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Understanding Older Adult's Perceptions of Factors that Support Trust in Human and Robot Care Providers

Rachel E. Stuck and

Georgia Institute of Technology Atlanta, United States

Wendy A. Rogers

University of Illinois-Urbana-Champaign, Champaign, United States

Abstract

As the population of older adults increase so will the need for care providers, both human and robot. Trust is a key aspect to establish and maintain a successful older adult-care provider relationship. However, due to trust volatility it is essential to understand it within specific contexts. This proposed mixed methods study will explore what dimensions of trust emerge as important within the human-human and human-robot dyads in older adults and care providers. First, this study will help identify key qualities that support trust in a care provider relationship. By understanding what older adults perceive as needing to trust humans and robots for various care tasks, we can begin to provide recommendations based on user expectations for design to support trust.

Keywords

home care robotics; older adults; elder; trust; care provider

CSS Concepts

Human-centered computing~User studies; Social and professional topics~Seniors

INTRODUCTION

The population of older adults (ages 65+) is increasing quickly worldwide. In the United States alone, the older adult population is expected to reach 84 million in 2050 [1]. With this growth, the World Health Organization recently published a report highlighting the need to create interventions that target individualized issues for the aging population [2]. Home health care providers is one such intervention that can support comfortable aging. The increase in elders will create an increase in the demand for care providers. As it is unlikely that personal care attendants (PCAs) will be able to fully support this need, creating an opportunity for technology, specifically robots, will help fill this gap. To maintain successful older adult and care provider relationships (both human-human and human-robot), we must understand the elements, such as trust, in these relationships that contribute to positive interactions.

In both human-human and human-robot contexts, trust impacts the success of the interaction. In human-human literature, trust has been shown to improve the effectiveness of communication [3]. An increase in human-human trust was also shown to positively impact well-being [4] and illness management in the nurse-patient relationship [5]. In the human-robot context, trust is likely to impact usage similarly to the human-automation context. So, if an operator trusts a system, they will use it and vice versa [6]. Trust is a key aspect for successful interpersonal relationships and technology use.

Trust is a versatile and context dependent variable. For this study, it is defined as “willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that party” [7, pg. 712]. In both human-human, human-automation, and human-robot contexts several key factors have been identified that influence trust. In the following sections, we will highlight a few of these key factors within each context.

Human-Human Trust

For human-human trust, we will focus on a model of trust developed by Mayer et al. for employer-employee relationships, seen in Figure 1 [7]. This model was chosen for use in the older adult-care giver relationship because of the analogy between an employer needing work to be done by an employee and an older adult needing care to be provided for by the caregiver. There are some limitations to using the model in this context because this relationship also involves personal tasks and is normally done in a home setting. Despite the limitations of this model, it is the best fit currently available in the literature to describe the older adult-PCA relationship.

In the model presented in Figure 1, characteristics of the trustee, characteristics of the trustor, and relationship are all components that influence trust. The trustee’s characteristics, such as their ability to perform the task, their values, and the extent to which they do the task for the good of the trustor, all contribute to their perceived trustworthiness [7]. The trustor’s characteristics such as their general propensity to trust and personality have been shown to influence trust [7].

Another area of human-human trust literature that may be applicable for this context is that related to nurse-client relationships. From this research, a few key findings are themes that the patients are concerned with the *intent* behind the performance of the task, not the task performance alone [5]. However, the context of being in a home versus a hospital may significantly impact the elements that support trust, as well as, the greater variety in the tasks being performed.

Human-Automation Trust

Human-automation trust has provided the theoretical foundation for understanding human-robot trust. This research has found that overall reliability of automation is a predictor of operator trust in the system, but failures of the system are complicated in how they impact the operators trust [6]. Further research determined that trust calibration occurs in automated

systems, in which the user dynamically adjusts his or her trust in the system based on system performance (or reliability) [8].

The technology acceptance model shows that people will accept technology based on their perceptions of using the system [9]. Acceptance is the foundational requirement for trust in a system, as users will only be able to trust a system once they have accepted it for use. Overall usage of automation is impacted by trust and prior research has shown that technology acceptance is influenced by user's perceptions (both perceived benefits and concerns) of the technology [9]. This initial acceptance is a key step in trust in automation as an operator cannot learn to trust technology if the operator refuses to interact with it.

