

Considering Information Privacy for Human Interaction with Household Robots

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Abstract. As AI-enabled robots enter society and converse with humans, important issues of ethics and privacy are raised. In this paper I discuss how privacy may be impacted by the disclosure of personal information to a robot performing domestic tasks in a home environment. Guided by Social Identity Theory the question I address is whether users will be more likely to self-disclose personal information to a domestic robot that they view as matching their own personal characteristics of race, gender, and ethnicity than if there is a perceived mismatch. Within this framework, and in the context of information privacy, I discuss whether features of domestic robots influence the extent of self-disclosure of personal, sensitive, and private information between humans and robots.

I. Introduction

The emerging use of humanoid, AI-enabled, and social robots operating within our homes is beginning to raise important issues of ethics and privacy for human-robot interaction (HRI). One of the main issues for household robots which have the ability to communicate with users is whether the communication between human and robot is private or whether it may be shared with a third party. Given more robots entering our homes performing a range of household tasks and given robots operate in environments where they may continuously record the communication between individuals, the issue of “conversational privacy” is becoming an important topic of discussion among software designers and roboticists.

Further, as AI agents progress in ability, and particularly social skills, the function of AI-enabled robots operating in the home is being changed from that of “mere tool” to a social entity

conversing with users using natural language processing ability. According to Denning et al. [1] future homes will be populated with robots exhibiting diverse functionalities, ranging from chore robots, elder care robots, and entertainment robots. While household robots will offer numerous benefits to users, they also have the potential to introduce new security and privacy vulnerabilities into the home. On this point, how characteristics of a domestic robot may influence the disclosure of personal information to the robot, and how information privacy is impacted by information disclosure between human and robot is the focus of this paper.

Discussing robots in the home that interact with family members, Pomarlan [2] used a knowledge-based approach for the design of a robot giving it the ability to explain its actions to users. This represents only one of many examples where household robots use an AI technique to initiate an exchange of information between users and domestic robots.

An interesting question is whether the features used to design the domestic robot influence the level and type of information disclosed to the robot? On this question, emerging evidence suggests that characteristics of the robot in terms of its design and behavior may influence the extent and quality of communication between human and robot. For example, for household robots, Wiltgen et al. [3] explained how the application of social cues, such as emotion, had the potential to make robots easier to use and understand. However, Wiltgen and colleagues explained that it was unclear how household robots should display emotion, and what considerations should be given to emotive behavior regarding the different contexts in which robots operate in the home [3]. In my own research I found that people tasked with

evaluating different AI techniques rated voice communication and the ability to detect the user’s emotions as particularly desirable features of social robots. However, in my prior research, I did not address whether AI techniques affected the exchange of information and thus impacted privacy between humans and robots experienced in the home.

Discussing the idea that both robot and user characteristics may be important for enhancing communication about household tasks, Kakiuchi et al. [4] discussed the development of a robotic household assistant, stating that it is necessary to examine the psychological aspects of users in order for a robot to be thought useful in a household environment. Similarly, in previous research [5] I investigated whether users would disclose personal information to robots as a function of the robot’s appearance. In this study it was found that various physical features of the robot would lead to more self-disclosure of personal information thus suggesting that factors influencing information privacy depend on robot design features. Specifically, a more friendly appearing robot in affect led to more information disclosure than a more mechanical appearing robot [5]. From this a question that can be raised is whether the user’s tendency to self-disclose to robots and the extent to which robots are anthropomorphized impacts information privacy concerns.

Taken together, the above research suggests that robot features, and type of AI techniques displayed by robots influence the evaluation of the robot and self-disclosure of information to the robot. In this paper, I extend the above stream of research on the evaluation of robots by exploring the idea that when robot characteristics of perceived race, gender, and ethnicity match those of its users, more personal information may be disclosed to the robot thus implicating privacy in information exchange.

Figure 1 represents a “high-level” drawing of three characteristics of users and robots (for robots the characteristics are perceived by users) that may impact disclosure of personal information to a domestic robot and as I argue have consequences for privacy. The arrows represent bi-directional communication exchanges between human and domestic robot. For household robots this may involve instructing

the robot to perform a cleaning task, general conversation with the robot, or the use of the robot for entertainment. Further, the figure shows that the user can be described by characteristics such as race, gender, and ethnicity, and for the robot by the perceived race, gender, and ethnicity of the robot as experienced in the home.

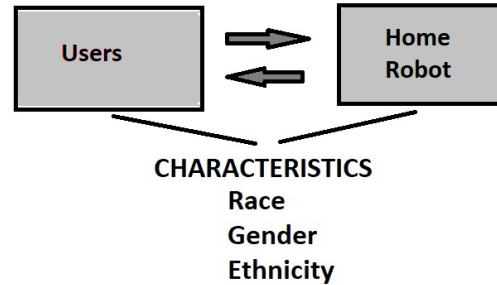


Figure 1. Characteristics of the human and robot may influence information disclosure and thus privacy for domestic robots.

