PRIVACY PERCEPTIONS OF VISUAL SENSING DEVICES:

EFFECTS OF USERS' ABILITY AND TYPE OF SENSING DEVICE

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PRIVACY PERCEPTIONS OF VISUAL SENSING DEVICES:

EFFECTS OF USERS' ABILITY AND TYPE OF SENSING DEVICE

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I dedicate this thesis to my parents who prepared me for and supported me in everything I have chosen to do and to Jamie who enthusiastically joined me in the adventure.

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SUMMARY

Homes that can collaborate with their residents rather than simply provide shelter are becoming a reality. These homes such as Georgia Tech's Aware Home and MIT's house_n can potentially provide support to their residents. Because aging adults may be faced with increasing mental and/or physical limitation(s) they may stand to benefit, in particular, from supports provided by these homes if they utilize the technologies they offer. However, the advanced technology in these aware homes often makes use of sensing devices that capture some kind of image-based information. Image-based information capture has previously been shown to elicit privacy concerns among users, and even lead to disuse of the system.

The purpose of this study was to explore the privacy concerns that older adults had about a home equipped with visual sensing devices. Using a scenario-based structured interview approach I investigated how the type of images the home captures as well as the physical and mental health of the residents of the home affected privacy concerns as well as perceived benefits. In addition, responses to non-scenario-based open ended structured interview questions were used to gain an understanding of the characteristics of the influential variables.

Results suggest that although most older adults express some concerns about using a visual sensing device in their home, the potential benefits of having such a device in specific circumstances outweigh their concerns. These findings have implications in privacy and technology acceptance theory as well as for designers of home based visual monitoring systems.

INTRODUCTION

Aware homes equipped with visual sensing devices may have many benefits, some of which may be particularly valuable to older adults. They may allow an older adult to "age in place" rather than move to an assisted care facility, provide peace of mind, or promote communication between family members. A visual sensing device placed in the home of an older adult could transmit images to relatives or caretakers such as medical personnel thus assuring interested parties that the older adult is well or alerting them to send help if a problem arises.

However, even with the many potential benefits of visual sensing devices, it is unknown if older adults will have concerns when deciding whether to use these technologies in their homes. Further, if there are concerns, the source and type of those concerns are unknown. Although intuition about visual sensing devices placed in the home environment often assumes fear about inviting a camera into one's home, such intuitions have yet to be systematically confirmed or even explored beyond anecdotal evidence.

Theoretical accounts of the basic dimensions of privacy in non-technology rich environments (see Margulis, 2003, for a review), as well as work in Computer Supported Cooperative Work (CSCW) (see Boyle & Greenberg, 2005) provide some guidance on the privacy concerns that may arise when older adults are faced with a home equipped with visual sensing technologies. Recent work has suggested that the potential intrusiveness of a technology affects older adults' acceptance of certain, potentially beneficial technologies (Melenhorst, Fisk, Mynatt, & Rogers, 2004). That research points to the need for systematic, laboratory based research on the issue of privacy and

technology. However, surprisingly little research has evaluated home-based privacy concerns.

The purpose of the present study was to understand the variables that affect privacy concerns related to a home equipped with visual sensing devices. Specifically, I have examined the way the mental and physical functioning of the resident, as well as the type of image that is captured affected privacy concerns. For the purposes of this study I have adopted Melenhorst, Fisk, Mynatt and Rogers' (2004) definition of invasion of privacy as an undesirable disclosure of private and personal information, not necessarily limited to a breech of security.

<center>Variables Affecting Privacy Concerns</center>

A review of the literature revealed a number of variables that relate to the presence and extremity of privacy concerns. Most of the literature that has addressed privacy concerns, especially with regard to monitoring systems, has come from within the CSCW domain. This perspective has historically viewed the privacy issue as a design flaw and a problem that could be resolved through thoughtful design changes. In 1993, Bellotti and Sellen presented a design framework made up of the following four design dimensions: capture, construction, accessibility and purposes. They proposed that these four design dimensions affect the acceptance of awareness monitoring systems within cooperative work settings. Capture refers to the nature of the data that is being recorded, construction refers to how the information that is recorded is processed and stored, accessibility refers to who has access to the recorded data, and purposes refers to why people want the data.

The Bellotti and Sellen (1993) design framework has been useful for describing privacy issues in media spaces; however, Bellotti and Sellen acknowledged that this

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framework was based on personal experience with the acceptance of video media systems

rather than empirical observations. Nevertheless, the design framework was used

successfully to shed light on privacy issues within a computer supported cooperative

work environment already in use (Bellotti & Sellen).

Of the variables that Bellotti and Sellen (1993) proposed within their framework,

capture stands out as being potentially critical to the acceptance of monitoring technology

(Boyle & Greenberg, 2005). Capture actually refers to image type, which is a focus of

the present investigation. This variable, image type, refers to how recognizable a

person's identity, environment or activity is within a captured image. Table 1 shows the

visual clarity, or visual "strength" of each of these cues separated by device type. The

video camera provides strong cues to the identity of the person in the image, the

environment where the person is as well as the activity the person is performing, where as

the Blob Tracker provides only activity cues in the form of location in the house. The

devices differ in the amount and type of information they capture and therefore can

provide.

Table 1. *Information capture characteristics of visual sensing devices*

Cues	Video	Point Light	Blob
Identity			
Face recognition	Strong	None	None
Gait recognition	Strong	Medium	None
Environment			
Condition of house	Strong	None	None
Items in house	Strong	None	None
Activity			
Position of body	Strong	Medium	None
Location in house	Strong	Medium	Strong

A video image (Figure 1), similar to images seen on television or in home movies,

captures details that make the people, environments and activities captured in the

Figure 1. *An image taken from a video camera visual sensing system*

images easily recognizable. In Figure 1, it is easy to tell that there is a young woman

standing in a kitchen. It would be possible to identify the woman in the picture if the

viewer knew the woman by name or even if the viewer did not know the woman but

resorted to using facial recognition software.

A second less recognizable image type, the point-light image (Figure 2), is an

image made up of white dots moving about on a black screen. This image type reduces

visual identification cues to a series of dots while still preserving activity and some

identity information, but completely removes environmental information. Based on

images with as few as 12 moving dots, viewers are able to recognize many activities

where significant movement of the body is involved. Although the identity of the person

depicted in the point-light image can sometimes be recognized (Stevenage, Nixon, &

Vince, 1999), it is less likely compared with the video image.
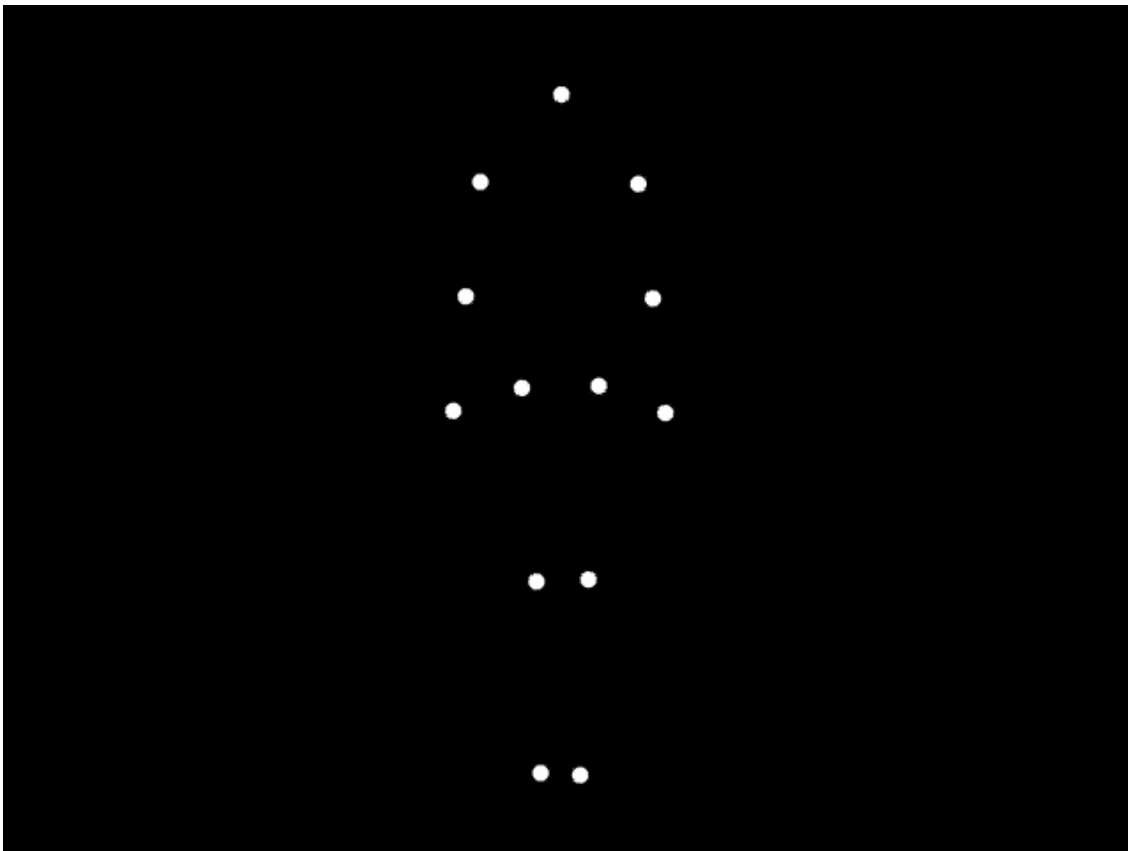
Figure 2. An image taken from a point-light visual sensing system

A third image capturing technique, blob tracking (Figure 3), assigns a number to

each person being tracked, and transmits an image that is unidentifiable as a specific

person, environment, or activity. Although blob tracking technology does not allow a

viewer to see exactly what the person in the image is doing, thus perhaps preserving

privacy, it does show where movement is occurring (in a home environment this could be

each different room for instance) and thus could provide some measure of activity.
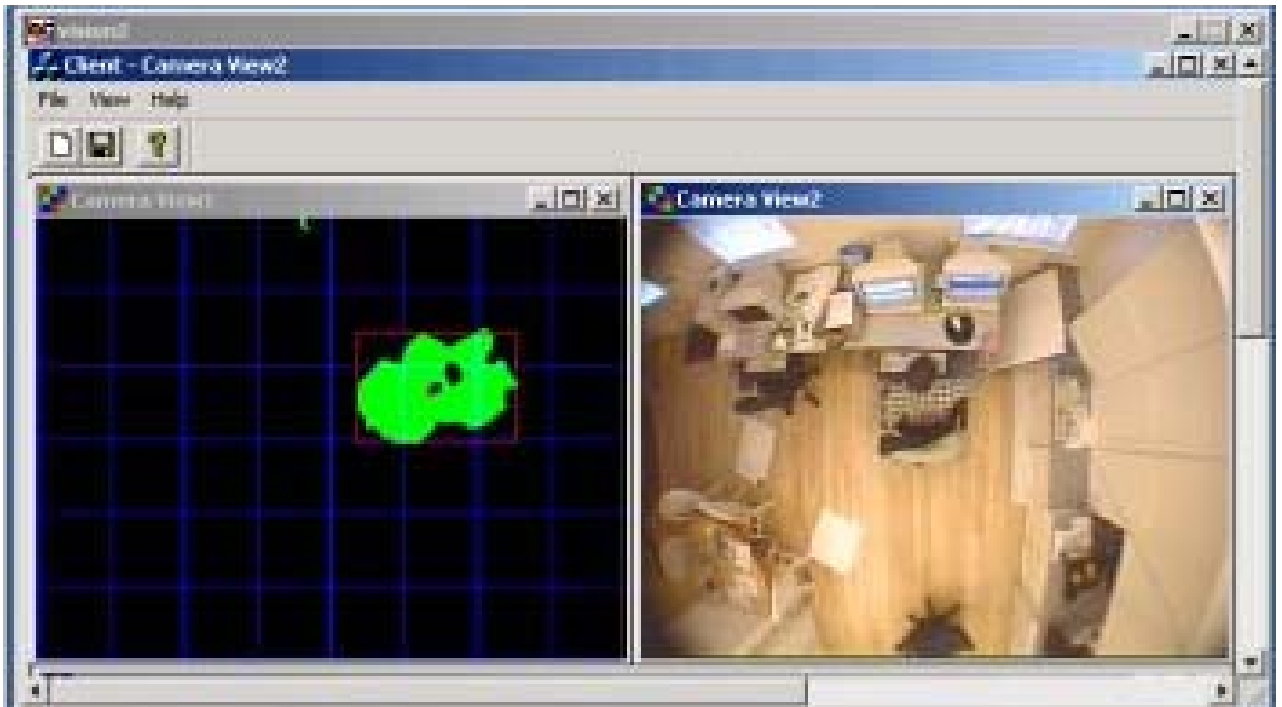
Figure 3. An image taken from a blob tracking visual sensing system

Even though researchers from the CSCW perspective have identified some design variables that influence privacy concerns, research from other areas, especially with older populations, has revealed that design considerations are only one part of a complex system that interacts to produce privacy concerns (Melenhorst, Fisk, Mynatt & Rogers, 2004). Privacy preferences, for instance, are affected by a person's current circumstances, and these preferences can change across different situations (Pastalan, 1974). Conditional reasoning also plays a part in the acceptance of privacy invasive technologies. For example, even if a device is considered to be intrusive, older adults are likely to accept the technology if they also view the device as necessary to support some need (Melenhorst et al.).

Another variable that is potentially critical for moderating privacy concerns is the mental and physical well being of the person being monitored, which affects the consequences of not employing the monitoring technology. As people age, health

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concerns and goals become more predominant (Hooker & Kaus, 1994); therefore, it would be expected that mental and physical health characteristics would become an important determinant of older adults' conditional reasoning relating to privacy concerns. Previous research on the perception of intrusiveness in a home setting has shown that older adults were more accepting of a device they perceived as being invasive, if that device was necessary for health or safety related reasons (Melenhorst, Rogers, Fisk, & Mynatt, 2004).

