

# Independence and Interaction: Understanding Seniors' Privacy and Awareness Needs For Aging in Place

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## ABSTRACT

As America's baby boom population gets older, aging in place — the idea that seniors can remain independent in a comfortable home environment while being monitored and receiving care from family and caregivers living elsewhere — has received significant attention. Fostering a sense of independence while simultaneously enabling monitoring and frequent interaction can seem paradoxical, however. This raises questions of how we can design technologies that help seniors retain their independence and a sense of comfort, while still interacting with and being monitored regularly by others. We present results from an interview study of 30 seniors, caregivers and relatives in which we sought to understand how they managed their interactions, availability, privacy and independence. Results suggest that they rely on attributes of the physical environment, temporal structures such as routine conversations and activities, and technological mediation.

## Author Keywords

Awareness, privacy, seniors, aging in place, home.

## ACM Classification Keywords

K.4: Computers and Society: Assistive technologies for persons with disabilities

**General Terms:** Human Factors, Design.

## INTRODUCTION

According to the 2007 US Census American Community Survey, 15% of Americans (nearly 45 million individuals) are age 62 or older [4]. Caring for all of these seniors as they age will be a critical problem that has garnered significant research attention both within the CHI community (e.g., [5, 23]) and more broadly (e.g., [9, 22]).

Given that many seniors wish to remain independent and live in their own homes, there has been a particular focus on

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technologies to support “aging in place” [19, 23]. Aging in place allows seniors to remain in a comfortable home environment, typically while receiving care and monitoring from others living outside the home.

These systems can be as advanced as “smart homes” instrumented with cameras and sensors [9] that allow doctors, caregivers and relatives to monitor seniors' activities [7] and check for evidence of potential problems [15, 22], which can then be conveyed to doctors, relatives and caregivers via ambient displays and visualizations [7, 23]. This allows for notification of potential problems or crisis situations, or simply knowing that everything is fine.

While aging in place allows seniors to maintain a sense of independence and to remain in a familiar environment, both of which are often desirable, it is important that they also be able to interact with others [10]. Communication, after all, serves as a foundation for social relationships [13] and can help seniors avoid the sense of isolation that often leads to loneliness and possible depression [29, 32].

The simultaneous desire for the sense of independence that comes from being “in place” and the need for interaction that can reduce social isolation creates something of a paradox. Indeed, many of the technologies that enable aging in place, such as monitoring and cameras, may seem to invade privacy and do so in the home, an environment where privacy issues can be particularly sensitive [26]. One open question, therefore, is how these seemingly conflicting behaviors can be supported with technology.

In some key ways, this relationship between independence and interaction is similar to the tension between privacy and awareness that has been the subject of much CSCW research and discussion (e.g., [2, 3, 14, 18]). A second open question, therefore, is if there are lessons from this CSCW literature that can be applied to aging in place, and if better understanding seniors' needs for aging in place can contribute to our understanding of privacy and awareness.

In the paper that follows we present results from an interview study of how seniors and caregivers manage these tensions and tradeoffs in their day-to-day lives. Our results suggest a complex relationship between independence and interaction in which seniors' sense of independence stems largely from the possibility of interaction with others. In managing their

independence and interactions with others, they rely on aspects of the physical environment, temporal structures such as routines, and technologies that can help them mediate and avoid interactions.

### BACKGROUND AND LITERATURE REVIEW

There is significant interest in using technology to enable “aging in place” [23], that is allowing seniors to remain independent and in their homes [19]. Aging in place can allow seniors to retain a sense of independence, as well as reduce the significant costs associated with assisted living or long term care scenarios. There are two general ways that technology can be useful here.

#### Monitoring and Sensing

While seniors may wish to maintain independence by staying in a familiar and comfortable home environment, they are also vulnerable to possible illness or a range of other emergency situations such as freak injuries or accidents that may impede their movement or ability to care for themselves [30]. Thus, their relatives, doctors and caregivers often want to speak to or get information from them to make sure that there are no problems [22].

One way to convey information about the senior’s status while still allowing them to maintain significant independence is via unobtrusive or ambient/ubiquitous sensing technologies that allow for apparent independence, but send information from the senior or their home to interested parties on a regular basis [9].

