

# Perceptions of Computer System Usefulness: Insights for Design from Experienced Older Users

Tracy L. Mitzner<sup>1</sup>(✉), Neil Charness<sup>2</sup>, and Wendy A. Rogers<sup>1</sup>

<sup>1</sup> Georgia Institute of Technology,  
Atlanta, GA, USA

tracy@gatech.edu

<sup>2</sup> Florida State University,  
Tallahassee, FL, USA

**Abstract.** Computer systems have the potential to assist older adults by supporting independence, enhancing social communication, and enabling health-care activities. Yet older adults' adoption rates continue to lag behind younger and middle-aged adults. We report data from 249 older adult computer users (65–93 years of age) that identify the details of their perceptions of computer usefulness for a range of everyday activities. Participants rated the importance of activities to their quality of life and the usefulness of current computer systems for supporting those activities. These experienced computer users indicated that computers were meeting their needs for some activities (e.g., social communication, games) but not for other activities (e.g., calendaring, healthcare, recreation and learning). Our data provide guidance for (a) introducing the potential of computer systems to current non-users and (b) designing systems targeted to meet the needs of older adults and enhancing computing functionality for them.

**Keywords:** Technology · Older adults · Adoption · Perceived usefulness · Perceived ease of use

## 1 Introduction

Computers systems, from desktop computers to tablets and smart phones, can assist with many tasks of daily life and provide users with the ability to connect with people, information, and resources in the world without having to leave their home. Particularly for older adults, there is much potential for computer systems to benefit their lives in tangible ways such as social communication [1], access to health and other information [2], and support for hobbies and leisure activities [3].

The potential for computer systems to support older adults is particularly compelling in light of current demographic trends. Across the globe, the number of people 60 years or over is expected to more than double, from 841 million people in 2013 to more than 2 billion in 2050 [4]. Such changing demographic distributions must be considered in the context of computer technology development. Helping older adults remain independent as long as possible could minimize use of costly long-term care resources. Older adults also value being independent rather than relying on others for

daily life tasks [5]. Computer systems that meet older adults needs could facilitate their independence and, in doing so, reduce their need to depend on others.

Despite the potential of computer systems, older adults (e.g., 65+) continue to underutilize them relative to other age groups. The latest findings from the Pew Research Center show that 97 % of those 18–29 years of age and 93 % of those 30–49 years of age report using the Internet, compared 88 % of those 50–64 years of age, but only 57 % of those 65 and older [6]. Although the Pew data reflect U.S. trends, similar trends have been noted in other industrialized countries [7].

Research has pointed to characteristics of the user, as well as of the interface of the technology to explain older adults' underutilization of computer systems. Older adults are less likely to have the prerequisite skills, attitudes, and experience as compared to younger adults. In a sample of 1,204 adults (18–91 years of age) Czaja, Charness, Fisk, and colleagues (2006) found that age, cognitive ability (i.e., fluid intelligence), ethnicity, computer anxiety, and education predicted *computer experience*. Gender, education, cognitive ability (i.e., fluid and crystallized intelligence), computer anxiety, and age predicted breadth of *computer use* [8]. Education, ethnicity, cognitive ability (i.e., fluid and crystallized intelligence), computer anxiety, and age predicted *Internet experience*. Furthermore, older adults typically have less general technology experience compared to younger adults [1], and that general technology experience is predictive of computer and Internet attitudinal acceptance [9]. Moreover, interface design issues have been noted as potential barriers for older users [10], especially those with limited technology experience [1].

Beyond experience and usability issues, it is possible that older adult non-users do not perceive computer systems as useful for supporting the tasks and activities that are important to them. Indeed, an AARP poll of adults 50 years of age and older found that 71 % of non-Internet users were not interested in learning to use the internet; 47 % of those respondents did not want to learn how to use the Internet because they were not interested in the Internet all together [11]. Perception of usefulness is a strong predictor of older adults' technology use in a variety of contexts [3, 12]. In fact, the absence of benefits may be a stronger influence than the presence of costs when predicting the non-acceptance of a new technology. That is, if older adults perceive a technology to provide many benefits they may accept a new technology despite associated costs such as effort, expenses, or lack of skills [13]. Older adult non-users may not recognize the potential benefits of computer systems for their lives and this perception cannot be assessed from prior research that focused on usage patterns.