Human-Robot Trust

In human-robot trust, a model developed by Sanders et al. 2011 (Figure 2) identified the main overall components that contribute to trust: human characteristics (e.g., personality), robot characteristics (e.g., ability), environmental characteristics (e.g., type of task, communication), training, and design [10, 11]. This is a general model that was built off a review of human-robot trust research [11]. Many of these studies built off the extensive theoretical foundation laid out in human-automation trust.

While extensive work in the area trust in older adults and care providers has not yet been completed, there are a few studies that have focused on this area of human-robot trust. One key finding by Ezer is that older adults reported they would prefer to stay at home with an assistive robot than transferring to a care facility [12]. In addition, the primary quality that older adults reported as impacting trust was the robot's ability [12]. Another study found that most commonly, older adults rated reliability, precision, efficiency, and safety as the main top descriptors of a trustworthy robot [13]. However, one weakness of these studies is that they did not look specifically at the tasks being performed, which as shown in the model is one of the key components to understanding trust [12,13].

Trust is variable and influenced by many factors, so to understand what supports trust in a particular context, it must be studied within the specific task relationships (e.g., nurse-patient), but past research has not specifically investigated trust in the older adult and PCA relationship. In the human-robot literature (HRI) literature, a few studies have explored some general concepts of human-robot trust in the home care context, but none have assessed how this trust varies by task. Moreover, past research has not examined whether human-robot trust differs from human-human trust in the home care context. The current study is investigating trust in the older adult-PCA and older adult-robot relationships in the context of various personal care tasks.

The goal of this study is to identify:

- Research Q1. What factors do older adults perceive influencing their trust in human and robotic care providers?
- Research Q2. What are the differences in factors that influence trust for human-human versus human-robot in the context of older adult and care providers?

METHOD

To gain a deeper knowledge about trust in this context, we took a qualitative approach to determine the underlying reasons behind why a person decides to trust a care provider for a certain task. Because very little is known about this context, as previously discussed, and there is no established standard measurement for trust [14], qualitative data collection is the most informative for our purposes.

Participants

In total, 32 older adults above the age of 65 will be interviewed (16 from assisted living facilities and 16 from independent living facilities). To be eligible participants must be fluent in English, be above the age of 65, live in either an assisted or independent living facility, and receive 4 or more days of care from a care provider. In addition, they must be able to pass the Wechsler Memory Scale (WMS) III to ensure that they are able to follow along and understand the interview [15]. Thus far, 15 older adults have been interviewed (2 in independent living and 13 in assisted living communities).

Procedures

Participants are being recruited through local assisted and independent living facilities through flyers and word of mouth. Prior to inclusion, participants are prescreened to ensure that they meet the eligibility requirements.

Prior to the interview, participants complete multiple questionnaires. These questionnaires were used to explore self-efficacy in daily living tasks and descriptive information about participants. Refer to Table 1 for more information about these questionnaires.

Following the questionnaires, an in-person semi-structured interview will be administered that delves into four care tasks performed by PCAs: 2 activities of daily living (ADLs) and 2 instrumental activities of daily living (IADLs). See Table 2. These scenarios were created by consulting subject matter experts (SMEs) to ensure that the descriptions were accurate. The interview will be divided into two sections (PCA and robot), which will be counterbalanced throughout data collection.

The semi-structured interview will go in depth on the first task of bathing for both care providers. The participants will be specifically questioned about their perceived importance of previously identified components of trust. For the following tasks, participants are both asked about what an ideal care provider would be like for them to trust them with each of these tasks. Then they are also asked what would cause them to not trust a care provider to identify all aspects of qualities that could impact trust.

Upon completion of the interview participants will also complete a variety of concluding questionnaires that obtain more information about the elements that are important to trust in this care context. For more detail about these questionnaires please refer to Table 3.

RESULTS

As data collection is on-going, no formal results will be presented in this paper. However, we will provide a brief summary of our planned analysis for the qualitative interviews and provide some example quotes from the completed interviews. The questionnaires will be analyzed using descriptive statistics.

Planned Qualitative Analysis

The audio recorded interviews will be transcribed verbatim. MAXQDA will be used to segment the transcripts and apply the coding scheme. A segment will be defined as a participant's complete response to a question. A thematic analysis will identify emerging themes from the interviews. The coding scheme will be developed using both these bottom-up themes [21] but also by using top-down themes [22] that have already been identified in prior research.