One stream of research in this area has focused on using environmental sensors for unobtrusive home monitoring via gathering information from the senior’s environment [33]. Examples of these systems have included sensors that monitor water consumption to detect abnormal usage patterns (i.e., a lack of toilet or sink usage at expected times) [15], temperature sensors to detect possible anomalies or emergencies [5, 28], and using computer vision algorithms and cameras to identify people in compromised, prone or otherwise unusual situations [9, 22].

Once collected, this sensor information must be aggregated and displayed in a manner that allows distant caregivers and family to notice either that everything is fine, or that something may be amiss. To allow for this monitoring, several ambient display systems have been developed, such as the digital family portrait [24], and mobile and other ambient display systems that have been shown to increase the sense of connection and peace of mind [7]. Others have developed systems for connecting with family members generally, including those both young and old [31].

An alternative approach to this problem is to allow seniors to wear a device that enables them to explicitly signal trouble, so that caregivers and emergency personnel can be notified immediately.

While these technologies allow for peace of mind and crisis aversion, there is more to maintaining a relationship with older relatives than sensor data.

#### Explicit Communication and Interaction

Regular and often mundane social interaction between individuals generally has been shown to improve the quality and strength of relationships [13], reduce loneliness and isolation, and also allow distant family members to stay close with one another [21].

In supporting communication between seniors and their family, videoconferencing was shown by Demiris and colleagues to positively impact the relationship between seniors in long term care facilities and their distant family members [10]. In particular, participants were enthusiastic about the sense of closeness the system fostered, and also expressed feelings of reduced guilt about not being able to visit as often as they might like.

Even as these technologies help to maintain relationships, however, they can be interruptive both for seniors and their distant relatives. Seniors have unique needs and schedules. They may not always feel energetic or may have other commitments [10]. Their relatives are also likely busy and have schedules of their own [25]. Just as is true in other social and work settings, it may be difficult to find a mutually convenient time to talk.

This confluence of research streams presents an important bridging opportunity. That is, ambient and environmental display information could be used not only to see if a senior is not in a state of crisis, but also to assess their availability for interaction, and vice versa [11]. When one sees an ambient display about a relative and is thinking about that person, they may also wish to talk to that person and want to know if they are available.

#### Bridging the Gap: Awareness and Privacy

Bridging the gap between ambient awareness and interaction systems requires consideration of the classic tension between privacy and awareness [18]. On the one hand, awareness information from sensors gives us a general idea of the status of a person, but may not say whether or not now is a good time for them to interact. Moreover, emergency monitoring systems can allow for immediate interaction when it is necessary, but are not suitable for everyday interaction. And interaction technologies allow people to talk, but don’t allow people to know if now is a good time or not.

As has been suggested before, these problems can be mediated by sharing more detailed awareness information and allowing for virtual “approaches” in interaction [34] and the gradual initiation of interaction [2].

Allowing for virtual approaches has been a significant issue in studies of informal workplace interaction. We know from this literature that awareness information can be useful to assess the presence and availability of others e.g.,[20], and

that people, particularly when motivated to do so, use this information to time their interruptions [8].

Moreover there has been some limited research on the use of ambient/unobtrusive sensors to provide information about what people in offices are doing [16] and if they are available or not [1], as well as providing this information via video cameras in media spaces (e.g., [12]).

In understanding how the awareness/privacy tradeoff is managed in open-plan offices that provide little explicit privacy, Birnholtz et al. [2] introduce the notion of attentional legitimacy. By this, they refer to what is it considered socially acceptable to pay attention to in assessing others' availability.

While these findings likely have some application to the situation faced by socially isolated senior citizens, there are some important differences. As Neustadter and Greenberg [26] suggest, video and awareness information more generally can be particularly invasive when people are in their homes, a sometimes socially sensitive location in which a far greater range of private activities takes place than in the typical office. In other words attentional legitimacy varies with context, and privacy is a significant concern of seniors considering sensing technologies [9].

To address these concerns and design technologies that can have active benefits, we need to know more about their specific context. Such lessons about their context are likely to be useful in two respects. On the one hand, they can help us design technologies to improve the capacity for aging in place, for which there is significant need.

On the other, Newell and Gregor [27] point out that the needs of ordinary users can often be better met and understood by studying the needs of extraordinary or users in special circumstances. We believe that improving our understanding of how seniors balance their need for independence and privacy with the need for interaction can shed light on how to address this problem more generally.