A goal for the present study was to assess perceptions of Internet usefulness of older adults who are experienced computer users. These data provide guidance for introduction, deployment, and training of non-users who represent nearly half of the older adult population in developed countries and a much higher percentage elsewhere. Knowing what other older adults find useful about the Internet might motivate non-user older adults to learn themselves. Alternatively, understanding what older adult users do not find useful can provide direction for design and instruction to computer developers, and provide insights about lack of awareness or understanding of utility. These findings have relevance to a wide range of current computer systems and software, including tablet, smart phone, and wearable applications, and also provide insight into the potential for future technologies, in terms of content and functionality.

## 2 Overview of Study

The Pew Research Center assessment of Internet use [14] is based on respondents saying yes to at least one of the following three questions: “Do you use the Internet, at least occasionally?”, “Do you send or receive email, at least occasionally?” or “Do you access the Internet on a cell phone, tablet or other mobile handheld device, at least occasionally?” The Pew data provide a valuable broad assessment of Internet use but much less depth regarding specific activities and preferences. Our goal was to garner in-depth information about the perception of usefulness for using the computer for a wide range of activities. We queried a large sample of older adult computer users about the importance of a range of activities to their quality of life (i.e., personal relevance), and assessed whether computers were useful to them in accomplishing these activities. The activities where there was a match between importance and usefulness represent target areas wherein non-users might find computers to be useful to them (and hence be more motivated to learn). The activities where there was a mismatch between importance and usefulness represent opportunities for designers: the activity is important but yet the older adults did not find the computer to be helpful to them.

## 3 Method

### 3.1 Participants

We mailed questionnaires to 662 older adults who were part of the databases maintained by the Human Factors and Aging Laboratory at the Georgia Institute of Technology (Atlanta, Georgia) and the Laboratory of Dr. Neil Charness at Florida State University (Tallahassee, Florida). A total of 321 completed questionnaires were returned (15 were returned as undeliverable) which translates to a return rate of 50 %. Of the questionnaires returned, 249 were completed by older adults (65 and older) who reported themselves to be computer users. In this report we have only included these 249 respondents. The age range of these respondents who were computer users was 65–93 ( $M = 75$ ,  $SD = 5.79$ ). Note that the sample was generally healthy (84 % reported good to excellent health), well-educated (81 % reported completing at least some college), and living independently (89 % reported living in a house/apartment).

### 3.2 Materials

We developed the 381-item Computer Preference & Usage Questionnaire (CPU-Q); additional details are also provided in Mitzner et al. (2010) [3]. The CPU-Q includes:

1. Background & Health Information - gender, age, education, marital status, race, ethnicity, housing, income, occupation, general health, health satisfaction, vision, hearing, and limitations related to sitting, using hands, and reading.
2. General Importance of Activities - perceptions of the importance of various tasks in daily life using a five point Likert-type scale with a neutral point (not at all important to very important). The tasks and activities this paper focuses on are

social communication (e.g., communicating with family and friends; sending or receiving photos), health-related (e.g., communicating with health care professionals; researching symptoms and illnesses), calendar tasks (e.g., creating appointment reminders, tracking events with a calendar), and recreation and learning (e.g., travel directions, learning new information), and games (e.g., solitaire, bridge).

3. Technology Experience - 17 items assessing frequency of use for a wide range of technologies (answering machine, ATM, electronic book reader, cell phone) and 3 items assessing computer/Internet use, including frequency and duration.
4. Potential for Computers/Internet to Support General Activities - perceptions of usefulness of computers in assisting with the same tasks and activities included in the General Importance of Activities section, also using a six point Likert-type scale with a neutral point (not at all useful to very useful).
5. Attitudes towards a Computer System Designed for Older Adults - perceptions of the importance for an ideal system to support different activities. Participants were instructed to imagine that they had been given a computer system developed specifically for use by older adults, along with the appropriate personalized training for its use. The description was based on a system used in a randomized clinical trial designed to assess the impact of a computer intervention on the well-being of seniors with minimal computer experience (ClinicalTrials.gov Identifier: NCT01497613) [15, 16].

