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Older adults talk technology: Technology usage and attitudes

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ABSTRACT

Older adults (n = 113) participated in focus groups discussing their use of and attitudes about technology in the context of their home, work, and healthcare. Participants reported using a wide variety of technology items, particularly in their homes. Positive attitudes (i.e., likes) outnumbered negative attitudes (i.e., dislikes), suggesting that older adults perceive the benefits of technology use to outweigh the costs of such use. Positive attitudes were most frequently related to how the technology supported activities, enhanced convenience, and contained useful features. Negative attitudes were most frequently associated with technology creating inconveniences, unhelpful features, as well as security and reliability concerns. Given that older adults reported more positive than negative attitudes about the technologies they use, these results contradict stereotypes that older adults are afraid or unwilling to use technology. These findings also highlight the importance of perceived benefits of use and ease of use for models of technology acceptance. Emphasizing the benefits of technology in education and training programs may increase future technology adoption.

1. Introduction

Technology adoption is becoming imperative to function in modern day society because it is pervasive across all domains of life. Moreover, technology can facilitate everyday tasks enabling older adults (i.e., 65 years of age or older) to remain independent longer. Over 90% of adults over the age of 65 live independently (US Census Bureau, 2000), and most of the older population prefers to remain in their own homes as long as they are able (AARP, 1996). The majority of older adults' activities occur within the home environment (Baltes, Maas, Wilms, Borchelt, & Little, 1999), and technology can support aging in place. Technology can support many home-based tasks such as cooking, cleaning, and yard maintenance. In addition, technology items such as cell phones and medical alert systems can be lifesaving when in need of immediate help. Older adults do recognize the potential of technology to facilitate independence. An AARP (2008) report showed that older adults are willing to use a wide range of technologies to maintain social connections, "gather information, be safe at home, and promote their personal health and wellness" (p. 1) if these technologies allow them to remain independent.

Technology is ubiquitous in the work domain as well and computer-related professions are projected to grow faster than any other career between 2006 and 2016 (Dohm & Shniper, 2007). These trends are relevant for older adults because workers are remaining in the workforce longer, either delaying retirement, starting a second career, or working on a volunteer basis. US Department of Labor Statistics (2008) demonstrate that older adults' participation in the workforce is increasing dramatically. Employment of workers 65 and over increased 101% between the years of 1977 and 2007, and are projected to increase by more than 80% from 2006 to 2016 (US Department of Labor). Extending work life can ensure a financially secure retirement and may have a benefit for health and well being (Calvo, 2006). To remain active, competitive, and useful in the workforce, older adults must use and learn to use technology.

Technology also has the potential to assist in monitoring and maintaining health as well as managing health conditions and diseases. Older adults may particularly benefit from using health technologies given that the likelihood of having a disability or health condition increases with age. In fact, 34% of adults aged 65 and over report having a health condition or disability, and

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37% of adults over 75 report having three or more chronic conditions (CDC, 2006). Survey data suggest that older adults are aware that health technologies can support their preference for remaining independent and living in their own homes (AARP, 2008). Three-fourths of the AARP survey respondents reported a willingness to use telemedicine as a means for healthcare professionals to diagnose or monitor health conditions remotely. Furthermore, technology has the potential to reduce medication and illness mismanagement, which could significantly impact society as a whole. Costs due to medication mismanagement alone for people 65 and older in the US were estimated to be $887 million in 2005 (Field et al., 2005). Technological interventions that defray these costs could dramatically lessen the burden on the healthcare system.

Although older adults report a willingness to adopt technology, usage data suggest that older adults are part of the "digital divide," (NTIA, 2004) a distinction made between those who do and those who do not adopt technology. Most literature on older adults' technology use stems from large-scale surveys. For example, US Census (2003) Statistics reveal that 25% of adults over 65 report using a personal computer whereas 56% of those 55–64 years of age and 68% of those 25–54 years of age reported such use. More recent surveys in the US show that in 2009 computer and Internet use among those aged 65+ has increased to about 40%, though very old cohorts are still unlikely to go online. Only about 25% of those 75–84 years of age and about 5% of those 85+ are computer or Internet users (Charness, Fox, & Mitchum, 2010). These findings suggest that only a subset of the older adult population uses technology. However, most surveys have focused on a limited number of technologies, namely the computer and Internet, which are specific, more recent and advanced technologies.

Technology as a concept can be generally defined as any electronic or digital product or service. To be able to predict technology usage in general it is important to understand the factors influencing older adults' acceptance and adoption of technology. Models of technology acceptance (e.g., Technology Acceptance Model (TAM), Davis, 1989) illustrate the multidimensional and complex set of factors that influence technology adoption and the strong impact of certain beliefs and attitudes (i.e., perceived ease of use and usefulness) on that relationship.

In a sample of 1204 participants Czaja, Charness, Fisk, et al. (2006) investigated factors that predicted technology use and found that older adults were less likely than younger adults to use computers, the Internet, and other technology items (e.g., cellular phone, automated teller machine, microwave oven). The following factors predicted general technology use: age, education, race, fluid and crystallized intelligence, computer self-efficacy, and computer anxiety. Greater technology use was associated with younger ages and those who were better educated, and White/European Americans and Hispanic/Latino Americans used more types of technology than Black/African Americans. Higher fluid and crystallized intelligence, higher computer self-efficacy, and lower computer anxiety were also associated with greater technology use. Moreover, the relationship between age and technology use was mediated by cognitive abilities, computer self-efficacy, and computer anxiety.

Large-scale surveys, such as Czaja, Charness, Fisk, et al. (2006), are useful in identifying general patterns of older adults' technology use and informing models of technology acceptance about higher order factors. Other studies have revealed important information about older adults' usage and acceptance of specific technologies and perceptions about specific factors in models of technology acceptance. Many of these studies explored acceptance of assistive technologies (e.g., McCreadie & Tinker, 2005; Tinker & Lansley, 2005), including smart home technologies (Demiris, Oliver, Dickey, Skubic, & Rantz, 2008), and some focused on specific technologies such as video Uniform Commercial Codes (UCC) services (Ryu, Kim, & Lee, 2009), automatic teller machines (ATMs; Smither & Braun, 2001), E-commerce websites (Smith, 2008), E-government services (Phang et al., 2006), online shopping (Li & Huang, 2009) and personal digital assistants (PDAs; Arning & Ziefle, 2007). However, less is known about the *reasons* that influence older adults' attitudes about the wide range of technologies available to them in their everyday lives. A thorough understanding of such attitudes can also contribute to the specification of models of technology acceptance which can increase their predictive ability.

