-efficacy, all of the displays were reflective and suggestive rather than prescriptive. This approach was also informed by the clinical practice of motivational interviewing, in which change is invited by presenting personalized health information. The displays mirrored current social state and behavioral trends but did not direct the elder to take any specific action, such as making a phone call. Explicit social directives were avoided because we were making inferences from experimental sensors about loneliness – a complex and fairly sensitive topic. The chances of specific instructions seeming inappropriate at any particular moment were significant. Another reason we avoided directives, or related features such as autodial of friends and family, is that these instructions could remove important opportunities for stimulation and self-efficacy. The executive functioning skills of planning and coordinating may be central in why social interaction is protective against dementia.

The goals of fostering social self-efficacy guided concept development and design. These systems were intended primarily to empower elders with information about themselves and other people and invite reciprocal exchange. To avoid stigmatizing elders with objects that looked like "assistive technologies," we tried to use existing objects in the home, familiar interfaces, and visually appealing representations of health states. This approach departs from the exclusive focus on monitoring in most sensor-based health technologies for older adults.

Next we explain the three guidelines for fostering self-efficacy and describe the social health prototype that aligns with each guideline.

14.3.1 Guideline 1: Depict Loneliness as a Temporary Drop in Social Activity Rather Than a Permanent Condition

The theories of learned optimism and self-efficacy suggest that people will feel more in control of their social situation if they perceive their social activity levels as dynamic or variable. The quote referenced above from one participant, "Loneliness is a part of old age and there ain't a damn thing you can do about it," represents the kind of helplessness that we wanted to shift by illustrating variability. This man described social engagement as something that he had completely lost and could not bring about on his own. Ideally, he would recognize the situational challenges he faces, such as not being able to drive by himself at night, understand his own patterns of isolation, and develop time-based strategies to compensate for these barriers.

Ethnographic research conducted for this project suggested that social engagement and feelings of isolation vary not only over the lifespan but also across relatively short periods of time. Gerontological studies point to changes over the lifespan, with a pruning of relationships in later life (Frederickson and Carstensen, 1990). We too encountered people who were very socially active in midlife but who became reclusive following retirement, the death of a spouse, illness, and relocation toward their family caregivers but away from their friends. This movement toward isolation in later life among people who were previously social has been implicated as a major risk factor for dementia and has raised the question of whether social withdrawal is an early indicator of dementia (Saczynski et al., 2006). We also observed micropatterns that have not been explored in traditional gerontology: Repeated interviews with the same participants showed variability in isolation over very short time periods. One woman who was content during the week dreaded the loneliness she experienced on the weekends, a time she felt neglected by her family. Another woman, active and content during the day, despised the evening hours, describing her retirement community as "a morgue after 7 p.m."

Visualization of social patterns could raise self-awareness and help people develop tailored strategies to improve social engagement. Microvariability in social behaviors and feelings of loneliness can be gathered through sensor measures. An early example of this measurement is Choudhury's "sociometer," which patterned social roles and conversational turn-taking from captured speech signals (Choudhury and Basu, 2005). These sensor-based methods are complemented by experience sampling methods in which individuals are frequently prompted to describe social interaction and social satisfaction, typically on a handheld device.

14.3.1.1 Prototype 1: Social Network Displays

We created dynamic social network visualizations to provide older adults with a real-time mirror of their contact with family and friends. The displays (see Figs. 14.1 and 14.2) showed how much time the elder was spending with people in the network, based on sensors and an online journal. Different modalities of the displays showed trends of social activity and aggregations of the data by person (e.g., how much time an elder spent with specific friends or family members over time). This display was an exploration of how social networks could be applied to motivate behavioral change (Morris, 2005). Traditionally, social network analysis has been used to analyze organizational dynamics and flows of information. This type of analysis identifies the centrality and clusters of individuals as well as the density of the links that connect them. The modeling of personal communication is radically changing the nature of professional and personal communication. Interesting representations are explored in research by Donath (2002) and Fisher and Dourish (2004), and online offerings such as the "Circle of Friends" application on Facebook.

