Catalyzing Social Interaction with Ubiquitous Computing: A needs assessment of elders coping with cognitive decline

Margaret Morris, Jay Lundell, Eric Dishman
Proactive Health, Intel Research
JF3-377; 2111 NE 25th Ave Hillsboro, OR 97214
Margaret.morris@intel.com
(503) 712-1374

ABSTRACT
This paper describes design directions for ubiquitous computing to facilitate social interaction. The study focuses on elders coping with cognitive decline and their caregivers, but it is expected that the concepts will have much broader applicability. Social needs and barriers were examined in a qualitative study of 45 households across the U.S. Directions for ubiquitous computing concepts are outlined to address these social needs and barriers. Two example concepts, an ambient display to facilitate joint activity and a social memory aid, are described in detail. An underlying principal of these design directions and concepts is the use of computing technologies as catalysts rather than substitutes for human relationships. These concepts are part of an integrated system of home health technologies under development in a multiyear "aging in place" study.

Author Keywords
Ubiquitous computing, health, elders, social interaction.

ACM Classification Keywords
H5.2. User Interfaces: Evaluation/methodology, user-centered design.

INTRODUCTION

Throughout the lifespan, supportive social relationships have demonstrated value for psychological and physical well being [15,17]. Social support has been shown to influence everything from the common cold to the incidence and progression of cancer [1,4,18,19]. Of particular interest to our current work are longitudinal studies demonstrating that close social ties play preventative role in the development of dementia [2,7]. Aging is generally associated with a restriction rather than an expansion of the social ties that confer these benefits. Although relational pruning in later life may sometimes be an adaptive strategy [8], it is clear that in many cultures older people have fewer relationships and fewer occasions for spontaneous contact than younger people [11].

The need for social connectedness among older adults signals opportunities for technology development, particularly ubiquitous computing. Examples of technology substitutes for human interaction span from the classic example of ELIZA, the chatterbot developed in the 1966 to mimic Rogerian psychotherapy [21], to SONY's robotic dog and humanoid robot. One shortcoming of such efforts is that they don't invite human interaction or strengthen individuals' social networks. Examples of home and personal interfaces developed to enrich interpersonal communication include the Georgia Tech picture frame [14], the "Floral Display" from Media Lab Europe's Human Connectedness group [5], Paulos' Connexus [16], Interliving's shared calendaring and video frames [3,10], the ScanBoard and Intentional Presence Lamp from Hindus' Casablanca project [9], and the seminal awareness displays of Strong and Gaver [20].

Like the projects above, our research strives to enhance interpersonal relationships through distributed computing. Thus, the concepts that emerge from our research not only mimic human models of caregiving, but when possible also catalyze and support social connection. Our work extends previous research by focusing on the significant social needs of a particular population – cognitively impaired elders and their caregivers. Our goals were to assess the specific social needs of this group, determine design directions that aligned with these needs, and generate appropriate concepts for ubiquitous computing technologies that would ultimately function within a home health system.

METHODS

Procedures

To understand the relational needs and barriers of elders with cognitive decline, we conducted focus groups, contextualized interviews and extended observations. Focus groups were conducted with elders, their family members, and their medical caregivers. Contextualized interviews were conducted in the home with all available members of a household. Interviewers mapped out participants' social

CHI 2004, April 24–29, 2004, Vienna, Austria.
ACM 1-58113-703-6/04/0004.

networks – identifying the participants' key contacts, the roles of each, the frequency and channel of contact, and changes in contact since the onset of illness. Several extended observations were conducted with elders and health care specialists.

Participants

This initial U.S. based study included participants from New York, Florida, Oregon, Washington, and California. Interviews and focus groups were conducted with cognitively impaired elders, caregiver spouses, family members, and professional caregivers. In total, we conducted 45 household interviews and seven focus groups. Of the household interviewees, ten were healthy elders, seven suffered from mild cognitive impairment, twenty-five were in various stages of dementia, and three were family caregivers of deceased dementia patients. Of the focus groups, one was with healthy elders, two were with mild cognitive impairment elders and spouses, two were with dementia patients and their spouses, and two were with professional caregivers. Participants ranged in age from 56 to 97. The majority of our interview participants lived with a spouse, but some lived alone. Households ranged from urban, to suburban, to rural, with broad span of socioeconomic status; nontraditional households (siblings, friends, unmarried couples) and elders living in senior living environments were also represented.