The goal of this study was to explore the details of older adults' attitudes about technology broadly to better understand trends that may be generalizable across different contexts, types of technology, and diverse groups of older adults. In this study we examined: (1) the range of technologies older adults use in their homes, for work, and for healthcare, (2) their attitudes about those technologies, and (3) the degree to which the range of technology use and attitudes toward technology vary as a function of domain. We employed a focus group methodology because this approach affords a relatively open and exploratory method for collecting qualitative data on technology use, providing insight into the details of actual usage, as well as perceived advantages and disadvantages of technology in different domains (Krueger, 1994). Although this study is not designed to directly test models of technology acceptance (e.g., TAM), our results can contribute to their specification by providing information about the reasons that drive the factors of these models.

2. Method

2.1. Participants

A total of 113 community-dwelling older adults participated in 18 focus groups, ranging in size from 4 to 9 participants in each group ($M = 6$; $SD = 1.65$). The focus groups were conducted at local senior centers and university conference rooms at three sites: Georgia Institute of Technology, Florida State University, and University of Miami. Male (42% of participants) and female participants ranged in age from 65 to 85 years ($M = 73$; $SD = 5.50$). All participants reported English as their primary language. Race/ethnicity varied between sites ensuring a diverse sample: 33% African American seniors from Atlanta, GA, 30% Caucasian seniors from Tallahassee, FL, and 37% Hispanic seniors from Miami, FL. For each testing location, education level varied between focus groups. Participants in the low education groups had less than a college degree (46% of participants), whereas those in the high education groups had obtained a college degree or higher (54% of participants).

Most participants reported living in a house, apartment, or condominium (76%) or independent senior housing (19%); the remaining 5% reported living with relatives, in low-income housing, or in assisted living. As expected for this age range, the majority of participants were retired (74%); the remaining participants reported occupational status as part-time (9%), full-time (4%), homemaker (4%), or volunteer (3%); the remaining 6% did not specify. Most participants (82%) rated their general health to be good or excellent (1 = Poor and 5 = Excellent), $M = 3.26$, $SD = .92$. In sum, participants varied with respect to education level and race/ethnicity, however most reported living independently and being generally healthy.

2.2. Materials

2.2.1. General materials

Standard CREATE materials (Czaja, Charness, Fisk, et al., 2006) were used for assessing study eligibility and for collecting demographic, health, and technology experience information. These

materials included a telephone prescreening interview, Background Questionnaire, and Technology Experience Questionnaire (available in Czaja, Charness, Dijkstra, et al. (2006)).

2.2.2. Focus group script

The script was designed to facilitate discussion about the range of older adults' technology use and their attitudes about technology in the domains of home, work, and health (full script is available from the first author). The script was pilot tested with two groups of older adults (n = 10) to ensure that the discussion questions were clear and prompted discussion relevant to the issues of immediate interest. Technology was defined as "electronic or digital products and services."

We first asked, "*What technologies do you use* [*in the context of home*, *work*, *or health*]?" which was followed by discussion prompts tailored to each domain. For the home domain, participants were given a strategy of doing a mental walk through their homes to think about the technologies in each room and were instructed to think about occasions when they used technology items. For the work domain, participants were instructed to consider "work" in a broad sense, including volunteer work and past work experiences. Participants were asked to think about technologies they use for performing their jobs, communicating with other people while at work, or learning new job skills or training. For the health domain, participants were asked to think about technology broadly and not be limited to technologically advanced items. Participants were instructed to think about occasions when they used technology for healthcare, such as using medical devices, communicating with healthcare professionals, or gathering information about diseases.

The second discussion question, "*For those of you who have used* [*each technology item*], *what do you like and dislike about using this technology* [*in the context of each domain*]?" was designed to encourage participants to discuss their attitudes about technologies. These questions were followed by a discussion of training, which is not the focus of the present paper (see Mitzner et al., 2008).

2.3. Procedure

Prior to participation, participants completed the telephone prescreening interview. When eligible participants reported to the focus group site, they first provided informed consent. Next, the moderator summarized the general goals of the study and outlined rules for the discussion (e.g., to speak one at a time and contribute their own unique ideas and experiences). Each group discussed technology use in the context of two of the three domains (domain order was counterbalanced). Following an icebreaker question during which participants provided their first name and favorite hobby, the moderator introduced the first domain of discussion. After completing discussion of the first domain, participants were given a five minute break and then asked to complete the Background Questionnaire. Next, the moderator introduced the second domain for discussion. When discussion was completed, participants were given another five minute break and then asked to complete the Technology Experience Questionnaire. Participants were debriefed and paid $25 for participation. Discussions were audio recorded for later transcription.

3. Results

3.1. Overview of coding and analyses for focus group discussion data

The audio recordings were professionally transcribed verbatim with personal information omitted. Transcripts were segmented into units of analysis by four independent coders. A segment was defined as a unique idea in a single, uninterrupted speaker turn, related to an attitude toward technology (i.e., an association between technology and a valenced evaluation) with which the speaker has had personal experience. The segmenting process was calibrated by conducting an initial round of independent segmenting of one randomly selected transcript followed by discussion of discrepancies between coders. A second round of independent segmenting on a different transcript yielded reliability estimates ranging from r = .79 to .87. The remaining transcripts were divided among the four coders to segment independently.

The coding scheme was developed by reviewing a random sample of the transcripts from each domain and extracting common themes, as well as incorporating the experiences older adults reported having with technology (Czaja, Charness, Fisk, et al., 2006). Every attitude segment was coded on each of three dimensions: the technology item that was discussed, the attitude valence (i.e., like, dislike, or unclear), and the attitude reason (see Table 1 for the attitude coding scheme). Coders were calibrated by conducting three rounds of independent coding on the same three randomly selected transcripts followed by discussion of discrepancies and revisions to the coding definitions. The final round of reliability yielded estimates ranging from r = .79 to .92. The remaining transcripts were divided among the four coders to code independently.

