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Preferences for technology versus human assistance and control over technology in the performance of kitchen and personal care tasks in baby boomers and older adults

Scott R. Beach¹, Richard Schulz¹, Judith T. Matthews¹, Karen Courtney², Annette DeVito Dabbs³

¹Center for Social and Urban Research, University of Pittsburgh, Pittsburgh, PA, USA

²Department of Human and Social Development, University of Victoria, Victoria, British Columbia, Canada

³School of Nursing, University of Pittsburgh, Pittsburgh, PA, USA

Abstract

Purpose—Quality of Life technology (QoLT) stresses humans and technology as mutually dependent and aware, working together to improve task performance and quality of life. This study examines preferences for technology versus human assistance and control in the context of QoLT.

Method—Data are from a nationally representative, cross-sectional web-based sample of 416 US baby boomers (45–64) and 114 older adults (65+) on preferences for technology versus human assistance and control in the performance of kitchen and personal care tasks. Multinomial logistic regression and ordinary least squares regression were used to determine predictors of these preferences.

Results—Respondents were generally accepting of technology assistance but wanted to maintain control over its operation. Baby boomers were more likely to prefer technology than older adults, and those with fewer QoLT privacy concerns and who thought they were more likely to need future help were more likely to prefer technology over human assistance and more willing to relinquish control to technology.

Conclusions—Results suggest the need for design of person- and context-aware QoLT systems that are responsive to user desires for level of control over operation of the technology. The predictors of these preferences suggest potentially receptive markets for the targeting of QoLT systems.

Keywords

Survey methods; technology acceptance

Introduction

Current demographic trends showing an aging population, combined with spiraling health care costs and the rapid pace of technological innovation have led to increasing interest in the use of technology to enhance quality of life and maintain function among older and disabled adults [1]. As the population ages, demands for caregiving increase while the availability of family, friends, and formal caregivers continues to decrease due to families having fewer children, increased geographic mobility, and labor shortages [2–4]. This provides further urgency for the development of technology solutions to enable “aging in place”. A new multidisciplinary effort directed towards developing “Quality of Life Technology” (QoLT) has evolved over the past several years, aimed at enabling individuals to remain as independent as possible while aging in place [1]. The emerging field of QoLT encompasses and adds to a broad range of applications including assistive technology [2]; telemedicine [5], telemonitoring [6]; telehealth, e-health, and gerontechnology [7]. Though novel QoLT applications have great potential to enhance health and functioning, many barriers to acceptance and effectiveness (e.g. cost, perceived need, complex interfaces, privacy concerns) must be overcome before this potential can be fully realized [8].

QoLT systems are envisioned as context-aware, person-aware *intelligent* systems capable of detecting evolving user needs and capabilities and adapting the level and type of assistance provided as needed. One of the primary distinguishing characteristics of QoLT systems is the idea of *person-system symbiosis*, in which the technology and user (or caregiver) are mutually dependent and work in concert to improve task performance and ultimately quality of life. The ultimate goal of the emerging QoLT field is to develop technology that works with individuals and their caregivers to provide the right amount of help at the right time, with the user being able control, or “override”, the technology based on their level of function and/or preference. This is envisioned as being done in an environment where both the user and the technology are *aware* of one another’s capabilities and limitations. The user “knows” what the technology can do, while the “intelligent” technology also “knows” what the user can (and cannot) do at any given time. We see QoLT and person–system symbiosis as aligning nicely with the definition of “assistive technology” from The Assistive Technology Act of 2004 (29 U.S.C. Sec 2202(2)): “...any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities”. QoLT and person-system symbiosis is a “high tech”, interactive, vision of assistive technology as defined. However, it does contrast with currently existing assistive technologies with more static or fixed capabilities that require user control for operation.

Several early QoLT prototype systems have begun to demonstrate the value of the person–system symbiosis approach in addressing barriers to acceptance [1]. Example QoLT systems under development include QoLTBOTS, which are intelligent robots for manipulation and mobility assistance (for the home and other environments) that are being designed to help a person perform personal care ADL activities; and a cueing kitchen, which consists of an intelligent, perceptive environment that will support a person’s ability to prepare meals and complete other kitchen activities. These systems are being developed through the Quality of

Life Technology Engineering Research Center (ERC) funded by the National Science Foundation. The research reported in this article was conducted within the QoLT ERC.

Fundamental questions remain about the person-system symbiosis approach to QoLT, which rests on the assumption that users (1) want technological systems and (2) want technologies that require active user participation. In addition to the complex technical and engineering challenges involved in building these systems, developers need to consider basic questions about potential user acceptance; namely:

1. Is technology a viable alternative to human help? If both are available, do baby boomers and older adults prefer human versus technology assistance for kitchen (e.g. preparing meals, washing dishes, cleaning) and basic personal care (e.g. transferring, dressing, eating, toileting, bathing) tasks? This question addresses the fundamental issue of how willing people are to accept technology assistance when explicitly contrasted to traditional human assistance.
2. Assuming people are willing to accept technology in place of human assistance, how much control do they want over actual operation of a QoLT system? Do humans actually want to work in collaboration with technology, or do they prefer to have the technology do the work for them, as is the case for traditional autonomous systems? A related question is, does the preference for control vary by the type of task performed by the technology?

These questions address an underlying assumption driving the approach to QoLT and their answers have critical implications for both the design of such systems and the ultimate systemic user experience [9]. It is important to note that these are two conceptually distinct questions involving basic preferences for human versus technological assistance, and, assuming use of technology, how much control people want over operation of a QoLT system. Thus, while we might expect the answers to be related to one another – that is, those with stronger preferences for technology might also be willing to allow more technology control – this may not necessarily be the case. In addition, the predictors of the two constructs may not be the same. These questions are explored in this article.

Given that QoLT systems featuring person-symbiosis capabilities are still being developed and the field is relatively new, we could not locate prior research that bears directly on our specific research questions. There has been a lot of work in the area of general technology acceptance, with various studies testing the “Technology Acceptance Model” (TAM) [10] on acceptance of currently existing technologies. Studies have been conducted both in the broader population [11], and among older adults looking at both health-related and non-health technologies [12–16]. Among the conclusions from this work are that older adults, while less positive towards technology and less likely to use it than their younger counterparts, are willing to accept technology that is perceived as easy to use and useful in helping them to accomplish important tasks. However, acceptance is not universal and several barriers to both health- related and non-health technology adoption remain. These include – among others – perceived high monetary costs of the technology, lack of perceived need for the technology, complex interfaces, poor reliability, safety concerns, and privacy concerns.

The work of Scherer and colleagues on Matching Person and Technology (MPT) is also relevant here [17–19]. The MPT approach argues that assistive technology will most successfully enhance function and quality of life if it is appropriately matched to unique user need and preferences. In other words, while it is true that users need to adapt to the features and demands of a technology, the technology also needs to be adapted to the individual user in order to be most effective. Scherer and colleagues have developed a series of standardized, validated assessment tools for the MPT approach, which has been successfully used in many applications (see Federici and Scherer [20] for a summary). Intelligent QoLT systems that automatically adjust to evolving user needs, provide appropriate levels of help, and allow for varying levels of user control might be excellent “matches” between the person and technology.

