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OLDER ADULTS' PREFERENCES FOR AND ACCEPTANCE OF ROBOT ASSISTANCE FOR EVERYDAY LIVING TASKS

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Abstract

Many older adults value their independence and prefer to age in place. Robots can be designed to assist older people with performing everyday living tasks and maintaining their independence at home. Yet, there is a scarcity of knowledge regarding older adults' attitudes toward robots and their preferences for robot assistance. Twenty-one older adults ($M = 80.25$ years old, $SD = 7.19$) completed questionnaires and participated in structured group interviews investigating their openness to and preferences for assistance from a mobile manipulator robot. Although the older adults were generally open to robot assistance for performing home-based tasks, they were selective in their views. Older adults preferred robot assistance over human assistance for many instrumental (e.g., housekeeping, laundry, medication reminders) and enhanced activities of daily living (e.g., new learning, hobbies). However, older adults were less open to robot assistance for some activities of daily living (e.g., shaving, hair care). Results from this study provide insight into older adults' attitudes toward robot assistance with home-based everyday living tasks.

INTRODUCTION

Robots have the potential to assist people with performing everyday living tasks within the context of the home (e.g., bathing, doing laundry). Robot assistance may be especially beneficial to older adults who frequently encounter limitations in performing such activities (Disability & Activity Limitations, 2010; Fausset, Kelly, Rogers, & Fisk, 2011).

Older adults prefer to age in place (AARP, 2005). To do so, there are many tasks that they must perform to maintain their independence and well-being, including self-maintenance, instrumental, (Lawton, 1990) and enhanced activities of daily living (Rogers, Meyer, Walker, & Fisk, 1998). Self-maintenance activities of daily living (ADLs) include the ability to toilet, feed, dress, groom, bathe, and ambulate (Lawton). Instrumental activities of daily living (IADLs) include the ability to successfully use the telephone, shop, prepare food, do the housekeeping and laundry, manage medications and finances, and use transportation (Lawton). Enhanced activities of daily living (EADLs) include participation in social and enriching activities (e.g., learning new skills, engaging in hobbies, and communicating for social reasons; Rogers et al.).

If an older adult can no longer perform an ADL or IADL, consequences could include needing help from others on a daily basis, moving into a senior living facility, or moving

into a family member's home. Robots have the potential to aid older adults in performing ADLs, IADLs, and EADLs in the home, and ultimately supporting their independence. There are many robots currently available or being developed to assist with some activities (e.g., housekeeping, ambulation, social communication), whereas other activities have few robot supports (e.g., money management, grooming, laundry; Smarr, Fausset, & Rogers, 2011).

Although there is potential for robots to support older adults in maintaining their independence and well-being by assisting with ADLs, IADLs, and EADLs, it is not known if older adults are open to robotic assistance in their homes with these activities or if this openness varies by task. A better understanding of the facilitators and barriers to older adults' acceptance of robots will help researchers and practitioners design robots that are more likely to be adopted.

Older Adults' Acceptance of Robots

User acceptance of robots is influenced by many factors. Broadbent, Stafford, and MacDonald (2009) found that both characteristics of the robot (e.g., size, adaptability, personality) and of the person (e.g., age, needs, attitudes) impacted users' acceptance of healthcare robots. Young et al. (2009) found the following factors to influence users' acceptance of home robots: safety; accessibility and usability; practical benefits; fun; social pressures; status gains; social intelligence; and perceptions.

Users' attitudes toward and perceptions of robots impacted their acceptance of robots (Broadbent, Stafford, & MacDonald, 2009; Young et al., 2009). In fact, both negative and positive attitudes that people hold influenced how they interacted with robots and were associated with robot acceptance (Heerink, Kröse, Evers, & Wielinga, 2010; Nomura, Kanda, Suzuki, & Kato, 2008; Stafford et al., 2010). These studies provide some insight into robot acceptance and attitudes in general. However, if robots are to be deployed as assistive aides to older adults it is important to understand their specific attitudes about robots. Both robot-based and person-based factors have been suggested to influence older adults' interactions with and acceptance of robots.

Robot factors influencing older adult acceptance

Robot-based factors are specific characteristics of the robot that may influence older adults' interactions with robots. In particular, functionality (i.e., the ability to perform a non-social task) has been shown to be influential on older adult acceptance. One aspect of functionality is the level of interactivity the robot has with the user. Findings have been mixed, with some evidence that older adults want more interactivity with a healthcare robot (e.g., they wanted the robot to talk about itself, talk about more topics than health and exercise; Klamer & Ben Allouch, 2010). Conversely, when older adults were interviewed about their imagined home robot, their responses suggested that they thought of robots as performance-directed machines, rather than social or non-productive devices (Ezer, Fisk, & Rogers, 2009).