### 3.3 Procedure

Questionnaires were mailed to participants, along with a postage-paid envelope to return it once it was completed. This was a lengthy survey (47 pages) – participants were instructed as follows: “We expect this questionnaire to take 45 to 60 min to complete. At your convenience, please find a quiet area and time when you will have about an hour free from interruption to complete this questionnaire.”

## 4 Results

For the goals of the current paper, the questionnaire responses were reviewed with the following goals in mind: (a) assess computer and Internet experience of the older adult computer users, and (b) identify activities that were important to them for which they found the computer to be useful as well as activities that were important but they did not find the computer to be useful. The data are descriptive but they represent a large sample and provide guidance for deployment, training, and design.

### 4.1 Computer and Internet Experience

Participants were included if they answered yes to the question “Do you ever use a computer and/or the Internet?” Most respondents (72 %) reported using the computer

and/or Internet at least 5 h per week and most (89 %) reported having used it for at least 5 years. Thus, this sample represents a group of experienced older adult computer users.

**4.2 Importance of Activities and Perceptions about the Usefulness of Perceptions of Current Computers**

We queried participants about two aspects of a variety of tasks and activities. We asked, “For each task and activities listed in the table below, please indicate how important they are to your quality of life.” Then, in a later section of the questionnaire we had the same list of tasks but the question was: “How useful are computers and the Internet for supporting the following tasks and activities?”

When participants were asked to indicate how important a wide range of activities were for their quality of life, on average they rated calendar, social communication, healthcare, and recreation and learning activities as important to very important. These contrasting sets of data for the categories of social communication, games, calendar healthcare, recreation and learning, and are presented in Table 1. In terms of the usefulness of current computer systems to support these activities, only the mean for social communication and recreation and learning approached a “useful” rating. We conducted a paired-sample t-test for each category to determine if the importance and usefulness responses were significantly different (see Table 1). The alpha level for significant effects was set at .001 to control for multiple tests.

**Table 1.** Importance and usefulness ratings

Activity categories	Importance mean (SD)		Usefulness mean (SD)		Df	t	p
Social communication	4.03	(.61)	3.97	(.90)	245	1.17	.243
Games	3.21	(1.17)	2.95	(1.41)	208	2.81	.006
Calendar	4.14	(.78)	2.49	(1.31)	230	17.26	<.001 (significant at .001)
Healthcare	4.02	(.73)	3.05	(1.08)	240	15.58	<.001 (significant at .001)
Recreation and learning	3.99	(.64)	3.77	(.93)	244	3.89	<.001 (significant at .001)

*Note.* Ratings were provided in the context of quality of life for importance (1 = not at all important to 5 = very important) and the usefulness of computers and the Internet for supporting tasks and activities (1 = not at all useful to 5 = very useful).

For social communication and games the ratings were not significantly different suggesting that computers were perceived to be successful in meeting older adults’ needs for these categories. Yet, for recreation and learning, health, and calendar activities the ratings of computer usefulness were significantly lower than the

importance ratings. To understand these patterns, we explored the data on an item level to gain insights about perceptions of usefulness for different tasks in the same categories.

**Social Communication.** We queried participants about six different social communication tasks; they were all deemed important to the older adults' quality of life (mean ratings > 3). Overall, the usefulness ratings were high with 3 of the tasks having a mean rating above a 4. The older adults were especially likely to perceive the usefulness of computers for communicating with family and friends and for staying in touch with people over long distance.

**Games.** We asked participants about both individual games (e.g., Solitaire, Dominos, Sudoku, puzzles) and group games (e.g., Bridge, Bingo, board games). Participants rated both types as important (mean ratings > 3), however the computer was only rated as useful for individual games, not group games ( $M = 3.37$  and  $M = 2.33$ , respectively). Considering both individual and group games and with an alpha set at .001, perceptions of usefulness were not significantly different than those of importance for games.