Chi-square tests of homogeneity were conducted to determine if there were significant differences between category frequencies (frequencies less than one were excluded from all analyses). Analyses of residuals were conducted to confirm which categories accounted for the significant effects (i.e., a residual greater than 2.00 indicates the factor was a major influence for the significant chi-square test statistic). Education differences were minimal at the attitude category level; therefore we collapsed across education for the remaining analyses.

3.2. Range of technologies reported

Responses to the question, "What technologies do you use [in the context of each domain]?" ranged from 3 to 32 items per focus group (see Table 2). Significantly more technologies were reported in the context of the home (M = 19 per group) compared to work (M = 13 per group). A greater number of technologies were reported in the context of work compared to health (M = 7 per group). These data suggest that older adults are willing to use various types of technology in different facets of their lives, particularly in their homes.

3.3. Attitudes about technologies

A primary goal of this study was to gain a better understanding of older adults' attitudes related to using different technologies. The following analyses include responses to the question: "*What do you like and dislike about using* [*each technology in the context of each domain*]?"

3.3.1. Number of attitudes

A total of 2360 segments were coded as attitudes. The number of attitude segments varied by domain: home (n = 1119), work (n = 785), and health (n = 560). That is, more attitudes were produced when discussing technology use in the home as compared to work, and more attitudes were elicited when discussing technology use for work compared to health. Older adults may have more attitudes about technologies used in their homes compared to work and health because they use a wider variety of technologies in the home and spend most of their time there.

Attitude segments were coded for the technology item to which they were referring. Technology items associated with 5% or more

Table 1
Coding scheme for assessment of attitudes toward technology.

Category	Definition	Subcategories
Convenience/inconvenience	Makes life easier or harder in some way	Effort Financial Home-based Interruptions Miscellaneous convenience Physical Time Unspecified convenience
Feedback	Any information that a person can use to monitor their performance	(No subcategories)
Features	Qualities of the technology itself	Access, storage, and retrieval Adjustability and versatility Appearance Content quality Durability Input devices Miscellaneous features Number and programming options Portability and size Quality Specific features Speed
Complexity	Nature of technology being complex or simple	(No subcategories)
Reliability	How well a technology does or does not work	(No subcategories)
Serviceability	Anything related to the service and/or maintenance associated with a technology	(No subcategories)
Miscellaneous system characteristics	A property of the system but does not fit into the above categories	(No subcategories)
Security	Increases or decreases feelings of security	Unspecified security Privacy Safety Trust Viruses, etc. Miscellaneous security
Activity (support for or lack of support)	Support for or lack of support for an activity	Administrative tasks Communication Cooking Emergencies Leisure, hobby, and entertainment Health monitoring and maintenance Research and education Financial Shopping Transportation Miscellaneous activities
Miscellaneous reasons	A reason that does not fit into the above categories	(No subcategories)

Table 2
Number of technology items reported in each focus group in response to "What Technologies Do You Use [in the Context of Each Domain]?"

Domain	Education level	Range	*M*	Median	*SD*
Home	Low	15–23	21	21	2.9
	High	12–25	17	15	5.0
Work	Low	6–32	14	11	8.9
	High	4–20	13	13	5.9
Health	Low	3–16	7	6	4.4
	High	4–13	7	5	4.0

Note. Focus groups ranged in size from 4 to 9 participants.

of the total attitude segments within a domain are listed in Table 3. These technologies represent those most commonly mentioned, serving as the basis for the discussions and, therefore, provide the specific context for the following data.

3.3.2. Relative proportion of likes and dislikes

Of particular interest was the relative proportion of like and dislike attitudes. Excluded from further analyses were attitude segments coded as unclear (4%), such as "I can't think of any [likes or dislikes]." and "I don't know whether it's a like or dislike." Counter to the stereotype that older adults hold negative opinions about technology, participants expressed significantly more likes than dislikes when discussing technologies used in the home (60% vs. 36% of the total segments, $\chi^2(1) = 69.07$, $p < .01$), for work (59% vs. 37%, $\chi^2(1) = 40.88$, $p < .01$) and for health (60% vs. 35%, $\chi^2(1) = 37.79$, $p < .01$). Note that due to the phrasing of the question it is possible that participants were primed to produce more likes because the word "like" preceded the word "dislike."

Table 3
Most frequent technologies discussed in each domain.

Domain	Top technologies discussed	Percentage of segments (%)
Home	Computer	13
	Microwave	12
	Cellular phone	11
	Television	9
	Telephone	5
	DVD VCR	5
Work	Computer	29
	Fax	14
	Telephone	13
	Cell phone	6
	Scanner	6
	Digital camera	5
Health	Blood glucose monitor	17
	Blood pressure monitor	16
	Telephone	15
	Computer	11
	Internet	7

Note. Only technologies accounting for 5% or more of the data are represented.

Nonetheless, the majority of older adults' attitudes were positive, suggesting that they perceived the benefits of using technology to outweigh the costs, regardless of domain. This finding is consistent with the results of Melenhorst, Rogers, and Bouwhuis (2006), which showed that perception of benefit was more indicative of acceptance than perception of cost.

3.4. Reasons associated with attitudes

We were also interested in the reasons provided for having positive or negative attitudes about technology. Some responses only contained an attitude without an additional reason (e.g., "*I like using the computer*"). This was true for 8% of the *like* segments for the home domain, 4% for work, and 6% for health. These segments were excluded from the following analyses.

3.4.1. Why people liked technology

With respect to the reasons mentioned for having positive attitudes about technology, the specific category frequencies differed within each of the three domains (see Fig. 1). However, across all domains older adults consistently focused on support for activities, convenience, and features as the top three reasons for why they liked technology. Segments in these three categories were also coded on a subcategory level (see Tables 4–6 for percentages and example quotes).

3.4.2. Like: Support for activities

When discussing what they liked about technology, participants frequently mentioned its ability to provide support for activities. Some activities were mentioned significantly more than others in the home, $\chi^2(10) = 105.40$, $p < .01$, for work, $\chi^2(8) = 189.50$, $p < .01$, and for health, $\chi^2(7) = 186.30$, $p < .01$. In the context of the home, older adults focused on communication (e.g., emailing, calling friends and family), cooking (e.g., microwaves), leisure, hobby, and entertainment activities (e.g., VCRs, computer games), and research (e.g., searching for information on the Internet) which together accounted for 68% of the support for activities data.