Overview of Studies

The purpose of these studies was to explore the privacy concerns that older adults had about a home equipped with a visual sensing device. In study 1 participants rated a set of 24 scenarios on the level of mental or physical functioning of the character described in the scenario. The 6 highest and 6 lowest rated scenarios were used as stimuli in study 2. In study 2, participants took part in a structured interview which included both open ended and rating scale questions. Rating scale questions were analyzed using repeated measures ANOVAs whereas transcripts from the open ended questions were coded using a qualitative coding scheme. Statistical analyses on the ratings revealed that older adults had different levels of privacy concerns depending on the type of visual sensing device used as well as the level of functioning of the person who was to be monitored. Participants also perceived differential benefits depending on device type and level of functioning. Interestingly, the devices that participants rated as producing the most privacy concerns were also rated as the most useful. Qualitative analysis revealed the types (rather than level) of concerns older adults had about visual sensing devices and how these concerns differed across both image type and level of functioning.

STUDY 1

A major factor in older adults' capability to maintain independence is their ability to perform Activities of Daily Living or ADLs (Clark, Czaja, & Weber, 1990). One way to measure the need for assistance with daily activities and thus the ability to stay in a community setting versus moving to an assisted living facility is a modified version of the Katz Index of Independence in Activities of Daily Living (Shelkey & Wallace, 1998). This scale provides a number of activities that are associated with the ability to maintain independence. Other activities, Instrumental Activities of Daily Living or IADLs (Lawton & Brody, 1969) have more to do with cognitive tasks rather than physical tasks. These activities were used in the construction of scenarios designed to vary the level of functioning of the character in the scenario in a systematic and validated manner.

Method

Participants

Participants were 25 older adults (11 males) who were participants in other studies going on in either the Human Factors and Aging Lab or the Adult Cognition Lab. Demographic information was not collected; however, participants were between the ages of 60 and 80.

Materials

Twenty four scenarios were developed to represent high and low mental and high and low physical functioning older adult characters. These scenarios were compiled into a questionnaire that included a rating scale from 1 (low functioning) to 5 (high functioning). The full questionnaire is given in Appendix A.

Scenario Development

Scenarios designed to represent low mental functioning had characters who were unable to perform an IADL, such as managing a medication regimen or managing money, whereas scenarios designed to represent high mental functioning had characters who could perform activities, such as playing chess or doing crossword puzzles. Although these two activities are not mentioned on the IADL scale, the logic behind choosing these activities was that if the character can do these activities then they would also be able to perform IADLs. The full pool of scenarios that were developed to represent mental functioning is given in Table 2.

Table 2. Scenarios Designed to Represent Mental Functioning

High
Mr. B does the New York Times daily crossword puzzle every day. He usually gets all the words right.
*Mr. F cooks almost every night. He can still remember all the recipes he usually cooks and sometimes tries out new recipes.
Mr. J plays chess every day. He can beat almost anyone he plays against.
*Mr. M always takes his medication on time. He never forgets a dose or gets his pills mixed up.
Mr. U stays current on all the news by reading the newspaper and watching TV. He likes to be able to talk about world events with his friends and family.
Mr. X reads daily. He is an active member of his local book club.

Low
*Mr. C has difficulty managing his own money. Sometimes he forgets to pay his bills and worries that the water or power company may turn off his utilities.
*Mr. G has difficulty taking his medications properly. Often he forgets what medications to take, when to take them, and sometimes even forgets to take them altogether.
*Mr. K has difficulty preparing meals for himself. He can no longer follow recipes or put microwave meals in the microwave for the right amount of time.
*Mr. O has trouble getting where he needs to go by himself. He can no longer drive or use public transportation because he gets confused with all the signs.
*Mr. T has trouble shopping for himself. He often forgets what he came to the store to get and usually has to ask for help with the weekly shopping.
*Mr. V has trouble keeping up with the housework. Sometimes he forgets to take out the trash, wash his clothes or do the dishes.

*Directly based on an IADL
Note. "Mr." was used for male participants whereas "Mrs." Was used for female participants

Scenarios designed to represent low physical functioning had characters who were unable to perform an ADL, such as getting in and out of bed by themselves or using the restroom by themselves, whereas scenarios designed to represent high physical functioning had characters who could perform activites such as walking or exercising every day. Similarly to the scenarios designed to represent high mental functioning walking regularly and exercising every day are not mentioned on the ADL scale, however, the assumption was that if a character could do these activities then they would also be able to perform ADLs.

Table 3. Scenarios Designed to Represent Physical Functioning

High
Mr. D walks 2 miles every day. He likes walking and hopes he can continue to take his walks for a long time.
Mr. H can work in his garden. He can still get down on his knees to plant flowers and carry the watering can without trouble.
Mr. L always keeps his house clean. He can still scrub the bathtub and wash the dishes by hand.
Mr. N swims once a week. He can get in and out of the pool and swim without assistance.
Mr. S exercises a good bit. He exercises for at least 20 minutes every other day or so.
Mr. W can ride his bike. He usually rides around the neighborhood a couple of times a week.

Low
**Mr. A has trouble getting in and out of bed by himself. Sometimes he worries that he might not be able to get out of bed by himself at all.
**Mr. E has difficulty bathing himself. He has difficulty getting in and out of the bath or shower without assistance.
**Mr. I has trouble eating by himself. Sometimes he finds it difficult to use utensils like a fork or spoon because of the shakiness in his hands.
**Mr. P has trouble getting in and out of his chair. It is difficult for him to get in his chair or out of his chair without assistance.
**Mr. R has trouble walking. He finds it difficult to get around his house without someone to help him.
**Mr. Q has trouble going to the bathroom by himself. He has difficulty getting on and off the toilet without assistance.

**Directly based on an ADL
Note. "Mr." was used for male participants whereas "Mrs." Was used for female participants

Results

Mental Functioning

The three scenarios that were rated as the lowest on mental functioning were

chosen to be used to represent low mental functioning in the scenario based portion of the

structured interview in Study 2 whereas the three scenarios that were rated as the highest

on mental functioning were chosen to be used to represent high mental functioning. The

3 scenarios chosen to represent low functioning are marked with 1 asterisk and the 3

scenarios chosen to represent high level functioning are marked with double asterisks in

Figure 4. The letters on the X axis of the chart represent each fictitious character in the

different scenarios (e.g., Mr. G).
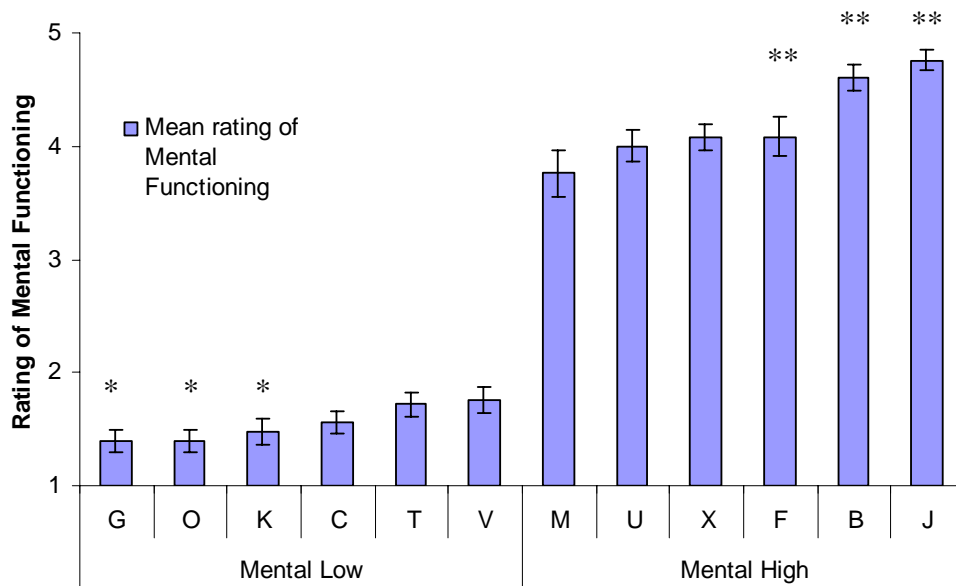
Figure 4. Mean ratings of scenarios representing mental functioning

Physical Functioning

The three scenarios that were rated as the lowest on physical functioning were chosen to be used to represent low physical functioning in the scenario based portion of the structured interview in Study 2 whereas the three scenarios that were rated as the highest on physical functioning were chosen to be used to represent high physical functioning. The 3 scenarios chosen to represent low functioning are marked with 1 asterisk and the 3 scenarios chosen to represent high level functioning are marked with double asterisks in Figure 5.
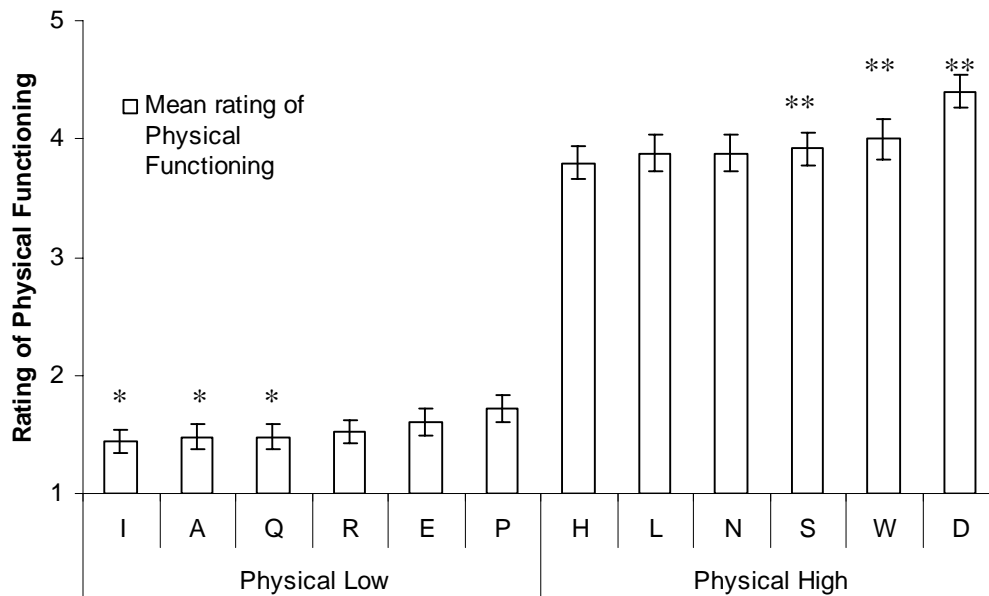
Figure 5. Mean ratings of scenarios representing physical functioning

Discussion

This calibration study did produce scenarios that were identified consistently to represent the extremes in physical and mental capabilities I wished to represent. The scenarios chosen to be used in Study 2 were those most consistent with the target mental or physical function characteristics and represented small variance among the raters.

STUDY 2

Method

Participants

Participants were 25 older adults (10 male) independently living older adults

between the ages of 65 and 80 who resided in or around the Atlanta area. Participants

differed across ethnicity: 8 African-American, 16 Caucasian, and 1 Hispanic. All

participants were fluent English speakers. Participants were compensated $30 for 3 hours

of their time. Abilities measures of the participants are given in Tables 4 and 5. Most

participants had normal hearing (threshold at or below 20 dB) at 1,000 hz, although

hearing thresholds ranged from below 20 dBs to 50 dBs when uncorrected.

Table 4. *Demographic and Ability Data*

	M	SD
Age	72.04	5.31
General health [a]	3.64	.81
Reverse digit span [b]	5.52	2.02
Digit-symbol substitution [b]	47.92	12.86
Shipley vocabulary [c]	31.36	7.05

[a] Self-rating: 1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent
[b] number correct; Wechsler (1997); [c] number correct; Shipley (1940)

Table 5. Vision Data

Vision [a]	N	Percent
20/20 or better	11	44%
20/20 – 20/30	11	44%
20/40 – 20/50	3	12%
Total	25	100%

[a]Corrected Far Vision

Participants were screened on living situation prior to inclusion in the study

because institutionalization may influence privacy perceptions (Pastalan, 1974). All

participants lived independently. Independent living was defined as those who do not

live in an assisted care or skilled nursing care. Nineteen participants lived in their own

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home, condo or apartment (9 alone, 10 with a spouse, roommate or relative) and 6 lived in an independent living community.

The decision to include only independently living participants was made with the understanding that there could be a situation where a participant would require the care provided by an assisted care facility if their spouse (or other live-in partner) were not assisting them in their daily activities. However, Pastalan (1974) argued that it is the institutionalization, which may be the first time when an older adult is no longer allowed to make all of his or her own choices, rather than assistance with daily activities that influences privacy preferences. Additionally of those older adults who live in their own home or apartment (alone or with family), financial considerations and health status were both reported more often than family or social support as factors thought to influence one's ability to remain living in their own home or apartment (Mack, Salmoni, Viverais-Dressler, Porter & Gar, 1997).

Materials

Pre-Screening. Prior to invitation to participate in the study, participants were asked about their living situation and asked to participate only if they lived independently as defined above.

Demographics. Demographic information such as the participant's age, educational level, current health status, and current medication regime was gathered via a demographics questionnaire developed by the Human Factors and Aging lab specifically for older adults.

Technology experience, housing and living situation questionnaires, everyday activities questionnaires and ability tests. Technology experience was assessed by a technology experience questionnaire designed to gather information about the

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experiences older adults have had with different types of technology. Housing and living situation were assessed using a housing and living situation questionnaire (Appendix B) designed for this study. Assistance with everyday activities was assessed using an everyday activities questionnaire (Appendix C) also designed for this study. Digit Symbol Substitution, a measure of perceptual speed (Wechsler, 1997), the Shipley Vocabulary test, a measure of verbal ability (Shipley, 1940), and the Reverse Digit Span, a measure of memory span(Wechsler, 1997), were used to measure the abilities of the participants in this study. Participants' visual and auditory acuity were also assessed.