Functionality may also imply the robot's ability to adapt to a user's preferences. After watching a video of a robot that adapted to an individual's needs, older adults reported a greater intention to use, more positive attitude, and perceived the robot as more enjoyable,

useful, and anxiety provoking than older adults who watched a similar video without the robot adapting to the individual (Heerink et al., 2010).

Person factors influencing older adult acceptance

Person-based factors are characteristics of the human who is interacting with the robot. Such factors influence older adults' perceptions of the usefulness and ease of use of robots. Usefulness and ease of use have been found to be important for predicting acceptance of robots and other technologies (Davis, 1989; Heerink et al., 2010; Stafford et al., 2010).

Older adults' perceptions of a robot's usefulness may be task-dependent. For instance, older adults rated a healthcare robot's performance on tasks related to physical assistance and monitoring (e.g., detecting falls and calling for help, lifting heavy objects) as most useful, compared to tasks related to judgment-making and care (e.g., providing medical advice, personal care; Broadbent et al., 2011). If a robot is not perceived as performing useful tasks, older adults may not use the robot or may even try to trick it to keep it from performing a task (Klamer & Ben Allouch, 2010).

Perceived ease of use can be used to predict an older adult's intention to use a robot (Broadbent et al., 2011). Younger and older adults with more technology experience perceived an imagined home robot as easier to use and as more useful than those with less technology experience (Ezer et al., 2009). Thus, perceptions of a robot may be influenced by experience with or knowledge of technology.

Goals of Current Research

User acceptance of robots is complex and influenced by many factors including robot factors (e.g., functionality, appearance) and person factors (e.g., perceptions of ease of use and usefulness). Additionally, the type of task a robot performs can influence perceptions and acceptance of the robot. There is a potential for robots to assist older adults with activities required for independent living (i.e., ADLs, IADLs, and EADLs). However, it is not clear if older adults would be willing to accept assistance from a robot for these tasks. As such, we used a qualitative approach to explore and better understand older adults' attitudes towards and acceptance of robot assistance. The goals of the current study were to:

- Determine whether older adults are open to accept robot assistance in the home
- Identify the tasks that older adults would or would not accept robot assistance with in the home
- Categorize those tasks into ADLs, IADLs, and EADLs

We sampled a range of common everyday tasks that older adults perform in their homes. The older adults' general attitudes towards robots were also assessed before and after a structured group interview.

METHOD

Participants

Demographics—The participants were 21 older adults (65-93 years of age; $M = 80.25$ years, $SD = 7.19$; 15 females) recruited from the local community. Most participants lived in an independent residence in senior housing (66.7%), or in a house, apartment, or condominium (28.5%); 4.8% lived in a relative's home. Nearly half (47.7%) of the participants had less than a college degree. Participants were diverse, 57.7% reported themselves as White/Caucasian, and 42.9% Black/African American. Most participants (90.5%) reported their general health as very good or excellent.

Technology experience—We measured frequency with which participants used a variety of technologies via a questionnaire. On average, participants reported using everyday technologies (e.g., cell phones, microwave ovens) occasionally. Moreover, 71.4% of participants reported using a computer and/or the Internet. Of those who used computer/Internet, 66.7% reported that they had been using it for five or more years.

Robot knowledge/experience—We measured robot familiarity and use for 13 different types of robots (e.g., manufacturing, domestic, entertainment) via a questionnaire (see Mitzner et al., 2011 for details). Overall, participants were somewhat familiar with robots (i.e., heard about or seen this robot), but were inexperienced in using them.

Personal Robot 2

Structured group interviews were conducted to obtain older adults' opinions of Willow Garage's Personal Robot 2 (PR2; Figure 1), which is a commercially available humanized mobile manipulator robot with two 8 degrees of freedom arms/grippers, a head with two stereo camera pairs and a light-emitting diode texture projector, a telescoping spine, and an omni-directional wheeled base. It is designed to interact with humans within their environment (e.g., home).

An eight minute, narrated collage of video clips was shown to participants to introduce the PR2 (Figure 1) and to provide a consistent, common foundation of knowledge about this robot. The narration in the video explained the structure of a PR2 (i.e., head, base, arms, grippers), its capabilities (e.g., navigation, grasping objects), and demonstrated a PR2 performing some home-related tasks (e.g., delivering drinks, folding towels, playing billiards). The video was used to provide a best-case scenario of the robot's capabilities.