Another relevant line of research has examined reactions toward intelligent healthcare and social assistance robots [21,22]. This research has shown that both individual user (e.g. age, needs, gender, experience with technology/robots, cognitive ability, education) and robot factors (e.g. appearance, humanness, facial features, size, gender, personality, adaptability) can affect acceptance. A related set of studies has examined potential user preferences for tasks that they think a robot should perform. In an early study in Sweden, Kahn [23] found that 21-to-60-year-olds wanted robots to help with chores like general cleaning, polishing windows, cleaning ceilings and walls, and moving heavy things. Respondents did not want the robot to help them with things like babysitting, reading aloud, acting as a “butler”, cooking food, and taking care of kitchen goods. Dautenhahn et al. [24] also found that younger and middle-aged adults thought robots should help with chores like vacuuming. Finally, Ezer et al. [25] found that both younger and older adults preferred robots to perform infrequent but important tasks that required little interaction with the human compared to service tasks that did require interaction. Both age groups were least willing to have the robot perform non-critical tasks that require extensive human–robot interaction. This work suggests that humans may be somewhat reluctant to actively interact with robots, but it says less about human desire for control over robot operation. It should be noted that all of the work reviewed here has generally relied on relatively small, unrepresentative non-probability samples and thus should be interpreted cautiously.

Our own research group has conducted two surveys that are relevant to the current study. The first was conducted via the web with a national opt-in volunteer internet panel that targeted disabled and non-disabled baby boomers (age 45–64) and older adults (65+). Though not a representative probability sample and comprised of only internet users, the panel offered the opportunity to collect data from a large sample ($n = 1610$), and more importantly, to target specific disability groups – physical disability, rheumatoid arthritis, stroke, emphysema, multiple sclerosis – as respondents [26]. We used written scenarios to describe hypothetical QoLT technologies being developed by the QoLT ERC. We were also interested in informational privacy concerns relating to the sharing and recording of sensitive health and functional behaviour information by QoLT systems. The key findings were that respondents were least accepting of sharing information about toileting and driving behaviour, sharing it with the government or insurance companies, and having the information recorded via video (versus non-video sensors). In addition, those reporting higher levels of disability were more accepting of sharing the information [26]. This implies

that persons most in need may be most willing to relinquish privacy for increased function provided by QoLT. Consistent with this argument, we also found that respondents who thought the QoLT systems applied to them personally were more positive towards the systems than those who did not [27].

A second survey was conducted using mailed paper and pencil methodology and utilized an existing research registry of older adults to insure that individuals without access to the internet were captured [28,29]. The 350 older adults who completed the survey were members of a local gerontology research registry at the University of Pittsburgh. The primary goal of this survey was to follow-up more explicitly on the idea of trade-offs (e.g. less privacy for increased function and independence) suggested by the prior results. We posed explicit trade-offs (e.g. video cameras throughout your home, but it will prevent you from having to go to a nursing home; takes 5 to 10 h to learn to use the technology, but will increase ADL/IADL function) and asked in a yes/no format about willingness to accept the technology given the conditions. Key findings included respondents being less willing to make trade-offs for independence or function when the QoLT systems: (1) involve video cameras throughout the home; (2) take twice as long as a humans to perform tasks; (3) take 5 to 10 hours to learn how to use; and (4) take one hour per day to maintain. Another interesting finding was that respondents were generally unwilling to trade off reduced opportunities for social interaction, even if it meant enhanced function. Only about 30% of the sample was willing to make such a trade-off. Finally, respondents with higher levels of disability were more willing to make QoLT tradeoffs, consistent with findings from the national web panel survey discussed above [26].

While our previous surveys have examined issues related to QoLT acceptance and the trade-offs involved in this acceptance, we have not yet directly examined the questions about person-system symbiosis laid out earlier. We have also not used representative probability sampling approaches, which could raise questions about the generalizability of our findings. The study reported here involved a web-based survey of a nationally representative sample of US baby boomers (age 45–64) and older adults (age 65+) to answer two key questions: (1) do potential QoLT users prefer humans versus technology to help accomplish kitchen personal care tasks?; and (2) assuming they are willing to accept technology assistance, how much control do they want over actual operation of the system versus allowing the technology to maintain control? In addition, we examine various potential predictors of these preferences based on our own and others previous work. These include age, gender, education, race, current disability level, current use of assistive devices, and general positive and negative attitudes towards technology. We also explore QoLT-specific attitudes including safety concerns, concerns about invasion of privacy, and perceived likelihood of needing help with kitchen and personal care tasks in the future. It is important to note from the outset that the goal of the article is to explore attitudes towards potential future technologies among potential future users – baby boomers and older adults – and not to obtain reactions to existing assistive technologies from currently disabled persons. We hypothesized the following:

- Baby boomers and older adults will have general tendencies to prefer human assistance and control, given the novelty of intelligent, symbiotic QoLT systems

and our previous strong findings of rejection of QoLT that reduces opportunities for social interaction;

- Younger respondents (baby boomers) are more likely to prefer technology and be more willing to allow technology control than older adults, given their higher familiarity with and acceptance of technology in general;
- Baby boomers and older adults who are currently disabled are more likely to prefer technology and be more willing to allow technology control, given our previous findings showing more acceptance of QoLT privacy invasions and trade-offs;
- Those with more positive general technology attitudes are more likely to prefer technology assistance and relinquish control to technology;
- Those with more safety concerns with QoLT are more likely to prefer human assistance and control;
- Those having greater concerns about privacy invasions from QoLT are more likely to prefer human assistance and control.

We were also interested in exploring how respondent estimates of the likelihood of ever needing help with kitchen and personal care tasks related to preferences for technology assistance and control. This was of interest given findings from the technology acceptance literature that a key barrier to acceptance is people's perception that they do not need the technology. However, we did not have specific hypotheses about perceived need. We also had no clear hypotheses for gender, education level, race, or current use of assistive devices, or for differences by kitchen versus personal care tasks.

Methods

Procedures

Participants completed an online survey consisting of a total of 95 questions that took an average of 25 min. The main outcomes for this article were preferences for technology versus a human assisting with kitchen activities and personal care tasks, and the desired amount of technology versus personal control over the operation of the technology when completing these tasks. Questions were also asked about safety concerns and invasion of privacy when using the technology at home, and the likelihood of needing help in the future with kitchen activities and personal care. Other survey items discussed in this article included general attitudes towards technology, disability status, current use of assistive technology, and demographic variables. Additional questions on the survey – which are not discussed further here – asked about general comfort with kitchen and personal care technology, willingness to pay out of pocket for each technology, attitudes towards safe driving technology, and reactions to video depictions of robots bathing humans and a “virtual valet” automatic vehicle parking system. To provide context, the general survey introduction read as follows:

This survey focuses on technology aimed at promoting independence and functioning among older and disabled adults. The goal of the survey is to get

general reactions to different ways such technology could be designed and different things it might do. For some of the questions, we ask you to assume that you need help with certain daily activities at some point in the future. We know it can be difficult to imagine needing this kind of help, but please do the best you can and provide us with your opinions. Your answers will provide valuable feedback to the engineers who are currently developing these technologies. Thank you for your participation.