Structured interview. The structured interview script was developed specifically to elicit older adults' ideas and concerns about privacy issues within a home equipped with a visual sensing device. Prior to implementation in this study the script was reviewed and modified both by experts on aging and researchers with experience using interview and survey methods and was further refined based on feedback from pilot testing with older adults.

Scenarios for the scenario-based portion of the structured interview were chosen from a pool of 24 possible scenarios described in Study 1. The 12 scenarios that were rated as exemplary of a particular category were chosen for use in this study. All participants received the same 12 scenarios in one of 8 random (with rules – e.g., no orders could have more than two of the same device types in a series) orders with the only difference between participants being that male participants received male characters in their scenarios and female participants received female characters in their scenarios. A representative version of the structured interview script is given in Appendix D.

Data collection. The majority of data collection was completed at The Aware Home at Georgia Tech (www.awarehome.gatech.edu) which is a research environment in the form of a smart home. The Aware Home is designed to look and act like a smart home of the future. It incorporates innovative devices, some of which are still in the development stage, into a home environment. The Aware Home was selected to serve as a backdrop to the technologies and images introduced to participants during this study because it was expected to encourage participants to actively imagine the technologies described in the interview as possible and "real", instead of fanciful. Four participants who were unable to come to the Aware Home were shown a video tour of the aware home before being interviewed.

Design

The independent variables in this study were Image Type: (Easy to recognize [High], Difficult to recognize [Medium], and Impossible to recognize [Low]) and Level of Functioning (High Mental Functioning, Low Mental Functioning, High Physical Functioning and Low Physical Functioning). These IVs were manipulated within twelve scenarios. The dependent variables were responses to rating scale questions (ranging from 1 to 5) as well as frequency counts of the number of participants whose responses were qualitatively coded into categories. The frequency counts were made after coding the comments taken from the structured interview.

The variable image type is based on work from within the CSCW perspective and consists of three recognition levels: low, medium and high. The unrecognizable images or "low" images were images from blob-trackers. The somewhat recognizable images or "medium" images were from point-light devices. Finally, the highly recognizable images or "high" images were from video cameras.

The level of functioning variable is based on work from within gerontology and psychology and is based primarily on the concept of ADLs and IADLs. Physical functioning is based on ADLs and mental functioning is based on IADLs. For low physical scenarios, the character (the person described) in the scenarios was unable to perform a particular ADL whereas for high physical scenarios, characters in the scenarios were able to perform some task that would imply that the character also be able to perform all ADLs. The assumption is that if a character can perform some activity that is more difficult than the ADLs they would also be able to perform the ADLs. For low mental functioning, characters in the scenarios were unable to perform a particular IADL whereas for high mental functioning, characters in the scenarios were able to perform some task that would imply that the character also be able to perform the IADLs. Again there is an assumption that if a character can perform some more difficult cognitive task, they would also be able to perform the IADLs. The design of the scenarios was confirmed in Study 1 where participants rated the character in each scenario on level of functioning and the highest and lowest of each category were chosen for use in the scenarios.

There were twelve scenarios based on a cross of the two independent variables: image type and level of functioning. Figure 6 gives a visual representation of the design of the twelve scenarios. One scenario was designed to fit each cell. Varying the scenarios on two dimensions allowed comparison across responses as well as provided the opportunity to control the number and type of situations to which the participant was exposed.

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	Level of Functioning			
	Mental		Physical	
Image Type	High	Low	High	Low
High				
Medium				
Low				

Figure 6. *Visual Representation of Scenario Design*

Procedure

Participants from the Human Factors and Aging Laboratory Participant Database were contacted if they were within the defined age range until all interview slots were filled. A calling script was used to give participants a brief description of the study and to screen potential participants. During this phone call participants were asked to describe their living situation and a determination was made as to whether or not they meet the definition of "independently living" described above. If the participant was deemed independently living and wanted to participate after hearing the brief description of the study, he or she was scheduled for the study. Participants were scheduled and interviewed individually.

Once informed consent was obtained, demographic information and technology experience information were collected, and abilities tests were administered. Next, participants were given a brief tour of the Aware Home to orient them to the technology rich home environment, introduce them to the different types of visual sensing devices, and to help acquaint participants with the interviewer. At the conclusion of the tour, participants were introduced to three different visual sensing devices each representing a different level of image quality and shown an examples of the image that each device captures. Specifically they saw images from a blob tracker, a point light camera, and a video camera.

After the tour and visual sensing device introduction, the structured interview was administered, beginning with non-scenario based open ended questions designed to elicit comments that were not associated with a scenario given by the interviewer. The questions were purposefully ordered such that general questions were posed earlier and more specific questions were posed later. Because the layout of questions in a structured interview follows the same layout (with the exception of the scenario order) for each participant it is important that the order of the questions follows logically and that early questions do not influence participants' later answers (Labaw, 1985).

The interviewer asked questions about situations where any visual sensing device might be useful, if so which device was preferred, and if there were any concerns about using a device in such a situation. These questions were not associated with any specific type of visual sensing device, rather participants could discuss any (and all) of the devices they chose. The complete set of questions is provided in Appendix D. An example question from the non-scenario based section is:

> *"Could you think of any situations where you might want someone to use*
> *a visual sensing device to monitor you in your home?"*

After the non-scenario questions the interview progressed on to a second section that consisted of a series of 12 scenarios within which a specific device was used and functioning of the character in the scenario was manipulated. An example of a scenario with a character that is low physically functioning and is considering using a monitoring device that captures highly recognizable images (video) is given below:

> *"Mrs. A has trouble getting in and out of bed by herself. Sometimes she*
> *worries that she might not be able to get out of bed by herself at all. This*
> *is representative of Mrs. A's overall physical condition. Mrs. A has the*

option to put a video monitoring system in her home so that someone

could monitor her."

Note that the part of this scenario that identifies it as low on the physical functioning dimension is, "she might not be able to get out of bed by herself at all," and the part of this scenario that identifies it as high on the image dimension is, that the device type is "video monitoring system." A reminder sheet with an example image from the type of device that was mentioned during each scenario was displayed for the duration of each scenario discussion. An example of the reminder sheet is given in Appendix E.

After explaining the scenario the interviewer asked specific pre-scripted follow up questions that sought perspectives about the concerns participants had, perceived benefits participants recognized, and about persons the participant would want to grant access to captured images for each scenario.

An example of a follow up question to the scenario presented above is:

"What are some benefits Mrs. A might get from having a video

camera in her home?"

Data Preparation & Coding

Each word of every interview was digitally recorded. Next, digitally recorded interviews were transcribed verbatim and then coded by one of two independent coders. A coding scheme is a set of criteria to label and categorize answers to open ended questions. It allows the large amount of raw recorded conversation to be reduced into a useful and usable set of counts of the number of individuals responding a particular way.

The initial iteration of the coding scheme was top-down - derived from a review of the literature and with the research question in mind. The coding scheme was also

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adjusted after data collection was completed to reflect ideas not represented in the initial

coding scheme (not identified in the literature) thus increasing the likelihood that all

relevant dimensions were represented in the final coding scheme. An overview of the

final coding scheme can be found in Appendix F.

After the data were organized into the final coding scheme, the number of

participants whose comments were categorized into each of the categories were counted.

For example, comments that followed the question about situations where having a visual

sensing system would be useful were sorted into categories such as "No times when

useful", "I need a monitoring system now" or "In a specific situation".   Next, counts of

the number of comments in each category were tabulated.

It is important to note that participants were encouraged to fully explain their

answers to all questions and were not limited to providing only one answer to each

question as would occur in a multiple choice survey for example. The benefit is that the

data are more elaborate and far richer and more detailed than what would have been

obtained using a survey. However, this also means that the data are more complex and

difficult to interpret than those coming from a survey. In a survey with multiple choice

answers, data from one question can usually be presented in the form of a pie chart where

the total number of participants is given and then each slice is a percentage of the number

of participants who responded a certain way.

However, with data from open ended questions each code at the lowest level must

be thought of as a yes/no question asked of the data. The question is: Does any part of

the answer to this question given by this participant fit into *this one code.* If the answer

was yes, then the evidence supporting that decision was coded into that category. The

same procedure was then applied to all of the other codes for that question. The number

of participants whose answer to a given question fit into a given code vs. the number of participants whose answer did not fit within a given code always summed to 100%. Relating back to the pie chart example discussed above, given this type of data, each *code* receives its own pie chart with two slices: the % of participants reporting that code and the % of participants not reporting that code.

Results

Results are separated into two main sections: scenario and non-scenario. Within the scenario section there are three sub-sections: rating of privacy concern, rating of benefit to family, and rating of benefit to individual. For the non-scenario questions, each question asked in the structured interview will form its own sub-section.

Scenarios

Rating of Privacy Concern

To obtain ratings of privacy concerns participants were asked to, "please rate how much Mr(s). X might be concerned about his/her privacy with having a [video, point light or blob tracker] monitoring system in his/her home" on a scale of 1 to 5 with 1 representing "no concern" and 5 representing "very much concerned." The quantitative analysis of the ratings for privacy concern was done using a 2 x 2 repeated measures ANOVA. Device type and level of functioning were the IVs and rating of privacy concern for each of 12 scenarios was the DV.

Figure 7. Rating of Privacy Concern

There was no significant interaction of device type and level of functioning across scenarios with respect to the rating of privacy concern, $p = .57$, indicating that for each device type the privacy concerns followed a similar pattern along level of functioning. As shown in Figure 7, the pattern of rating of privacy concerns was similar for level of functioning across device type. Therefore, further analyses were conducted to investigate main effects in detail.
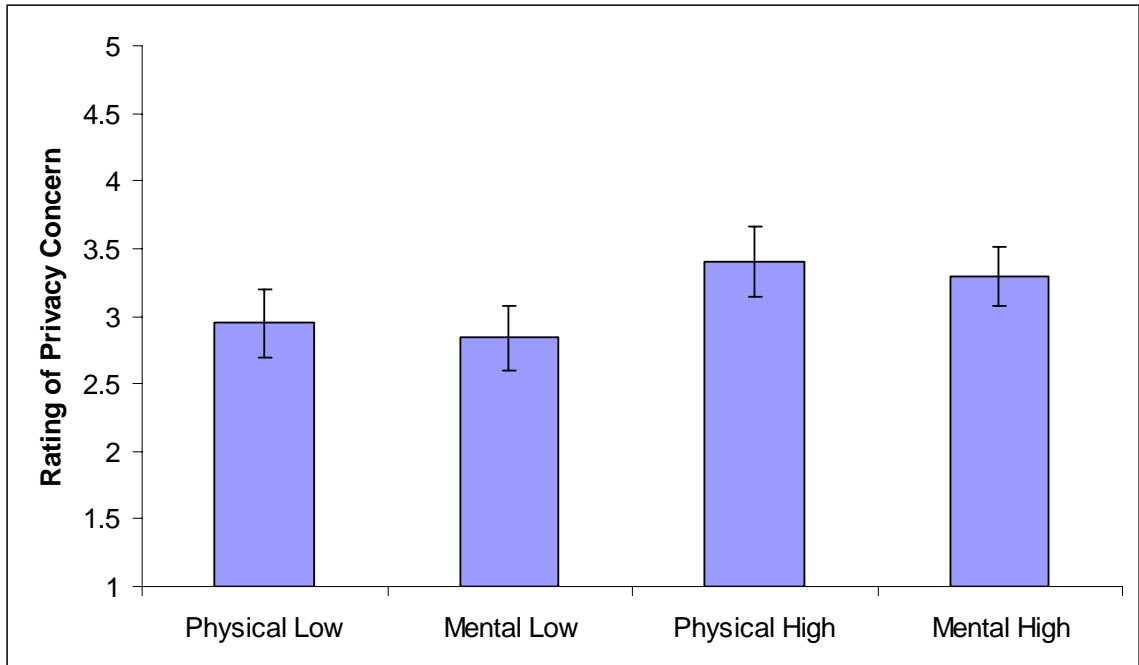
Figure 8. Privacy Concern by Level of Functioning

Ratings of privacy concerns differed significantly across level of functioning $F(3,72) = 2.72$, p =.05, $\eta p^2 = .10$ indicating that the level of functioning of the individual in the scenario was related to the level of privacy concern participants had. Follow up pairwise comparisons revealed a significant difference in privacy concerns between mental low and physical high (p = .04) and mental low and mental high (p = .05) indicating that participants rated privacy concerns lower for those scenarios where the character had low mental functioning.
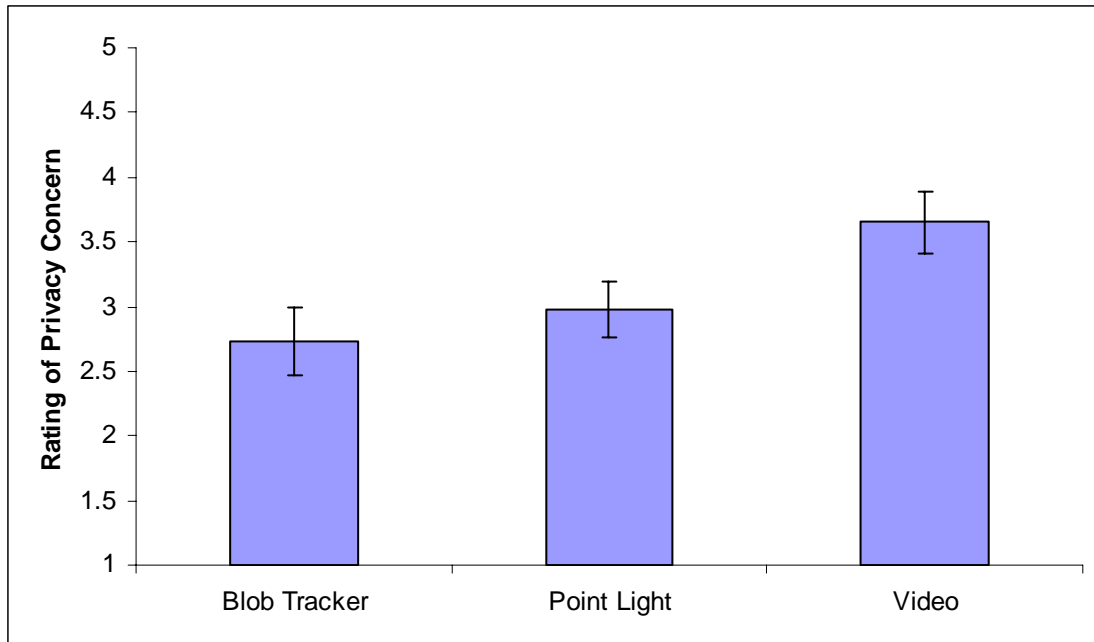
Figure 9. Privacy Concern by Device Type

Ratings of privacy concerns also differed significantly across device type $F(2,48)$ = 7.96, p = .001, ηp^2 = .25 indicating that the type of device that was described in each scenario was related to the level of privacy concern participants had. Follow up pairwise comparisons revealed a significant difference in privacy concerns between the video camera and blob tracker (p = .002) and the video camera and the point light camera (p= .013) indicating that participants rated privacy concerns higher when the device in the scenario was a video camera.