### THE PRESENT STUDY

This study seeks to answer these questions via interviews with seniors, remote family members and caregivers. In particular, we were interested in how seniors balance their desire for independence with the need to interact, and how caregivers and relatives help them do this. We specifically asked them about:

- Where do they live, and what are the properties they like about their environment?
- With whom do they speak on a regular basis? What do they talk about? Do they wish they could talk more or less? When do they talk? How do they coordinate their interactions?
- How do they communicate their desire to interact or not interact at particular times, or with particular people?

With answers to these questions we hope to inform the design of systems that bridge the gap between unobtrusive sensors and ambient displays, and real-time interaction technologies such as telephone and videoconferencing.

### Participants

Thirty people participated in this study between January and July, 2009. These included 11 seniors (3 Male, 8 Female;  $M$  age = 74,  $SD$  = 7.9), 10 professional program workers or caregivers (0 Male, 10 Female;  $M$  age = 40,  $SD$  = 13), and 9 family members (1 Male, 8 Female;  $M$  age = 58,  $SD$  = 13). We did not intend to overrepresent females, but we believe this reflects both life expectancy trends in that women are more likely than men to outlive their spouses and that females are traditionally more likely to take on caregiving responsibilities and work roles.

Participants were recruited via fliers posted at local senior activity centers and organizations, a caregiver email listerv from our university, already established contacts at various organizations providing care to seniors, and snowball sampling. In one case, we spoke simultaneously with a senior as well as her remote caregiver, and in one other case, spoke simultaneously with both a family member and caregiver of a senior. Aside from those two instances, all interviews were conducted one-on-one. All participants lived in the area surrounding our university, which is a combination of rural and small cities.

### Procedure

All interviews were conducted in the participant's work or living space. All interviews were conducted by one of the authors and they were semi-structured in nature. Interviews lasted an average of 30-60 minutes and they followed an established protocol. The protocol was iteratively refined as the first few interviews progressed. The order of items was sometimes changed to accommodate the flow of conversation, and to accommodate the different roles of each participant. Participants were asked about their daily routine, who they speak with on a regular basis, what they talk about, if there are times when they prefer not to speak with others, their preferred modes of communication, and how they go about managing their interactions and availability. Similar protocols were used for all three types of participants, but, for caregivers and relatives, the focus was on interaction with the seniors they care for (as opposed to their interactions more generally).

### Data Analysis

All interviews were recorded and fully transcribed for analysis. Data analysis generally followed a grounded theory approach [17]. Both authors carefully read and re-read the transcripts using constant comparison, making notes throughout and independently listing important themes. Conversations throughout this process aided iterative open coding, and much of the data were initially coded using the open source WEFT Qualitative Data Analysis Software.

WEFT allows for the management of transcripts and the coding of segments of these transcripts into a tree of hierarchically arranged categories.

As this process progressed, the categories were expanded and refined. The data were re-coded to fit the latest scheme, again using the WEFT software. Compilations of transcript-fragments representing the different categories were reviewed for coherence, and these were then used in selecting quotations to use in the paper. While it is unclear whether we reached true theoretical saturation, there was clear repetition in what our participants told us by the end of the data gathering and analysis, and we feel that we have sufficient data to make exploratory claims. The themes identified in coding are used in presenting the results below.

## RESULTS

The presentation of results reflects the categories we developed in coding the data. In particular, we argue that participants relied on a number of strategies for balancing the tension they felt between the need for independence on the one hand (privacy) and their reliance on others (awareness) on the other. They accomplished this using several structures, including physical attributes of the environment, temporal structures and routines, and technological mediation.