Following questions on general attitudes towards technology, an additional context-setting statement was provided, prior to questions specific to kitchen and personal care technology:

As people age they often lose some of their ability to manage on their own. Technology can help people remain independent by monitoring their abilities and providing assistance when needed. This technology could help with a variety of tasks or activities, and provide assistance at varying levels of intensity – from simple passive monitoring to providing feedback, evaluation and coaching to helping you with the task to performing the entire task for you. We are interested in your general reactions to such technology.

Sample

Respondents were a nationally representative sample of 530 members of the Knowledge Networks (KN) KnowledgePanel®, a probability-based, online, non-volunteer US access panel (www.knowledgenetworks.com). Sampled non-internet households, when initially recruited, were provided a netbook computer and free internet service to enable their participation as online panel members. This distinguishes the KN web panel from the vast majority of online panels that consist of self-selected volunteers with internet access, thus excluding those without internet access. KnowledgePanel members are initially recruited using a statistically valid sampling method with a published sample frame of residential addresses that covers approximately 97% of US households. This involves probability-based sampling of addresses from the US Postal Service Delivery Sequence File. Randomly sampled addresses are invited to join KnowledgePanel through a series of mailings (English and Spanish materials) and by telephone follow-up to non-responders when a telephone number can be matched to the sampled address. Invited households can join the panel by one of several means: completing and mailing back an acceptance form in a postage- paid envelope; calling a toll-free hotline staffed by bilingual recruitment agents; or going to a dedicated KN recruitment web site and completing the recruitment information online. The address sampling is conducted throughout the year on a rolling basis. KnowledgePanel consists of about 50000 adult members (age 18 and older) and includes persons living in cell phone-only households. The panel allows targeting of specific demographic groups based on a profile survey that all members complete when they join. On average, most KN panelists participate in two surveys a month and the average panel life is 2 years. Although incentives are generally not offered for completion of specific surveys, panel members are entered into special sweepstakes with both cash and other prizes awarded.

This study targeted 400 baby boomers (defined as age 45–64) and 100 older adults (defined as age 65 and older) from the KnowledgePanel. For baby boomers, 1478 panel members

were initially sampled, 829 responded (56.1% cooperation), and 416 were able to view the videos that were included as part of the survey (but not discussed here), and were included in the final sample (an overall completion rate of 28.1%). For older adults, 421 panel members were initially sampled, 240 responded (57.0% cooperation), and 114 were able to view the videos and were included in the final sample (an overall completion rate of 27.1%). A comparison of those who were able to view the videos and those who were not (due to various internet connectivity issues; most panel members use their own computers and internet browsers) on various demographic characteristics revealed no statistically significant differences, lessening concerns about coverage bias. In sum, the sample consisted of 416 baby boomers age 45–64, and 114 older adults age 65 plus (total $n = 530$).

Data from the KnowledgePanel are statistically weighted to adjust for: (1) deviations from an equal probability of selection design (“base weight”); (2) non-coverage, initial panel non-response, and panel attrition (“panel demographic post-stratification weight”); and (3) study sample design – in this case targeting 45–64 year olds and those 65 and older – and study non-response (“study-specific post-stratification weight”). The post-stratification weights use the most recent demographic data from the Current Population Survey (CPS) as benchmarks. The weights are combined into a final weight that results in the sample mirroring the US population in terms of gender, age, race, education, census region, metropolitan area (versus not), and internet access (versus not) to the closest extent possible. In the case of this survey, the weighting adjustment attempts to make the sample of 530 mirror the US population of adults age 45 and older. The weighted sample was 48% male (compared to 47% in 45+ US population); 33% had a high school education (31% US) and 30% had at least a bachelor’s degree (26% US). The sample was 74% Non-Hispanic White (75% US), 11% Non-Hispanic African-American (11% US), 9% Hispanic (10% US), and 6% Non-Hispanic other race (primarily Asian; 5% US). Thus, although the sample was fairly close to the US population for gender and race, our respondents remained slightly more educated than the US population of adults age 45 and over even after statistical weighting adjustments. The margin of error (adjusted for design effects) for the full sample estimates reported in the article is approximately $\pm 5.5\%$. All data presented in this article are weighted using the final weight variable supplied by KN.

Measures

The survey measures used in this article are described in more detail in this section, beginning with the two outcome variables. Then demographic and health-related variables, attitudes towards general technology, safety and privacy concerns with kitchen and personal care technology, and perceived likelihood of needing help with kitchen and personal care tasks in the future are described. The measures were derived from our previous work and based a general model of technology uptake described in Schulz [1]. The model describes system characteristics, individual (user) characteristics, and societal factors that affect system-user fit, which in turn determine user perceived costs and benefits and user uptake or abandonment. The survey measures were reviewed by multiple faculty from the QoLT Center, including engineers, computer scientists, rehabilitation specialists, clinical, and social science faculty. Pilot testing was done with approximately 10 individuals age 45–64, including both those with current disability and non-disabled.

Person–system symbiosis preference measures—Survey questions for *kitchen technology* asked the respondent to “assume you needed help with *kitchen activities* and that technology was available to help you with things like *meal preparation and washing dishes*”. Questions for *personal care technology* were prefaced with “assume you needed help with *personal care* and that technology was available to help you with things like *getting in and out of bed dressing, and toileting*”.

This article examined predictors of two main outcomes related to QoLT person–system symbiosis. The first was simple preference for technology versus a human to provide kitchen and personal care help. The items were worded “To what extent would you prefer having [Kitchen/Personal care] technology versus a human provide this type of feedback and support”? Response options were “definitely prefer technology”, “probably prefer technology”, “no preference”, “probably prefer human”, and “definitely prefer human”.

The second question measured preference for technology versus human *control* in operation of the technology for kitchen and personal activities (assuming technology acceptance). These items were worded “How much control would you want over the operation of the technology versus allowing the technology to control things”? Response options were “100% technology control”, “75% technology, 25% you control”, “shared – 50% technology, 50% you control”, “75% you control, 25% technology”, and “100% you control”.

Demographic variables—The article examined gender, education, age, and race as predictors of preferences for technology versus human assistance and control. Education was analysed using four categories (less than high school, high school graduate, some college, bachelor’s degree or higher). Age was analysed using three categories representing younger baby boomers (45–54), older boomers (55–64), and older adults (65 plus). Race was categorized as White, African-American, Hispanic, and other (primarily Asian American).

Disability—Respondents were asked “Because of a health problem or disability, do you get help with...” followed by a series of tasks that captured both instrumental activities of daily living (IADL) and more basic activities of daily living (ADL). There were six IADL items: taking medications, preparing meals, doing laundry, cleaning, shopping, and transportation; and five ADL items: bathing, dressing, grooming (e.g. shaving, brushing teeth), feeding yourself, and transferring in and out of a bed or chair. A three-level variable was created, and coded “0” if the respondent did not report needing help with any IADL or ADL items; “1” if they reported at least one IADL difficulty but no ADL difficulties; and “2” if help was needed for at least one ADL difficulty. This single variable was used as a general disability level measure.

Assistive technology use—Current use of assistive technology for mobility was measured with the item “On MOST DAYS do you use any of the following assistive devices to walk or get around”? This was a “check all that apply” item that included cane, quad (four-pronged) cane, crutches, walker, wheeled walker, wheelchair (manual), wheelchair (power), scooter, prosthesis, and other (specify). If the respondent checked any option, he/she was coded as a current assistive device user.