**Calendar.** We queried about four different calendaring activities, including scheduling events and setting reminders. Although calendaring activities were rated as important to participants' quality of life (mean rating > 4), computers were rated as not useful for putting reminders on a calendar, creating appointment reminders, and tracking events with a calendar. The only calendaring activity for which computers were perceived as being useful was creating medication reminders. These findings indicate a mismatch (and thus a potential opportunity) between activities older adults consider important for their quality of life and the ability of computers to support them.

**Healthcare.** We queried participants about six different healthcare activities, all of which were rated as important to the quality of life of the older adults (mean rating > 3). Overall, the participants did not find the computer to be very useful for supporting the health-related tasks, with the exception of most research tasks. Researching general health issues, symptoms/illnesses, and medications were all above 3.0, suggesting that the older adults perceived the usefulness of computers for research tasks.

There were three health tasks that were rated quite low in usefulness (i.e., communicating with doctors or other healthcare professionals, researching health insurance, managing illnesses) but quite high in importance. These represent another mismatch between the older adults' needs and their perceptions of usefulness. Certainly computing technology has the potential to assist with these tasks but the older adult computer users in our sample did not perceive that usefulness.

In sum, clearly the older adults perceived healthcare activities as important to their quality of life, most notably communicating with doctors or other healthcare professionals, managing illness and researching general illness, medications, and symptoms. But there was a disconnect between the activities important to the respondents and their perceptions that computers and the Internet can be useful for these tasks. The notable exception to this pattern was for research.

**Recreation and Learning.** We asked participants about seven learning and recreation activities, all of which were rated as important to their quality of life (mean ratings > 3).

Nevertheless, ratings of computer usefulness to support these activities were significantly lower. The largest disconnect between importance and usefulness ratings were for following the news, acquiring new skills, learning new information, and accessing community resources. Although computers have the potential to be quite useful for these types of learning and recreation activities, these older adults did not perceive current computers as useful for such activities.

## 5 Discussion

The purpose of this study was to understand what types of activities are important to older adults and whether computers are perceived as useful for providing support for those activities. We explored the attitudes of experienced older adult computer users about current computer usefulness for different activities because we wanted to understand perceptions that were based at least partly on usage rather than primarily on expectations and assumptions. We sampled an older adult population who became users at a time when they were a minority user group in the older population (i.e., early adopters [17]). Although these participants are not representative of the total population of older adults, they are representative of older adult computer users, as reflected by large-scale survey data (e.g., mostly white/Caucasian, highly educated, and in good health) [18–20]. These experienced computer users showed a disconnect between what activities were important to them and how useful they found computers for supporting those activities, a finding contrary to what might be expected from technology-savvy people. That is, even having considerable computer experience may not prevent an individual from encountering barriers when trying to use computers for certain activities.

Previous research has provided insight into the types of computer and Internet activities older adults are engaged in. The Pew Research Center, in particular, has provided much data about what activities older adults engage in using the Internet, such as using email, search engines, hobby or interest, maps or directions [21]. Another large-scale study also collected data on activity engagement and found almost 86 % of Internet users 65 and older sent emails/text messages, 51 % shopped, paid bills, and/or did banking, and 45 % conducted health-related tasks on the Internet. However, 9 % of the users used the Internet only for sending emails/text messages and these users were more likely to be socially and economically disadvantaged [22]. These findings provide insights into Internet usage patterns of seniors and the findings presented here complement those data showing also how important different activities are to older adults' quality of life and how useful they perceive computers to be for providing support.

Our findings indicate that computers are meeting older adults' needs for some activities (e.g., social communication, games) more so than others (e.g., calendaring, healthcare, recreation and learning), an insight that has significant implications for training and design. For example, the finding that computers are meeting older adults' needs for social communication and games is a point that should be highlighted for their non-user peers during technology introduction and training. That is, if non-users can see how their peers benefit from using computers, they may be more likely to see those potential benefits for themselves.