II. Social Identity Theory and Privacy

My approach to human-robot communication and its impact on information privacy is guided by Social Identity Theory (SIT) which concerns the categorization of social entities into different classes [6]. A threshold question within robotics, and particularly HRI, is whether robots are categorized into social classes as are humans, and if so, is the disclosure of personal information and thus privacy affected by the category robots are placed in? Evidence that this may be the case is provided by recent studies showing that people react to robots as if they had a race or gender. For example, Sparrow [7] commented that robots are often viewed as white and Bartneck et al. [8] found that people categorized robots by race and would discriminate more against a darker colored robot than a lighter colored one.

Based on my research, I also propose that robots are categorized by the combination of their perceived race, gender, and ethnicity. I further propose that the robot categorization may influence the extent of information disclosure to the robot and topics discussed, thus implicating privacy concerns in the user’s home environment.

Given robots may be categorized by their perceived gender, race, and ethnicity [5, 8], the question which interests me is whether an increased exchange of information between

human and robot occurs when these characteristics match those of the user. And is privacy for information disclosure more of an issue when there is a match or mismatch? Further, does the type of information disclosure matter? And in either case, from a design perspective, how can human-robot interfaces be designed which encourage communication, but does not violate the users' privacy?

To experimentally evaluate the extent to which a match between users and the perceived gender and ethnicity of a robot affects information disclosure I plan to vary robot ethnicity (by changing information in a spoken narrative, using an ethnic name for the robot, an ethnic spoken accent, and international place of origin) and gender (by using a female gendered voice and female name of the robot which is common for the given ethnicity). I believe the manipulation of these variables for domestic robots will allow me to explore whether robot characteristics (i.e., in my current research, robot ethnicity) influences the extent and quality of conversation in the home and thus whether privacy is impacted.

While the focus of my current research is on how the perceived ethnicity of a robot may impact privacy, the following figure shows that the perceived robot race and gender may also be used to categorize a robot and influence the disclosure of information to the robot.

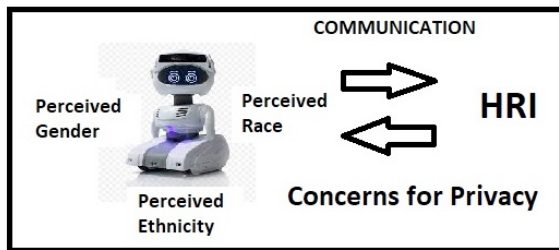


Figure 2. Perceived robot race, gender, and ethnicity during HRI may implicate communication privacy.

Considering the categorization of robots by race or gender, from my literature search, studies have shown that people react to and engage a robot differently based on its categorization [8, 9]. For example, for gender, female gendered robots are thought to be more communal, and male gendered robots more agentic. Thus, based

on stereotypes, robot gender may lead to more disclosure for tasks in which females are expected to be better at. In my studies I found evidence to support this conjecture [see 5]. Summarizing the approach I take in this paper, robots may be categorized into different social groups which may influence the extent of information disclosure to the robot and thus implicate issues of privacy in the home. I further argue that this is especially true for domestic robots given the increased exposure of users to such robots in terms of proximity and personal social interactions.

III. Future Research Directions

As robots are designed for different environments, and perform a range of tasks within the home, there will be far more communication occurring between humans and domestic robots as they exchange information with users on different topics. Of particular concern for privacy, domestic robots will have the ability to continuously listen and record what occurs in one's home, which has generally been considered a retreat from the prying eyes (or ears) of the government or the public. In this paper I proposed the idea that the design of robots in terms of their perceived gender, race, and ethnicity may influence the extent of information disclosure to a domestic robot, and thus implicate information privacy.

In addition, in preliminary studies which guide my future research plans, I have found empirical evidence to suggest that AI techniques may be used to trigger the formation of robot categories which could possibly influence the extent and nature of information disclosure in homes or other environments. From my research, such categories may be based on robot speech ability, computer vision, facial and emotion recognition ability, and the robot's ability to respond to touch. However, given the preliminary nature of my findings on robot categorization as a function of AI technique, I propose that more research needs to be done to determine if robots are classified by the AI technique(s) controlling the robot and if so, how communication to the robot is affected, and whether privacy in information exchange is impacted. Here I propose to equip a robot with different AI techniques and determine whether one or a combination of techniques form robot categories from the user's perspective, and whether such

categories affect disclosure of information and thus privacy.

Finally, knowledge of whether users categorize robots by characteristics such as race, gender, and ethnicity, may be valuable to robot designers whose goal may be to either increase or decrease information disclosure to a robot given the task requirements of the situation. For example, it is

possible that a robot perceived as female may result in more disclosure for a domestic-oriented task than if a male gendered robot was used, and it may be the case that people self-disclose more to a robot whose perceived ethnicity matches theirs. My current research is directed at these issues.

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