General attitudes towards technology—These were measured with 10 items presenting general statements about positive and negative characteristics of technology (5 items each). Items were prefaced with “To what extent do you believe that technology...”. A 10-point rating scale was used for each item, with 1 labeled “Not at all”, and 10 labeled “Completely”. Positive statements included “makes life easy and convenient”, “makes life more comfortable”, “gives people control over their daily lives”, “increases personal safety and security”, and “brings people together”. Negative statements included “reduces privacy”, “makes people dependent”, “makes life stressful”, “makes people isolated”, and “makes life complicated”. Positive and negative items were alternated in the scale. Previous work [26,28,29] has shown that these items form distinct positive and negative factors, and that they operate somewhat independently. An exploratory factor analysis replicated this finding in this data set, and thus separate positive and negative general technology attitudes scales were constructed by computing the mean of the five positive and the mean of the five negative items. Cronbach’s α was 0.78 for the positive scale and 0.74 for the negative scale.

Safety concerns with kitchen and personal care technology—For both the kitchen and personal care technologies, the following request was made, “Please rate how concerned you would be about safety when using this technology in your home under each of the following conditions...”. For each technology, two scenarios were presented: (1) “The technology monitors and coaches you – it gives you advice on how to complete [kitchen/personal care] activities”; and (2) “The technology monitors you and helps you complete [kitchen/personal care] tasks”. A 10-point rating scale was used, with 1 labeled *Not at all concerned with safety* and 10 labeled *Completely concerned with safety*. Ratings were obtained for both scenarios, and the mean of the two ratings was calculated and used in all analyses. The correlations between the two ratings were very high (kitchen $r = 0.88$; personal care $r = 0.84$), providing justification for their combination in the analyses.

The kitchen safety concerns measure was used only in the analyses of preferences for kitchen technology (not preferences for personal care technology), while the personal care safety concerns measure was used only in analyses involving preferences for personal care technology (not preferences for kitchen technology). This was also the case for measures of privacy concerns and perceived likelihood of needing future help described next.

Privacy concerns with kitchen and personal care technology—For both the kitchen and personal care technologies, the following question was asked, “Please rate how concerned you would be about invasion of your privacy when using this technology in your home”. A 10-point rating scale was used with 1 labeled *Not at all concerned with privacy invasion* and 10 labeled *Completely concerned with privacy invasion*.

Perceived likelihood of need for future help with kitchen and personal care tasks—For kitchen technology, the following question was asked, “how likely do you think it is that you will need help with KITCHEN activities like meal preparation and washing dishes at some point in the future”? The parallel question for the personal care technology was “How likely do you think it is that you will need help with PERSONAL CARE activities like getting in and out of bed, dressing and toileting at some point in the future”? The response format was a sliding scale that could be moved between 0% and 100%. There

was also a box which could be checked that stated “Already need help”. Very few respondents checked this latter option, but for those who did, their probability estimate was re-coded to 100% for analysis. There was a fairly high level of missing data on these items ($n = 59$ or 11.1% for kitchen activities; $n = 71$ or 13.4% for personal care activities). However, comparisons between those missing on these variables and those providing valid data revealed no significant differences on any of the survey demographic variables or the two outcome variables. Thus, these cases were dropped from the multivariate statistical analyses presented in this article. All available data were used for univariate and bivariate data analyses.

Statistical analysis

Standard descriptive statistics (i.e. frequencies, means) were computed to examine univariate distributions. The two main outcome variables – preference for technology versus human assistance for kitchen activities and personal care tasks; and preference for technology versus human control over the operation of the technology in completing kitchen and personal care tasks – were analysed with their original five response option formats for descriptive purposes.

For bivariate analyses, both outcomes were collapsed into three levels for simplification and due to small numbers in certain response categories. The preference for assistance outcome was collapsed as follows: (1) “definitely” and “probably” prefer technology were combined into a generic “prefer technology” category; (2) “no preference” was kept as a separate category; and (3) “definitely” and “probably” prefer human were combined into a generic “prefer human” category. The preference for control outcome was collapsed as follows:

1. “100% technology” and “75% technology, 25% you control” were collapsed into a generic “prefer technology” category;
2. “no preference” was kept as a separate category; and
3. “100% you control” and “75% you control, 25% technology” were collapsed into a generic “prefer human” category. Bivariate analyses were conducted using appropriate regression models (see below) with predictors entered one at a time.

Different statistical approaches were used for multivariate modeling of the two outcome variables due to different measurement approaches. For the preference for technology versus human assistance outcome, the three-level categorization just described was used. Since we were interested in differences in preferences for each of three options (technology, human, no preference) in relation to each other, and there is not an implicit ordering of the categories, multinomial logistic regression models were run. These models produced odds ratios for the preference for each category versus the others, and the relationships of these preferences to each predictor variable, controlling for all variables in the model. We included all of the measures described above in single predictive models - gender, education, age, race, disability, assistive technology use, positive and negative general attitudes towards technology, safety concerns with kitchen/personal care technology, privacy concerns with each technology, and perceived likelihood of need for future help with kitchen/personal care tasks. Separate models were run for kitchen and personal care technology.

The preference for control outcome was treated as a continuous, interval-level variable due to the use of defined percentages in the response options (100% technology control, 75% technology control/25% you control, etc.). The original five-level response options were used but were reverse scored such that higher scores meant higher preferences for technology control. Since the original distributions were positively skewed, the variables were transformed by taking the square root, which resulted in distributions closer to normal in shape. Then, ordinary least squares regression was used to model preferences for control using the full set of predictors. Again, separate models were run for kitchen and personal care technology. We also replicated the preference for control analyses using ordinal (i.e. ordered logit) regression to test the robustness of the findings in relation to the interval measurement assumption.

Results

Sample descriptive statistics

Weighted univariate descriptive statistics for all variables are shown in column 1 of Table 1. The sample reports fairly low levels of disability (over 90% with no IADL or ADL limitations), and only about 6% report current use of assistive technology (primarily canes). The sample not only exhibits moderately positive general attitudes towards technology (mean = 6.5 on a 10-point scale), but also exhibits some negative technology attitudes (mean = 5.8). There was moderate concern with the safety of both kitchen (mean = 5.8) and personal care technology (mean = 6.2), and even greater concerns with invasion of privacy, particularly with personal care technology (means = 6.6 kitchen and 7.3 personal care). Finally, and quite interestingly, respondents reported fairly low perceived likelihoods of ever needing help with kitchen and personal care tasks, with the average being little more than a one-in-three chance for both.

Person–system symbiosis descriptive statistics: preference for technology versus human assistance

The distributions for preferences for technology versus human assistance for kitchen and personal care tasks are shown in Figure 1. In both cases, a little over half of the respondents showed a preference for human assistance. In addition, 21% preferred technology for kitchen tasks and 26% preferred technology for personal care tasks, although very few (only 3% in both cases) definitely preferred technology over human assistance. Interestingly, roughly one fourth of the sample showed no preference. In one sense, these results show high potential acceptance of QoLT, with nearly half of baby boomers and older adults in the US showing either no preference for technology versus humans or actually preferring technology over humans.