In the work domain, the most frequently reported activities for which participants reported liking to use technology were communication (e.g., conference calls, exchanging documentation), administrative tasks (e.g., copying, executing mass mailings), and research (e.g., finding information on the Internet, profession-specific research tasks), accounting for 79% of the data.

In the health domain, research (e.g., finding information about physicians, health conditions, and medications) and health monitoring and maintenance (e.g., checking blood pressure and monitoring weight) were the most frequently reported activities for which participants reported liking to use technology, accounting for 73% of the data.

These data show clearly that older adults perceived technology that can support their research activities to be a significant benefit, regardless of domain. In addition, older adults perceived technological support for administrative tasks and communication as important advantages in the home and at work. These data reveal that the activities for which participants liked to use technology were more varied in the home than at work or for health, which may reflect that the home is a broader domain encompassing a wider range of activities.

3.4.3. Like: Convenience

Convenience was another frequently reported benefit of technology use. Significant differences emerged between the convenience subcategory frequencies for home, $\chi^2(7) = 75.50$, $p < .01$, work, $\chi^2(5) = 102.30$, $p < .01$, and health, $\chi^2(6) = 46.83$, $p < .01$. In the home domain, effort and unspecified convenience were most frequently mentioned (50% of convenience data). Effort is analogous to ease of use and was defined to include physical and mental forms of effort. Participants reported liking technology (e.g., dishwasher or sprinkler system) because it reduced their own effort in performing household tasks. Unspecified convenience refers to general statements about convenience without specifying a type or form of convenience.

In the work domain, effort and time (70% of convenience data) were the most frequently mentioned convenience-related reasons for liking a technology. Older adults expressed positive attitudes about using technology to reduce effort in their work tasks, which varied greatly (e.g., using a computer instead of writing by hand and using electric instead of manual hair clippers), as well as to increase work performance by reducing the time it takes to perform tasks (e.g., scanning barcodes rather than typing item numbers).

In the context of health, the effort and home-based categories (63% of convenience data) accounted for the significant effect. Participants expressed positive statements about technology reducing their own effort for performing health-related tasks, such as using automatic medication refill telephone systems rather than going to the pharmacy. Participants also liked that technology afforded them the ability to perform health-related tasks at home, such as checking their blood pressure.

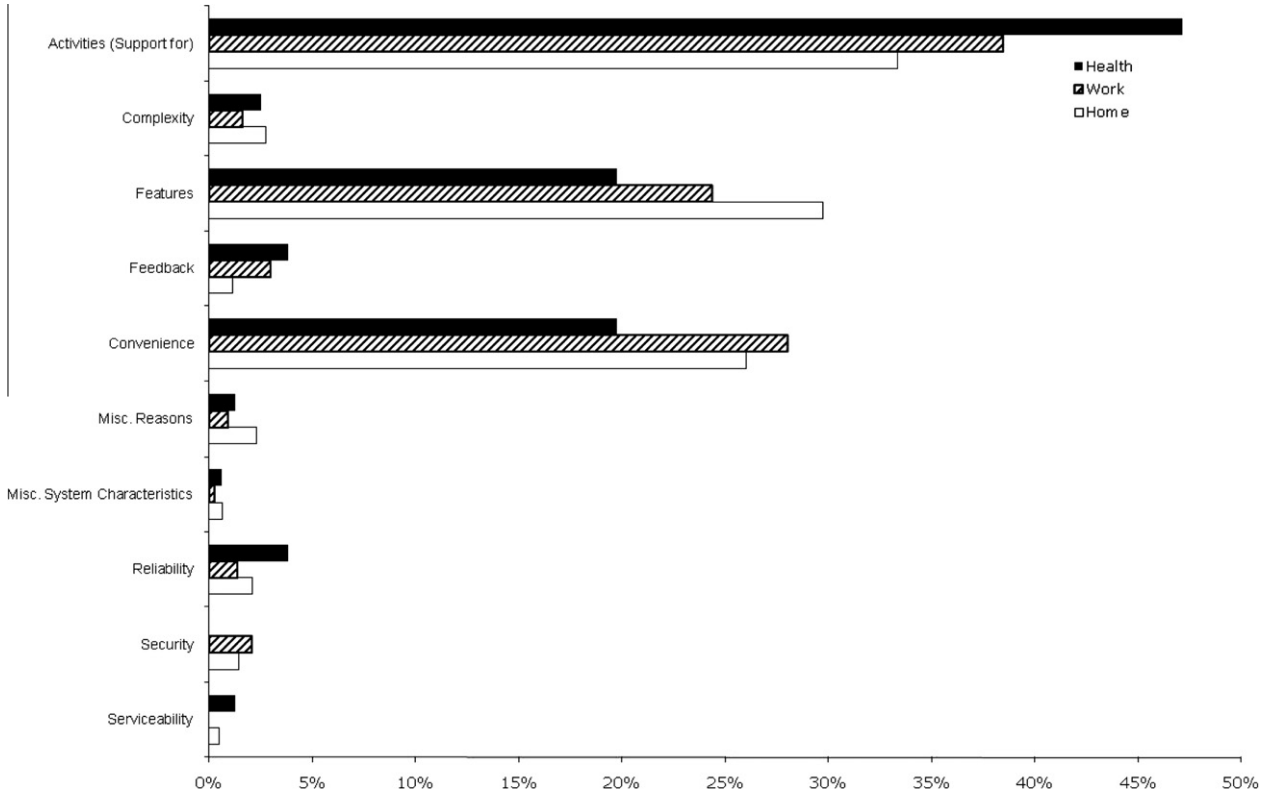

Fig. 1. Percentage of likes in the context of home, health, and work (*y*-axis in alphabetical order).

Table 4
Support for activities subcategories related to likes about technology.