### Using Physical Features: The Environment

The first thing we noticed was that our participants live in a wide range of settings, ranging from their own homes to assisted living facilities or with family members. Regardless of the setting, however, virtually all of the seniors placed significant value on their independence, even in settings where one would not necessarily expect them to feel independent. In doing so, they draw on both tangible and intangible attributes of the environment

#### *Tangible Attributes*

Several factors contributed to their sense of independence at home. One of these was the presence of familiar locations and people, and their ability to use attributes of the environment to regulate interaction. As Joseph (a pseudonym, as are all subsequent proper names), a senior who lives in a home with his wife, pointed out:

one of the things that we really like about living in town is having people around... We have a porch; if you sit out on the porch in the late afternoon and have a gin and tonic, on a hot day, people come by and they talk to you, you talk to them, you invite them up on the porch. It's nice! (Senior)

Joseph's experience highlights the sense in which their home has both public and private spaces that can be used in balancing the need for privacy with a desire for interaction. Sitting on the porch serves as an implicit signal to neighbors and passers by that Joseph is available for interaction, and his invitations render this message explicit. In this way, sitting

on the porch is a mechanism by which Joseph can manage how much he interacts with others.

The same was true even for participants who lived in assisted living facilities, who noted that they could go to common spaces when they desired interaction with others, and stay in their rooms when they wanted to be alone.

A familiar environment also allows for easy coordination with and the establishment of regular activities with nearby friends and relations. Shirley notes that:

Usually, yeah, weekends I do something with my daughter and my son-in-law. We go to <nearby town> and we shop lots of different places. Maybe go to the Army and look around and have fun doing that. And on Sundays, I usually make dinner for my family and everybody comes over. (Senior)

Rose, another senior who lives in her own home, said that:

I have a, I have some friends like from a lot of different places. Like I have, there's a few people in this building that we go out with kind of. There's people from our synagogue that are friends from way, way, way back, and those are the people we probably go out with socially the most. I also have one kid in town. I see them. (Senior)

Both of these experiences highlight a common sense among participants that a familiar environment gave them the option to interact with close friends and family on a regular basis. They seemed to take comfort in having options; knowing that interactions would happen or were possible.

#### *Intangible Attributes: Familiarity & Comfort*

One goal of both seniors and caregivers was giving seniors a sense of comfort that can augment their independence. Independence without social comfort, after all, is akin to loneliness. Tracy, a professional care worker, expressed her desire to do this:

You lose friends; you lose spouses. So, it's not necessarily like so much difficult functioning in society, but society kind of gives up on you at a certain point, unfortunately in our society particularly. (Care Worker)

Remaining in a familiar environment helped to give several participants a sense of security and connection to past memories. Sally, a caregiver talked about her mother's desire to stay at home:

She hung onto her house for a long time because she didn't want to give it up. That was the house she lived in with her second husband and she was totally, absolutely head-over-heels in love with him and he was a wonderful man. She just didn't wanna be anyplace else. But the house was getting old and it was wearing on her pocketbook, it was wearing on her health. It was a lot on her mind. And that's a hard

thing to do, to try to talk them into giving up a home like that, and she didn't wanna hear that very often either, but she finally faced the fact that she had to do it. (Family caregiver)

Sally's experience reflects another issue, which is that it often fell to family to try to suggest options, but seniors were generally perceived to be in control of their situation by both the seniors and the caregivers. Their decisions about where to go were sometimes based on a desire to be in a familiar environment, but sometimes they opted instead to be with familiar people in an unfamiliar space. Judy described how her parents made an unexpected choice that had a significant impact on the rest of the family:

I'd say, about six or seven years ago when my parents still lived in Pennsylvania, I strongly encouraged them to look at continuing care communities. I collected all kinds of piles of information and packets. There were some very nice continuing care communities in their area in Pennsylvania. But instead of doing that, they decided to move to Tennessee so they could be closer to my sister so that she could care for them, and now she's getting more than she bargained for. (Family caregiver)

What all of this suggests is that various tangible and intangible elements of the environment help seniors balance their independence with the need for contact and interaction. Tangibly there are physical spaces that serve as indicators that they are available for interaction or might desire privacy, as well as proximity to friends and family which can facilitate routine activities (see below). Intangible attributes include a sense of connection to the past and a familiar environment.

### **Building Temporal Structure: Routines**

In addition to properties of the physical structure of their environment, seniors and caregivers also relied heavily on temporal structures such as routines to help balance each others' needs for independence and information. Sometimes this was effective, but we also noticed some problems as we will report below.