Person–system symbiosis descriptive statistics: preference for technology versus human control

As shown in Figure 2, there was less preference for allowing technology versus human control during assistance with kitchen and personal care tasks. About two-thirds of the sample preferred either complete or most of the control of the operation of the technology. About one-fourth were willing to share control, and fewer than 10% preferred allowing the

technology to control the majority of the operation for either type of task. These results show that while US baby boomers and older adults may be accepting of the idea of technology for personal assistance, they prefer to retain control over the operation of the technology.

Bivariate analyses

Bivariate relationships (not controlling for other variables) between the predictor variables and preference for technology versus human assistance with kitchen (columns 2–4) and personal care (columns 5–7) tasks are shown in Table 1. These analyses use the three-level collapsed categorization described above as the outcome variables, with each predictor entered one at a time in multinomial logistic regression (technology versus human assistance) and ordinary least squares regression (technology versus human control) models.

Preference for technology versus human assistance: multivariate analyses

Results of the multinomial logistic regression models for preferences for technology versus human assistance for kitchen tasks are shown in Table 2. Overall, the models explained 19.7% of the variance. Respondents age 55–64 (older baby boomers) were more likely to prefer technology versus humans or no preference than were those age 65 and older, independent of all other variables in the model. Respondents reporting a race other than White, African-American, or Hispanic were also more likely to prefer technology for assistance with kitchen tasks. Those with higher scores on the positive general attitudes towards technology scale were more likely to prefer technology than those with less positive attitudes. Those who had more privacy concerns with kitchen technology were more likely to prefer human assistance relative to technology or having no preference.

Table 3 shows results of the multinomial logistic regression models for preference for technology versus human assistance for personal care tasks. These models explained 28.3% of the variance. Males were more likely to have no preference than to prefer technology for assistance for personal care tasks. Less educated respondents were also more likely than those with bachelor's degrees or higher to express no preference for assistance with personal care tasks rather than to favor technology or human assistance. In addition, baby boomers (age 45–64) were more likely to prefer technology versus human assistance for personal care tasks than were those 65 and older. White respondents were more likely than African-Americans to prefer technology assistance for personal care tasks. On the other hand, Whites were more likely to prefer human assistance for such tasks than were those in the other race category (primarily Asians). Respondents with more positive general technology attitudes were more likely to prefer technology versus human assistance for personal care tasks. In addition, and somewhat surprisingly, those with more *negative general technology attitudes* were also more likely to prefer technology versus humans for personal care assistance. In addition, greater concerns with invasion of privacy of personal care technology were associated with greater preference for humans in performing personal care tasks. Respondents who perceived a greater likelihood of needing help in the future with personal care tasks were more likely to prefer technology versus humans for personal care assistance.

Preference for technology versus human control: multivariate analyses

Table 4 reports results of the ordinary least squares (OLS) regressions for preferences for technology control versus human control in the use of kitchen and personal care technologies. Recall that the original five-point scale was coded such that higher scores represent more desire for technology as opposed to human control for the completion of kitchen/personal care tasks, and that the variable was square root transformed prior to analyses to reduce positive skew.

Columns 1 and 2 show the model for kitchen tasks, which explained 21.6% of the variance. African-American respondents were more likely to prefer technology versus human control for the completion of kitchen tasks, controlling for all other model variables. Higher levels of disability were predictive of greater preferences for technology control versus human control. On the other hand, those with more privacy concerns about kitchen technology were more likely to prefer human control. Lastly, respondents with a higher perceived likelihood of needing help with kitchen tasks in the future were more likely to prefer technology control when completing kitchen tasks.

The results for personal care tasks are presented in Table 4 columns 3 and 4. This model accounted for 10.9% of the variance. Hispanic respondents were more likely to favor technology control for personal care tasks than were Whites. Current users of assistive devices (primarily canes) were more likely to prefer human control for personal care tasks. Also somewhat unexpectedly, respondents with *more safety concerns* about personal care technology were more likely to prefer technology control than human control. Consistent with previous models, those with more privacy concerns about personal technology were more likely to prefer human control. Finally, respondents with a higher perceived likelihood of needing help with personal care tasks in the future were more likely to prefer technology control.

In order to test the robustness of these findings to the interval measurement assumption required to use OLS regression, we also ran the models in Table 4 as ordered logistic regressions, which assume an ordinal level of measurement. Both the kitchen and the personal care ordered logistic models resulted in the same set of significant predictors as reported with OLS regression. Thus, we are more confident that the results are not due to incorrect assumption about level of measurement for the preferences for control measures.

Discussion

This study explored US baby boomer and older adult preferences for technology versus human assistance and control for completing IADL kitchen tasks and ADL personal care tasks. The study was an attempt to explore the theme of QoLT person-system symbiosis more explicitly with a large nationally representative sample. The results were generally consistent with our hypotheses, although not all of the findings were in line with expectations.

Looking first at overall preferences for technology versus human assistance and control, the results appear consistent with the general premise of QoLT person-system symbiosis. While

nearly half of the sampled baby boomers and older adults seem open to the idea of technology assistance for kitchen and personal care tasks (by expressing a preference for technology or “no preference”), over two-thirds preferred having the majority of control over operation of the technology versus allowing the technology more autonomous control. These results suggest that potential users want to work with the technology rather than relinquishing control to the technology. While the results are technically consistent with our hypothesis that baby boomers and older adults would prefer human over technology assistance and control, they also reveal openness to the idea of working in concert with intelligent person- and context-aware systems to complete important life tasks if it becomes necessary.

Turning to our hypotheses about predictors of preferences for technology versus human assistance and control, we did find that baby boomers were more likely to prefer technology versus human assistance than were their older counterparts. This is consistent with some of our own previous work as well as that of others looking at acceptance of currently available technologies [13,15,16,26]. This suggests that the currently aging baby boomers’ familiarity with and generally high acceptance of technology may translate into more acceptance of QoLT applications in the future if and when they begin to need help with daily tasks due to illness or disability. It also suggests that in the near term the oldest cohorts who need it most may be more resistant to QoLT. We found no significant age group differences in preferences for control over operation of the technology. Thus, even though baby boomers may be more willing to accept technology assistance, they are no more willing to hand over control to technology than the older cohort.

As hypothesized, we found few consistent gender or education differences in preferences for technology versus human assistance and control. Females were more likely to prefer human versus technology assistance for personal care tasks than males, who were more likely to state no preference. The least educated respondents were more likely to have no preference for assistance with personal care tasks. We did, however, find various race differences, but these should be treated with caution as they were somewhat inconsistent and based on fairly small sub-samples. Additional research on gender, education and race as factors in attitudes towards QoLT systems is warranted.

Our hypothesis that disabled baby boomers and older adults would prefer technology assistance and control was only partially supported. Disability level was not related to basic preference for technology versus human assistance, but those with more disability were more in favor of technology control over kitchen tasks (but not personal care tasks). In addition, current use of assistive devices was generally not related to these preferences. In the one significant finding, current users of devices were more in favor of human control for personal care tasks. Caution is also warranted here given the relatively small sub-samples of disabled and assistive device users. However, the results suggest that there may not be a simple translation between current disability and/or assistive device use and preferences for technology versus human assistance and control in the context of intelligent person-aware QoLT systems.

