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Help! I Can't Reach the Buttons: Facilitating Helping Behaviors Towards Robots.

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Abstract. Human-Robot-Interaction (HRI) research is often built around the premise that the robot is serving to assist a human in achieving a human-led goal or shared task. However, there are many circumstances during HRI in which a robot may need the assistance of a human in shared tasks or to achieve goals. We use the ROBO-GUIDE model as a case study, and insights from social psychology, to examine two factors of user trust and situational ambiguity which may impact promote human user assistance towards a robot. These factors are argued to determine the likelihood of human assistance arriving, individuals' perceived competence of the robot, and individuals' trust towards the robot. We outline an experimental approach to test these proposals.

Keywords: HRI, design, guidance, mapping,

1 Background

Human robot interaction (HRI) research typically explores interactions based around a robot in a supportive or assistive role for the human user [1]. However, there are circumstances in HRI that could require the user to support a robot in shared tasks or to achieve its aims. Current research in this area identifies means for robots to determine *when* to request help [2] and where to *seek* help [3] from humans. However effective means of *how* socially adaptive robots ask for help to encourage user response and helping behavior is still a challenge in HRI.

In this paper, we discuss two factors identified in social psychology, trust and ambiguity, which have impact on human-human cooperative and helping behavior, and their relevance to HRI. Insights from social psychology can be useful in exploring HRI, given that HRI is a somewhat novel and developing area of research [4]. We explore models of cooperation and helping from social psychology in an applied HRI scenario of humans helping robots and outline an experimental proposal to test these.

1.1 Promoting cooperation

A prominent social psychological model of interpersonal cooperation, including helping behavior towards an individual, identifies trust as its foundation [5]. McAllister argues that for a task that necessitates two individuals working together to be achieved successfully and efficiently, both individuals need to trust each other. More specifically, cooperation is argued to benefit from both affective trust (arising from personable interactions by one's peers) and cognitive trust (evidence that one's peers carry out their responsibilities reliably) [5]. Analogues for both forms are seen in, for example, 1) a meta-analysis of factors promoting trust in HRI [1]; 2) user's perceptions of robots' performance (analogous to cognitive trust); and 3) a robots' attributes such as personality (analogous to affective trust), which are found to positively contribute towards user trust in robots.

1.2 Promoting helping behavior

Key studies from social psychology indicate that ambiguity in helping scenarios result in substantial detriment to pro-active helping behavior in individuals [6]. Interaction with robots in cooperative environments may present a novel scenario for many people, as a result human agents in this situation face potential ambiguity in how to behave towards the robot, and uncertainty regarding *whether to help* the robot. Similarly, with respect to cognitive trust, a lack of a clear plan or intention communicated by the robot may create further ambiguity in *how* the individual may help a robot, limiting their action taken[1].

2 ROBO-GUIDE Helping Scenario

To explore the suggested social factors influencing cooperation with, and helping behavior displayed towards a robot by a human agent it is useful to consider an interactive scenario in which these circumstances arise. The ROBOtic GUidance and Interaction DEvelopment (ROBO-GUIDE) project [8] is an ideal scenario to consider the impact of such social factors as it requires humans to place trust in a robot, whilst also assisting in the robot overcoming obstacles or barriers to progress.

ROBO-GUIDE is implemented on the Pioneer LX mobile platform. The platform is able to autonomously navigate a multistory building and lead users from their arrival to their destination. Our focus here is the point at which the platform changes between floors as it navigates the multistory building. As the ROBO-GUIDE is unable to call for an elevator itself it must rely on human support to press buttons to call the elevator and select the required floor[2]. For both the user and the robot this scenar-

[1] Existing robot design may have indirectly addressed user unceratinty to some extent by using animal-like or non-threatening [7] morpholiges.

[2] The wheeled ROBO-GUIDE is also unable to use stairs to navigate between floors – or rather, would only able to travel down stairs and likely only the once.

io presents a simple and low-risk circumstance in which a human user can act in order to meet a robot's needs.