Summary of privacy concern data from ratings

Level of privacy concern was related to both the level of function of the individual in the scenario as well as the type of device used in the scenario. Participants reported lower levels of privacy concerns when the character in the scenario had low mental functioning and higher levels of privacy concerns when the type of device that was used in the scenario was a video camera.

Rating of Benefit to Family

To obtain ratings of benefit to the family participants were asked to, "please rate how much Mr(s). X's family might benefit from having a [video, point light or blob tracker] monitoring system in Mr(s).'s home" on a scale of 1 to 5 with 1 representing "no benefit" and 5 representing "very much benefit." The quantitative analysis of the ratings for benefit to the family was done using a 2 x 2 repeated measures ANOVA. Device type and level of functioning were the IVs and rating of benefit to the family for each of 12 scenarios was the DV.
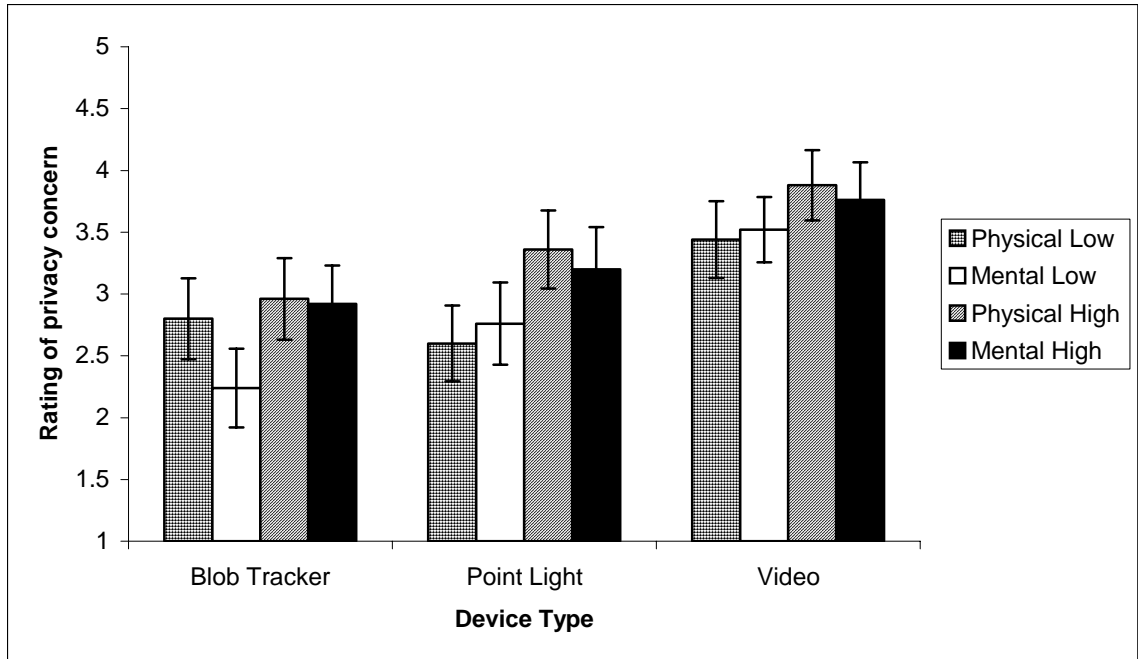

Figure 10. Rating of benefit to family

There was no significant interaction of device type and level of functioning across scenarios with respect to the rating of benefit to the family of the character in the scenario, $p = .405$, indicating that for each device type the benefit to the family followed a similar pattern along level of functioning. As shown in Figure 10, the pattern of rating of benefit to family was similar for level of functioning across device type. Therefore further analyses were conducted to investigate main effects in detail.

Figure 11. Rating of benefit to family by level of functioning

As shown in Figure 11, ratings of benefit to family differed significantly across level of functioning $F(3,72) = 21.10$, p <.001, $\eta p^2 = .47$ indicating that the level of functioning of the individual in the scenario was related to the level of benefit to the family of the character in the scenario. Follow up pairwise comparisons revealed a significant difference in level of benefit to the family between all levels of functioning (p's < .04) except between physical low and mental low (p = .30), indicating that participants thought that the family of those characters who were lower functioning would benefit more than the family of those characters who were higher functioning.
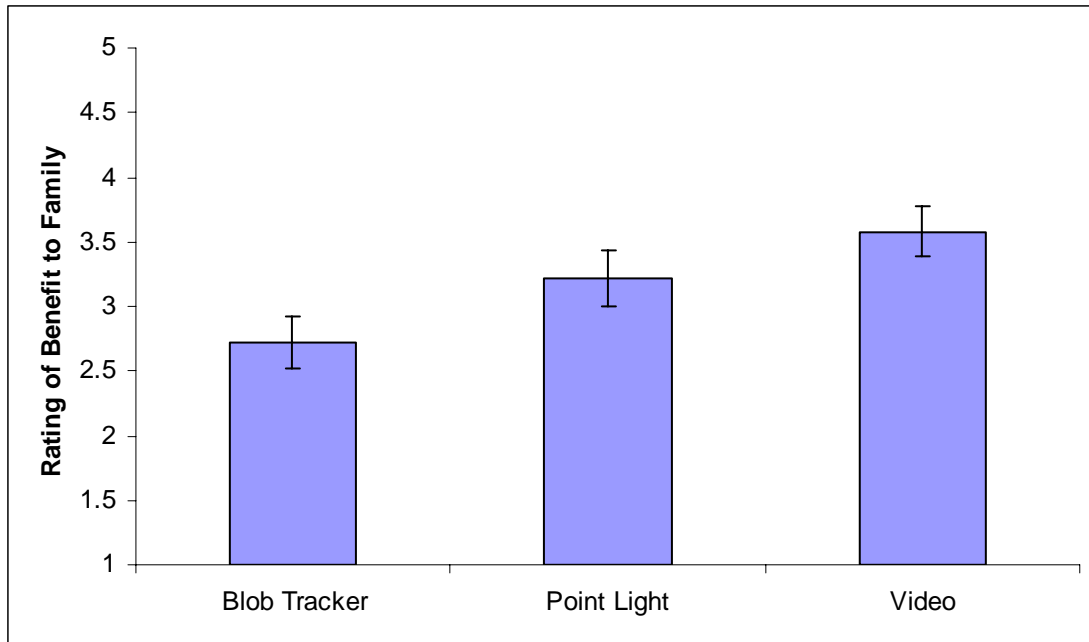
Figure 12. Rating of benefit to family by device type

As shown in Figure 12, ratings of benefit to family differed significantly across device type $F(2,48) = 7.26$, p =.002, $\eta p^2 = .23$ indicating that the type of device mentioned in the scenario was related to the level of benefit to the family of the character in the scenario. Follow up pairwise comparisons revealed a significant difference in level of benefit to the family between the blob tracker and point light camera (p = .03) and between the blob tracker and the video camera (p = .001), indicating that participants rated benefit to the family lower when a blob tracker was used.

Summary of rating of benefit to family data

Level of benefit to the family of the character in the scenario was related to both the level of function of the individual in the scenario as well as the type of device used in the scenario. Participants rated the benefit to the family lower when the character in the scenario was high functioning and when the device used was a blob tracker.

To obtain ratings of benefit to individual participants were asked to, "please rate how much Mr(s). X might benefit from having a [video, point light or blob tracker] monitoring system in his/her home" on a scale of 1 to 5 with 1 representing "no benefit" and 5 representing "very much benefit." The quantitative analysis of the ratings for privacy concern was done using a 2 x 2 repeated measures ANOVA. Device type and level of functioning were the IVs and rating of privacy concern for each of 12 scenarios was the DV.
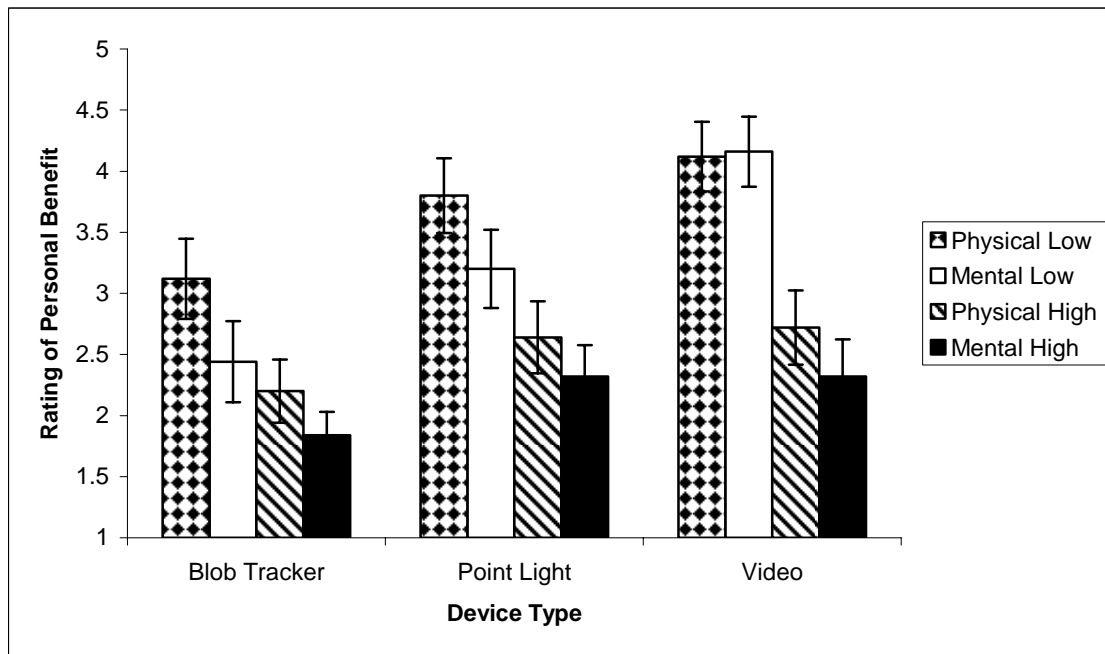
Figure 13. Rating of benefit to Individual

The quantitative analysis of the ratings for benefit to the character was done using a 2 x 2 repeated measures ANOVA. Device type and level of functioning were the IVs and rating of benefit to the ch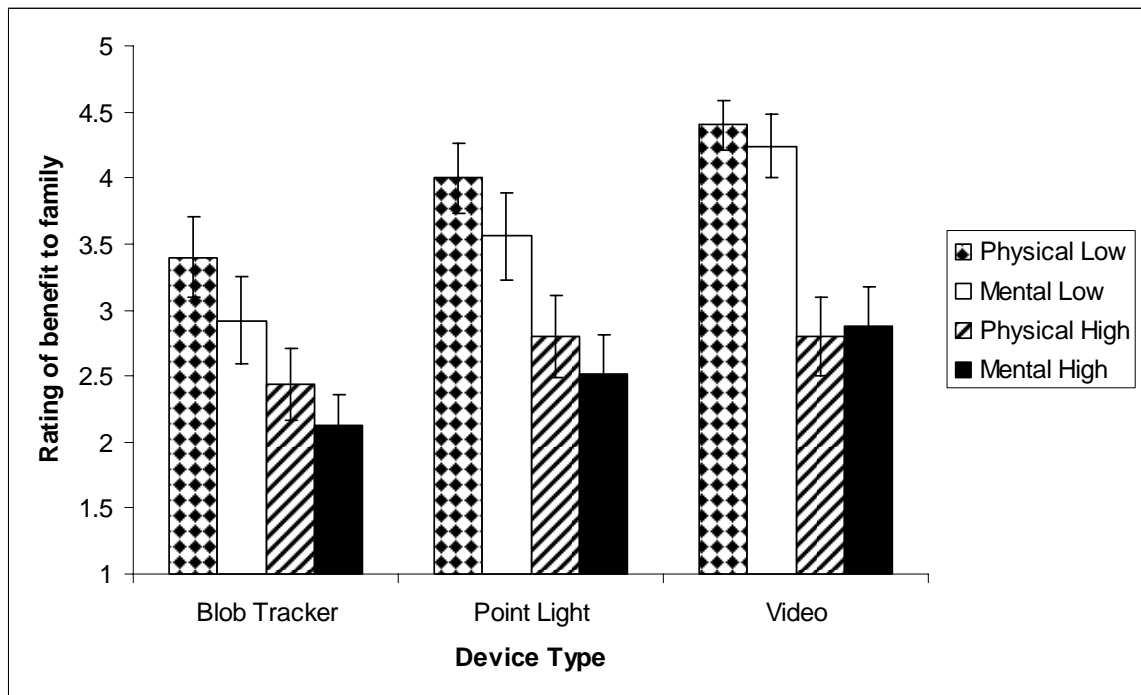aracter for each of 12 scenarios was the DV. There was no significant interaction of device type and level of functioning across scenarios with respect to the rating of benefit to the character in the scenario (p = .1), indicating that for each device type the rating of benefit to the character followed a similar pattern along