Preliminary Results

As mentioned, these results are only a few example quotes to represent some of the current themes that have started to emerge within the current data. A few of the emerging themes related to the human caregiver is a concern with the caregiver's personal cleanliness and other personal qualities such as personality, rudeness, etc. The current data seems to show that it is not just the performance and abilities of the caregiver, but also various personal qualities that would impact the older adults trust.

For the human-robot trust, a few emergent themes are those that demonstrate that many older adults desire the robot to be empathetic and understand not only their emotions, but also understand their capabilities and limitations. However, this is not true for all the older adults, as there has been several that acknowledge they do not believe the robot is capable of benevolence or empathy. However, again this is preliminary and has yet to be formally qualitatively analyzed.

Overall, we do expect that previously identified human-human themes will emerge as important in older adult-caregiver context. However, based on pilot data, we also expect themes to emerge that focus on personality and the general goodness of the PCA. We also expect that previously identified human-robot themes to emerge as important in older adult-robot context. In addition, we expect that human-human and human-robot trust will have differences in the various factors that support trust. For example, we expect that aspects such as personal cleanliness will be important in the human-human context, but not the human-robot context.

CONCLUSION

As the number of older adults in the United States continues to increase, it is important to understand what is needed to create successful relationships between older adults and their care providers [1]. In the future, it is possible that care providers could be human or robotic, so supporting trust in both of these contexts needs to be understood. In general, we know from previous research that trust is variable and that they key components that attribute to

human-human trust are the characteristics of the trustor (e.g., personality), characteristics of the trustee (e.g., ability) [7] and the context of the relationship (e.g., nurse-client) [5]. In human-robot literature, we know that the characteristics of the trustor, characteristics of the robot, and the environment all contribute to trust [10].

Trust literature has not addressed the factors that are needed to support trust within the context of older adults and care providers. In particular, aspects not addressed are the tasks within this relationship and the differences between human-human and human-robot trust. Therefore, our research questions sought to address these gaps by understanding the factors that support trust between older adults and care providers, comparing these factors between the older adult-caregiver and older adult-robot context.

We will expand the understanding of trust through learning about the relevance of previously identified dimensions in this relationship as well as any new dimensions that might emerge. This knowledge can be applied to improve the relationship of older adults and PCAs, and to the development of assistive robotics in the home by understanding elements needed to support trust for specific tasks.

This study will advance the theoretical knowledge of trust by gaining insight into the older adult and care provider relationship that is currently relatively unexplored. First, we will identify what specific factors older adults perceive as contributing to trust in the context of older adults and PCAs, which no other studies have explored. Second, we will identify the factors that support trust in the older adult-robot context, which has not been explored within the context of specific care tasks or with older adults who have experience with caregivers. Thirdly, we will gain further insight into the differences between human-human trust and human-robot trust, which will expand what is known about volatility of trust and the true impact of task within a context.

By identifying the factors that are perceived to support trust and the differences in human-human versus human-robot trust, we will be able to provide preliminary guidelines for designing assistive care robots for older adults. For example, if there are significant differences in what is needed to support trust between the human-human and human-robot context, this may highlight that using a human-human relationship as a model to build a robot may not result in a robot that older adults would accept and use. In addition, this study will give further insight into impact of task on the elements that are important for supporting trust. This could help guide development of robots so that within specific tasks they highlight certain qualities. This study was not done with the end goal of designing a specific assistive robotic device, but to provide general recommendations of design to support trust.

Preliminary Design Guidelines

As data collection is still ongoing, it is possible that these predominant themes will change. However, as expected from previous literature, the robot's ability to perform the task is important across all tasks. Within these tasks there is more variation. For example, with bathing, the gentleness with which the robot performs the task is key. In addition, ensuring the robot performs the task to the older adult's preference and not a set standard has emerged to be important. This would highlight the need for a robot to be able to do this task in a

customizable way. However, with medication assistance, it is clear that older adults are primarily concerned with timeliness of delivery and knowledge of the medicine. With the task of transferring, older adults are extremely concerned that the robot is willing to work with them to transfer them in the most comfortable way, which again reflects the need for some customizability to the person. They also highlight the importance of clear communication both ways. In household tasks, the primary concern is the ability, but there are more individual differences within this task.