Questionnaires

A Robot Opinion Questionnaire was administered to participants to assess older adults' attitudinal acceptance of robots. This questionnaire was a revision of standard technology acceptance scales (e.g., Davis, 1989) to be specific to robots. Participants used a 7-point Likert scale (1 = Extremely unlikely, 4 = Neither unlikely or likely, 7 = Extremely likely) to respond to 12 items. Example items included "My interaction with a robot would be clear and understandable;" "I would find a robot useful in my daily life;" and "Using a robot would make my daily life easier."

An Assistance Preference Checklist was administered to assess older adults' preferences for human versus robot assistance using a 5-point Likert scale (1 = Only a human, 3 = No Preference, 5 = Only a robot). This checklist was locally developed, and asked for older adults' preferences for assistance on 48 home tasks. These tasks were based on tasks older adults reported as important for maintaining their homes (Fausset et al., 2011). Participants were instructed to assume that they needed assistance with performing these tasks and that the robot could perform the tasks to the level of a human.

Structured Group Interviews

Five group interviews were conducted with a total of 21 participants; each interview lasted nearly three hours. Each group comprised two to five participants and was stratified by gender to encourage open discussion.

Procedure

Prior to the interview discussion, participants completed informed consent and questionnaires on demographics/health, technology experience, robot experience, and a pre Robot Opinions Questionnaire. They were then asked an ice-breaker question to foster discussion from each member of the group. After watching the PR2 video, group discussion occurred in the following order: qualities of the PR2 (e.g., size); brainstorming tasks a robot could perform at home; and pros/cons of a robot assisting with household chores, finding/fetching objects, and managing medications. After the structured group interview, the participants completed the post Robot Opinion Questionnaire and the Assistance Preference Checklist, and were debriefed.

RESULTS

The results described in this paper focus on the questionnaire portions of this study. See Beer et al. (2012) for a review of older adults' preferences for robot assisted chores and finding/fetching objects.

Are Older Adults Willing to Accept Robot Assistance?

A mean overall score was computed for the Robot Opinions Questionnaire (i.e., responses to 12 questionnaire items). Scores for pre-discussion ($M = 5.16$, $SD = 1.32$) and post-discussion ($M = 5.21$, $SD = 1.60$) were both above 5.0 (Slightly likely) which suggests that these older adults were generally willing to accept robots. Participants' overall score did not statistically change from pre-discussion to post-discussion ($t(20) = -0.26$, $p = .80$), suggesting that watching the video of a PR2 and discussing robots did not change the average acceptance of the robot by older adults.

Means were also computed for each of the 12 questionnaire items. The item mean for pre-discussion and post-discussion was greater than or equal to 5.0 (Slightly likely) for 8 of the 12 questionnaire items. The remaining four items had pre- and post-discussion means greater than 4.0 (Neither unlikely or likely). Taken together, these data provide additional support that older adults are open to, or "slightly likely" to accept robots. In other words, the

older adults were not averse to accepting robot assistance for performing tasks within their homes.

What Types of Tasks are Older Adults Willing and Not Willing to Accept Robot Assistance?

An analysis of the Assistance Preference Checklist revealed that older adults did not show a preference for human or robot assistance ($M = 2.99$; $SD = 0.42$, where 3 = No preference) when responses were averaged across all 48 tasks. However, this global measure is misleading because preferences varied across tasks, even highly related ones. For example, assistance from a robot was preferred for a reminder to take medicine ($M = 3.29$, $SD = 1.10$) whereas assistance from a human was preferred for a decision on what medicine to take ($M = 2.38$, $SD = 1.16$).

Although the Assistance Preference Checklist included 48 common tasks that older adults perform around the home (Fausset et al., 2011), for generalizing purposes, we categorized the Assistance Preference Checklist tasks post hoc into groups of activities older adults must perform around the home to maintain their independence (i.e., ADLs, IADLs, and EADLs). Thirty-two of the 48 tasks asked about could be grouped into ADLs, IADLs, (Lawton, 1990) and EADLs (Rogers et al., 1998).

Participants' responses were grouped into three categories: (a) preferred assistance from a human (response = 2); (b) preferred assistance from a robot (= 4); or (c) no preference (= 3). As shown in Table 1, the older adults were most receptive to assistance from a robot for IADLs, followed by EADLS, and finally ADLs.