Domain	Subcategories	Percentage of support for activities segments (%)	χ^2 adjusted residual	Example quotes
Home	Communication	20	5.53	"*I like it. I just called a friend who's vacationing in Alaska.*" "*I like* [*emailing*] *with my grandson.*"
	Cooking	19	4.98	"*I like* [*the microwave*] *for reheating food.*"
	Leisure, hobby, and entertainment	15	3.12	"*To record movies* [*with the VCR*]." "*To play games* [*on the computer*]."
	Research	14	2.34	"*I'm using the internet to research a new car.*"
Work	Communication	34	10.82	"[*The fax machine*] *gives each person involved a documentation, an exact copy.*"
	Administrative tasks	29	8.26	"*I like being able to edit as you go* [*when writing on the computer*]." "*You just run off all your labels from your program.*"
	Research	16	2.06	"[*I like the computer because*] *you put your numbers in there and find out how much stock and inventory you have.*" "[*To find information about*] *business news to follow trends that might be useful to our planning and what our activities are.*"
Health	Research	38	11.05	"*To research medications and side effects.*" "*Checking references.*"
	Health monitoring and maintenance	35	9.67	"*I like to know what my* [*blood glucose level*] *is everyday.*" "[*I like that*] *you can call in* [*to order*] *your prescriptions.*"

Note. Only categories accounting for significant chi-square effects (residual > 2) are included.

These convenience data demonstrate that older adults appreciated that technology can make their lives easier in general, as well as make specific tasks less effortful in their homes. Older adults also perceived the importance of being an efficient worker and understood that technology can facilitate efficiency. In sum, across all domains, the reduction of physical or mental effort was a major contributing factor to older adults' positive perceptions about the convenience introduced by technology.

3.4.4. Like: Features

Participants expressed positive attitudes about many properties and characteristics of technology. Some features were discussed significantly more frequently than others in all domains: home, $\chi^2(11) = 324.70$, $p < .01$, work, $\chi^2(9) = 130.70$, $p < .01$, and health, $\chi^2(9) = 20.90$, $p < .01$. Specific features, speed, and number of features accounted for the significant effect in the home domain (69% of feature data). Examples of specific features were the water and ice dispenser (refrigerator); the timer and sleep mode (television); and the redial button, caller id, and voicemail features (telephone). Speed referred to the technology's ability to perform operations quickly, and the number category encompassed comments about number of features, quantity, or amount, including the number of programming options.

In the context of work, specific features, speed, and access, storage and retrieval made the greatest contribution to the significant effect (72% of feature data). As seen in the home domain,

Table 5
Convenience subcategories related to likes about technology.

Domain	Subcategories	Percentage of convenience segments (%)	χ^2 residual	Example quotes
Home	Effort	32	8.39	"*It's so convenient when you can turn* [*the television*] *on* [*and you*] *don't have to get up*." "*We don't have to wash so many dishes*." "*You're not having to go out and move sprinklers*."
	Unspecified convenience	18	2.22	"*I like* [*the technology*] *because it's convenient*." "[*I like the technology because*] *it's handy*."
Work	Effort	46	11.01	"[*Using the computer*] *is an easier way to write because you can change it*." "*Oh your fingers would be so tired* [*before*] *but now* [*with the electric clippers there is*] *nothing to it*." "*It*['*s*] *easier for me to place orders* [*using a computer*]." "*What I liked about it, it eliminated a lot of hard work. This machine just goes right into the coal. And it eliminated the pick and shovel*."
	Time	24	2.41	"[*The barcode scanner is*] *quicker than if I have to stand there and type in the title of the item or the number that's on the back*."
Health	Effort	40	6.98	"*You just put it on your wrist and push the button*." "*I had everything programmed on my cell phone so I don't have to remember phone numbers*." "*I find* [*the telephone automatic refill system*] *very easy*."
	Home-based	23	1.94	"[*Using my own blood pressure monitor*] *is a lot better than running by the doctor's office once a day*." "*Well,* [*I like using a blood glucose meter*] *because I don't have to go in and have it done*." "[*I like having a treadmill because*] *you can exercise in your home*."

Note. Only categories accounting for significant chi-square effects (residual > 2) are included.

Table 6
Features subcategories related to likes about technology.

Domain	Subcategories	Percentage of features segments (%)	χ^2 residual	Example quotes
Home	Specific features	43	21.26	"*I like the* [*toasters*] *that you can toast the bagels..*" "*I like the water dispenser and ice dispenser* [*on the refrigerator*]." "[*I like that the television*] *will tell you what time it is and wake you up and put you to sleep*." "*You can even redial by pushing a button without doing all of that* [*entering the complete phone number*]." "*I like caller id, call waiting, call forwarding.*" "[*I like*] *voicemail*." "*I like email*." "*I like the timer and clock* [*on the oven*].'" "[*I like that the garage door opener*] *light stays onto get your key and get in the back door*."
	Speed	13	2.13	"*Yeah, I like* [*the microwave*] *because it warms your food much faster than having to put it in the oven*." "*I like the high speed* [*of the computer*]." "[*Digital cameras are*] *quick. You can see what you got*."
	Number/ programming options	13	2.13	"*And also* [*I like the*] *the ability to get a whole lot of pictures* [*on a digital camera*]." "*The big TV's do everything now. So, you can pick one that will fit your needs*."
Work	Specific features	37	11.31	"*Yeah, I used the electric* [*typewriter*] *some years ago and I loved it. You could go back and if you made an error and erase it and go over it again*." "*The speed dialing* [*on the telephone*] *is great*." "[*I like that on*] *the telephone you have conference*[*s*], *open mic conferences*." "*Sometimes the speakerphone is handy if you have a need for it, or if you want more than one person to be able to listen to a phone call, conference calls, that's another feature, multi-lines you can set up conference calls*." "*I like the spell check*."
	Speed	19	3.15	"[*I like using the computer because*] *it's fast*." "[*The electric*] *sewing machine is faster*." "*The food processor is very fast*." "*Well, one thing I like is...the encryption of messages is much faster now*."
	Access, storage, and retrieval	16	2.10	"*You can store* [*information on computers*] *and you can go back and retrieve them whenever you want to. That is the thing that I like about it*" and "[*to*] *backup everything that we make*."
Health	Specific features	21	3.07	"[*I like that the blood pressure monitor*] *even takes your pulse*." "*On some blood pressure cuff*[*s*] *they have the date and time*." "[*I like that*] *you can get a print out* [*from a blood glucose meter*]."
	Portability and size	18	2.12	"*I like that they made* [*the hearing aid to fit*] *inside the ear*." "[*I like that the blood glucose meter*] *is so small, you can carry it anywhere*." "[*I like that the nebulizer*] *is very portable*."

