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Investigating Healthcare Providers' Acceptance of Personal Robots for Assisting with Daily Caregiving Tasks

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Abstract

Robots have potential to provide assistance to healthcare providers in daily caregiving tasks. The healthcare providers' acceptance of assistive robots will mediate the success or failure of implementation of robotic systems in care settings. It is essential to understand why and how providers would accept implementation of a robot in their daily work routines. We identified caregiving tasks with which healthcare providers would or would not accept assistance from a personal robot (Willow Garage's PR2). We also explored preferences for human or robot assistance. The healthcare providers we interviewed were quite open to the idea of receiving robot assistance for certain tasks.

Keywords

Technology Acceptance; Assistive Robot; Healthcare Providers; Caregiving Tasks; H.1.2 User/Machine Systems

Introduction

Many countries are currently experiencing a nursing shortage. A primary factor contributing to this phenomenon is the growing demand of the aging population on the healthcare system [1]. Other relevant factors include an aging nurse workforce, a growing private sector, and an increasing workload that leads to nurses' dissatisfaction and burnout [2]. Consequences of the shortage include reduced job satisfaction, inadequate quality of care, and unsatisfactory patient outcomes. Assistive robots have been proposed as one solution to address effects of the nursing shortage [3].

Assistive robots can play a central role in supporting caregiving by supporting self-maintenance and instrumental activities of daily living (ADLs and IADLs – [4;5]), alleviating the burden and the workload of providers, reducing older people's dependence on others, and promoting quality of life and care services [6;7]. A recent review on the use of assistive robots in healthcare settings described two categories of robotic devices: non-interactive and interactive [8]. Surgical, rehabilitation, and medication delivery robots are defined as non-interactive robots whereas animal or creature-like and human-like robots are classified as interactive robots. Assistive robots designed specifically for eldercare are categorized as rehabilitation robots or social robots [7]. Assistive robots can also be used for telemedicine as a means of healthcare delivery [9].

For assistive robots to succeed as useful tools for supporting healthcare providers, the end users must accept them. The Technology Acceptance Model [10] highlights the importance of the constructs Perceived Ease of Use and Usefulness for technology user acceptance and usage. Holden and Karsh's review [11] included a variety of healthcare professionals and outlined the strong relationship between Perceived Usefulness and Intention to Use or Actual Use for health technological systems. That is, to promote use and acceptance, a technological system must be perceived as useful. However, studies that have focused on external variables influencing technology acceptance by healthcare providers are still few [12; 13]. When considering healthcare providers as end users of a technological device, it is necessary to take into account not only their attitude towards technology but also factors related to the impact of technology on professional autonomy, on relationship with patients, on their routines, and on workflow [14].

Goals of Current Research

When a robot is developed for use in a healthcare setting (e.g., skilled nursing or assisting living facility) healthcare providers' acceptance and attitude play an important role in determining the overall success of its implementation. It is necessary to understand how assistive robots can support healthcare providers' daily work, and which caregiving tasks an assistive robot should perform. We used a qualitative approach to:

- Identify caregiving tasks that healthcare providers would or would not accept assistance from an assistive robot in their work.
- Understand healthcare providers' preferences for a human assistant versus a robot assistant in performing daily job tasks.

Method

Participants

The participants were 14 healthcare providers (aged 19–59, $M=38.8$, $SD=13.7$; 13 female, 1 male) recruited from skilled nursing and assisted living facilities in the Atlanta, GA metropolitan area. Almost all reported themselves as Black/African American (93%). Participants' job titles varied: Registered Nurses (3); Medical Assistant (1); Developmental Disabilities Professionals (1); and Certified Nurse Assistants (9). They either worked in skilled nursing homes (57%) or assisted living facilities (43%) and had an average of 11.6

years of experience ($SD=9.2$) in the healthcare field. They performed health monitoring and management tasks (e.g., vital checking and medical tasks; 42%) and patient personal care tasks (e.g., bathing, dressing, toileting, feeding; 57%).

Participants reported very little familiarity and no experience using any type of robot (e.g. domestic/home robot, surgical robots or entertainment/toy robots). Participants reported using an information technology application/device (e.g., computer) quite frequently in their job.

PR2 Personal Robot

The robot depicted in this study was the PR2 (Personal Robot 2), developed by Willow Garage, Inc. (see Figure 1). The PR2 is a commercially available mobile manipulator currently used by a number of robotics researchers. This robot has an omni-directional wheeled base with two 8 DOF arms/grippers, a telescoping spine, and a pan-tilt head. The PR2 is capable of autonomously navigating around an environment, and manipulating objects.

Structured Interview Procedure

On arrival to the structured interview, participants provided written informed consent and were informed about the goals and topic of the structured interview. Participants were introduced to the PR2 by viewing a short video demonstrating its capabilities. The video served as a foundation for the healthcare providers' discussion in the interview. Prior to their arrival to the interview discussion, participants completed a pre-packet of questionnaires on Demographics/Health; Technology Experience; Robot Usage and Familiarity; Robot Opinions; Robot Appearance, Robots Acceptance and Assistance Preference Checklist. Upon completion of the structured interview, the participants completed the Robot Acceptance, Robot Appearance and Assistance Preference Checklist again.