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level of functioning. As shown in Figure 13, the pattern of rating of benefit to the individual was similar for level of functioning across device type. Therefore further analyses were conducted to investigate main effects in detail.
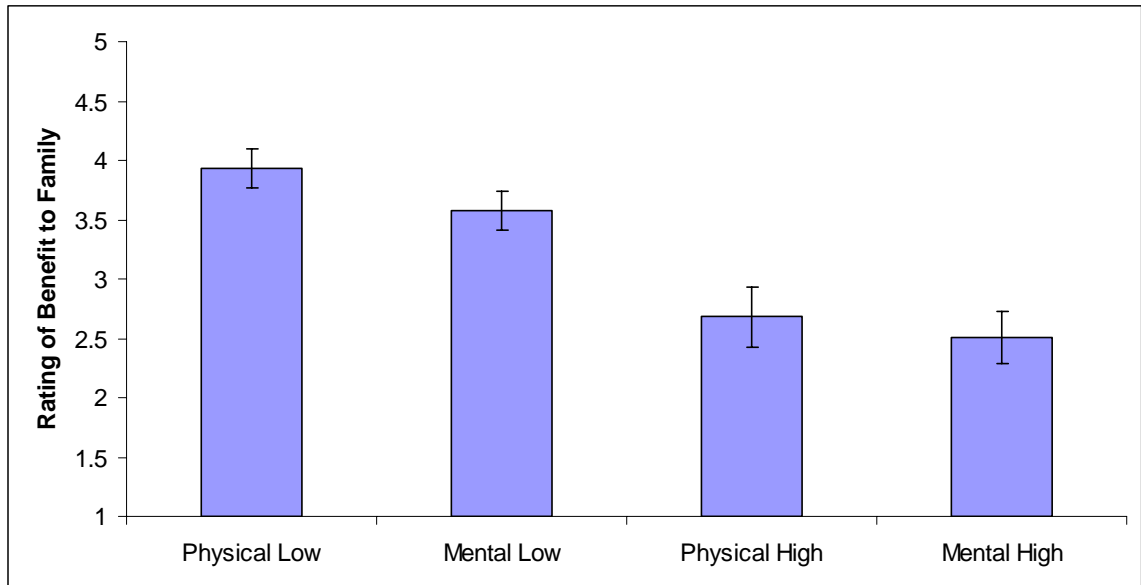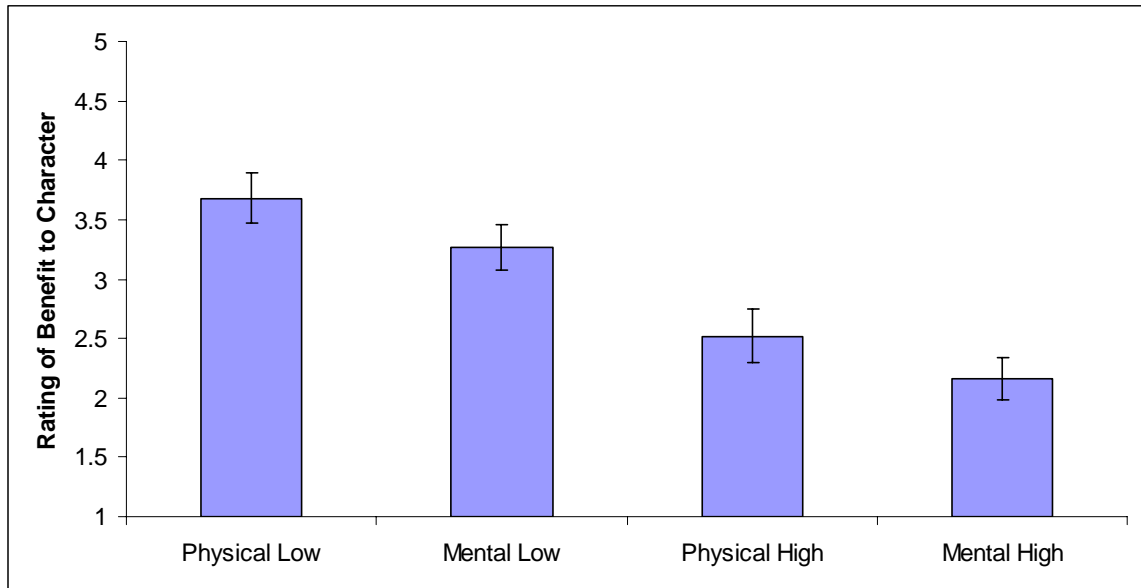

Figure 14. Rating of benefit to Individual by level of functioning

As shown in Figure 12, ratings of benefit to individual differed significantly across level of functioning $F(3,72) = 20.59$, $p < .001$, $\eta p^2 = .46$ indicating that the level of functioning of the individual in the scenario was related to the level of benefit to the character in the scenario. Follow up pairwise comparisons revealed a significant difference in level of benefit to the individual between all levels of functioning (p's < .03), indicating that participants thought that those characters who were lower functioning would benefit more than those who were higher functioning and that participants who needed assistance in physical activities, rather than in mental activities would benefit the most from being monitored.
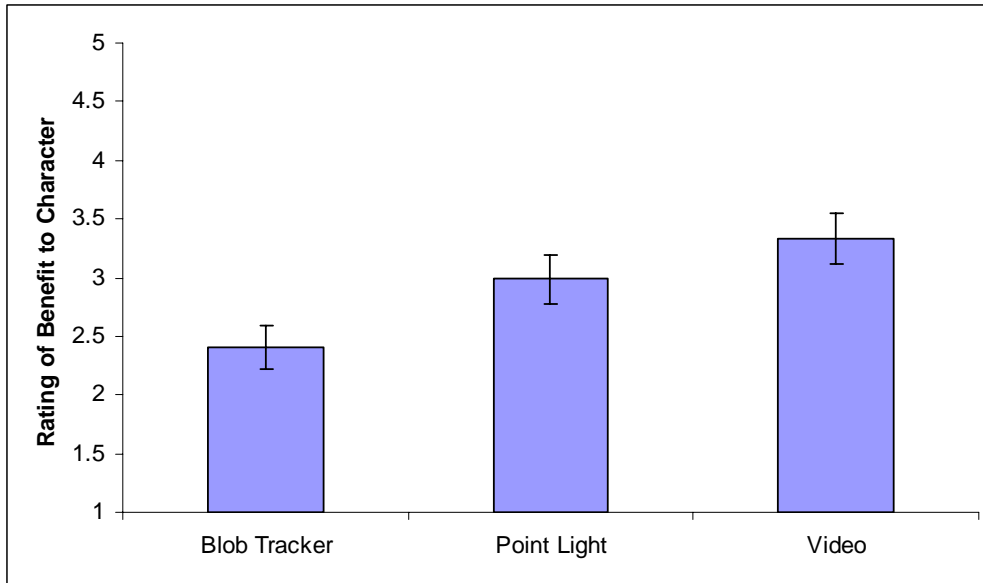
Figure 15. Level of benefit to Individual by device type.

As shown in Figure 15, ratings of benefit to the character differed significantly across device type $F(2,48) = 8.26$, p =.001, $\eta p^2 = .26$ indicating that the type of device mentioned in the scenario was related to the level of benefit to the character in the scenario. Follow up pairwise comparisons revealed a significant difference in level of benefit to the character between the blob tracker and point light camera (p = .02) and between the blob tracker and the video camera (p < .001), indicating that participants rated benefit to the character lower when a blob tracker was used.

Summary of rating of benefit to character

Level of benefit to the character in the scenario was related to both the level of function of the character in the scenario as well as the type of device used in the scenario. Participants rated the benefit to the character highest when the character was low on physical functioning and lower when the character in the scenario was high functioning. In addition, the pattern of ratings for the benefit by devices followed a stepwise pattern such that the video was rated as the most beneficial; the point light in the middle, and the blob tracker was rated as the least beneficial.

Non-Scenario

All questions in the non-scenario section were open ended questions that were coded using a qualitative coding scheme. Quantitative results from each question are given in the form of percentage of participants whose answer to an open ended question was coded as falling into a particular category. Inter-coder agreement was computed using Cohen's Kappa, a statistic used to measure inter-coder agreement that accounts for agreements due to chance. Cohen's Kappa should not be interpreted as the percentage of times coders agreed, but rather interpreted according to standards for Kappa. Cohen's Kappa for the non-scenario section of coding was .68 which is considered "good" inter-coder agreement (Graphpad Software, 2005).

Situation where monitoring useful

Participants were asked the following question, "Can you think of a situation where it might be useful to have someone check up or watch you with a visual sensing device?" As is shown in Table 6, the majority of participants (84%) reported that monitoring using a visual sensing device would be useful in a specific situation.

Table 6. Situations where monitoring useful.

Category	Total (N = 25)	Percentage of 100 % of participants
No situation where useful	**3**	**12%**
I need monitoring now	**1**	**4%**
In a specific situation	**21**	**84%**
If fall	**6**	24%
If ill	**6**	24%
When older	**6**	24%
If living alone	**6**	24%
For security	**4**	16%
If more cost effective	**2**	8%
To monitor a child or babysitter	**2**	8%
To check up on someone	**1**	4%
If monitored has a deficit	**1**	4%
If monitored has memory trouble	**1**	4%
If monitored is handicapped	**1**	4%
If there is an emergency	**1**	4%
If there is an accident	**1**	4%
If monitored couldn't do for self	**1**	4%

*The first 3 categories sum to 100%

Device choice

Following up on the situation where participants reported that a visual sensing system would be useful, the question, "In this situation, which visual sensing device would you want to have in your home?" was asked. The majority of participants reported that they would choose the video camera monitoring system given the situation they mentioned. The three people who reported that there was no situation where a monitoring device would be useful were coded as "no device" for this question.

Table 7. Device choice for home in situation given.

Category	Total (N = 25)	Percentage of 100 % of participants
Video	17	68%
Not the video	4	16%
No device	3	12%
Point Light	3	12%
Point light or video	1	4%

* 4 participants chose different devices depending upon the situation, so device choice does not sum to 100%.

Concerns about being monitored

When asked, "Would you have any concerns about having a visual sensing device in your home," most (68%) participants reported having some concerns about having a visual sensing device in their home. However, 32% reported that they would have no concerns about having a visual sensing system in their home.

Table 8. General Concerns about visual sensing device in home

Category	Total (N = 25)	Percentage of 100 % of participants
Concerns	**17**	**68.00%**
Privacy	9	36.00%
Person monitoring me	5	20.00%
Don't want to be seen in compromising situations	2	8.00%
Being monitored would make me uncomfortable	3	12.00%
Cost of monitoring	2	8.00%
Would be a loss of independence	1	4.00%
Big brother	1	4.00%
It would be ok if I controlled when I was monitored	1	4.00%
Having to look ones best all the time	1	4.00%
Voyeurism	1	4.00%
No Concerns	**8**	**32.00%**
It would be nice	3	12.00%
Because I would have it for safety	1	4.00%
If it had my blessing	1	4.00%
It would be convenient	1	4.00%

*Participants either reported concerns or did not, so the categories
"**Concerns**" and "**No Concerns**" sum to 100%.

Discussion

The findings from this study are important because they help us to better

understand the privacy concerns of older adults and how such concerns may change as a

function of an individual's ability and the specific device type. This study provides the

first evidence that variables such as device type and level of functioning of an individual

are related to privacy concerns. Overall the data suggest that older adults have more

concerns about devices that produce high fidelity images; but, the perception is that full

image capabilities are more beneficial and more desirable than visual sensing devices of

low fidelity.

Because of the research design employed in the present research, quantitative

differences in the level of privacy concerns reported across these variables could be

considered along with qualitative differences in the kinds of concerns reported across situations.

Participants reported higher levels of privacy concern when the functioning of an individual was higher suggesting that older adults who are higher functioning may have greater privacy concerns about inviting visual sensing devices into their home. In addition, participants reported higher levels of privacy concern when highly recognizable images were captured. Given this evidence, one could conclude that older adults have more privacy concerns about devices such as video cameras that capture high fidelity images. However, that would be an incomplete assessment of the situation, yet it is the conclusion most previous investigations have come to.

"Qualitative" Evaluation: Expanding our understanding of cost/benefit analysis

When deciding if intrusive technology is to be accepted, it appears that individuals engaging in an "if-then-else-if" decision making process. It is important to consider such decision making sequences because simply asking individuals if they are concerned about privacy issues with cameras leads to an incomplete and perhaps even inappropriate understanding of the role of privacy in technology acceptance. By expanding the evaluation to include an analysis of costs as well as benefits, a more complete picture emerges. Technology acceptance is determined by many variables and a critical variable is the technologies "usefulness" – that is, the benefit to the user (Van Ittersum, Rogers, Capar, Caine, O'Brien, Parsons, & Fisk, (2006); O'Brien, Caine, Seifert, Rogers, & Fisk,(2006). If a technology is not useful in some way it is immediately rejected. Once a benefit is determined then other factors are considered.

The present study demonstrated that older adults evaluate cost along with benefit of visual sensing devices. Despite privacy concerns expressed by the older adult

participants, these older adults did realize benefits afforded by having a visual sensing system in the home. Almost all participants reported at least one situation when having a visual sensing system in their home would be useful. When probed about which device they would want to use given the situation they just reported, the majority volunteered that they would want to use a video-based system. In addition, during the scenario section of the structured interview, participants rated benefits higher to both the character in the scenario and the character's family when the device used in the scenario was a video camera. This pattern of data suggest that older adults engage in similar decision making concerning acceptance of possible privacy intrusive devices as they do with other devices. The data indicate that individuals may be willing to overlook higher levels of concern (costs) about a device when they perceive a concern-producing-device as more beneficial than other devices that evoke less concern about privacy intrusion.