Social communication was an activity our participants rated as important and that the computer was useful for providing support. Indeed, the Pew Research Center showed that email is a common computer activity of older adults [6]; 86 % of internet users ages 65 and older use email and 48 % do so on a typical day [23]. Nevertheless, there may be design opportunities for chat and social networking software. People are living longer and therefore more likely to have mobility losses. The majority of older adults are also choosing to stay in their homes. These factors may contribute to increased social isolation for older adults, which may be particularly severe for their age group [24, 25]. Consequently, there may be more of a need for social communication technologies in the future and the needs of older adults should be specifically considered.

Playing games was another activity for which participants seemed to feel the computer was meeting their needs. This finding suggests that computer games may be a ripe entry activity to show non-computer users potential benefits of using computers. Furthermore, games to support cognitive health by providing cognitive exercise are becoming popular and are being marketed toward older adults. Although challenges have been documented regarding the benefits of games for cognitive exercise [26], there is promising evidence and increasing interest in computer games designed to provide cognitive exercise [27]. However, the participants did not find the computer useful for group games and this represents a missed opportunity for increasing social interaction.

The older adults we surveyed did not view the computer as meeting their needs for calendaring, healthcare, and recreation and learning activities. Calendaring activities had the highest mean ratings for importance to quality of life and the largest mean difference between importance to quality of life and usefulness of computers for providing support. The high value placed on the importance of calendaring is consistent with the widely accepted finding that aspects of prospective memory declines with age [28] and that older adults are aware of this decrement [29, 30]. Nevertheless, these experienced computer users did not rate current computers as useful for supporting calendaring activities. This is a prime domain for which computer software has the potential to make a significant impact on the lives of older adults, yet our findings show that more work is needed to develop systems that are useable and useful to older adults.

Healthcare is another domain for which computer systems may be particularly useful for older adults [31], especially given that the percentage of adults with multiple chronic conditions increases with age [32]. Nearly 90 % of older adults have at least one chronic disorder [33]. In fact, in another large-scale survey, 53 % of adults who were Internet users and had chronic conditions reported using information found on the Internet in their decision-making about their own health or someone they care for [34]. However, with respect to design, the healthcare results presented here provided evidence that current computer options are not meeting the needs of older adults. Even experienced computer users did not perceive the usefulness of computers for a range of important healthcare tasks such as managing illness, scheduling appointments, and creating reminders for appointments or medications. These activities influence quality of life and potentially health care costs and safety as well. This finding suggests an opportunity for designers to capitalize on computing power to support these activities of older adults.



Computers were also not seen as meeting participants' needs for supporting recreation and learning activities. These types of activities can be thought of as enhanced activities of daily living [35] and are important for providing social opportunities and cognitive exercise [36]. Future computer systems and software should be designed to better support these activities, particularly in light of the relationship between social isolation and mortality [37] and cognitive exercise and cognitive functioning [38].

Our findings provide guidance for (a) introducing the potential of computers to current non-users and (b) design targeted to meet the needs of older adults and enhance computing functionality for them. First, consider older adults who are currently non-users. There are of course many reasons why people choose not to use computers, some of which may relate to financial cost or lack of training opportunity. However, perceived usefulness, attitudes, and anxiety are also predictive of computer and technology use [8, 9]. In fact, the most frequently stated reason for not using the Internet was 'not interested' (31 %) [21]. It is likely that many of the respondents who indicated they were not interested do not perceive the Internet as being useful. The present findings illustrate the value of computers for older adults performing activities that are important to their quality of life. Communication with family and friends in particular was important to life quality and computers were perceived as useful for these activities. Therefore, these activities are likely to be a good point of introduction for motivating and engaging older adults to use computers.

**Acknowledgements.** This research was supported in part by a grant from the National Institutes of Health (National Institute on Aging) Grant P01 AG17211 under the auspices of the Center for Research and Education on Aging and Technology Enhancement (CREATE; [www.create-center.org](http://www.create-center.org)). Data from this general questionnaire were presented at Human Factors & Ergonomics Society (Burnett et al., 2011), FICCDAT (Mitzner et al., 2011), GSA (Mitzner et al., 2011), and at the Cognitive Aging Conference (Burnett et al., 2012).