#### *Routine Interactions: Knowing they're ok*

It was clear from our data that both seniors and those who care for them know that the seniors are in a vulnerable state. Leslie, for example, talked about an experience of a friend of hers who was injured and had trouble calling for help:

I had a friend who fell out in her yard. She wasn't old, she fell off a ladder and broke her, um, tibia, absolutely cracked the hell out of it here because she came straight down on it. And uh, she crawled in the house, but her phone was on the wall. (Senior)

Judy, who helps care for her aging parents several hundred miles away, was also acutely aware of their health issues:

Both of them have had hip replacements. Dad has had a knee replacement. Dad has a pacemaker. Dad has type II diabetes. Let's see, what else? And Mom has some kind of early dementia. (Family caregiver)

These vulnerabilities mean that everybody derives some satisfaction from having some sort of routine in place to know that the senior is okay. Routines for this purpose took several forms.

One was a daily routine for simply knowing that things are as usual. Marilyn talked about how her mother sends her an email each morning as part of the daily routine:

And she sends me an email in the morning, along about 10 o'clock, to let me that she's up and that she's feeling well and she's OK.... And <my brother> walks the dog at eight o'clock. So then, after that, I get the message at like 10 o'clock. Between 10 and 11, the message comes in. And if I don't hear from her between 10 and 11, then I'm calling my brother to make sure she was OK at eight o'clock when he was there. (Family caregiver)

Marilyn's experience highlights how routine can be used to preserve privacy. As long as Marilyn hears from her mother between 10 and 11, she respects her mother's independence. When this routine is violated, however, this serves as an implicit license to inquire for more information – and slightly change the balance between independence and awareness.

The same is true in the opposite direction. Violation of routines and norms surrounding communication can serve as a cause for concern, of which both seniors and their caregivers are aware. Sally described how calls late at night can be a cause for concern, and how her mother knows this:

She knows. Yeah, she knows. And sometimes the phone rings in the middle of the night because of problems that she's had in the past with her lung cancer surgery and stuff like that, makes my heart go pitty pat a little bit because, yeah, that worries me a bit. And she knows that. (Family caregiver)

#### *Routine as Coordination*

A second role played by routine interactions is coordination. Routine here allows people with busy schedules and many obligations to have a regular time when they know they will be able to interact. It also allows seniors a way to know they are not burdening their caregivers with excessive interaction. Many seniors expressed concern about not wanting to bother their family. David, for example, said that:

I let them seek out a comfort level, that it's comfortable for them given their busy lives. They certainly know that I'm interested in their lives. But it's primarily governed by special events. (Senior)

He went on to express particular concern about bothering relatives via their cell phones:

I normally don't try to catch my family on their cell phones. I'll usually call the house because they're very busy...I don't want to interrupt their routines. (Senior)

Joseph also expressed concerns about bothering his son:

I may be ready to go to bed by the time it's possible to reach our son. And if we want to reach him, we don't want to bother him at work. (Senior)

Some caregivers also mentioned difficulty finding time to talk to their aging parents, who may not be in complete control of their schedules. Nancy said that:

She takes a nap generally right after lunch. It's generally somewhere between 1:00 and I'll say 2:30. I never know the length of it. So I don't call during those times. I can call after those times or right after supper, or even through right up to eight, and there have been times when I've called, and they have taken her up to her room upstairs and they're getting her ready for bed. (Family caregiver)

In addition to establishing times when caregivers and family would be available, routines also served as a way for caregivers to know that seniors will be expecting a call when the caregivers are likely to be available. Judy, for example, said that:

It's just become a habit that I call on Sunday afternoon. And so they're usually expecting a call. (Family caregiver)

Diane also said she had a routine and talks to her parents often: "I talk to them the same amount. I probably talk to them at least once a day."

Judy noted further that the conversation itself followed a sort of routine from which both she and her mother derived some comfort. Note that the point of this interaction is not an update on her parents' condition (for which, as she says, she relies on her sister), but to have a routine and comfortable interaction with her mother:

I usually rely on my sister to tell me how she's doing. But I always ask her if she and Dad have been to their exercise classes during the week, and if their caretaker has come over. And since I usually talk to her on Sundays, I ask if they went to church that morning, and she usually says, "No." (Family caregiver)

In these ways, having routine times, and sometimes topics, for interaction serves several functions. For seniors it allows for independence while still knowing that they will be able to talk to their family and maintain those important relationships without straining or burdening them. For caregivers and family, talking regularly seemed to be a source of comfort and reassurance, as well as a way to mediate their own tensions between caring for a senior and other demands on their time.

