



Cheery companions or serious assistants? Role and demeanor congruity as predictors of robot attraction and use intentions among senior citizens



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ABSTRACT

Using a robot designed for senior citizens in a retirement home setting, an experiment (N=51) was conducted to investigate whether variations in the role (companion vs. assistant) and social demeanor (playful vs. serious) of a robot influence senior citizens' perceptions of the robot's social attractiveness, intelligence, anxiety, and eeriness. Results show that assistant robots are perceived as more socially attractive and intelligent when their demeanor is playful rather than serious. In addition, companion robots are evaluated as less anxious and less eerie when their personality is serious rather than playful. Finally, companion robots with a serious demeanor have a positive indirect effect on robot use intentions via heightened perceptions of intelligence and social attractiveness, while assistant robots with a playful demeanor have a positive indirect effect on intentions via lower perceptions of anxiety. The implications of our findings for human-robot interaction and the design of socially assistive robotics are discussed.

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1. Introduction

The design of socially interactive robotics has gained much emphasis in recent years (Fong et al., 2003). This interest has been fostered in large part by the growth of the elderly population that poses a wide array of challenges to the healthcare system. Some scholars anticipate that robots can potentially supplement the healthcare system by providing senior citizens with physical assistance and emotional support in the comfort of their own homes. As a result, it is of increasing importance to scholars and practitioners of social robotics to understand the factors that promote healthy communications between humans and robots, yielding positive user evaluations, especially from senior citizens.

Advances in robot functionality have broadened the range of possible roles that robots can fulfill for users. Similarly, improvements in robot dialogue systems now afford robot designers the opportunity to imbue robots with a personality or social demeanor based on slight variations in speaking rate or tone. These advances raise the issue of congruency between the role and demeanor of

robots. Should assistant robots have a more serious demeanor than companion robots, or should they both be playful in order to provide a satisfactory user experience? As robots adopt a variety of potential social characterizations, it is important to know whether variations in the role or demeanor of a robot affect attitudes towards robots, especially among senior citizens who are increasingly likely to encounter robots in a wide variety of roles.

One relevant theoretical framework is the Computers are Social Actors (CASA) paradigm, which suggests that we respond to and evaluate computers based on interaction rules primed by social cues embedded within media interfaces (Nass and Moon, 2000; Nass et al., 1994; Reeves and Nass, 1996). For example, several studies have found that computers (Nass et al., 1996) and robots (Sah et al., 2011) labeled with the role of "specialist" are evaluated as more trustworthy and credible than their "generalist" counterparts. In addition, subtle manipulations of voice in computers and robots have been found to prime gender stereotypes (Nass et al., 1997) and personality assessments (Lee et al., 2006) of technology. Variations in robot roles and robot demeanor should thus have significant implications for the psychology of human-robot interactions, although the specific direction of such effects is unclear. From one perspective, the CASA paradigm would predict that relevant social psychological constructs such as the "positivity" heuristic (e.g., Cialdini, 2007) or the "matching hypothesis" (e.g.,

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Bonner, 2000) shape how robots are evaluated. Under this formulation, robots with a demeanor that matches their anticipated social role would be expected to receive more positive user evaluations. In contrast, the uncanny valley hypothesis (e.g., Mori, 1970) would predict that such matching may actually elicit negative evaluations because the imitation of humanness is undesirably eerie, even when that imitation is not appearance-related, but pertains to human-like roles or interface cues (Dautenhahn, 2002). Thus, while it is expected that the categorization of robots primed by role and audio cues should guide seniors' evaluations of robots, dominant theoretical approaches from the human robot interaction (HRI) domain offer competing predictions that warrant testing.

The current experiment tested these alternative assumptions of CASA and the uncanny valley hypothesis by examining senior users' responses to a social robot in a retirement home setting. Specifically, a 2 (robot role: companion vs. assistant) × 2 (robot demeanor: playful vs. serious) between-subjects experiment was conducted to assess how the congruency between robot role and robot demeanor affects senior citizens' perceptions of a robot's social attraction, intelligence, eeriness, and anxiety. In the following sections, previous research on the CASA paradigm, social robotics, and the uncanny valley hypothesis is reviewed, followed by a description of the study's methods and results. Implications for HRI theory and the design of socially assistive robots for the elderly are also discussed.

2. Literature review

A review of the literature in the domains of human-computer interaction and HRI was undertaken to derive predictions about the effects of robot role and robot demeanor on psychological responses of senior citizens to social robots, as detailed below.