RESULTS

General Benefits of Social Connectedness

Our observations echo previous findings on the benefits of social connectedness. Supportive contact from friends and family appears to greatly ameliorate the pain of cognitive decline for both afflicted elders and their caregivers. Those elders with close contacts inside and outside the home expressed more life satisfaction and optimism than those who were more isolated. The value of social capital was expressed by Carl, a man with modest financial resources, who exclaimed "I am a rich man, I have three daughters."

Needs: Critical Features of Social Connectedness

The specific social needs of cognitively impaired elders are far ranging. Each household has unique interpersonal dynamics and challenges. Nonetheless, we found consistent expression of three general social needs – for reciprocity, diversity, and extensiveness in social relationships. The design implications of each are explored later in the paper.

Reciprocity

Most participants expressed a strong desire for reciprocal relationships in which they help or in some way have an impact on others. When opportunities to influence other people were taken away, many experienced a loss that was extremely difficult to fill. A poignant example is a man who was asked to stop teaching because his lectures became highly repetitive and at other times incoherent. His identity is tied to seeing himself as an intellectual who develops the minds of others – something which he no longer has opportunities to do.

Diversity

Elders in our study valued heterogeneity, especially of age, in their social networks. One participant described a visit to a friend's retirement home, "It was ghastly … all old people, walkers and oxygen tanks … no young people, every one was very very old… not my idea of a way to live." Another, a retired attorney and avid cyclist in her late sixties, described recruiting friends and cycling partners from age 30-90. She enjoys their different perspectives and finds role models in people vastly younger and older than herself. Another participant said she that expects her strength in old age will result from continually adapting to diversity: "…keeping a connection with a huge span of different aged people, so that I'm not locked in to a certain way of thinking."

Extensiveness

To a certain degree, the sheer number of social ties is valuable. Couples who relied almost exclusively on each other for support seemed most vulnerable to the stress brought on by cognitive decline. This relational style was common among those who refused to acknowledge cognitive decline or tried to conceal it from outsiders. Those who acknowledged the impairment were often able to retain ties and build new connections with people in similar struggles. For example, many of our participants found crucial support and new friendships through Alzheimer's Association support groups.

Barriers: Threats to Social Connectedness

Cognitively impaired elders and their caregivers encounter major barriers to the social needs outlined above. Some of these barriers are symptoms of the impairment itself, such as losing track of conversation and forgetting, while others, such as fears of imposing on others, are psychosocial reactions to the impairment.

Losing Track

The delayed information processing involved in cognitive impairment makes it hard to follow and participate in conversation. Words simply flow too fast for meaning to register. Many said that they withdraw during social events and ask their spouse for a synopsis afterwards. "What's hardest for me is not being able to understand and communicate with people …I'm continually asking questions. I try to avoid that – I wait and ask her later."

Forgetting

Impaired memory greatly strains the cognitively impaired elder's attempts to maintain a social network. Failing to recognize people and remember their names or important personal information causes awkwardness and anxiety. A compelling example is provided by Ben, a small business owner with rapidly advancing Alzheimer's Disease. His inability to remember names of longstanding clients, along with other important information, threatens his livelihood as well as his social confidence. Anxiety about recognizing people and remembering names causes many elders to avoid social events and even stop answering the phone.

Fears of Imposing

Most of our participants expressed great reluctance to impose upon others. Such hesitancy may be exaggerated among this population because cognitive impairment is not well understood. Explaining her current isolation, one spouse-caregiver said, "We have a few friends … but even those few don't come around anymore…for some reason, people don't know how to deal with this situation." In attempting to hide the illness, many cut themselves off contact from possible sources of support. Regardless of disclosure, many hesitate to initiate impromptu social contact due to fears of interrupting or burdening others.

Design Directions for Catalyzing Social Connectedness

The social needs and barriers experienced by cognitively impaired elders and their caregivers suggest distinct design directions. General design guidelines to support needs of cognitively impaired – supporting early detection, adapting to variability, catalyzing social relationships, and leveraging familiar interfaces -- are described in Morris et al. [12].