In discussing other demands on caregivers time, it is also important to note that the extent and duration of these routines varied widely among the caregivers we spoke with. When Vera describes how her routine was disrupted by her own illness, her substantial commitment to many routines is highlighted:

I stop every morning on my way to the bus to come to work. I have to walk right by her house to and from the bus stop, so I stop on the way to work and on the way home from work. And I was going over every evening and watching Jeopardy with her and helping her get ready for bed. But then I got sick and my doctor said I needed to stop doing that. So in recent weeks I have not been going over except to check on her in the morning and at night, and on the weekend I'm in and out doing the laundry and taking that over for her and getting groceries for her, and stopping by with that. So unfortunately our meaningful time together has been limited by my health issues because I can't stop doing the other things that need to be done. (Family caregiver)

This is contrasted with other family members. Two caregivers, who were female, noted that their brothers played a much less significant role, for example, despite being physically closer to their parents. Marilyn said, for example, that:

And she has my brother, who lives across the driveway from her. But he's just not hardwired into helping. [laughs] Boys just don't seem to be that inclined into helping. I think daughters are just more inclined to help. (Family caregiver)

The point here is that some seniors and caregivers have routines that are very extensive, while others are much more minimal. Nonetheless, all of the routines share the trait of allowing for mediating the various constraints.

### **Technological Mediation: Monitoring and Control**

A third way that seniors and caregivers maintained balance was by using technology to mediate between themselves and others. By mediation we refer here not to interaction media (e.g., the telephone, etc.), but rather to systems that mediated access to others. Systems did not always function ideally, however, and this raised several interesting issues.

#### **Safety Systems**

As mentioned above, a common concern reflected by most participants was safety. Seniors want to know that, if anything goes wrong, they can contact somebody for help. One way they used technology as a mediator was via systems and procedures for emergency communication.

Louise, who lives in an independent living facility for seniors, said that:

I guess if I could get to the phone I would call the emergency numbers. If I had the little button around

my neck, I would press that and then they would call me. If they do not get an answer they come down and see me. I might call a neighbor. If it is a weekend, it is problematic of getting help because their staffing is not as good on the weekend. A neighbor could come and help me. If it is really bad, they tell you to call 911. (Senior)

There are several interesting issues in Louise's reflection on her options in an emergency. First, the phone seems to be her first choice, but she acknowledges that she might not be able to get to the phone. She also discusses the "little button," which is an emergency call device provided by the facility where she lives, but her answer implies that she does not always wear it, and that the system is not always rigorously attended to by staff. She ends by saying that a neighbor could come help or that she could call 911, but this would, of course, require getting to the phone or somehow notifying a neighbor. While her answer does not imply discomfort or dissatisfaction with her situation, it also does not likely inspire confidence in the reader.

In reflecting on these different ways of maintaining safety, Louise seemed to express some doubt in the "little button" around her neck, which she had only recently received when she was interviewed. She noted that she had not yet worn it, but planned to, particularly when she was walking outside. At the same time, though, she said that she also could see the utility of having a cell phone, "keeping it with me or taking it in my pocket; having it close like that."

There is a tension in Louise's attitude toward safety in that she seems to be aware of her vulnerability, in saying that she *should* wear the notification device or carry a cell phone. At the same time, however, she does neither of these things. We believe this tension also reflects Louise's desire for independence. Having the devices gives her and those who care for her a sense of security, even if she does not use them all the time or properly.

This attitude was reflected in other seniors' attitude toward similar safety devices, as with Rose, who said that:

I can see that when I get really old that that would be part of what I need in order to stay independent, just so that one of my kids knows every day at a certain time that mom's ok. So that, while I don't, you know, it doesn't excite me too much right now, it might excite me a lot more if it meant the difference between being able to stay wherever it was I was living or having to move into someplace that's more structured and regulated and expensive and everything else. (Senior)

#### *Avoiding Interaction*

Another way that participants used technology to mediate interaction was to avoid interaction at certain times. Just as the physical environment could afford privacy when it was desirable, participants expressed a desire sometimes to be

free of interactions with others, and some expressed an appreciation for technologies that allowed them to interact when they wanted.