Summary

The study presented will expand the knowledge in the older-adult and care provider domain. While initial results demonstrate both support of previous research and apparent emerging themes, future work should attempt to validate these through experimental manipulation. This study will help improve older adults' lives by identifying key factors that can influence both the training of PCAs and the development of assistive robots to better support trust.

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Figure 1.
Model of Human-Human Trust

Figure 2.
Model of Human-Robot Trust

Table 1**Pre-Interview Questionnaires Administered**

Questionnaire Title	Description of Measured Variables
Demographic/Health	General descriptive information about the health and hearing/vision/motor capabilities of the participants
Technology Experience Profile	Usage and experience with various types of technologies within the last year [16]
Daily Living Self-Efficacy Scale	Level of confidence on various ADL and IADL tasks [17]
Assistance Level	Level of assistance with various ADL and IADL tasks, who assists them, and how often they receive help
Formal Caregiver Experience	Information about experience with caregiver either personal or through assisted living
Ten Item Personality Inventory	Big 5 personality traits: openness, conscientiousness, extraversion, agreeableness, and neuroticism [18]
Propensity to Trust	General inclination to trust other people [19]
Montreal Cognitive Assessment	General cognitive ability and level of cognitive impairment [20]

Table 2

ADLs and IADLs for Interview

Imagine you have a new (caregiver/robot) that is going to assist you with:	
Bathing	This will include them helping you remove your clothes and physically helping you bathe.
Medication Assistance	This means they would help remind you to take medications at the appropriate time and perhaps bring the medication bottle to you.
Transfer	This will include the caregiver helping you sit up, lifting you, and moving you to the wheelchair.
Household Tasks	These tasks will include helping plan and prepare meals and doing some light housework such as laundry, doing the dishes or making the bed.

Table 3

Interview Questionnaires Administered

Questionnaire Title	Description of Measured Variables
Care Provider Visualized Questionnaire (Robot & Human)	Obtains whether participants were visualizing a care provider when discussing scenarios and descriptive information of what was visualized
Trust Dimensions by Task (Robot & Human)	Obtains level of importance of ability, communication, reliability, appearance, precision, values, predictability, and benevolence for each task and with each care provider
Desired Ten Item Personality Inventory (Robot & Human)	Rates the desired personality of a care provider for the older adult to trust them
Trust in Assistance	Gains understanding of whether older adults would prefer to trust a human or robot on a set of 12 ADLs and IADLs
Robot Familiarity and Usage	How familiar are the older adults with various robotics
Robot Usage Self-Efficacy	How confident are the older adults that they could operate a robot

Table 4

Human-Human Trust Quotes

Task	Example Quote:
Bathing	<i>"I think she has to be physically...capable of for instance lifting me out of the bathtub if that's what I need. So... size, physique, strength, I think would be important for that particular task."</i>
Medication Assistance	<i>"I'd need to know them really well. I would need for them to know me really well. And to know that you can't make decisions for me without my permission. You can't discontinue a drug because you don't think I should be taking it"</i>
Transfer	<i>"Strength. She has to be strong enough. Also she has to pay attention so that she wouldn't let me slip or fall."</i>
Household Tasks	<i>"I don't want them to be intrusive and I don't want them to mess with my stuff and place them in different places, then where I had them."</i>

Table 5

Human-Robot Trust Quotes

Task	Example Quote:
Bathing	<i>“That they be gentle, and, because I have a lot of pain. And that...I would be secure, that I wouldn’t fall. So that it would either hold me or put me down on something to sit. And so I’d be safe and...that they would be able to reach parts of my body, my anatomy, that I can’t reach.”</i>
Medication Assistance	<i>“Well, to start out with, if he acts like he knows what he is doing. I mean if he knows it is time for my medicine and he goes and gets it and brings me my water and says now look this is what you take today. Then we would work together okay.”</i>
Transfer	<i>“Well that it remembers things about me that are hurting so that it doesn’t pick me up in such a way that hurts or it forgets, if you will, that I can’t do certain things. That I have considerations, I have health considerations that would include my doing certain things”</i>
Household Tasks	<i>“That they would do it when it needs to be done. And not say, ‘we only do it on Mondays’ or something. And... that they would help me on holidays that they would help me decorate do things that I can’t because they take too much energy...And that they make sure that there’s not things I can trip over.”</i>