The social network visualizations we developed were intended not just to capture an individual's contact list but to describe social states and motivate social engagement. We wanted to convey information in a way that would empower elders to ini-

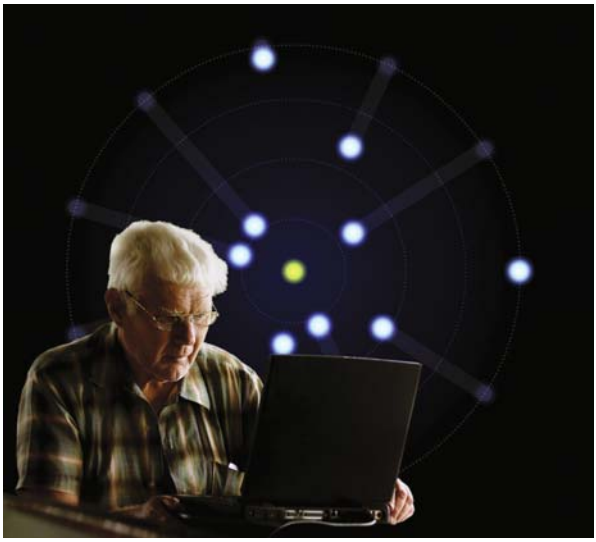

Fig. 14.1 The solar model of social activity. The elder, positioned at the center of the display, is surrounded by planetary representations of friends and family. Movement toward and away from the elder is generated by sensor data

Fig. 14.2 Social activity displays: **(a)** solar display, **(b)** line graph and **(c)** bar graph show variability to promote social self-efficacy

tiate interaction and help their caregivers become more effective social liaisons. The social network visualizations were placed in the homes of both elders and their primary caregivers. The primary caregiver, typically an adult daughter, could monitor her own contact with the elder as well as that of other family members and friends. We expected the display would prompt contact for some caregivers, and that for others it would invite a strategy for redistributing contact and responsibilities among a larger set of friends and family.

A solar system visualization was selected to represent social activity because it is a vital symbol of relatedness. The solar system has an intrinsic structure, but like social interconnectivity, it is always in movement. It is emotionally resonant and visually appealing to people across age, race, gender, and educational and socioeconomic lines. It is a metaphor that we thought would invite attachment and identification, two critical components for adoption. We wanted a visual metaphor that

elders would see as a positive self-reflection and that friends and family, should they see it, would also want to be part of.

The older adult is represented as the sun, positioned in the center of the display. The goal was to present compelling opportunities for elders to draw others into the centers of their worlds. Family and friends rotate around them as planets; their proximity to the sun –updated hourly – was determined by the extent and modality of their contact and their emotional significance to the elder. The planets' inward movement reflected and was intended to reinforce the success of the elderly person's social efforts. The solar display shows current social state and a historical trace: a line between each person's initial and current level of contact with the elderly person at the center.

Friends and family could see themselves in the display and monitor how much time they and others were spending with the elder. We thought that for some, the desire to appear on the display and to move in toward a central position in the display might motivate contact. We wanted these other family members to view the display in their caregiving capacity and also to reflect on their own lives (Fig. 14.1).

To preserve confidentiality and limit stigma, minimal information is conveyed to the casual viewer; details such as names and photos of contacts appear only when a particular planet is selected. Users could toggle between the solar display and several other views, including a line graph (a longitudinal indication of the elder's aggregate contact with everyone in the social network) and a bar graph (showing levels of contact with each person on a given day). Figure 14.2 depicts these three image modalities; a text summary of social activity was also included.

14.3.2 Guideline 2: Provide Windows into Others' Availability

Many elders we interviewed dreaded the idea of burdening their children or other people. Fears of imposing at an inconvenient time often stopped them from making calls. This avoidance, and underlying fear of rejection, often overrode their desire for contact. Analogous dilemmas came from their children, who wanted to feel "in touch" but did not always have time for a long conversation. The children of elders especially wanted the reassurance that their parents were okay and were going about their normal routines.

Cues about others' availability might lower elders' fears of rejection and provide confidence that a phone call or visit would be well received. For their children, indications that their parents are awake and going about their daily activities may provide a piece of mind. Such cues about another's availability can be inferred from sensors or other location-awareness systems. Our work in this area was inspired by the "presence lamp" developed at Interval research (Hindus et al., 2001).

14.3.2.1 Prototype 2: Presence Lamp

We developed a bidirectional presence lamp, linked to sensors and actuators, to provide elders with visibility into the availability of their children and to give children

Fig. 14.3 Presence lamps provide lightweight indicators of wellness and allow elders and their children to signal their availability to one another

a sense of their parents' routines. The caregivers' lamp was activated by a sensor in the elder's home; it switched on whenever the elder sat in his or her typical chair (Fig. 14.3). The elder's lamp switched on when the caregiver pressed a key fob; this was a way of saying "I'm home now," or "It's a good time to call if you want to." Informally we referred to this as "okayness checking" – a lightweight, approximate indicator of someone's state.