Not surprisingly, most participants said there were times when they did not want to interact with others. These ranged from Elenore, who takes regular naps:

I treasure my naps. I take a nap every day and I will turn the ringer off on the phone. (Senior)

Elenore further noted that, "neither of us keeps our cell phones on as a matter of course." This reflects a common attitude among seniors to cell phones, which many described as interruptive both in that they did not want to be interrupted, and did not want to disturb others.

Louise also reported that sometimes she needs time to rest:

Sometimes if I'm really tired or if I've had a lot of things going on in the day, and I just don't want to talk to somebody. (Senior)

For her, though, there was no need to turn off the ringer:

I hardly ever get calls. I think if I get one a day, that's a lot. And usually it's someone trying to sell me something [laughs]. (Senior)

Louise's experience also reflects a common experience that many participants felt they were frequently interrupted by calls from telemarketers or salespeople from whom they did not want to hear. Leslie was particularly frustrated by this, and expressed a desire for technology to help her with this:

Jiminy Christ! I mean, I'm on the Don't Call list, and that doesn't seem to stop anybody. I mean, it's the same thing with email practically. I keep unsubscribing, tell them not to send me the stupid emails. Don't call me on the telephone! Um, if there was a technology, which I haven't figured out yet, even – because I'm ill, a chronic illness, and it's only gonna get worse as I get older – a way for people to check on me or if I'll need to just let them know I'm OK or be able to signal that I'm not OK... (Senior)

Others just felt they were too busy to interact with others on a regular basis, and so have resisted some communication technologies. Rose, for example, said:

Sometimes I just wanna. I don't wanna be in touch with everybody all the time. I want to have time to read, and time to do my art, and time to write and time to cook and time to do all the other things... which is why I don't really get into the cell phone thing. (Senior)

Some professional caregivers also explicitly did not use technology or limited their use of technology to communicate with seniors, because they felt it was outside of their job description, or would be too difficult to manage.

Brenda, for example said, “Oh, no I don't call on the phone. It's not in my directives.” And Paula, another professional caregiver, said:

I try to limit my contact via email. Certain family members have cell phones. I give them my cell phone if there's a real problem that they speak to me about. But you can't work, I don't feel that you can work for this association and not have your work get carried into your home life. (Care Worker)

#### *Disliking Others' Mediation Strategies*

Even as participants used technology to mediate their own interruptions, and consciously avoided burdening their families with excessive communication, many also expressed frustration with others' interaction habits or mediation strategies.

Elenore, for example, said:

It's frustrating to call my children and just leave messages because they're out. (Senior)

This is particularly interesting given her earlier comment about not keeping her cell phone on regularly.

Rose also noted that her priorities in communicating with family did not always align with theirs':

Staying in touch with them is really, really important to me. It's more important to me than it is to them, probably at this point, but I understand that... I would like it better if they had more time to communicate, but they don't, so you just take what you can get" (Senior)

In this way, technological mediation served not only to help balance the tension between interaction and independence, but also was sometimes a source of conflict and tension.

## **DISCUSSION**

We began with the goal of understanding how seniors manage the classic tension between privacy and awareness. We discovered that, in some ways, this was better described in terms of seniors' ongoing need for a sense of independence, while simultaneously feeling able to connect to and interact with others for safety, comfort and peace of mind. They accomplished this using attributes of their physical environment, temporal structures such as routines, and technological mediation. Our results have implications for our theoretical understanding of awareness and privacy as well as for designing technologies for seniors and others.

### **Implications for Theory**

The first theoretical implication of these results is a suggestion that, in conceptualizing the tensions inherent in understanding seniors' awareness and privacy needs, we will need to think broadly about the many structures and constraints that are used to manage interaction and independence. Independence stemmed not just from a sense

of solitude and confidentiality (typical dimensions of privacy, e.g., [3]), but also from attributes of the environment like connection with the past, and the ease of connection with others.

It also stemmed from their routines – activities and interactions that occurred regularly and helped structure their lives. These routines and their roles in interaction are similar in some respects to studies of home coordination (e.g., [25]) as well as the structuring role that routines play in organizations (e.g., [6]). There may be some utility in looking at these other conceptualizations of coordination, and how these structures relate to issues faced by seniors.