In previous literature on technology and privacy, researchers have focused on image quality and security issues to the exclusion of other relevant variables such as a person's level of functioning or other variables that may point toward need for a device. One other gap in the privacy literature that this study fills is the dearth of research on older adults' privacy concerns and acceptance when making decisions about home-based advanced technology. Few studies (with the exception of work done by Melenhorst and colleagues, 2004) have addressed privacy in the context of older adults living in there home.

The data obtained from the structured interviews provide information about the types of privacy concerns that older adults have about a home equipped with visual sensing devices and how these concerns differed across the dimensions of image type and person characteristics. Specifically, the data revealed the nature of the concerns that

older adults had about visual sensing devices in the home and how these concerns change as a function of image type and person characteristics.

It was expected that the specific type of privacy concerns would be variable across participants (Sarkisian, Melenhorst, Rogers, & Fisk, 2003). The present study confirmed this expectation. For instance, some participants reported concerns about having a visual sensing device in their home, whereas others reported no concerns. However, even with the variety of general privacy concerns reported among participants there were consistent changes in level of concern across the independent variables; level of functioning of the character in each scenario and the type of device that was mentioned in the scenario were both related to the level of privacy concerns.

The findings suggest that as long as the person being monitored has lower mental functioning, there may not be as many concerns with collecting images of these people. This finding would be consistent with the findings of Melenhorst et al. (2004), who reported that older adults were more willing to accept a device if they perceived a need for the device. In addition to being consistent with Melenhorst et al.'s findings this study also extends their work by bringing the variables of interest under experimental control and manipulating them using scenario based questioning. The combined evidence from these two separate studies, employing somewhat different methodologies, point to a model where that evaluation of benefits (benefits that fill a need) is considered in a manner that outweighs concerns about invasive technologies.

The findings from this study have broad implications both theoretically and practically. From the perspective of privacy theory this study provides initial evidence that current frameworks of privacy are inadequate – for no current frameworks take user ability, a variable shown to influence privacy concerns in this study, into account. From

a practical standpoint this study suggests that designers of monitoring systems, particularly monitoring systems for older adults, should consider not only the privacy concerns that devices may evoke, but also the benefits they provide.

APPENDIX A

SCENARIO CHOICES

Instructions

- ## **<u>Please read the instructions carefully!</u>**

- This activity should take no more than 10 minutes.

- Please read each statement and rate the person in the statement on either

  their mental or physical functioning.

- There are no right or wrong answers – We are interested in what you

  think about the person described in each statement.

    - The people in each statement are imaginary – they are not based

      on real people.

    - The imaginary people in each statement are all older adults

      <u>between the ages of 65 and 80.</u>

Please turn the page and begin.

Mrs. S exercises a good bit. She exercises for at least 20 minutes every other day or so.

1) Please rate Mrs. S on her **physical** functioning.

   ☐$_1$ ☐$_2$ ☐$_3$ ☐$_4$ ☐$_5$
Very low   Low   Average   High   Very high

Mrs. Q has trouble going to the bathroom by herself. She has difficulty getting on and

off the toilet without assistance.

2) Please rate Mrs. Q on her **physical** functioning.

   ☐$_1$ ☐$_2$ ☐$_3$ ☐$_4$ ☐$_5$
Very low   Low   Average   High   Very high

Mrs. G has difficulty taking her medications properly. Often she forgets what

medications to take, when to take them, and sometimes even forgets to take them

altogether.

3) Please rate Mrs. G on her **mental** functioning.

   ☐$_1$ ☐$_2$ ☐$_3$ ☐$_4$ ☐$_5$
Very low   Low   Average   High   Very high

Mrs. N swims once a week. She can get in and out of the pool and swim without assistance.

4) Please rate Mrs. N on her **physical** functioning.

$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$
Very low	Low	Average	High	Very high

Mrs. O has trouble getting where she needs to go by herself. She can no longer drive or use public transportation because she gets confused with all the signs.

5) Please rate Mrs. O on her **mental** functioning.

$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$
Very low	Low	Average	High	Very high

Mrs. M always takes her medication on time. She never forgets a dose or gets her pills mixed up.

6) Please rate Mrs. M on her **mental** functioning.

$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$
Very low	Low	Average	High	Very high

Mrs. C has difficulty managing her own money. Sometimes she forgets to pay her bills

and worries that the water or power company may turn off her utilities.

7) Please rate Mrs. C on her **mental** functioning.

$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$
Very low	Low	Average	High	Very high

Mrs. A has trouble getting in and out of bed by herself. Sometimes she worries that she

might not be able to get out of bed by herself at all.

8) Please rate Mrs. A on her **physical** functioning.

$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$
Very low	Low	Average	High	Very high

Mrs. R has trouble walking. She finds it difficult to get around her house without

someone to help her.

9) Please rate Mrs. R on her **physical** functioning.

$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$
Very low	Low	Average	High	Very high

Mrs. V has trouble keeping up with the housework. Sometimes she forgets to take out the trash, wash her clothes or do the dishes.

10) Please rate Mrs. V on her **mental** functioning.

$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$
Very low	Low	Average	High	Very high

Mrs. T has trouble shopping for herself. She often forgets what she came to the store to get and usually has to ask for help with the weekly shopping.

11) Please rate Mrs. T on her **mental** functioning.

$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$
Very low	Low	Average	High	Very high

Mrs. F cooks almost every night. She can still remember all the recipes she usually cooks and sometimes tries out new recipes.

12) Please rate Mrs. F on her **mental** functioning.

$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$
Very low	Low	Average	High	Very high

Mrs. U stays current on all the news by reading the newspaper and watching TV. She likes to be able to talk about world events with her friends and family.

13) Please rate Mrs. U on her **mental** functioning.

  ☐1   ☐2   ☐3   ☐4   ☐5
Very low   Low   Average   High   Very high

Mrs. L always keeps her house clean. She can still scrub the bathtub and wash the dishes by hand.

14) Please rate Mrs. L on her **physical** functioning.

  ☐1   ☐2   ☐3   ☐4   ☐5
Very low   Low   Average   High   Very high

Mrs. J plays chess every day. She can beat almost anyone she plays against.

15) Please rate Mrs. J on her **mental** functioning.

  ☐1   ☐2   ☐3   ☐4   ☐5
Very low   Low   Average   High   Very high

Mrs. D walks 2 miles every day. She likes walking and hopes she can continue to take her walks for a long time.

16) Please rate Mrs. D on her **physical** functioning.

$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$
Very low	Low	Average	High	Very high

Mrs. K has difficulty preparing meals for herself. She can no longer follow recipes or put microwave meals in the microwave for the right amount of time.

17) Please rate Mrs. K on her **mental** functioning.

$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$
Very low	Low	Average	High	Very high

Mrs. P has trouble getting in and out of her chair. It is difficult for her to get in her chair or out of her chair without assistance.

18) Please rate Mrs. P on her **physical** functioning.

$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$
Very low	Low	Average	High	Very high

Mrs. E has difficulty bathing herself. She has difficulty getting in and out of the bath or shower without assistance.

19) Please rate Mrs. E on her **physical** functioning.

| $\square_1$ | $\square_2$ | $\square_3$ | $\square_4$ | $\square_5$ |
| Very low | Low | Average | High | Very high |

Mrs. H can work in her garden. She can still get down on her knees to plant flowers and carry the watering can without trouble.

20) Please rate Mrs. H on her **physical** functioning.

| $\square_1$ | $\square_2$ | $\square_3$ | $\square_4$ | $\square_5$ |
| Very low | Low | Average | High | Very high |

Mrs. I has trouble eating by herself. Sometimes she finds it difficult to use utensils like a fork or spoon because of the shakiness in her hands.

21) Please rate Mrs. I on her **physical** functioning.

| $\square_1$ | $\square_2$ | $\square_3$ | $\square_4$ | $\square_5$ |
| Very low | Low | Average | High | Very high |

Mrs. B does the New York Times daily crossword puzzle every day. She usually gets all the words right.

22) Please rate Mrs. B on her **mental** functioning.

□₁	□₂	□₃	□₄	□₅
Very low	Low	Average	High	Very high

Mrs. W can ride her bike. She usually rides around the neighborhood a couple of times a week.

23) Please rate Mrs. W on her **physical** functioning.

□₁	□₂	□₃	□₄	□₅
Very low	Low	Average	High	Very high

Mrs. X reads daily. She is an active member of her local book club.

24) Please rate Mrs. X on her **mental** functioning.

□₁	□₂	□₃	□₄	□₅
Very low	Low	Average	High	Very high

Housing / Living Situation Questionnaire

Check the answer that most closely matches your current living situation.

1. Do you:

   1   Live alone

   2   Live with your spouse or life partner

   3   Live with a family member (for example a son, daughter or parent)

   4   Live with a non-family member (friend, roommate, etc.)

   5   Live in a retirement community

   - if so, please provide the name of the retirement community_____

2. How long have you lived in your current living situation?

   1   Less than 1 year

   2   More than 1 year

Everyday Activities Questionnaire

1. Who prepares the <u>majority</u> of your meals? (please check only one)
   1 You
   2 Your spouse
   3 A Restaurant
   4 A part time (not live in) paid assistant (for example a maid, nurse or chef)
   5 A full time (live in) paid assistant (for example a maid, nurse or chef)
   6 A delivery service like meals on wheels
   7 Other, please describe_____

2. Who is responsible for making <u>most</u> appointments (such as doctors appointments) for you? (please check only one)
   1 You
   2 Your spouse
   3 Your children
   4 Other (please specify) _____

3. Does anyone help you get in and out of chairs or bed?
   1 Yes
   2 No
        3 a. If "Yes", who?
           1 Spouse
           2 Your Children
           3 Friends
           4 Other (please specify) _____

2. Who is <u>primarily</u> responsible for making sure that you take your medications? (please check only one)
   1 You
   2 Your spouse
   3 Your children
   4 Other (please specify) _____

4. Does anyone help you remember to take medications?
   1 Yes
   2 No
        4 a. If "Yes", who?
           1 Spouse
           2 Your Children
           3 Friends
           4 Other (please specify) _____

APPENDIX D

Script

INTRODUCTION

Hello and welcome to this interview being conducted by the Human Factors and Aging
Group at Georgia Tech. Thanks for taking the time to come and talk with me. We
conduct research designed to support older adults in their daily activities such as
the use of technology. Most of our projects are funded by the National Institute
on Aging.

The things we learn from interviews like this one help us to focus on important issues that
older adults deal with, and this, in turn, directs our research. For example, in the
past, we have learned a lot about the kinds of activities that older adults do each
day and the kinds of problems that come up during those activities. We can use
this information to recommend design changes for systems and products or to
develop improved instructions.

Today, I would like to discuss your ideas and concerns about a home equipped with
visual sensing devices. Visual sensing devices are devices such as video cameras
that can record activities. You may be familiar with similar devices which are
used to monitor gas stations or other types of stores. I am interested in your
thoughts about visual sensing devices in the home, and any possible related
privacy issues.

I care very much about what you have to say. Because I will be tape-recording the
interview, please speak up. I do not want to miss anything that you have to say.

INFORMED CONSENT

I have given you two copies of the consent form, one copy is for us and the other is for your own records. Note that before you sign the consent forms, please make sure that you feel comfortable with participating today. If you decide for any reason that you are not able to participate today, let me know at any time. If you do not have any questions and you still wish to continue, you may sign the consent forms.

ABILITY TESTS

Now we are going to do three short tests that measure vocabulary, memory, and speed of responding. We will provide you with the instructions for each test in turn and you may ask questions for clarification at that time.

Finally, I would like to test your hearing and vision.

Now, we will move on to the structured interview. Before we begin, you should understand that there are no right or wrong answers, only different experiences and opinions. That's why this kind of interview is so valuable to us, it enables us to learn a lot about the different kinds of opinions that people have.

The session will last about an hour and a half. If there is something that I can do to make you more comfortable, like get you a different chair or get you something to drink, please let me know. Also, before we begin, if you need to use the restroom, please do so now.

Ok, I'm going to turn on the tape recorder and begin recording now.

1) Tell me about where you live.

2) Can you think of a situation where it might be useful to have someone check up or watch you with a visual sensing device?

    i) In this situation which visual sensing device would you want to have in your home?

        (1) Why?

    ii) What about a video camera?

        (1) Why not?

    iii) What about a point light camera?

        (1) Why not?

    iv) What about a blob camera?

        (1) Why not?

  b) Can you think of any other situations where you might want someone to use a visual sensing device to look in on you in your home? [repeat i – iv above, then "b" until participant cannot think of any other situations.]

3) Would you have any concerns about having a visual sensing device in your home?

  a) Like what?

  b) Any other concerns?

  c) Are there specific activities you would or would not want a visual sensing device in your home to see?

  IF they do not mention all devices, ask:

    i) Would you have any concerns about having a video camera visual sensing device in your home?

        (1) Like what?

        (2) Any other concerns?

        (3) Are there specific activities you would or would not want a video camera visual sensing device in your home to see?

    ii) Would you have any concerns about having a blob-tracker visual sensing device in your home?

        (1) Like what?

        (2) Any other concerns?

(3) Are there specific activities you would or would not want a blob-tracker visual sensing device in your home to see?

iii) Would you have any concerns about having a point light visual sensing device in your home?

(1) Like what?

(2) Any other concerns?

(3) Are there specific activities you would or would not want a point-light visual sensing device in your home to see?

4) If you could design the visual sensing device for your home any way you wanted to, how would you design it?

a) What rooms in the house would it be able to see?

i) Any other parts of the house?

b) Who would be able to turn the monitoring system on or off?

i) Anyone else?

c) Who would be able to view the pictures?

i) Anyone else?