Note. Only categories accounting for significant chi-square effects (residual > 2) are included.

participants reported liking specific features such as speakerphone and spell check. Again, older adults expressed positive attitudes about technologies performing operations quickly, such as faxing rather than mailing documents. Participants also spoke positively

of the ability to access, store, and retrieve information, such as the computer's ability to perform these actions rather than having to rely on hard copies.

For the health domain, specific features, and portability and size were significant contributors to the effect (39% of feature data). Specific features included date and time on medical devices and the ability to get a print out from a device. Portability and size characteristics were viewed positively as well, such as the design of hearing aids to fit inside the ear and the size and portability of blood glucose meters.

The data about technology features reflect that older adults perceived the benefits of technology to include performing specific and quick actions, as well as offering many options. The perceived benefits of technology were similar for home and work domains (i.e., specific features and speed), although accessing, storing and retrieving information was an additional benefit for work. Participants spoke most frequently about their positive attitudes toward specific features of multi-function health technologies, and the characteristic of health technologies being small and portable. The feature data demonstrate that the older adult participants had preferences for the design of technology items, which is of particular importance for technology designers.

3.4.5. Why people disliked technology

We were also interested in the reasons for which older adults reported *disliking* technology, as these details could provide insight into technology acceptance (i.e., the reasons for which a person might *not* adopt technology). The category frequencies varied within all domains (see Fig. 2). In comparison to the top three likes (support for activities, convenience, and features), when a reason was provided for disliking a technology, it was most frequently related to inconvenience brought on by using the technology and features of the technology, regardless of the domain being discussed. Security and reliability issues were also frequently mentioned as dislikes: security concerns emerged in the home and work domains, whereas reliability concerns arose in all domains. Subcategories for inconvenience, features, and security provide more details about older adults' reasons for *disliking* technologies (see Tables 7–9 for percentages and example quotes); the reliability category did not have subcategories.

3.4.6. Dislike: Inconvenience

Various types of inconvenience were frequently mentioned dislikes. There were significant differences among the frequencies of types of inconvenience discussed in the home, $\chi^2(7) = 82.43$, $p < .01$, for work, $\chi^2(7) = 71.42$, $p < .01$, and for health, $\chi^2(5) = 21.11$, $p < .01$. In the home domain, interruptions, financial issues, and effort accounted for 76% of inconvenience data. Participants mentioned technology causing interruptions in their lives (e.g., unwanted calls, commercials) and being expensive (e.g., the cost of ink cartridges and cellular phones). They also made negative comments about technology requiring or increasing effort, such as the computer requiring too much mental effort to use or having to carry around a cellular phone.

In the work domain, the most frequently reported dislikes related to inconvenience were interruptions and effort (58% of inconvenience data). Just as in the home, participants discussed disliking interruptions (e.g., cell phones ringing at inappropriate times) and the effort required for using certain work technologies. In the health domain, the most frequently reported inconveniences fell into the physical and effort categories (57% of inconvenience data). Participants reported disliking the physical inconveniences of using certain technologies, such as having to prick a finger to use a blood glucose meter. Effort inconveniences included physical and mental effort required to use certain medical devices or other health-related technologies.

The inconvenience data suggest that older adults perceived interruptions, financial expenses, and effort to be costs of using

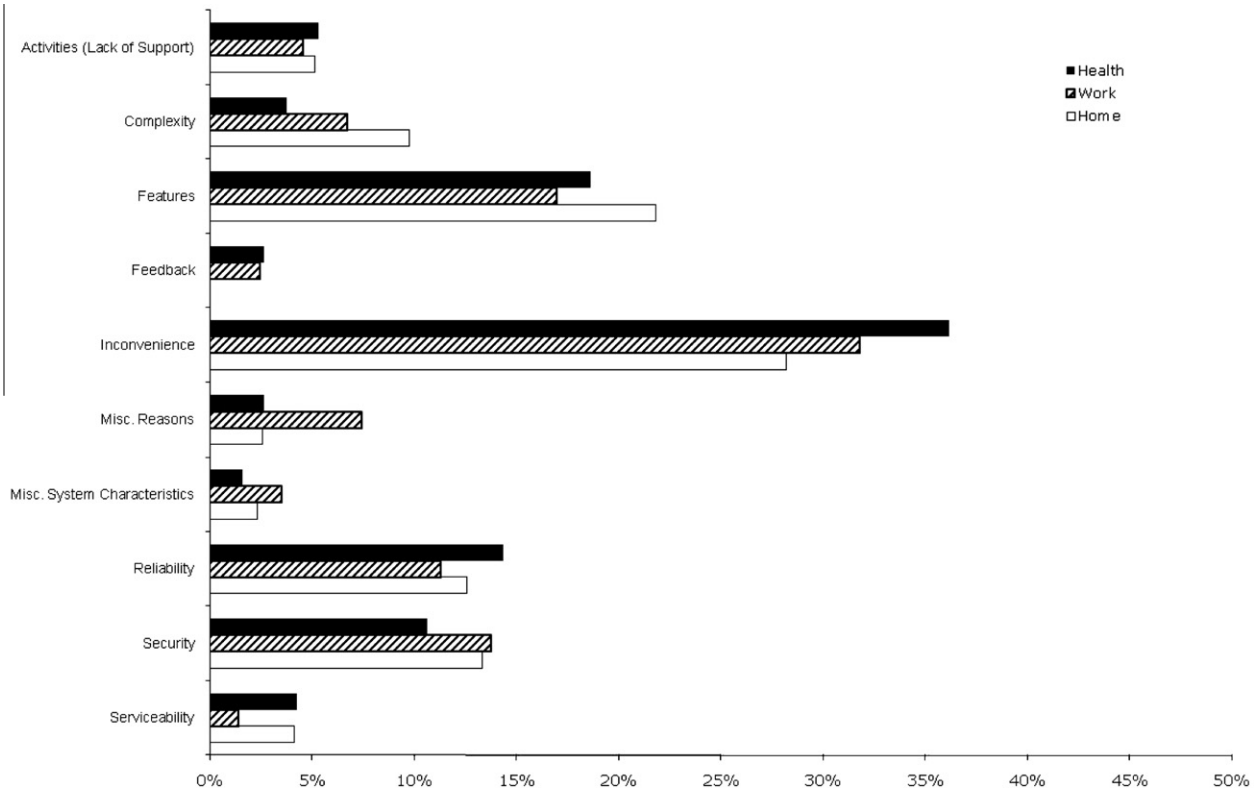

Fig. 2. Percentage of dislikes in the context of home, health, and work (*y*-axis in alphabetical order).