2.1. Social robots, social perceptions: computers are social actors paradigm

It is not uncommon for users to evaluate technology according to the same interpersonal rules that we apply in our everyday interactions. For example, a large body of research from the CASA paradigm has found that subtle social cues embedded within technology can elicit a wide range of related social heuristics such as gender stereotypes (Nass et al., 1997), similarity attraction (Moon and Nass, 1996), and the norm of reciprocity (Moon, 2000). Given that initial CASA research focused on user interactions with computers, it is assumed that users will also apply social rules to other forms of technology that exhibit anthropomorphic characteristics (Nass and Moon, 2000). In the domain of human-robot interaction, it has been found that individuals tend to anthropomorphize robots more strongly than other forms of technology (Duffy, 2003). Thus, as robots take on more human-like traits, they are also more likely to be evaluated according to social rules derived from the context of human-human interaction.

2.2. The Role of the Robot: Assistant vs. Companion

Although past research has begun to explore how manipulations of robot morphology affect users' evaluations of robots (Fong et al., 2003), it is also important to examine the effects potentially elicited by variations in robot categorization. For example, one study (Nass et al., 1996) found that individuals evaluated media content more favorably when it was viewed on a "specialist" television set than if the same content was viewed on a "generalist" television set. In addition, web sites (Koh and Sundar, 2010), smartphones (Kim, 2014), and robots (Sah et al., 2011) identified as

a "specialist" elicit higher levels of trust than their "generalist" counterparts. Thus, labels applied to technology can have significant implications for user perceptions of a technology's utility. In the context of robot design for senior citizens, recent research has highlighted that the distinction between robots as "assistant" and robots as "companion" is particularly salient (Dautenhahn, 2007).

In the "robot-as-assistant" perspective, robots are conceptualized as useful machines that aid humans in the completion of everyday tasks. Common examples include robots that aid the physically impaired in the home (e.g., wheelchair robots, robotic arms; Glover et al., 2004; Yanco, 1998) and robots that provide assistance in hospitals and schools (e.g., medication reminders, educational supplementation; Kanda et al., 2003; Scanail et al., 2006). By comparison, the "robot-as-companion" perspective is characterized by robots that provide users with emotional support. Robots in this context are not considered to be slaves or servants; rather, they function as considerate, flexible, and trustworthy personal companions in typical everyday environments. For example, robotic pets like Paro (i.e., a seal-shaped robot manufactured by Intelligent System Co.) have been developed to comfort senior citizens and reduce loneliness in their daily lives (Beck et al., 2003). As social networks decline with age and senior citizens are physically distant from their family members or close friends (Sigman, 2009), it is anticipated that companion robots will serve an important role in promoting the overall quality of life for senior citizens.

Initial evidence suggests that senior citizens prefer robots that assist with everyday tasks rather than robots designed to be a friend or companion (Dautenhahn, 2007), but their actual user experience may be shaped by the way in which the robot role is framed for them. The label of "assistant" and the label of "companion" can both trigger heuristics (or mental shortcuts) that elicit positive evaluations from the user. For example, the MAIN model (Sundar, 2008) would predict that the label of assistant is likely to trigger the "helper" heuristic, or the positive evaluation of technology that assists users with the completion of tasks. Likewise, the label of "companion" might trigger the "social presence" heuristic, or the perception that one is co-present or communicating with another social entity, which can also result in positive evaluations. Given the lack of prior research on the heuristics associated with "companions" vs. "assistants," the following research question is proposed:

RQ1: Does the role of a robot as assistant vs. companion influence the ways in which senior citizens perceive and evaluate the robot?

2.3. Robot's social demeanor: playful vs. serious

Aside from evaluations of robots based on their anticipated role, previous HRI research has also found that variations in a robot's speaking frequency and inflection can be socially significant (Lee et al., 2006). Psychologists have long demonstrated that social demeanor can predict the way a person interacts with others. The positivity hypothesis (Cialdini, 2007) suggests that individuals typically have a tendency to comply with others whose social demeanor is pleasant or enthusiastic. Similarly, extraverted individuals are more likely to maintain positive relationships with others and are typically more persuasive (Bonner, 2000). An enthusiastic speaking style is typically defined by a wider range of tones and an accelerated speaking rate. Thus, if previous social science findings are applicable to the domain of HRI, basic manipulations of a robot's speech patterns (such as higher pitch) should elicit more positive evaluations from users via the positivity heuristic.

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