Participants' mean preference for assistance is shown in Figures 2-4 for each of the 32 tasks categorized as an IADL, EADL, or ADL. Older adults indicated that they preferred assistance from a robot over a human for 15 of 32 tasks.

For IADLs, participants mostly preferred robot assistance ($M > 3$) in performing housekeeping tasks (e.g., cleaning bathrooms, making bed/changing sheets), laundry, and being reminded what medication to take (Figure 2).

For EADLs, participants preferred robot assistance with new learning (e.g., getting information on weather/news) and hobbies (e.g., getting information on hobbies/topics of interest) whereas they preferred human assistance with social communication (e.g., entertaining guests; Figure 3).

In general, the older adults we interviewed were willing to accept assistance from a robot in performing tasks within the home. In particular, they preferred assistance from a robot over a human for performing IADLs and EADLs. However, they were less receptive to robot assistance in performing ADLs (e.g., eating/feeding self, getting dressed, shaving, walking). In fact, on average they preferred human assistance ($M < 3$) for all ADLs about which they were asked (Figure 4).

DISCUSSION

Although the older adults were largely open to assistance from robots in performing home tasks, this willingness was selective. Older adults reported they would most prefer assistance from a robot over a human for IADLs, followed by EADLs. More specially, they reported preferring robot assistance for housekeeping tasks (IADL), laundry (IADL), being reminded to take medication (IADL), new learning (EADL), and hobbies (EADL). Conversely, on average, older adults reported they would prefer assistance from a human for ADLs, and selective IADLS (e.g., preparing meals, deciding on medication) and EADLs (i.e., social communication).

These findings suggest that the older adults were more willing to accept robot assistance for IADLs and EADLs compared to ADLs. However, preferences varied across tasks, even highly related ones. For example, assistance from a robot was preferred for *reminding* participants to take medications whereas assistance from a human was preferred for *deciding* what medication to take. Both tasks are involved in medication management but require very different robot capabilities (e.g., intelligence, decision-making). The robot reminding someone to take a medication requires little, if any, decision-making whereas deciding what medication someone takes requires many decisions (e.g., what medication, when to take it, dose, possible interactions with other medications). This pattern of attitudes is similar to previous research in which older adults rated tasks related to decision-making (e.g., providing medical advice) as less useful for a robot to assist with, compared to physical assistance or monitoring tasks (e.g., detecting falls; Broadbent et al., 2011). Therefore, generalization of older adults' preferences, even with related tasks, should be made carefully when designing assistive robots.

Participants' overall opinions did not change significantly from pre-discussion to post-discussion, which is in contrast to previous research suggesting that older adults' attitudes became significantly more positive after using a healthcare robot (Stafford et al., 2010). One possible reason is that watching the robot (e.g., via video) may not impact users' attitudes in the same way as actually using the robot.

Generalization of this study's results may be limited to older adults similar to our sample, which reported some familiarity with robots but were inexperienced in using them. Older adults' preferences may be based on inexperience or misconceptions of what robots can or cannot do (e.g., a robot can only be pre-programmed, or cannot make contact with water; Broadbent, Stafford, & MacDonald, 2009). Experience with or knowledge of technology has been identified as important to users' perceptions of ease of use and usefulness, as well as users' acceptance of robots (Broadbent, Stafford, & MacDonald, 2009; Ezer et al., 2009; Young et al., 2009). For example, a home robot was perceived as easier to use and more useful when people had more technology experience (Ezer et al., 2009).

Although this study asked about preferences for assistance for commonly performed tasks within the home, future studies should develop a more comprehensive list of ADLs, IADLs, and EADLs a priori, including tasks performed when toileting (ADL), as well as managing finances and transportation (IADLs). Additionally, the older adults in this study were

healthy and independent, many of whom reported they did not need immediate assistance. This population was unlikely to have required assistance for ADLs which may have influenced their preference for assistance. Future research should include older adults who currently need assistance with these types of self-maintenance tasks.

Research exploring older adults' needs and preferences for robot assistance can provide direction for researchers and practitioners to create robots that are more likely to be accepted by older adults and that are useful to older adults. This study provides insights into older adults' attitudes toward and preferences for robot assistance with home tasks. Although the older adults indicated they were largely open to assistance from robots in performing activities of daily living, this willingness was selective even for highly related tasks. A better understanding of the facilitators and barriers to older adults' acceptance of robots will help in the design of robots that are more likely to be adopted by older adults.

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Figure 1.
The PR2 (Personal Robot 2) developed by Willow Garage (www.willowgarage.com).