Table 7
Inconvenience subcategories related to dislikes about technology.

Domain	Subcategories	Percentage of inconvenience segments (%)	χ^2 residual	Example quotes
Home	Interruptions	28	4.63	"*But I dislike it when people call you* [*on the telephone*] *at night time*." "*They can do away with all that advertising* [*on television*]." "*And what I dislike about is that sometimes I'm in my room on the cordless phone and with these long conversations* [*then*] *beep, beep, beep* [*the battery alarm sounds*]."
	Financial	27	4.36	"*Air conditioners are too expensive*." "*I dislike the expense* [*of VCR and DVD players*]." "*You really have a high bill if you use* [*a cellular phone*] *excessively and don't have the proper plan that suits your needs*." "[*Printer ink cartridges*] *are too expensive*."
	Effort	21	2.47	"[*Learning to use a computer is*] *too much racking my brain*." "*I have to…disable the digital recorder in order to plug in the fax machine*."
Work	Interruptions	29	4.42	"*They send you some stuff* [*through the fax machine*] *like these financing offers or stuff like that*." "[*Cellular phones are*] *a distraction*." "*The bad part is when you are in a closing and your beeper starts vibrating and you think not now!*"
	Effort	29	4.42	"*I dislike that* [*the cordless drill*] *is kind of heavy*." "[*If you*] *make an error or punch the wrong button* [*on an adding machine*]*…you got to go over it again*."
Health	Physical	29	2.58	"*I dislike the tightness* [*of the blood pressure cuff*]." "*I dislike sticking my finger* [*when using the blood glucose meter*]." "*It can be difficult to use* [*an automated telephone menu*] *when you have arthritis*."
	Effort	28	2.29	"[*The wheelchair*] *is heavy*." "*If you have to get up to use the bathroom during the night, you have to disconnect* [*the nebulizer*]." "*When…you have eight or nine* [*prescriptions*] *and you have to push the button on the phone and put all the numbers in*."

Note. Only categories accounting for significant chi-square effects (residual > 2) are included.

Table 8
Features subcategories related to dislikes about technology.

Domain	Subcategories	Percentage of features segments (%)	χ^2 residual	Example quotes
Home	Number/programming options	21	4.18	"*There is just so much stuff… it's too many gadgets*." "[*There are*] *too many options* [*on the automated telephone menu*]." "*There are too many choices* [*on digital cameras*]." "*I dislike* [*cellular phones*] *because they have a lot of capabilities*."
	Content quality	21	4.18	"*I dislike the* [*television*] *programs we get*." "*Too many sports* [*programs on the television*]."
	Quality of output	21	4.18	"*What I dislike about* [*the microwave is that*] *if I leave* [*the food*] *in there too long it's like rubber*." "*I can't get good reception to play the stereo in the bedroom*." "[*The scanner*] *doesn't make a good, sharp, crisp copy*." "[*Lawnmowers are*] *noisy*."
Work	Number/programming options	31	5.61	"[*The calculator*] *doesn't show enough information*." "[*Computers use*] *too much paper*." "*You are limited* [*in what you can do with a computer*]." "*Sometimes you're calling and the* [*automated*] *menu does not have what you're looking for*."

Note. Only categories accounting for significant chi-square effects (residual > 2) are included.

Table 9
Security subcategories related to dislikes about technology.

Domain	Subcategories	Percentage of security segments (%)	χ^2 residual	Example quotes
Home	Safety	71	11.63	"*They tell me that the microwave has a lot of radon in it, which I don't like using microwaves for that reason*." "[*Microwaves*] *are dangerous*." "*I think it's dangerous* [*to use a cellular phone while driving*]." "[*Using a computer can cause*] *carpel tunnel syndrome, back trouble, and eye trouble*."
Work	Safety	49	3.25	"*And you have to be very careful how you use* [*a drill*]*, you can break your hand very easily*." "[*Cell phones can be*] *deadly*." "*Sitting at the computer for too long is very debilitating*."

Note. Only categories accounting for significant chi-square effects (residual > 2) are included.

technology in their homes. Workplace technologies were disliked for some of the same reasons (i.e., interruptions and effort). Physical inconvenience was a complaint specific to healthcare technologies, which may be due to the fact that many measures of physical health status rely on some sort of physical intrusion or discomfort.

3.4.7. Dislike: Features

Participants expressed negative attitudes about many features of technology. There were significant differences between the subcategories of features for home, $\chi^2(10) = 56.70$, $p < .01$, and for work, $\chi^2(9) = 29.08$, $p < .01$. There was not a significant difference between the subcategories for health, $p = .17$. In the home domain, number of features, content quality, and quality of output accounted for 63% of the feature data. Participants reported disliking when technology items had too many or too few features or programming options, poor content or programming quality (e.g., too much violence on television), and poor output quality, such as the quality of sound or the picture of a visual display (e.g., on a cellular phone).

In the work domain, number (31% of feature data) accounted for the significant effect. In particular, older adults disliked work technologies with too many or too few features or programming options (e.g., telephones and fax machines). These data demonstrate that just as participants liked technologies that made them more efficient workers, they disliked technologies that reduced their efficiency.

The feature-related data demonstrate that the older adult participants had specific ideas about features they view as costs in using technology. Moreover, features of technology constituted the majority of the older adults' dislikes. In the home and work domains, participants focused on the number of features as a common dislike. In the home domain content quality and output quality was also a frequent dislike. The relative frequencies of the remaining categories varied by domain suggesting that attitudes about features are relatively context dependent; hence, customization or adjustability of features may be preferable in cases where it is possible.

3.4.8. Dislike: Security and reliability

In the home and work domains security issues were frequently mentioned when discussing dislikes of technology; especially with respect to safety which was reported significantly more than other security subcategories: home, $\chi^2(3) = 60.46$, $p < .01$, and work, $\chi^2(5) = 32.84$, $p < .01$. Safety concerns (71% of security data for the home domain and 49% for work) encompassed worries of physical danger, including health risks. These safety fears, whether they were real or misconceptions, contributed to older adults' negative views about home and work technologies.