14.3.3 Guideline 3: Provide Cues to Foster Mastery of Social Situations

Self-consciousness about memory loss is one of the factors that push elders into isolation. Forgetting names and other critical information creates awkward and painful social interactions. Some described rehearsal strategies such as practicing names while looking at a wall of family photos before a wedding or other gathering, but the critical need, not always aided by this preparation, was for helpful hints at the moment of an encounter. Many relied on a spouse to whisper names or information relayed in recent conversations. The shame and awkwardness related to memory loss may be one of the early reasons that people with dementia shy away from answering the phone or initiating calls. Given that phones are a critical tie to the outside world and inherently smart about participants, they are a logical site for social prompts. Some extremely complex systems have been developed for social prompting, such as Starner's eyewear (Starner et al., 1997), but even simple prompts may have benefit if they are offered at the right moment.

14.3.3.1 Prototype 3: Context ID

We developed an enhanced caller ID application called "Context ID" to facilitate phone conversations. The Context ID prototype displayed an image of the caller, his or her relationship to the elder, and the date of last contact. Calls from the care-

Fig. 14.4 Context ID. Just-in-time cues of the caller's name, face, relationship, and last contact are provided to ease anxiety about recognizing people and starting conversation

giver/study partner were also annotated with highlights of the last interaction, which were pulled from the caregiver's online journal. Incoming calls were matched to a database of names and numbers collected during interviews at the beginning of the study. The visual prompts appeared when the phone rang and remained on the display throughout the call (Fig. 14.4).

These three displays were part of a platform that included wireless sensors: a phone sensor board linked with a caller ID service, mote radios to relay sensor data to an in-home laptop server, and a laptop for social heath displays. The laptop also contained an online journal that we developed for elders to report their social interactions.

14.4 Participant Reactions

We gathered feedback about these systems during a 3-month in-home field study with six pairs of elderly people and their primary caregivers. We conducted case-study evaluations. In an introductory phase, the elder's social activity was measured by an online journal and a sensor platform. During the second half of the study, we continued this sensor and self-report measurement but added the three social health displays described above: the solar-based social network, the presence lamp, and context ID. We interviewed participants at key junctures in the study (specifically during intake, end of baseline, and end of intervention). Following are some emergent themes from these interviews related to self-efficacy and social engagement.

Display preferences: In keeping with self-efficacy theories, people preferred the displays that helped them succeed in their social and familial roles. Most elders preferred the solar display and chose it as their default display instead of either the line graph or the bar chart. They appreciated its circularity and movement and reported using it as a game-like stimulus for family conversation. In contrast, several caregivers expressed a preference for the line graph; one woman explained, "The

solar display tells me more about how much other people are interacting with my mom, but the line graph is what really tells me what she's doing." There was a general dislike of text adaptation of the visual displays. Historical views, trends that required several clicks to activate, were used more by caregivers than elders. These reactions underscore the importance of representing data according to the goals of particular audiences. In general, people seem to like seeing themselves literally at the center of things or having the data depiction centered on their needs and aspirations.

Interest in variability: Elders and caregivers were surprised by the ups and downs in their social activity levels as depicted in the displays. They expressed interest in spotting downward trends early on and intervening to avoid isolation and depression.

Awareness of social needs: Displays drew elders' attention to deficits not only in the amount of social contact but also in the members of their networks. For most, this meant an awareness of inadequate peer contact. By the end of the study, several had made shifts in increasing contact with friends: One elderly woman formed a list of old friends with whom she was going to reconnect, another started intensifying interactions with acquaintances, and another became significantly more socially involved in her retirement community.

Dialogue facilitation: The social displays and lamp sparked discussion about communication patterns with family and friends. As one caregiver explained, the displays provided a shared visual reference and permission to discuss sensitive issues, particularly her mother's lack of peer relationships and passivity in family interaction.

Enthusiasm for Journaling: Enthusiasm for the online journal increased markedly when the three displays were introduced. Participants had used the journal for 6 weeks during the baseline phase of the study and were asked to continue using it once the three displays were introduced. The online social journal was designed as a validation of sensor data, but people typically viewed it as a therapeutic tool. The ability to select photos of social contacts was particularly appealing. For some, mastering the journal built confidence; and anticipating the journaling seems to have motivated social interaction. Increased acceptance of journaling when it is coupled with feedback supports the model of embedded assessment and indicates directions for health technologies to increase self-efficacy.

Mastery of Technology: Participants surprised us and themselves with their ability to use the prototypes. Because the elders of the participant dyads were born before 1938, we expected them to have little experience with computers. To reduce the interface complexity, the keyboard and the track pad of the elder's laptop were covered with an opaque plastic board. Contrary to our expectations, several had significant experience with computing applications. All of the participants, even those without this familiarity, were able to use the interfaces for monitoring and feedback. This use provided a sense of accomplishment. Those with more technical experience rejected the simplicity of the prototype. One participant removed the plastic cover from the keyboard to play games embedded in the operating system and three complained that the limited interface prevented them from email and online chat-

ting. These observations point to the danger of simplified interfaces, which may limit beneficial activities and stigmatize users. They also indicate opportunities for adaptive systems, which expand features based on an individual's use patterns.