## References

1. Olson, K.E., O'Brien, M.A., Rogers, W.A., Fisk, A.D.: Understanding age and technology experience differences in use of prior knowledge for everyday technology interactions. *ACM Trans. Access. Comput.* **4**(2), Article No. 9 (2012)
2. Charness, N., Demiris, G., Krupinsky, E.A.: *Designing Telehealth for an Aging Population: A Human Factors Perspective*. CRC Press, Boca Raton (2012)
3. Mitzner, T.L., Boron, J.B., Fausset, C.B., Adams, A.E., Charness, N., Czaja, S.J., Dijkstra, K., Fisk, A.D., Rogers, W.A., Sharit, J.: Older adults talk technology: technology usage and attitudes. *Comput. Hum. Behav.* **26**(6), 1710–1721 (2010)
4. United Nations DoEaSA, Population Division. *World Population Ageing 2013* (2013)
5. Wiles, J.L., Leibing, A., Guberman, N., Reeve, J., Allen, R.E.: The meaning of "aging in place" to older people. *Gerontologist* **52**(3), 357–366 (2012)
6. Internet user demographics. <http://www.pewinternet.org/data-trend/internet-use/latest-stats/> (2014). Accessed 3 Jul 2014
7. Eurostat: Individuals frequently using the internet. Eurostat. <http://epp.eurostat.ec.europa.eu/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tin00092&language=en> (2011). Accessed 31 Jul 2014

8. Czaja, S.J., Charness, N., Fisk, A., Hertzog, C., Nair, S., Rogers, W., Sharit, J.: Factors predicting the use of technology: findings from the center for research and education on aging and technology enhancement (CREATE). *Psychol. Aging* **21**(2), 333–352 (2006)
9. Mitzner, T.L., Rogers, W.A., Fisk, A.D., Boot, W.R., Charness, N., Czaja, S.J., Sharit, J.: Predicting older adults' perceptions about a computer system designed for seniors. *Univ. Access Inf. Soc.* (2014, in press)
10. Pak, R., McLaughlin, A.: *Designing Displays for Older Adults*. CRC Press, Boca Raton (2010)
11. Keenan, T.A.: Internet use among midlife and older adults: an AARP bulletin poll. *AARP Bulletin* (2009)
12. Caine, K.E., O'Brien, M.A., Park, S., Rogers, W.A., Fisk, A.D., Van Ittersum, K., Capar, M., Parsons, L.J.: Understanding acceptance of high technology products: 50 years of research. In: *Proceedings of the Human Factors and Ergonomics Society 50th Annual Meeting, San Francisco, California, Human Factors and Ergonomics Society* (2006)
13. Melenhorst, A.S., Rogers, W.A., Bouwhuis, D.G.: Older adults' motivated choice for technological innovation: evidence for benefit-driven selectivity. *Psychol. Aging* **21**, 190–195 (2006)
14. Rainie, L.: *Changes to the Way We Identify Internet Users*. Pew Research Center, Washington (2012)
15. Boot, W.R., Charness, N., Czaja, S.J., Sharit, J., Rogers, W.A., Fisk, A.D., Mitzner, T.L., Lee, C.C., Nair, S.: The computer proficiency questionnaire (CPQ): assessing low and high computer proficient seniors. *The Gerontologist* (Advance online publication) (2013)
16. Czaja, S.J., Boot, W.R., Charness, N., Rogers, W.A., Sharit, J., Fisk, A.D., Lee, C.C., Nair, S.N.: The personalized reminder information and social management system (PRISM) trial: rationale, methods and baseline characteristics. (1559–2030 (Electronic)). doi:D-NLM: NIHMS645340. Accessed 01 Jan 16, D - NLM: PMC4314316. Accessed 01 Jan 16, OTO - NOTNLM
17. Smith, A.: *Older Adults and Technology Use*. Pew Research Center, Washington (2014)
18. Choi, N.: Relationship between health service use and health information technology use among older adults: analysis of the US national health interview survey. *J. Med. Internet Res.* **15**(5), e33 (2011)
19. Neter, E., Brainin, E.: eHealth literacy: extending the digital divide to the realm of health information. *J. Med. Internet Res.* **14**(1), e19 (2012)
20. Werner, J.M., Carlson, M., Jordan-Marsh, M., Clark, F.: Predictors of computer use in community-dwelling, ethnically diverse older adults. *Hum. Factors* **53**, 431–447 (2011)
21. Zickuhr, K., Smith, A.: *Digital Differences*. Pew Research Center, Washington (2012)
22. Choi, N.G., DiNitto, D.M.: The digital divide among low-income homebound older adults: internet use patterns, eHealth literacy, and attitudes toward computer/internet use. *J. Med. Internet Res.* **15**(5), e93 (2013)
23. Zickuhr, K., Madden, M.: *Older adults and internet use* (2012)
24. Cacioppo, J.T., Hawkley, L.C.: Social isolation and health, with an emphasis on underlying mechanisms. *Perspect. Biol. Med.* **46**, S39–S52 (2003)
25. Tomaka, J., Thompson, S., Palacios, R.: The relation of social isolation, loneliness, and social support to disease outcomes among the elderly. *J. Aging Health* **18**, 359–384 (2006)
26. Green, C.S.B.D.: Exercising your brain: a review of human brain plasticity and training-induced learning. *Psychol. Aging* **23**(4), 692–701 (2008)
27. Boot, W.R., Blakely, D.P., Simons, D.J.: Do action video games improve perception and cognition? *Front. Psychol.* **2**, 226 (2011)