3 Helping Behavior & Experimental Proposal

Factors potentially affecting user helping behavior in HRI, identified in section 1, can be applied to the ROBO-GUIDE usage of elevators. We outline a brief experimental proposal to test their impact for the user in the helping scenario, described in section 2. Requests for help by the robot are planned to be manipulated in a 2x2 experimental design: inclusion or absence of competency-oriented, intentional statements and the inclusion or absence of friendly-oriented, relatable statements. Statements will be communicated using the on-board speech synthesizer, (although the viable alternatives of pre-recorded spoken phrases or an on-screen display are acknowledged and considered in further work). These statements are predicted to impact through four channels on helping-related affect and cognitions, along with perceptions of the situational ambiguity, robot's task-capability, and user-liking of the robot (see figure 1). The following sub-sections show proposed control-condition statements or requests in quotes and normal font, whereas additional, experimental statements are in the same quotes and italics.

3.1 Influencing trust & cooperation

Affective trust.
ROBO-GUIDE's primary purpose is to guide new visitors to the robotics laboratory. It is anticipated that many guests would be unfamiliar with everyday interaction with social and responsive robots and could find the experience unusual. To promote affective trust, we aim to include friendly and relatable references by the robot to the situation that is helping the user as a tour guide, "Please follow me; *I am here as your tour guide*". It is anticipated that perceptions of the robot's likability and affective trustworthiness would be greater with additional phrases regarding its offering 'face-to-face' direct assistance to the human user.

Cognitive trust.
Cognitive trust is developed through clear demonstration of an agent's ability to capably meet its intended and/or required responsibilities [5]. In this case the robot may imply its capability of finding the target destination by clearly communicating its aims. "Please follow me *to get to the robot labs,*" gives indications that ROBO-GUIDE has a goal and will work towards it. It is anticipated that perceptions of the robot's competence and cognitive trustworthiness would be greater with the inclusion of additional phrases that directly address its intended aims.

3.2 Influencing ambiguity & helping

Global circumstances.
As discussed for affective trust, this scenario and HRI *in general* may be an unusual circumstance for many users. To reduce ambiguity in the case of interacting with a novel robot, especially a robot that needs help, we aim to include friendly and relatable references by the robot to HRI. Essentially, we aim to explore the impact of ROBO-GUIDE stating that it is a robot with limitations, which the user can help with: "Please press the down button; *I can't quite reach the buttons*", and "Please press Ground floor; *good thing you're here to do that for me*". It is anticipated that this could diffuse the ambiguity in whether the robot needs help and encourage user liking of, and relating to, the robot.

Local circumstances.
It is anticipated that ROBO-GUIDE's statements of intentions alongside requests for help will promote user helping through a reduction of ambiguity *specific* to the interaction. In this case, demonstrate the robot has a clear goal it is trying to achieve but it is now facing an obstacle and so asks for help: "Please press the down button *to call the lift*" and "Please press Ground floor *for the Robot Labs"*. Without declaring *why* the tasks are to be completed, requests for help are ambiguous in their purpose. It is anticipated that perceptions of the robot's competence would be greater and interaction ambiguity be lower with the additional phrases regarding its aims.

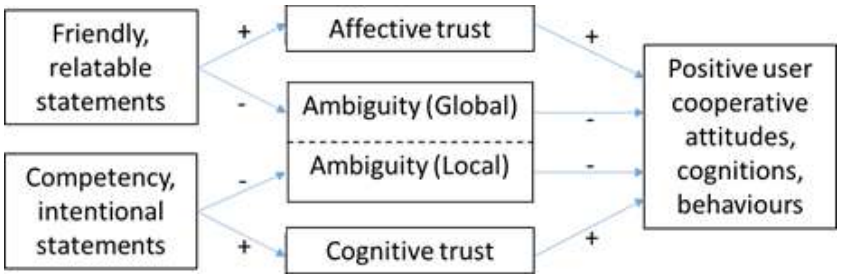

Fig. 1. Structural model of hypothesized impact of friendly and competency statements by the robot on user cooperative behaviors and cognitions.

3.3 Experimental Summary

We anticipate that the use of two forms of phrases: friendly-oriented, relatable statements and competency-oriented, intentional statements will both encourage user helping affect, cognitions, and behaviors. We further anticipate that these statements will act through separate channels of raising trust and lowering ambiguity, independently targeting distinct elements of both (Figure 1). This paper offers a novel proposal for exploring HRI in terms of how robots may effectively encourage user helping.

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