Questionnaires

In this paper we present detailed results from the Assistance Preference Checklist that was administered after the interview. This checklist, therefore, assessed preferences for assistance (robot vs. human) as a function of task after participants had seen the video of the PR2 and after they had discussed their attitudes about the robot assisting them with healthcare tasks. Participants were instructed to imagine they needed assistance in performing their daily job tasks and to indicate their preferences for assistance with Activities of Daily Living (ADLs); Instrumental Activities of Daily Living (IADLs); Medical tasks; and Administration/Communication tasks on a five-point scale (1=only a human, 3=no preference, 5=only a robot). We asked participants to assume that the robot could perform the task to the level of a human.

Results

Below we present data from the Assistance Preference Checklist, as well as portions of the interview data.

Which are the caregiving tasks for which healthcare providers would or would not accept a robot assistant? A mean overall score was computed for participants' responses on the Assistance Preference Checklist. Scores revealed that healthcare providers did not show a preference for human or robot assistant for the aggregate of the 25 caregiving tasks ($M=2.7$; $SD=0.5$, where 3 = No preference). However, there were preferences observed when we assessed responses at the task category level (see Table 1).

We categorized participants' responses as (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 healthcare providers were most willing to have assistance from a robot for IADLs, followed by ADLs, Medical and Administration/Communication tasks.

Means were also computed for each task. The data show that participants' preferences varied across some of the tasks within each category. For IADLs there was a preference for the robot to assist with light housework tasks ($M=3.9$; $SD=0.7$) but no preferences for the remainder of those activities (Figure 2). For the ADLs, participants indicated a preference for robot assistance in transfer tasks, such as transferring patients from beds to chairs ($M=3.5$; $SD=1$), whereas they preferred human assistance with feeding tasks ($M=2.1$; $SD=1.2$). They did not have a preference in the rest of tasks (Figure 3).

For Medical tasks there was a tendency to prefer robot assistance for only checking vitals ($M=3.2$; $SD=1.1$), whereas they preferred human assistance with IV use ($M=2$; $SD=1$), diabetic ($M=2.3$; $SD=1.3$), and ostomy care ($M=2.1$; $SD=1$). Participants did not show a preference for the catheter and bandage change tasks.

No preferences emerged for the specific Administration and Communication tasks.

Do healthcare providers prefer a human assistant or robot assistant in performing their daily job tasks? Participants' responses to the interview prompt "If you were going to be given an assistant, would you rather it be a human or a robot?" revealed that 61.5% of the healthcare providers would prefer a robot assistant (e.g., "...[the robot] can reduce those number of tasks by taking responsibility for those instead of the nurse doing all those tasks". The rest (38.5%) preferred a human assistant because "I know a human just about would know what I know. And I know what humans do, but a robot, I don't...". Only one of the healthcare participants did not have a clear preference.

Discussion and conclusion

This work-in-progress paper presents initial analyses of an Assistance Preference Checklist and interview aimed to understand healthcare providers' acceptance of assistive robots in care settings. The data showed participants would be likely to accept assistance from a personal robot like the PR2 for IADLs, followed by ADLs, Medical tasks and Administration/Communication tasks. In particular, they would prefer a robot assistant for light housework tasks (IADLs), transferring patients from beds to chairs (ADLs), and checking vitals (Medical). Conversely, healthcare providers showed a preference for assistance from a human for the remaining ADLs (e.g., feeding tasks), and for IADLs (e.g., IV use, diabetic, ostomy care tasks). Participants did not show a preference for human versus

robot assistance in Administration/Communication tasks. Overall, most of the healthcare providers were reportedly willing to have a robot as an assistant.

One interpretation of the findings is that healthcare providers are more likely to want a robot as an assistant for physically demanding or routine tasks (e.g., recording vital signs). On the contrary, for tasks directly linked to the health of the patient (e.g., diabetic care) or requiring physical contact and direct interaction with the patient, participants preferred to rely on a human assistant. A possible explanation may lie in the lack of trust in the interaction abilities of the robot and in healthcare providers' concern about feelings and reactions of a patient interacting with a robot. Moreover, gaining experience working with a robot may change healthcare providers' preferences affecting positively acceptance and intention to use.

Nevertheless, these findings provide insights into healthcare providers' attitudes towards and preferences for robot assistance with caregiving tasks before they have had experience working with a robot assistant. For certain tasks, they were quite positive about the potential for robots to assist them. Understanding how assistive robots can support healthcare providers' work will be a useful guide in the design assistive robots more suitable and acceptable for healthcare settings.

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Figure 1.
The PR2 (Personal Robot) developed by Willow Garage

Figure 2.
Mean preferences rating for human versus robot assistance in Instrumental Activities of Daily Living (the red line indicates the activity with the highest robot preference)

Figure 3.

Mean preferences rating for human versus robot assistance in Activities of Daily Living (the red line indicates the activity with the highest robot preference and the blue one indicates the activity with the lowest robot preference)

Table 1

Assistance Preference Checklist – Human versus robot?

Tasks	Percentage of Participants' Responses				
	Prefer Human (2)	No Prefer (3)	Prefer Robot (4)	M	SD
ADLs	45%	24%	32%	2.7	0.4
IADLs	23%	30%	47%	3.2	0.4
Medical	57%	17%	26%	2.5	0.4
Administration/Communication	45%	38%	17%	2.5	0.2