28. Hubbert, F.A., Johnson, T., Nickson, J.: High prevalence of prospective memory impairment in the elderly and in early-stage dementia: findings from a population-based study. *Appl. Cogn. Psychol.* **14**, S63–S81 (2000)
29. Gilewski, M.J., Zelinski, E.M., Schaie, K.W.: The memory functioning questionnaire for assessment of memory complaints in adulthood and old age. *Psychol. Aging* **5**, 482–490 (1990)
30. Zeintl, M., Kliegel, M., Rast, P., Zimprich, D.: Prospective memory complaints can be predicted by prospective memory performance in older adults. *Dement. Geriatr. Cogn. Disord.* **22**, 209–215 (2006)
31. Taha, J., Sharit, J., Czaja, S.: Use of and satisfaction with sources of health information among older internet users and nonusers. *Gerontologist* **49**(5), 663–673 (2009)
32. Ward, B.W., Schiller, J.S., Goodman, R.A.: Multiple chronic conditions among US adults: a 2012 update. *Prev. Chron. Dis.* **11**, E62 (2014). doi:[10.5888/pcd11.130389](https://doi.org/10.5888/pcd11.130389)
33. Prevention CfDca: The state of aging and health in America 2013. Centers for Disease Control and Prevention, US Dept of Health and Human Services, Atlanta, GA (2013)
34. Fox, S.: E-patients with a Disability or Chronic Disease. Pew Research Center, Washington (2007)
35. Rogers, W.A., Meyer, B., Walker, N., Fisk, A.D.: Functional limitations to daily living tasks in the aged: a focus group analysis. *Hum. Factors* **40**, 111–125 (1998)
36. Williams, K., Kemper, S.: Exploring interventions to reduce cognitive decline in aging. *J. Psychosoc. Nurs. Ment. Health Serv.* **48**(5), 42–51 (2010)
37. Pantell, M., Rehkopf, D., Jutte, D., Syme, S.L., Balmes, J., Alder, N.: Social isolation: a predictor of mortality comparable to traditional clinical risk factors. *Am. J. Pub. Health* **103** (11), 2056–2062 (2013)
38. Valenzuela, M., Sachdev, P.: Can cognitive exercise prevent the onset of dementia? Systematic review of randomized clinical trials with longitudinal follow-up. *Am. J. Geriatr. Psychiatry* **17**(3), 179–187 (2009)