(1) How would [this person OR these people] be able to get these pictures?

ii) Where would the pictures be stored?

iii) How long should the pictures be stored, wherever they're stored?

(1) Why?

(2) Why not longer?

iv) Do you think there is any risk that other people might be able to see these pictures even though you do NOT want them to?

(1) If YES

(a) Who would be able to get them?

(b) How would they get these images?

(c) What would they do with these images?

(2) If NO

(a) Why do you think that there is no risk that other people might be able to see the pictures?

Introduction to Scenarios

Now we're going to move on to another type of question. For the last questions you answered questions about situations where you might want to use a visual sensing device in your home. For the following questions I'm going to tell you about an imaginary person in an imaginary situation. The people in the stories are not real people and are not based on real people. The stories have been created specifically for this study.

For the people in the stories I'll show you in just a minute, cost is not a consideration. They do not have to worry about the cost of using a monitoring system in their home. They are all older adults between the ages of 65 and 80. After I tell you about each person I'm going to ask you a few questions. These questions may seem repetitive, but please remember that it's important to answer each question, even if it is asked more than once. Also please do not use comments like, "well, just like I said before…" instead please repeat the comment even if you just said it before. Please be patient because it is important that I ask all of the questions. We're very interested in your opinions and ideas about each person in each story.

Feel free to look back at the scenarios at any time.

{IF necessary – say, "Please do not use comments like, "well, just like I said before…" instead please repeat the comment even if you just said it before." after each scenario, before beginning the questions.}

{SCENARIOS}

1. What are some benefits Mrs. [A] or her family might get from having a [video camera] monitoring system in her home?
    a. What are some other benefits?
    b. Any others?
2. What are some concerns Mrs. A might have about having a video camera in her home?
    a. IF concerns
        i. What are some other concerns?
        ii. What could Mrs. A do to [solve this problem] address or reduce her concerns?
            1. What else could she do to alleviate these concerns?
    b. IF NO concerns
        i. Why is there no need for Mrs. A to be concerned?
3. What is a situation where Mrs. A would want to have the [video camera] monitoring system in her home?
    a. Any other situations?
4. Who might Mrs. A WANT to see the pictures taken with a video camera monitoring system?
    a. If "family"
        i. Which members of her family in particular?
        ii. Why this family member in particular?
    b. If "friend"
        i. Which friend

ii. Why this friend in particular?

c. If "health care provider"

i. Why this health care provider in particular?

d. If "other"

i. Why this person in particular?

e. Who might Mrs. A NOT want to see the images captured with a video camera monitoring system?

i. Why?

Standard follow-ups for all questions:

If off track – say, "That's good, but the focus of this question is [repeat part of question]."

If need additional probe – say, "Any [others, more, one else, thing else]?"

If need explanation – say, "What do you mean?"

Final questions.

We've just talked a lot about people who are in different life situations using a variety of visual sensing devices. Now I want to ask you a few questions about circumstances that any of the people in the stories could be in. Please think generally about all the people as you answer these questions.

1. Let's say that the people in the stories above were originally against having a visual sensing device in their home

   a. If there was an emergency situation do you think they would still be against having a visual sensing device in their home?

      i. Why?

     ii. Which device would they choose?

          1. Why?

b. If they were forced to choose between having a visual sensing device in their home, or going to an assisted living facility which do you think they would choose?

      i. Why?

     ii. Which device would they choose?

          1. Why?

APPENDIX E

Image Type Reminder Sheets

Video Camera Monitoring System

- Easy to identify who the person is.

- Easy to identify what the person is doing

Point Light Monitoring System
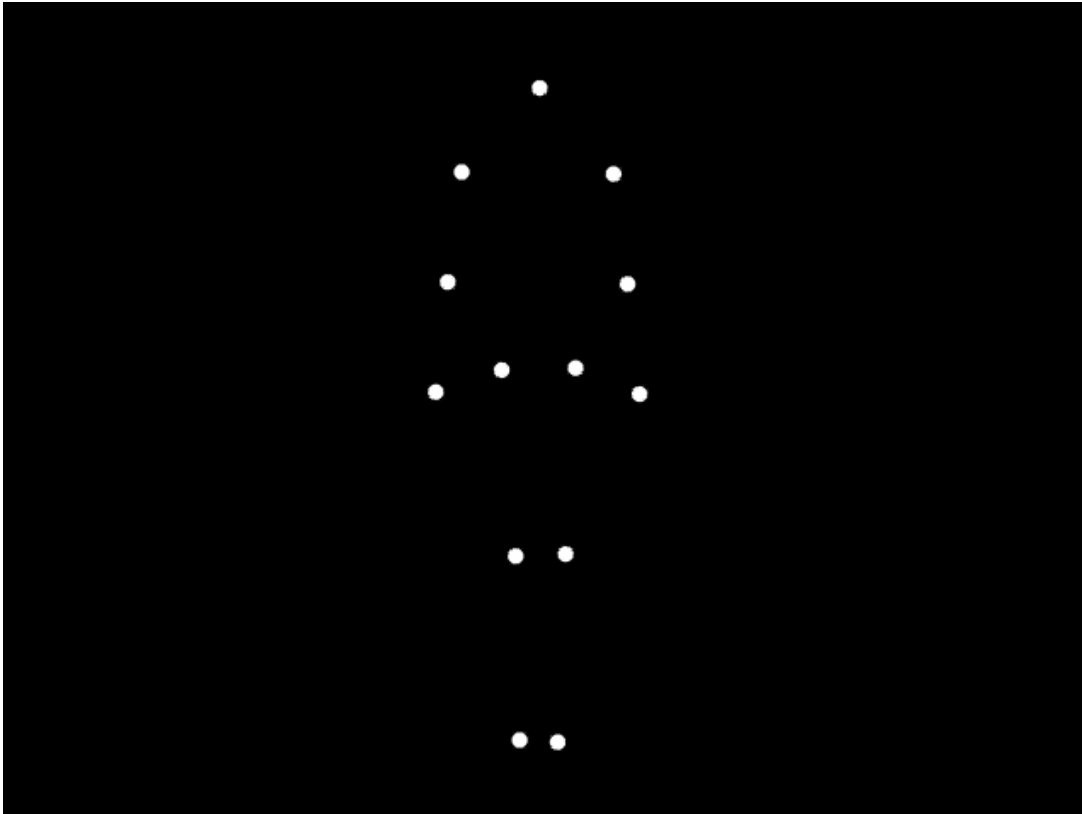
- Difficult to identify who the person is.
- Easy to tell what the person is doing.

Blob Tracker Monitoring System.
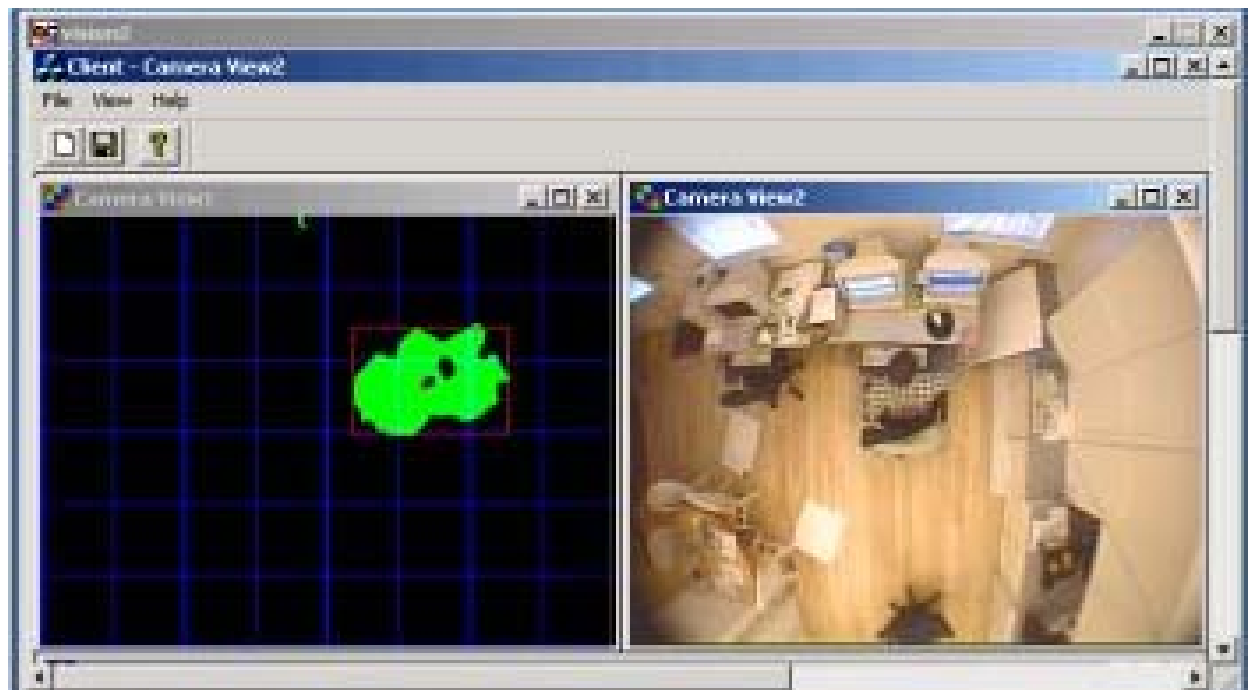
- Impossible to tell who the person is

- Difficult to tell what the person is doing

Final Coding Scheme

Non-Scenario

    i. Situation where monitoring useful?
        1. monitoring useful
            a. Initial value judgments
                i. I don't want to be dependent
                ii. it would make me uncomfortable
                iii. Rather have a person
                iv. Privacy
                v. Not useful for me now
                vi. wouldn't want it for self
                vii. want to be safe but not by being monitored visually
                viii. Against visual system
                ix. Other
            b. Combined (Self only)
                i. When useful?
                    1. Never
                    2. Need now
                        a. due to memory problems
                    3. specific situation
                        a. if fall
                        b. if ill
                        c. when older
                        d. If living alone
                        e. for security
                        f. if more cost effective
                        g. to monitor teenager or child or babysitter
                        h. check up
                        i. if have a deficit
                        j. if memory problems
                        k. if handicapped
                        l. if emergency
                        m. if accident
                        n. if couldn't do for self
                ii. Which device?
                    1. Not the video
                        a. Why?
                            i. the blob or point light would be ok
                            ii. others don't have the right to know
                            iii. don't need to know

what im doing
iv. don't want to see someone in daily activities
v. don't want someone to view me in daily activities
vi. too invasive
2. No device
3. Video
   a. Why?
      i. Able to identify more
      ii. Able to identify person
      iii. Able to identify activity
      iv. gives full picture
      v. pick up everything
      vi. Clearer picture
      vii. would enable those who want to help you
      viii. provides better evidence
   b. Why not?
      i. no need for it
      ii. because healthy
      iii. Invades privacy
4. Point Light
   a. Why?
      i. could tell if fallen
      ii. could still see movement
5. point light or video
   a. Why?
      i. to know everything is ok
      ii. Can still tell if you fell
      iii. Clearer than the blob
   b. Why not?
      i. Not as good as the video

  2. Who?
    a. Self
ii. Comments about devices
  1. Video

a. general
    i. relationship to other devices
        1. less privacy concerns with video than with point light
        2. less privacy concerns with point light than video
    ii. big brother
    iii. visual not necessary
    iv. good in security situations
    v. good if I fall
    vi. I would have to have some control

b. Concerns
    i. No
        1. No specific concerns about video
        2. would be advantageous
        3. would be device of choice
        4. Good for security
    ii. Yes
        1. too much detail
        2. Id be uncomfortable with it
        3. it would be like someone could come into my apartment
        4. more intrusive
        5. not blind
        6. don't want it in private areas
        7. could be used as evidence
        8. Feel like someone is spying
        9. privacy
        10. wouldn't care for it
        11. what if I wanted to pick my nose
        12. Big brother
        13. It's nobody's business what I do all day
        14. Don't want third person watching
        15. Video catches everything

c. specific activities
    i. other
        1. Id have to accept it if I was in danger of hurting myself
    ii. Yes
        1. Nudity
            a. Dress and undress
        2. Bedroom activities
            a. Sex
            b. Intimate relations
        3. Bathroom activities

a. going to the bathroom
                    b. Taking a bath
                4. Wouldn't want it to pick up
                    conversations
                5. any activities in private areas
                6. Activities with significant others
                7. While doing socially unacceptable
                    activities
                8. When not looking your best
            iii. No
            iv. wouldn't want it in any situation
             v. I wouldn't mind if
                1. cooking
                2. watching TV
                3. sitting
                4. sleeping
            vi. Good in certain areas
    2. point light
        a. general
            i. Negative aspects
                1. too much information
                2. not enough information
                    a. cant see condition of house
                    b. able to see if something went
                        wrong
                    c. cant tell what person is doing
                    d. cant tell who the person is
                    e. Doesn't show what's around
                    f. Can't tell difference between
                        sleep and fall
                    g. Confuse dog with a person
                3. Not helpful
            ii. relationship to other devices
                1. might start with this then move to
                    video
                2. Not much better than blob and not as
                    good as video
                3. rather point light than blob
                4. Maybe as a second choice
                5. Clearer than the blob
                6. might be better than the blob
                7. not as good as video
            iii. Wouldn't want one
                1. Not helpful
                2. Cant tell much with it
                3. don't want any kind of visual device