The first social need – for reciprocal relationships – suggests that technology should enable bi-directional communication that is experienced as sharing rather than monitoring. The same information need not be shared by both parties, but there should be an exchange. For example, an adult child may want to know that her mother has gotten dressed and retrieved the newspaper, while her mother may want to know that her daughter arrived safely to work. We use the term "Okay-ness checking" to describe a glimpse into a particularly salient aspect of another's experience. One activity serves as indicator of the other's wellbeing.

Next, the need for diverse relationships suggests that communication technologies should connect elders with others across a wide array of ages, ethnicities, cultures, socioeconomic strata and regions. Similarly, needs for extensive social networks indicate that computing should help helping elders strengthen their existing relationships and establish new lines of communication.

Social Needs	**Features**
Reciprocity	Bi-directional presence and "Okayness checking" displays
Diversity	Support for communication across demographic divides
Extensiveness	Catalyzing interaction with broad networks; supporting formation of new relationships
Social Barriers	
Difficulty following conversation	"Pace control" to replay missed segments of conversations
Forgetting names and faces	Memory cues that help performance and ease anxiety
Fears of imposing	"Opportunity hunting" – detecting good times for people to connect.

Table 1. Design Directions

The particular barriers encountered by households coping with cognitive decline also point out design ideas and directions. Trouble following conversation inspired a concept we are calling "pace control." Like a TiVo for everyday life, pace control would allow elders to catch up on what they've missed during naturally occurring breaks or other conversational "commercials." Trouble remembering names and other important social information suggests the value of personal memory stores that could offer reminders during or before social situations (see example concept below). Fears of imposing on others could be ameliorated by systems that identified moments when others were available (see example concept below).

Example concepts (from [12])

Social synchronizer for activity companions

This prototype is intended to facilitate and synchronize spontaneous joint activity. The system signals opportune moments for companions to join each other. In the example of walking partners, the system recognizes that one person is about to leave her home and signals the other the opportunity to join her. In another scenario, the system notifies the companions when both are at periods of low activity. The activity trending information and prompting appears on the interface of choice – the TV screen, a clock radio or a wind chime. This same "opportunity hunting" technology principle could be used to facilitate other forms of socializing, by helping people know a good time to call someone for a phone conversation or impromptu dinner. Regardless of the specific activity, the goal is to provide reassurance that the other person is available and likely to accept a bid for social contact.

This prototype consists of activity tracking sensors that detect and log activity in the household, an inference engine for detecting activities and deciding on appropriate responses, and an intelligent network of household objects and appliances for interacting with elders. Sensors are connected with motes – small, relatively inexpensive wireless processors that can be positioned nearly anywhere and automatically configure themselves into an ad hoc network. 3D tracking is implemented via infrared cameras that detect an infrared beacon worn by the elder. Multiple cameras triangulate on the infrared beacon to determine location within the household. Movement throughout the house is logged into an activity database.

Social memory aid

This concept allows healthy or mildly impaired individuals to practice name and face recognition. The rehearsal is designed to decrease social anxiety and provide ongoing cognitive assessment [13]. To practice, the elder selects tangible photos which link up with a rich media database of personal contacts. Questions and clues about the person in the photo are presented on a TV screen or other familiar interface. Our lab and partners are exploring portable interfaces (wearable forms such as watches, glasses and hearing aids) to offer on-the-spot help with person recognition.

This prototype includes RFID tagged photographs, an RFID reader and a media database. The application progressively reveals hints from the media database according to the user's needs during to a particular session. Data from each session, such as the number of hints required, whether or not the hints are helpful, and the response time, are stored and trended over time.

CONCLUSIONS

This needs assessment research extends our understanding of how ubiquitous computing can enable social connectedness for people at great risk of isolation and consequent health problems. The social needs of older adults, particularly those with illnesses that threaten communication abilities and mobility, demand innovative solutions. Everyday objects, from hearing aids and watches to alarm clocks and refrigerator doors, can serve as computing surfaces to help these individuals sustain ties to their communities [6]. The concepts and features laid out in this paper provide examples of how ubiquitous computing and everyday objects can catalyze and support social interaction. The challenges are to integrate these and other home health technologies and deploy them in actual homes. Our upcoming in-home prototype testing and integrated trials will be assessing the livability and effectiveness of such systems.