General attitudes towards technology were related to preferences for technology versus human assistance but not to desires for control. As predicted, those with more positive general technology attitudes were more likely to prefer technology for both kitchen and personal care tasks. In addition, and somewhat surprisingly, those with higher scores on the negative general technology attitudes scale were also more likely to prefer technology versus humans for personal care assistance. This suggests that people with both positive and negative attitudes towards technology in a broader sense – who may in some ways be more sophisticated or have thought more about both favorable and unfavorable implications of technology – may ultimately be more receptive to QoLT.

Regarding beliefs about QoLT-specific barriers, our hypothesis about safety concerns was not supported. This is surprising, given the potential issues with having robots or other technology actually touching humans for tasks like bathing and transfer, and may reflect the fact that respondents assumed that the proposed technologies had to be safe in order to be made available to users. However, our prediction that baby boomers and older adults with greater privacy concerns would be less supportive of technology and more supportive of human assistance and control was strongly supported. In fact, this was the only variable in our analyses that was a significant predictor of all four outcomes. These results confirm that privacy concerns are a fundamental barrier to acceptance of QoLT and should receive continued attention from researchers and designers.

Finally, our findings regarding the likelihood of needing future help with kitchen and personal care activities are interesting in several regards. First, the absolute levels reported by our respondents (average probabilities between 35% and 40%; median probabilities of about 25% for both activities) are very low given the reality that most people will at some point in their lives need some kind of assistance with IADL or ADL tasks. The findings are consistent with general risk perception research showing that people tend to underestimate the likelihood of negative personal events [30,31], and helps to explain previous findings in the technology acceptance literature that people generally think that they do not – and will not – need technology assistance. We also found that baby boomers and older adults who did perceive greater likelihood that they will need future help with IADL and ADL tasks showed higher preferences for technology versus human assistance (for personal care) and were also more willing to relinquish control to the technology for both kitchen personal assistance tasks. Perceptions of current and future needs for assistance are a major potential barrier to QoLT acceptance and should continue to be a focus of research. Need perceptions are also an excellent potential target for educational interventions for baby boomers and older adults.

We have also shown that preferences for person–system symbiosis do in some cases vary by type of task performed by the technology. In general, we found more significant predictors and explained more variance for preferences for assistance with personal care than for assistance with kitchen tasks. We found gender, education and perceptions of future need for help with personal care all were related to preferences regarding personal care but not kitchen tasks. On the other hand, we explained more variance in our model for preference for human versus technology control over kitchen tasks than we did in the model for personal care tasks. These findings suggest that the different aspects of person–system symbiosis may require careful thought about model specification, and that somewhat

different processes are operating in the determination of whether to accept technology assistance versus how to interact with technology.

This study has provided evidence that baby boomers and older adults are open to the idea of having “intelligent” technology provide IADL and ADL task assistance. However, they also express desires to maintain control over the operation of such technology. The article provides rich data on the predictors of such preferences, which may be useful for designers for targeting technology to specific populations. The study adds to the literature on acceptance of assistive technology through examination of previously unexplored outcomes, particularly preferences about how much control to relinquish to technology while receiving assistance. The main contrast between this work and prior work on technology acceptance among older adults [12–16] is that while prior work has focused on adoption and acceptance of existing applications (e.g. computers, health monitoring devices), our work on QoLT attempts to obtain broad preferences about technology that does not yet exist, in the hopes of informing future design. Our work also expands on the work on acceptance of social robots [21–25] with the addition of desired operational control as an outcome, and through use of large, population-based representative sample survey methods. Finally, we see our work as potentially adding another important dimension for the “match” between person and technology – desired level of control of operation – to consider within the Matching Person and Technology (MPT) framework [17–19]. Designing QoLT systems that allow the user to increase and decrease control as needed and desired may also ultimately increase their accessibility and usability and thus enhance the systemic user experience [9].

The study has limitations which should be acknowledged. First, we rely on self-report data about technology that does not yet exist, which needs to be imagined in order to respond to the survey questions. Further, most of the baby boomers and older adults surveyed had to imagine needing help at some point in the future, which can also be difficult. In fact, our data on perceived likelihood of needing future help show this. Potentially confounding this result, however, is the possibility that the perceived need for future help was underestimated due to some respondents’ certainty that spouses or adult children, for example, could be counted on for help, thereby obviating the need for additional assistance. Thus, the results should be interpreted cautiously. However, this is the fundamental challenge when attempting to get feedback on futuristic QoLT that does not yet exist. In addition, we were interested in broader issues of general technology acceptance and desires for control of technology and not evaluations of specific existing technologies among currently disabled persons. Another limitation was the fairly small sample size for the older adults ($n = 114$), which limits generalizability to that sub-population. The effect sizes and variance explained reported in the article are fairly small and will need to be replicated in future work. Additional predictors of person–system symbiosis attitudes and preferences will also need to be included in future studies. Finally, the article is limited in the sense that broad social policy issues around user participation in technology service delivery are not addressed.

Conclusion

This study of a nationally representative sample of US baby boomers and older adults provides evidence supporting the fundamental assumption behind QoLT person–system

symbiosis. These potential users of future QoLT systems appear quite willing to accept technology versus human assistance for kitchen and personal care tasks. At the same time, they prefer to maintain control over the operation of the technology, as opposed to allowing the system to autonomously control operation. Baby boomers and older adults want to work with QoLT rather than relinquish control to QoLT. This suggests the need for design of person- and context-aware QoLT systems that are responsive to users' desires for level of control over operation of the technology. The demographic, health-related, and technology-specific predictors of these preferences suggest potentially receptive markets for the targeting of QoLT systems.

Acknowledgments

Declaration of interest

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Implications for Rehabilitation

- In anticipation of potential needs for help with instrumental activities of daily living (IADL) and activities of daily living (ADL), approximately half of US baby boomers and older adults are open to having intelligent, person-aware technology provide assistance. The remainder would prefer human assistance.
- US baby boomers and older adults are generally not in favor of relinquishing control to the technology when receiving IADL or ADL assistance.
- Preferences for technology versus human assistance and control over technology vary by socio-demographic, health-related, and technology attitude variables.
- Intelligent, person-aware quality of life technologies for rehabilitation must be designed to be sensitive to user characteristics and preferences for control over operation of the technology.

Figure 1. Preferences for technology versus human assistance for kitchen and personal care tasks (% shown).

Figure 2.
Preferences for technology versus human control for assistance with kitchen and personal care tasks (% shown).

Table 1.

Descriptive statistics and bivariate analyses of relationships between demographic, health, and technology-related variables and preferences for technology versus human assistance and control for kitchen and personal care technology.