65

        iv. blind
        v. not necessary
        vi. doesn't work in this situation
        vii. requires monitor to be capable at reading image
        viii. Maybe for someone who is incapacitated
        ix. to track burglars
- b. concerns
  - i. Less than video
  - ii. Yes
    1. more information than you need
    2. can tell what people are doing
    3. Don't want it in private areas
    4. Don't want it to pick up me doing embarrassing things
  - iii. No
  - iv. No answer
- c. specific activities
  - i. No
    1. not as long as I was in need
  - ii. Yes
    1. embarrassing activities
    2. Nudity
       a. Dress and undress
    3. Bathroom activities
  - iii. Depends of who's watching
3. blob-tracker
   - a. general
     - i. positive aspects
       1. comfort
     - ii. Negative aspects
       1. not enough information
          a. Cant tell what person is doing
          b. Can tell difference between lying on bed and on floor
          c. Cant tell who person is
       2. no particular advantage
       3. It's useless or doesn't do much good
     - iii. relationship to other devices
       1. doesn't provide as much information as video so better for privacy
       2. Rather have video
       3. might start with this them move to video
     - iv. Wouldn't want one
       1. Not as good as video

2. Its useless
          3. don't want any kind of visual device
          4. Can't identify people from pets
      v. blind
      vi. Could still be good for security
      vii. doesn't work in this situation
  b. concerns
      i. No
      ii. Yes
          1. cant identify people
          2. wouldn't want it in the bathroom
          3. Wouldn't want one in private areas
          4. Don't want to have to be careful about what I do
          5. The same as for visual
  c. specific activities
      i. Yes
          1. bathroom activities
              a. Knowing that they are going to the bathroom
          2. not useful
          3. No activities in private areas of the house
      ii. no
4. Concerns
  a. Yes
      i. Privacy
          1. You can't hide anything
          2. Everything is out in the open
          3. don't want people to know what I'm doing
          4. Not anyone else's business
      ii. person monitoring me
      iii. Don't want to be seen in specific situations
          1. when naked
          2. getting dressed
          3. use the bathroom
      iv. Would make me uncomfortable
          1. Feels like an intrusion
          2. would be like being in jail
          3. It would be embarrassing
      v. information getting into the wrong hands
      vi. Don't' want third person watching
      vii. Cost
          1. To install
          2. To maintain

   viii. Would be a loss of independence
     1. encroaches on dignity
   ix. Big brother
   x. but it would be ok if I controlled when they followed me
   xi. putting on show and looking best all the time
   xii. voyeurism
  b. No
   i. It would be nice
   ii. because I would have it for safety
   iii. If it had my blessing
   iv. It would be convenient
   v. Because I wouldn't have it now
  c. Other
 5. Specific Activities
  a. Yes
   i. bathroom activities
     1. shower
     2. Anything in bathroom
   ii. bedroom activities
     1. Sex
     2. sleep
   iii. making a mess
   iv. personal things
   v. nudity
   vi. activities in private parts of house
   vii. while doing socially unacceptable activities
  b. No
   i. not doing anything that I wouldn't want any to see
   ii. don't want system at all
  c. Other
   i. Id rather not have a sensor watching me
   ii. Would be ok if watch me reading
 iii. You Design
  1. General answer
  a. Not a video camera
  b. Like another device
   i. Like a point light
   ii. Prefer an audio system
   iii. Like a video camera
   iv. like a security system
  c. Would have specific features
   i. privacy station
   ii. Have it on for certain hours

iii. on and off quickly
iv. remote control
d. Would be in certain areas of the house
i. picks up everything in room
ii. In every room but bathroom
2. Parts of house
a. Not in
i. bedroom
ii. bathroom
iii. Nowhere in house
iv. Why not in these rooms?
1. Privacy
b. Would want it in
i. Everywhere
ii. door(s) or entranceways
iii. porch
iv. Outside or yard
v. public rooms
1. living area
2. dining
3. great room
4. Kitchen
5. Living room
6. rec room
7. the Den
vi. private rooms
1. bathroom
2. Bedroom
3. Who turn on or off
a. Anyone
b. Individual
i. but NO ONE else
ii. as well as spouse but NO ONE else
iii. as well as spouse
c. Never considered turning it on and off
d. sensing device
e. care giver (unspecified distance)
f. Service relationship (large distance)
i. social worker
ii. building manager
iii. Security or monitoring company
g. Familial or friendly relationship (small distance)
i. Friend
ii. Family
1. sibling
a. sister

    2. Children
      a. Godson
      b. son
      c. Daughter
4. Who view pictures
  a. Anyone
  b. Must physically be close by
  c. Individual
    i. as well as spouse
    ii. but NO ONE else
  d. care giver (unspecified distance)
  e. Familial or friendly relationship (small distance)
    i. friend
    ii. Family
      1. Children
        a. son
        b. Daughter
        c. Godson
      2. Sibling
        a. sister
  f. Service relationship (large distance)
    i. Health care provider
      1. doctor
      2. nurse
    ii. social worker
    iii. Security or monitoring company
    iv. The police
5. How get pictures?
  a. Existing technology
    i. like a security system
    ii. information transmission
      1. Connected systems
      2. E-mail
      3. satellite or phone or cable
      4. Wireless feed
      5. Via signal
    iii. information storage
      1. CD or DVD
      2. TiVo type machine
      3. Video Tape
    iv. information capture and/or display
      1. closed circuit TV
      2. TV
      3. video camera
  b. Non-tech methods
    i. Through individual being monitored

ii. Mail
  c. Other
6. Where pictures stored
  a. on screen
  b. In house and with monitoring service
  c. In house
    i. On recording device
    ii. On tape in house
    iii. In the kitchen (on CD)
  d. On computer
  e. monitoring company
  f. No storage
7. How long
  a. Forever or until something bad happened
  b. Years
    i. four or five years
    ii. a year
  c. Months
    i. four to six months
    ii. at least a month
    iii. six months at the most
    iv. a month
    v. 3 months
  d. Weeks
    i. One week
  e. Days
    i. 1 day
    ii. a few days
  f. No storage
  g. No answer
8. Why that long?
  a. could be used against you or for harm
  b. Medical History
  c. Personal use
  d. because system is for safety and security
  e. to help improve the system
  f. To help someone else
  g. Could be used for a study
  h. No reason to keep longer
  i. Long enough
    i. Enough time to use in court
    ii. compare year to year
    iii. Allows time to go back and see if anything was missed
    iv. Long enough to look at interesting things
    v. enough time to see a pattern

9. Why not longer?
    a. Don't want life stored on tape
    b. Not useful
    c. No need to store longer
    d. I can always get a copy made
    e. No value to anyone
    f. storage issues
10. Risk leak pictures?
    a. No Risk
        i. Why no risk?
            1. Nothing hidden on it
            2. Individual controls images
            3. Wont store images
            4. Images are secure
            5. Wouldn't bother me if neighbors saw them
    b. Maybe risk
    c. Yes Risk
        i. Who would get them?
            1. I don't know
            2. Anyone who wants them
            3. Anyone with access to house
            4. People with potential to cause harm or have control
                a. anyone who knowledgeable electronics
                b. hackers
                c. big brother
                d. litigants
                e. Criminal intent
                    i. con artist
                    ii. a bad guy
                    iii. someone trying to break in
                    iv. Illegal sources
                f. building manager
                g. Security/ Police
        ii. How get them?
            1. No idea
            2. No answer
            3. From whoever is receiving pictures
            4. Monetary transaction
            5. take tape
                a. so wouldn't store
            6. Find the camera
            7. Legally

a. warrant
            b. Through investigation
        8. Using technology
            a. hacking
            b. wirelessly
                i. pick them up as they
                   drive by
            c. via computer
    iii. What would they do with them?
        1. personal humor and curiosity
        2. Use to their advantage
        3. No answer
        4. Negative
            a. to know if doing something
               not supposed to
            b. Embarrass you
            c. use information to evict
            d. use information to decide
               nursing home
            e. Use information to break in
            f. Blackmail
            g. cause harm
        5. Positive
            a. Medical research
            b. Use to improve the system
        6. Erode privacy
    iv. risk dismissive
        1. we are video taped everywhere
           anyway
        2. But cant' get much info from blob
           and point-light
        3. I don't think anyone would be
           interested
    v. only if you store them
    vi. Could cause disarray
d. Other

Scenario

    a. Benefits
        i. Safety and Security
            1. Security
                a. Security System
            2. Safety
                a. shows emergency
                b. Monitor could send help
                c. shows if individual is in trouble
        ii. Device Characteristics
            1. shows activity
            2. shows identity
            3. shows location
        iii. use to see if need additional care
        iv. Preserves privacy
        v. use information to show capabilities-status
        vi. Peace of mind
            1. of family
            2. of individual
        vii. Personal use of images
        viii. better than no system
        ix. Only benefit if status changes
        x. prepared if need in future
        xi. see if pattern changes
        xii. improve communication with family
        xiii. No benefits
            1. Character needs more care than device
        xiv. NR

    b. Concerns
        i. Privacy
            1. feel like someone is spying
            2. Loss of dignity
            3. Embarrassment
            4. Invasive
        ii. Don't want others to know
            1. that there is a problem
            2. no one else's business
            3. When not doing as supposed to
            4. when home
        iii. could be used as evidence to put in home
        iv. No need for monitoring
        v. Device Characteristics
            1. device location
            2. ability to turn on and off

      vi.   cost
1. Time
2. Expense
    vii. Would have to self monitor
1. self conscious
2. Couldn't do certain things
    a. socially unacceptable
3. Keep clean
  viii. Doesn't want device
    ix. Security and Safety
1. personal safety
2. home security
     x. Device does not provide enough info
1. Person needs more help than device provides
2. cant tell identity
3. cant tell activities
    xi. Access
1. Unwanted recipient
    a. Big brother
    b. hackers
    xii. Misinterpretation of images
  xiii. irritate friends with wellness
  xiv. signals loss of independence
   xv. waste of time
  xvi. Concerns depend on ability
 xvii. usefulness of device
xviii. no concerns
  xix. NR

REFERENCES

Bellotti, V., & Sellen, A. (1993). Design for privacy in ubiquitous computing environments. In G. d. Michelis, C. Simone & K. Schmidt (Eds.), *Proceedings of the Third European Conference on Computer-Supported Cooperative Work*. (pp. 77-92). Boston: Kluwer Academic Publishers.

Boyle, M., & Greenberg, S. (2005). The language of privacy: Learning from video media space analysis and design. *ACM Transactions on Computer-Human Interaction, 12, 238-370.*

Clark, M. C., Czaja, S. J., & Weber, R. A. (1990). Older adults and daily living task profiles. *Human Factors, 32*, 537-549.

Graphpad Software, I. (2005). *Quantifying agreement with Kappa*. Retrieved March, 2006 from http://graphpad.com/quickcalcs/kappa1.cfm.

Hooker, K., & Kaus, C. R. (1994). Health-related possible selves in young and middle adulthood. *Psychology & Aging, 9*, 126-133.

Labaw, P.J. (1985). *Advanced Questionnaire Design*. Abt Books, Cambridge, Massachusetts

Lawton, M. P., & Brody, E. M. (1969). Assessment of older people: self-maintaining and instrumental activities of daily living. *Gerontologist, 9*, 179-186.

Mack, R., Salmoni, A., Viverais-Dressler, G., Porter, E., & Gar, R. (1997). Perceived risks to independent living: The views of older, community-dwelling older adults. *The Gerontologist*, 37, 729-736.

Margulis, S. T. (2003). On the status and contribution of Westin's and Altman's theories of privacy. *Journal of Social Issues,* 59, 411-429.

Melenhorst, A. S., Fisk, A. D., Mynatt, E. D., & Rogers, W. A. (2004). Potential intrusiveness of Aware Home technology: Perceptions of older adults. In *Proceedings of the Human Factors and Ergonomics Society 48th Annual Meeting*. Santa Monica, CA: Human Factors and Ergonomics Society.

Melenhorst, A. S., Rogers, W. A., Fisk, A. D., & Mynatt, E. D. (2004). *Older Adults' perceptions of a technology-rich home environment*. Unpublished manuscript, Atlanta GA: Georgia Institute of Technology.

O'Brien, M.A., Caine, K. E., Seifert, E. A., Rogers, W.A. & Fisk, A.D. (2006). *Developing a model of technology acceptance and aging* [Abstract]. 11th Cognitive Aging Conference Abstracts of Paper and Poster Presentations.

Pastalan, L. A. (1974). Privacy preferences among relocated institutionalized elderly. In D. H. Carson (Ed.), *Man-environment interactions: evaluations and applications* (Vol. 2, pp. 73-100). Stroudsburg, Pennsylvania USA: Dowden, Hutchinson & Ross, Inc.

Pfeiffer, E. (1975). A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. *Journal of the American Geriatric Society,* 23, 433-441.

Sarkisian, G. P., Melenhorst, A. S., Rogers, W. A., & Fisk, A. D. (2003). Older adults' opinions of a technology-rich home environment: conditional and unconditional device acceptance. In *Proceedings of the Human Factors and Ergonomics Society 48th Annual Meeting*. Santa Monica, CA: Human Factors and Ergonomics Society.

Shelkey, M. & Wallace, M., (1998). Katz index of independence in activities of daily living (ADL). *Try This: Best Practices in Nursing Care to Older Adults*, 3. Retrieved May 10, 2005 from http://www.hartfordign.org/publications/trythis/issue02.pdf.

Shipley, W. C. (1940). A self-administered scale for measuring intellectual impairment and deterioration. *Journal of Psychology, 9*, 271-377.

Stevenage, S. V., Nixon, M. S., & Vince, K. (1999). Visual analysis of gait as a cue to identity, *Applied Cognitive Psychology*, 13, 513-526.

Van Ittersum, K., Rogers, W. A., Capar, M., Caine, K. E., O'Brien, M.A., Parsons, L.J. & Fisk, A.D. (2006). *Understanding technology acceptance: phase 1 – literature review and qualitative model development* (HFA-TR-0602). Atlanta, GA: Georgia Institute of Technology, School of Psychology, Human Factors and Aging Laboratory.

Wechsler, D. (1997). *Wechsler Memory Scale III* (3rd Ed. ed.). San Antonio, TX: The Psychological Corporation.