Caregiver awareness: The displays also appeared to help adult children become more aware of their roles – be they overburdened or under-active caregivers – and modulate their activity accordingly. Some children who were not terribly active in their parents' care have painful insights after repeated exposure to dips in their parents' social graphs or seeing themselves at the outskirts of the solar display.

Reassurance and lightweight communication: The lamp and displays gave additional information to caregivers who were content with their level of involvement but who wanted additional reassurance about their parent's well-being. Sometimes the lamps prompted a call but other times the presence signals provided people with a feeling of connectedness and intimacy, independently of whether phone calls were made at this time. As one woman said, the lamp "just gave me a warm feeling about her."

Caregiver validation: The displays were most helpful for those adult children who were very actively involved as caregivers. They appreciated the validation of their caregiving activities, and some wanted to share the displays to spark other relatives' involvement. In fact, most caregivers shared the displays with siblings and enjoyed a playful competition about who could be the closest planet (i.e., the best child). Family members made a point of checking their position in the elder's social network when visiting either the elderly relative or the primary caregiver. Some even conducted informal tests to see how much contact would make a perceptible difference in the display. Any system failures in registering phone calls or visits from these relatives elicited strong complaints.

Caregiver self-reflection: Ultimately, the displays sparked new insight among some participants about the significant time and energy they devote to caregiving. One woman explained that seeing her central position in her mom's network made her realize how many areas of her own life she had been neglecting. Consequently, she initiated several strategies to bring other people into her mom's daily life and started scheduling time for her own hobbies and interests. Another woman, who at the beginning of the study insisted that her father was entirely self-sufficient and that she was "by no means a caregiver," began to see how much she was doing for him: "I now realize that I kind of am a caregiver and I feel okay about pushing him to see other people." This perceptual shift was validating: she felt more confident that she played a valuable family role and more energetic about helping her father maintain outside social ties.

14.5 Future Directions

Extensions of this research primarily involve mobility and more elaborate feedback to facilitate social engagement. There was a clear desire among elders and caregivers for systems that worked outside the home and that were accessible to a larger family

or social network. Mobile systems should ideally be able to sense contact in all the places it occurs and provide contextually appropriate feedback. For an older man, a mobile display might show behavioral feedback to motivate him to start an interaction, cues about forgotten names during or just before an interaction, and an indicator of when his daughter or someone else is available to talk (see Fig. 14.5). Another direction that emerged from this research is the creation of tools that help adults in midlife address their own health concerns while staying in better touch with parents. Such feedback for midlife adults could include feedback on emotional and physical health states or time management systems. Several caregivers expressed an interest in something like the solar display that reflected their progress on various activities and goals – one woman wanted to see progress on her reading and how much time she was spending with her husband. Such feedback could converge with caregiving features tested in this study (Fig. 14.6). If such life-optimization applications were adopted in midlife, there is greater likelihood that they could meaningfully assist in early detection and prevention of disease. For, in addition to providing immediate value propositions for health improvement or caregiving, they could help establish personal baselines and show meaningful patterns of change. Emerging technologies can reach vast numbers of people and offer feedback that could enhance self-efficacy with regard to mental and physical health. A project called Mobile Heart Health (Morris and Guilak, 2009) has begun to explore the use of mobile technologies for self-awareness and emotional regulation.

The promises of technology to foster social engagement and self-efficacy have strengthened dramatically in years since the research described in this chapter was

Fig. 14.5 Mobile applications for availability signaling and remote caregiving

Fig. 14.6 Mobile applications for remote caregiving and self-reflection

started. To start, communication technologies such as WiMAX and 700 MHz radio spectrums provide far more pervasive connectivity. WiMAX removes constraints associated with sparse Wi-Fi or poor wired access. The adoption of the 700 MHz spectrum by Google and Microsoft is paving new ground for ubiquitous computing (Kaplan, 2008). Also on the horizon are low-power Wi-Fi radios integrated into embedded systems for sensors and simple information displays. Home health applications of these Wi-Fi solutions have recently been demonstrated by Healthsense (Fuhr, 2008).

Social self-efficacy will be supported by these ubiquitous technologies as well as new interaction models. Tools such as Facebook have normalized social networking across generations. The mobile versions of these applications, e.g. such as those for the Apple iPhone, allow for very frequent updating of geographical and social context. Many elements of context will be captured seamlessly, and other behavioral documentation will require less effort from users than in the past. These tools will permit rich self-reflection and allow people to view the daily activities of others in their social networks with little restriction (Merrit, 2008). Ideally these tools will evolve to encourage people to share select types of information with the relevant clusters of people in their networks.

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