Variable	Descriptive statistics	Preference for Tech versus Human Assistance						Preference for Tech versus Human Control					
		Kitchen tasks			Personal care tasks			Kitchen tasks			Personal care tasks		
		Tech	No Pref	Human	Tech	No Pref	Human	75-100% Tech	50/50	75-100% Human	75-100% Tech	50/50	75-100% Human
Female	51.7 (274)	19.3	24.7	56.0	26.6	17.2	56.2	7.4	25.2	67.4	7.8	21.5	70.7
Male	48.3 (256)	22.8	28.7	48.4	25.5	26.3	48.2*	10.6	26.0	63.4	6.7	24.8	68.5
Education – Less than high school	11.0 (58)	7.1	25.0	67.9	6.8	30.5	62.7	3.5	29.8	66.7	1.8	22.8	75.4
High school	33.2 (176)	14.8	31.8	53.4	20.9	29.9	49.2	4.0	29.3	66.7	6.9	28.2	64.9
Some college	26.2 (139)	28.8	23.7	47.5	31.2	13.8	55.1	12.3	21.0	66.7	11.6	18.8	69.6
Bachelor's degree or higher	29.6 (157)	26.1	23.6	50.3*	34.8	15.5	49.7*	13.6	24.0	62.3*	6.4	21.7	72.0*
Age – 45–54	42.6 (226)	22.1	29.2	48.7	28.4	20.0	51.6	10.3	24.2	65.5	5.3	25.7	69.0
55–64	35.3 (187)	24.7	20.4	54.8	31.0	22.5	46.5	10.3	26.5	63.2	8.2	24.0	67.8
65+	22.1 (117)	12.8	31.6	55.6*	13.7	23.1	63.2*	4.3	27.0	68.7	9.6	15.8	74.6
Race – Black	11.3 (60)	13.3	26.7	60.0	11.7	21.7	66.7	13.3	40.0	46.7	1.7	30.5	67.8
Hispanic	9.0 (48)	10.9	21.7	67.4	16.7	29.2	54.2	10.9	10.9	78.3	10.9	17.4	71.7
Other race	6.1 (32)	34.4	28.1	37.5	31.3	31.3	37.5	9.4	25.0	65.6	15.2	24.2	60.6
White	73.6 (390)	22.1	27.2	50.8	29.0	19.8	51.2*	8.3	25.1	66.6	7.2	22.5	70.3
No IADL or ADL difficulties	90.7 (480)	20.9	27.0	52.1	27.1	21.5	51.5	8.6	23.8	67.5	8.0	22.5	69.5
IADL difficulties only	6.5 (34)	26.5	11.8	61.8	20.6	14.7	64.7	14.7	32.4	52.9	2.9	22.9	74.3
ADL difficulties	2.8 (15)	12.5	43.8	43.8	6.7	33.3	60.0	6.7	66.7	26.7*	0.0	40.0	60.0
No assistive device use	94.2 (499)	21.5	26.7	51.8	26.9	21.8	51.3	9.3	25.1	65.6	7.7	23.3	69.0
Assistive device use	5.8 (31)	12.9	25.8	61.3	13.3	16.7	70.0	3.3	33.3	63.3	3.2	19.4	77.4*
Positive general technology attitudes	6.50 (1.52)	6.98	6.44	6.35*	6.71	6.56	6.37*	7.17	6.53	6.42*	6.60	6.51	6.52
Negative general technology attitudes	5.77 (1.66)	5.72	5.75	5.81	6.00	5.53	5.78*	5.31	5.71	5.88	6.10	5.44	5.87
Safety concerns (kitchen)	5.79 (2.48)	5.65	5.81	5.84				5.47	5.90	5.78			

Variable	Descriptive statistics	Preference for Tech versus Human Assistance				Preference for Tech versus Human Control			
		Kitchen tasks		Personal care tasks		Kitchen tasks		Personal care tasks	
		Tech	No Pref	Human	Tech	No Pref	Human	75-100% Tech	75-100% Human
Safety concerns (personal care) ^a	% (n)	6.15 (2.60)			5.79	5.60	6.56 [*]	6.82	6.10
Privacy concerns (kitchen)		5.53	6.17	7.30 [*]					
Privacy concerns (personal care)					6.47	6.69	8.00 [*]	7.17	7.64 [*]
Likelihood will need future help (kitchen)		40.5	38.9	33.8					
Likelihood will need future help (personal care)					46.5	40.5	35.5 [*]	39.0	36.6 [*]

All analyses are weighted (see text for explanation).

* $p < 0.05$ in multinomial logistic regression (tech versus human assistance) and ordinary least squares regression (tech versus human control) with predictor variables entered one at a time.

Table 2.

Multinomial logistic regression analysis of relationships between demographic, health, and technology–related variables and preferences for technology versus human assistance with kitchen tasks.

Predictor Variable	Comparison	Exp (b)	95% Exp (b) interval	p
Male (Ref cat: female)	Tech versus no preference	0.877	0.488–1.576	0.660
	Tech versus human	1.128	0.663–1.919	0.656
	Human versus no preference	0.777	0.481–1.255	0.302
Education – Less than high school (Ref cat: Bachelor's degree or higher)	Tech versus no preference	0.343	0.091–1.291	0.114
	Tech versus human	0.388	0.113–1.325	0.131
	Human versus no preference	0.885	0.387–2.024	0.773
High school (Ref cat: Bachelor's degree or higher)	Tech versus no preference	0.614	0.289–1.306	0.205
	Tech versus human	0.979	0.494–1.941	0.951
	Human versus no preference	0.627	0.338–1.163	0.139
Some college (Ref cat: Bachelor's degree or higher)	Tech versus no preference	1.188	0.570–2.477	0.646
	Tech versus human	1.632	0.847–3.146	0.144
	Human versus no preference	0.728	0.382–1.388	0.335
Age – 45–54 (Ref cat: 65+)	Tech versus no preference	1.477	0.667–3.272	0.337
	Tech versus human	1.350	0.640–2.850	0.431
	Human versus no preference	1.094	0.611–1.956	0.763
55–64 (Ref cat: 65+)	Tech versus no preference	3.096	1.369–7.003	0.007
	Tech versus human	2.232	1.056–4.719	0.036
	Human versus no preference	1.387	0.751–2.563	0.296
Race – Black (Ref cat: White)	Tech versus no preference	0.752	0.259–2.182	0.600
	Tech versus human	0.510	0.202–1.288	0.154
	Human versus no preference	1.475	0.674–3.228	0.331
Hispanic (Ref cat: White)	Tech versus no preference	0.608	0.182–2.034	0.420
	Tech versus human	0.684	0.228–2.056	0.499
	Human versus no preference	0.889	0.381–2.073	0.785
Other race (Ref cat: White)	Tech versus no preference	3.263	1.010–10.536	0.048
	Tech versus human	4.841	1.741–13.462	0.003
	Human versus no preference	0.674	0.225–2.017	0.480

Predictor Variable	Comparison	Exp (b)	95% Exp (b) Interval	p
Disability level	Tech versus no preference	1.011	0.473–2.164	0.977
	Tech versus human	1.036	0.512–2.097	0.921
	Human versus no preference	0.976	0.546–1.744	0.935
Assistive device use	Tech versus no preference	0.719	0.162–3.187	0.665
	Tech versus human	0.688	0.172–2.749	0.597
	Human versus no preference	1.046	0.378–2.894	0.931
Positive general technology attitudes	Tech versus no preference	1.418	1.148–1.753	0.001
	Tech versus human	1.403	1.157–1.701	0.001
	Human versus no preference	1.011	0.863–1.184	0.893
Negative general technology attitudes	Tech versus no preference	1.115	0.928–1.341	0.246
	Tech versus human	1.139	0.962–1.348	0.131
	Human versus no preference	0.979	0.845–1.135	0.782
Kitchen technology safety concerns	Tech versus no preference	0.978	0.867–1.103	0.714
	Tech versus human	1.065	0.953–1.189	0.266
	Human versus no preference	0.918	0.830–1.015	0.097
Kitchen technology privacy concerns	Tech versus no preference	0.910	0.811–1.022	0.110
	Tech versus human	0.759	0.682–0.845	0.000
	Human versus no preference	1.199	1.086–1.324	0.000
Likelihood will need future kitchen help	Tech versus no preference	1.000	0.990–1.010	0.982
	Tech versus human	1.005	0.996–1.014	0.274
	Human versus no preference	0.995	0.987–1.003	0.213

$n = 466$; Nagelkerke pseudo $R^2 = 0.197$ All analyses are weighted (see text for explanation). Exp (b) shows odds ratio for preferring first versus second option in the comparison.