REFERENCES

1. Antonucci, T.C. Social support influences on the disease process. *Mechanisms of psychological influence on physical health: With special attention to the elderly*, Plenum Press, New York, NY, USA, 1989, 23-41.
2. Bassuk S.S., Glass T.A., Berkman L.F. Social disengagement and incident cognitive decline in community-dwelling elderly persons. Ann Intern Med (1999) 131: 165-173.
3. Beaudouin-Lafon, Michel, et al. InterLiving deliverable 1.2 & 2.2, Co-design and new technologies with family users (2002) http://interliving.kth.se/papers.html.
4. Cohen, S. Social relationships and susceptibility to the common cold. *Emotion, social relationships, and health. Series in affective science*. Oxford University Press, London, UK (2001), 221-233.
5. Cullinan, C. Floral Display. http://www.medialabeurope.org/hc/projects/one2one/.
6. Dishman, E., Matthews, J. T., Dunbar-Jacob, J.: Everyday Health: Technology for Adaptive Aging. *National Research Council Workshop on Adaptive Aging*. January 23-24, 2003.
7. Fratiglioni L., Wang HX., Ericsson K., et al. The Influence of Social Network on the Occurrence of Demenia; a Community-based longitudinal Study. *The Lancet*. London, UK (2000) 355(9212), 1315-1319.
8. Fredrickson, B.L., Carstensen, L.L. Choosing social partners: How old age and anticipated endings make people more selective. *Psychology & Aging* (1990) 5(3), 335-347.
9. Hindus, D. Mainwaring, S.D., Leduc, N. Hagstrom, A.E., Bayley, O. Casablanca: Designing social communication devices for the home. SIGCHI (2001) 325-332.
10. Hutchinson, H., Bederson, B.B., Druin, A., Plaisant, C., Mackay, W., Evans, H., Hansen, H., Conversy, S., Beaudouin-Lafon, M., Roussel, N., Lacomme, L., Eiderbäck, B., Lindquist, S., Sundblad, Y., Westerlund, B: Technology Probes: Inspiring design for and with families. CHI 2003.
11. Lansford, J.E., Sherman, A.M., Antonucci, T.C. Satisfaction with social networks. *Psychology and Aging* (1998) 13(4).
12. Morris, M. Lundell, J. Dishman, E, Needham B. New perspectives on ubiquitous computing from ethnographic studies of elders with cognitive decline. *Proc. Ubicomp* (2003), 227-242.
13. Morris, M., Lundell, J., Dishman, E. Ubiquitous Computing for Mild Cognitive Impairment: A Prototype for Embedded Assessment and Rehearsal. *Proc. Gerontology Society of America* (2003), 393-394.
14. Mynatt, E.D., Rowan, J. Cross-generation communication via digital picture frames. *Proc. IFIP WG 9.3 International Conference on Home Oriented Informatics and Telematics (HOIT 2000)*.
15. Palinkas, L.A., Wingard, D.L., Barrett-Connor, E. The biocultural context of social networks and depression among the elderly. *Social Science & Medicine* (1990), 30(4), 441-447.
16. Paulos, E. Connexus: A communal interface. *Dux 2003 Case Studies,* http://www.aiga.org.
17. Sarason, I.G., Sarason, B.R, Pierce, G.R. Social support, personality, and health. *Topics in health psychology*. John Wiley & Sons, Oxford, UK (1988), 245-256.
18. Spiegel D., Bloom J.R., Kraemer H.C., Gottheil E. Effect of psychosocial treatment on survival of patients with metastatic breast cancer. *The Lancet* (1989), 2(8668), 888-891.
19. Spiegel D., Kato P.M. Psychosocial influences on cancer incidence and progression. *Harvard Review of Psychiatry*, (1996), 4(1),10-26.
20. Strong, R., Gaver, B. Feather, Scent, and Shaker: Supporting simple intimacy. In Videos, Demonstrations and Short Papers of CSCW'96 (1996). ACM Press, 444.
21. Weizenbaum, J. ELIZA – A computer program for the study of natural language communication between man and machine. *Communications of the ACM*, 1996 9(1).