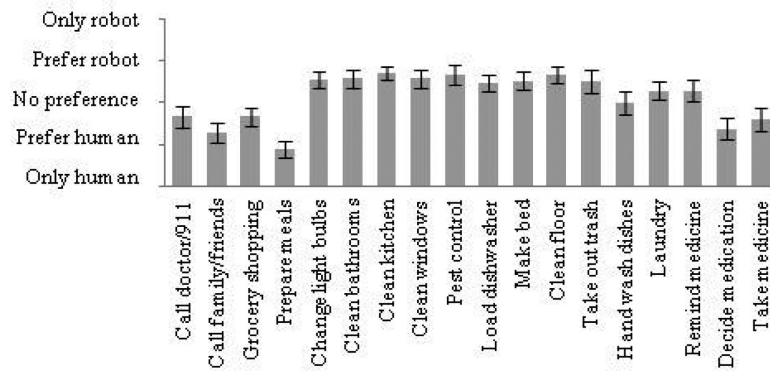


Figure 2.
Mean preference rating for robot versus human assistance by task categorized as an Instrumental Activity of Daily Living.

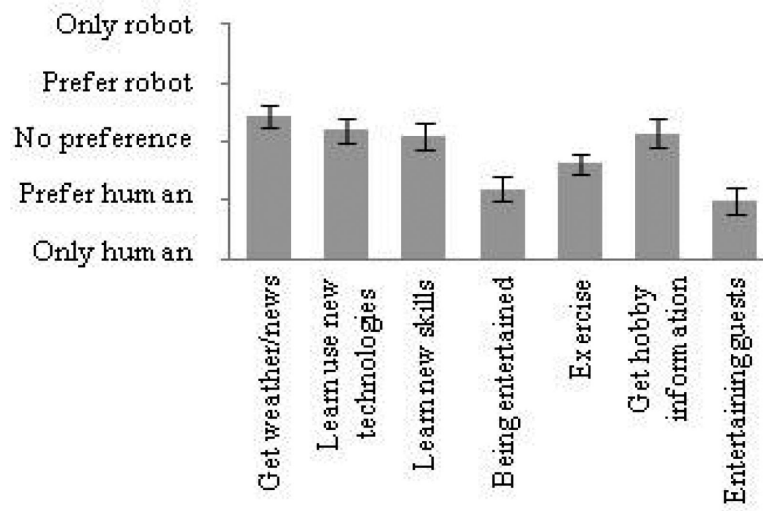


Figure 3.
Mean preference rating for robot versus human assistance by task categorized as an Enhanced Activity of Daily Living.

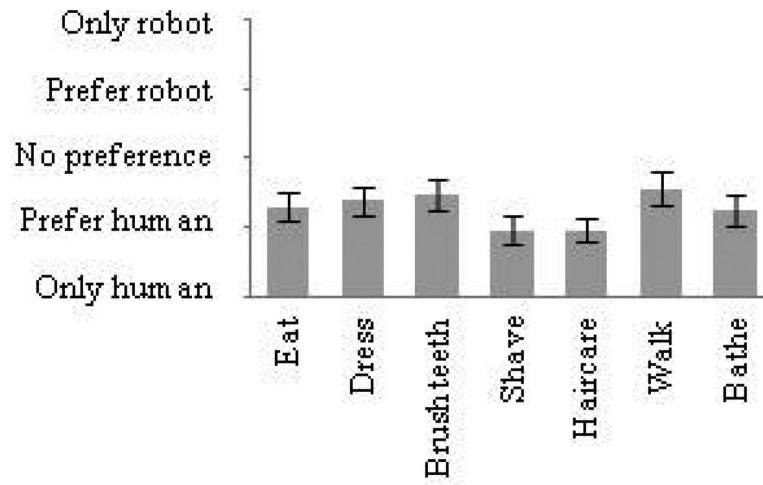


Figure 4. Mean preference rating for robot versus human assistance by task categorized as an Activity of Daily Living.

Table 1

Assistance Preference – Humans or Robots?

	Percentage of Participant Responses			<i>M</i>	<i>SD</i>
	Prefer Human (2)	No Preference (3)	Prefer Robot (4)		
ADLs ^a	63%	26%	12%	2.26	0.96
IADLs ^b	31%	19%	50%	3.13	1.02
EADLs ^c	41%	25%	34%	2.81	1.07

^a Activities of Daily Living comprised 7 tasks

^b Instrumental Activities of Daily Living comprised 18 tasks

^c Enhanced Activities of Daily Living comprised 7 tasks