Table 3.

Multinomial logistic regression analysis of relationships between demographic, health, and technology-related variables and preferences for technology versus human assistance with personal care tasks.

Variable	Comparison	Exp (b)	95% Exp (b) interval	p
Male (Ref cat: female)	Tech versus no preference	0.512	0.277–0.945	0.032
	Tech versus human	0.863	0.522–1.428	0.567
	Human versus no preference	0.593	0.343–1.024	0.061
Education – Less than high school (Ref cat: Bachelor's degree or higher)	Tech versus no preference	0.137	0.035–0.533	0.004
	Tech versus human	0.412	0.117–1.451	0.167
	Human versus no preference	0.333	0.135–0.823	0.017
High school (Ref cat: Bachelor's degree or higher)	Tech versus no preference	0.376	0.177–0.799	0.011
	Tech versus human	1.402	0.741–2.654	0.299
	Human versus no preference	0.268	0.134–0.539	0.000
Some college (Ref cat: Bachelor's degree or higher)	Tech versus no preference	1.579	0.666–3.739	0.299
	Tech versus human	1.499	0.792–2.837	0.214
	Human versus no preference	1.053	0.467–2.378	0.900
Age – 45–54 (Ref cat: 65+)	Tech versus no preference	1.837	0.806–4.185	0.148
	Tech versus human	2.264	1.128–4.546	0.022
	Human versus no preference	0.811	0.415–1.585	0.540
55–64 (Ref cat: 65+)	Tech versus no preference	2.196	0.944–5.105	0.068
	Tech versus human	3.912	1.901–8.050	0.000
	Human versus no preference	0.561	0.283–1.113	0.098
Race – Black (Ref cat: White)	Tech versus no preference	0.327	0.108–0.991	0.048
	Tech versus human	0.287	0.106–0.778	0.014
	Human versus no preference	1.137	0.497–2.600	0.761
Hispanic (Ref cat: White)	Tech versus no preference	0.318	0.095–1.069	0.064
	Tech versus human	0.497	0.167–1.481	0.210
	Human versus no preference	0.640	0.262–1.561	0.327
Other race (Ref cat: White)	Tech versus no preference	0.426	0.146–1.239	0.117
	Tech versus human	1.880	0.673–5.248	0.228
	Human versus no preference	0.227	0.083–0.618	0.004

Variable	Comparison	Exp (b)	95% Exp (b) interval	p
Disability level	Tech versus no preference	0.433	0.180–1.045	0.063
	Tech versus human	0.481	0.218–1.061	0.070
	Human versus no preference	0.901	0.479–1.696	0.747
Assistive device use	Tech versus no preference	1.081	0.173–6.764	0.933
	Tech versus human	0.382	0.075–1.940	0.246
	Human versus no preference	2.833	0.863–9.296	0.086
Positive general technology attitudes	Tech versus no preference	1.149	0.931–1.417	0.196
	Tech versus human	1.222	1.020–1.465	0.030
	Human versus no preference	0.940	0.789–1.119	0.486
Negative general technology attitudes	Tech versus no preference	1.200	0.996–1.445	0.055
	Tech versus human	1.182	1.005–1.391	0.043
	Human versus no preference	1.015	0.861–1.196	0.860
Personal care technology safety concerns	Tech versus no preference	1.080	0.953–1.224	0.230
	Tech versus human	0.987	0.890–1.095	0.811
	Human versus no preference	1.093	0.982–1.217	0.102
Personal care technology privacy concerns	Tech versus no preference	0.960	0.849–1.084	0.509
	Tech versus human	0.765	0.685–0.855	0.000
	Human versus no preference	1.254	1.118–1.407	0.000
Likelihood will need future help with personal care	Tech versus no preference	1.008	0.998–1.018	0.121
	Tech versus human	1.012	1.004–1.020	0.004
	Human versus no preference	0.996	0.987–1.005	0.359

$n = 456$; Nagelkerke pseudo $R^2 = 0.283$. All analyses are weighted (see text for explanation). Exp (b) shows odds ratio for preferring first versus second option in the comparison.

Table 4.

Ordinary least squares regression analysis of relationships between demographic, health, and technology-related variables and preferences for technology versus human control of kitchen and personal care technology. (Higher scores indicate greater preference for technology control.).

Variable	Kitchen (<i>n</i> = 465)		Personal care (<i>n</i> = 458)	
	<i>B</i> (se)	<i>p</i>	<i>B</i> (se)	<i>p</i>
Male	−0.010 (0.030)	0.729	−0.027 (0.032)	0.407
Education – Less than high school	−0.101 (0.053)	0.057	−0.087 (0.058)	0.133
High school	−0.046 (0.039)	0.239	0.064 (0.041)	0.117
Some college	0.007 (0.039)	0.863	0.036 (0.043)	0.395
Age – 45–64	0.070 (0.038)	0.071	−0.023 (0.041)	0.572
55–64	0.043 (0.039)	0.265	−0.044 (0.042)	0.298
Race – Black	0.160 (0.048)	0.001	0.059 (0.053)	0.265
Hispanic	0.051 (0.053)	0.342	0.123 (0.059)	0.039
Other race	0.039 (0.062)	0.528	0.061 (0.064)	0.342
Disability level	0.080 (0.038)	0.034	−0.007 (0.042)	0.875
Assistive device use	−0.042 (0.066)	0.524	−0.166 (0.073)	0.024
Positive general technology attitudes	0.007 (0.010)	0.512	−0.012 (0.011)	0.255
Negative general technology attitudes	0.003 (0.009)	0.752	0.011 (0.010)	0.238
Safety concerns	0.009 (0.006)	0.155	0.015 (0.006)	0.018
Privacy concerns	−0.043 (0.006)	0.000	−0.031 (0.007)	0.000
Likelihood will need future help	0.002 (0.000)	0.000	0.002 (0.001)	0.002
Total Model <i>R</i> ²	0.216		0.109	

All analyses are weighted (see text for explanation). The dependent variables were coded as 1 = 100% you control; 2 = 75% you control, 25% technology; 3 = shared – 50% technology, 50% you control; 4 = 75% technology, 25% you control; 5 = 100% technology control. Thus, higher scores represent more desire for technology control. The dependent variables were square root transformed for the regression analyses to adjust for positive skew.