Second, these results suggest that the tension between independence and interaction does not reflect a continuum with these two attributes at its ends, but rather a complex set of interdependencies. In many ways, independence for seniors depends critically on the perceived possibility of interaction. For example, Seniors we spoke with either valued or recognized the value of technology that gave them the option to call for help in the event of a crisis, and this allowed them to feel comfortable in their independence. Similarly, caregivers and seniors also appreciated the value of routine interaction in communicating that everything is fine. Many caregivers would not feel comfortable allowing their senior relatives to live independently without such a routine in place. As seniors' health worsens, these interdependencies have the potential to become more complex, because more regular interaction and more modes of interaction and information sharing may be required in order to maintain a similar level of independence.

In this way, for seniors and others who depend on the possibility of interaction for their independence, there is a sense in which privacy, particularly in terms of solitude, is enabled by sharing awareness information, or at least the possibility of sharing this information. This is importantly distinct from prior conceptualizations of a dialectic tension between privacy and awareness (e.g., [18]).

Third, we raised the issue of attentional legitimacy at the start of the paper, suggesting that this is a useful way to conceptualize acceptable behavior with regard to gathering information about others' activities and initiating interaction. These results point to the importance of time and routines in establishing situation- and relationship-specific norms of legitimacy. Participants described routines involving vastly different levels of activity, ranging from a weekly phone conversation to multiple daily visits and conversations, that helped them know what was expected and considered legitimate. Routines and times were frequently a basis for determining whether or how to make contact with a remote relative.

### **Implications for Design**

From the standpoint of designing systems to better support aging in place via balancing the need for independence with a

simultaneous need for interaction, our results have three key implications.

First, existing systems have relied largely on monitoring seniors' environments via sensors that detect anomalies in daily routines and notify distant relatives or caregivers in the event of a potential problem. Such systems are useful, but our results point to the important role that routine interactions and activities also play in seniors lives. Enhancing these systems with ways to support routine interaction, in addition to checking for routine activities, could help support relationships and existing activities. The digital picture frame [24], for example, could also be used as a real-time interaction device when both seniors and caregivers are nearby.

Second, supporting interaction raises the issue that one persistent source of tension, and sometimes conflict, for our participants was not knowing when others were available for interaction. We have already discussed the importance of interaction in fostering comfort, independence (for seniors) and peace of mind (for caregivers). Routine was one way to ensure that these valuable interactions took place, but participants also expressed some frustration about not always knowing when others were available. Seniors were conscious of not being burdensome or disturbing their relatives at work and in caring for their immediate family. Similarly, relatives and caregivers were not always aware of seniors' schedules, sleep patterns, etc. Thus, there could be use for systems that rely on sensors and ambient displays to indicate not just that everything is fine, but also that an individual is available for interaction.

Another related implication is that systems to signal availability for interaction could rely not just on sensors of activity, but also presence in particular locations. Several of our participants expressed that they valued having places where they could go when they wished to interact with others (i.e., a front porch, common rooms in an assisted living facility, etc.). Their presence in these spaces served as an implicit indicator of a desire for interaction. Designers could build on this by designating specific physical regions of, for example, a senior's home or room where they could go when they wished to be alone, or wanted to interact with remote others. They could also possibly select which others they wanted to be available to – friends, family, etc.

While our purpose in this study was not to highlight the unique design requirements that accompany aging (e.g., [27]), we note that implementation of any of these design suggestions would require sensitivity to these principles.

#### Limitations and Future Work

As with any study, there are several reasons why these results might be interpreted with caution. First, we have spoken with a limited number of seniors, family members and professional caregivers. While we believe they provide us with a useful range of experiences and opinions, these should not be considered exhaustive or representative.

Second, one limitation of interview studies is the possibility that participants did not accurately portray their experiences in our conversations with them. While we have no reason to believe that our participants were not truthful, this is a possibility that must be considered. Future observational study could help overcome this issue.

This study provides a basic overview of how seniors and caregivers manage these issues, but much more research in this area is necessary to help us understand and support the requirements for aging in place. There is a need, first of all, for more detailed observational studies that capture the subtlety and nuance of the routines we have described, and the ways in which these routines and other interactions are managed and enacted.

There is also a need for broader studies to better understand how representative these views are, and if there are any key issues that we have not identified, or populations to whom our findings do not apply. This could be achieved via additional interview studies in other areas, as well as via survey studies of larger populations.

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