Reliability (i.e., whether the technology functions accurately) was mentioned frequently in all domains. Participants reported disliking the lack of reliability with some technology items such as "*once the network is down, nobody can do anything* [*on the computer*]," "*some of the bar-coded items, my scanner will not pick up*," and "*my* [*blood pressure monitor*] *doesn't work well. I don't get accurate readings*." Not surprisingly, older adults had negative views about technology performing inaccurately and undependably, and these negative attitudes can impact future usage.

4. Discussion

A thorough understanding of older adults' usage and perceptions of technology is essential for maximizing the potential that technology has to offer for facilitating independence in everyday life. The goal of this study was to explore in-depth a large and diverse sample of older adults and their attitudes about a wide range of technologies they use in a wide variety of contexts (i.e., their homes, for work, and for health). The findings from this study supplement past research that was limited with respect to the details about technology usage or the generalizability to different types of technologies, contexts, or users. The results elucidate some of the reasons behind older adults' attitudes toward technology, provide insight into how people define the constructs in technology acceptance models, and can enable designers to better meet older adults' needs and preferences.

Stereotypes suggest that older adults are unable, unwilling, or afraid to use technology. Indeed, consistent with these stereotypes, several large scale usage studies have found that older adults do not use certain technologies to the extent that younger adults do (Adler, 2006; Pew, 2000). The older adults we interviewed used a wide variety of technologies, ranging from microwaves to cell phones to computers. Participants reported using the greatest number of technology items in their homes, a finding perhaps reflecting that our sample comprised mostly retired and healthy older adults. Older adults who have health problems would be expected to have more experience using health technologies and those who are still employed would be expected to have more experience with work-related technologies.

By focusing on a broader range of technologies than that of large-scale surveys (e.g., Pew, 2000) and by employing qualitative methods, we were able to provide a more detailed depiction of older adults' attitudes about technology in general. Participants clearly perceived many benefits of using technology, regardless of domain, and they viewed those benefits as outweighing the costs, judging by the number of comments they made about the positive aspects of technologies. Benefits discussed related to technology supporting activities (i.e., communication, research, and health monitoring and maintenance), adding convenience (i.e., when technology reduces effort), and having useful features (i.e., specific features of technology). Although the benefits discussed were greater in number, costs or dislikes of using technology were discussed as well. The dislikes were more varied than the likes and included technology causing inconvenience, features of technology, security issues, and reliability of technology. These data are consistent with the findings of Melenhorst et al. (2006) in that older users' motivation for using email technology was driven by perception of benefit more so than perception of costs associated with usage.

Overall, our results paint a positive picture of older adults' perceptions of the technology items they use. Together with the Czaja, Charness, Fisk, et al. (2006) data, these findings suggest that older adults' relationship with technology is much more complex than would be suggested by the stereotype of older adults simply being afraid and unwilling to use technology. Czaja et al. found two personal barriers to technology adoption: low self-efficacy regarding computer use and high anxiety for computer use. The present study showed that for technologies that are adopted, older adults perceived a positive outcome of such use. Hence, to increase older adults' technology use two approaches can be taken: (1) improve education about benefits for technologies that have not yet been adopted and (2) address computer self-efficacy and computer anxiety.

Models of technology acceptance suggest that a large number of variables may impact technology acceptance including characteristics of the technology (e.g., perceived complexity, level of innovation) and characteristics of the user (e.g., experience and personal traits) (Caine et al., 2006). Characteristics of technology can be further categorized as usage characteristics and outcome-of-usage characteristics. Usage characteristics relate to the actual usage of the technology, such as perceived ease of use (Davis, 1989) and perceived compatibility (Rogers, 2003). Outcome-of-usage characteristics relate to the benefits of using the technology, such as

usefulness (Davis, 1986) and fun and enjoyment (Davis, Bagozzi, & Warshaw, 1992). The present data highlight some of the attitudes that drive the ease of use (being analogous to reducing or not requiring effort) and usefulness (in terms of supporting activities) factors.

The results of this study also provide convergent evidence that ease of use and usefulness are significant variables in predicting technology acceptance as they were salient characteristics of technology associated with positive attitudes. It is important to note that benefits need not only exist but must also be clear to the potential user for technology acceptance to increase. Enhanced training and education may be necessary to inform older users about the outcome-of-usage benefits from using technology.

Technology developers can benefit from our findings by gaining a better understanding of older adults' needs and preferences with respect to the design of future technologies, particularly because our results are relevant to a wide range of technologies used in different contexts. Current usage patterns and attitudes can provide insight about characteristics that could make a technology more likely to be perceived positively and therefore more likely to be adopted. For instance, effective design strategies might focus on ways to maximize convenience benefits, provide potential support for activities, and enhance features that are viewed positively. Likewise, some dislikes can be eliminated or reduced at least to the point that the benefits of using the technology far outweigh the costs. User testing with the older adult population is critical for directing design solutions (Fisk, Rogers, Charness, Czaja, & Sharit, 2009).

The present findings raise questions for future research. For instance, do older adults' technology preferences align with performance outcomes? Would education and training about the benefits of new technology items (i.e., support for activities, convenience, features) increase technology use? Past research does suggest that training and education may increase technology adoption (Rogers, Cabrera, Walker, Gilbert, & Fisk, 1996). Another important area for future research is that of the perception and use of heath information obtained from the Internet. In the present study most of the references about conducting health-related research were made in the context of discussing the computer and Internet (see also Taha, Czaja, & Sharit, 2009). Although health information is readily accessible on the Internet, it is not necessarily accurate or from a reliable source. Hence, we need to better understand the trust and reliance issues related to health information obtained via the Internet.

In sum, technology acceptance and adoption has implications for older adults and for society as a whole. Technology use can maximize independence for older adults, which can increase the perception of quality of life (Mynatt & Rogers, 2002). By fostering older adults' independence, technology has the potential to provide assistance with activities of daily living and medical care while also lessening the caretaking burden of family and professional caregivers. Older adults could also experience a financial benefit by reducing their dependence on professional caregivers. Therefore, as the aging population grows and technologies continue to develop it is imperative that we understand how to design technologies that support the needs and preferences of older adults.

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