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What robots can teach us about intimacy: The reassuring effects of robot responsiveness to human disclosure

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ABSTRACT

Perceiving another person as responsive to one's needs is inherent to the formation of attachment bonds and is the foundation for safe-haven and secure-base processes. Two studies examined whether such processes also apply to interactions with robots. In both studies, participants had one-at-a-time sessions, in which they disclosed a personal event to a non-humanoid robot that responded either responsively or unresponsively across two modalities (gestures, text). Study 1 showed that a robot's responsiveness increased perceptions of its appealing traits, approach behaviors towards the robot, and the willingness to use it as a companion in stressful situations. Study 2 found that in addition to producing similar reactions in a different context, interacting with a responsive robot improved self-perceptions during a subsequent stress-generating task. These findings suggest that humans not only utilize responsiveness cues to ascribe social intentions to robots, but can actually use them as a source of consolation and security.

1. Introduction

Robots are predicted to serve in an increasing number of intimate support roles, such as nursing, childcare, education, and elderly care. In these roles, robots may be required to monitor their human interlocutors and engage in supportive interactions. For example, a robot serving in an elderly care facility might provide support by listening to the experiences of elderly people. The way a robot responds to the human's communication in such scenarios may have a profound effect on various personal and relationship outcomes, including the human's perception of the robot, the human's sense of support and security, the human's willingness to continue to interact with the robot, and the human's overall well-being.

Indeed, in humans, perceiving another person as responsive to one's needs is inherent to the formation of emotional bonds. As such, it plays a key role in intrapersonal and interpersonal processes (e.g., self-regulation, relationship well-being; Reis, 2014) in a variety of contexts, including parent-child relationships, adult close relationships, and therapeutic relationships (Reis & Clark, 2013; Reis, 2014). Unfortunately, the social skills displayed by many caregiving robots are not sufficiently effective in evoking the appropriate sense of responsiveness that is characteristic of human disclosure and well-being (Torta, Oberzaucher, Werner, Cuijpers, & Juola, 2012). In the present research, we sought to explore whether implementing responsiveness cues in a robot would be compelling enough for these keys to human bonding to be also evident when interacting with inanimate objects. Specifically, we examined whether humans would be receptive to responsive support from a robot, using it as a safe haven in times of need and as a secure base for becoming more confident in a subsequent stressful interaction.

1.1. Related work

1.1.1. Socially assistive robots

Robots that assist human users through social interaction, as

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opposed to merely assisting them by their mechanical capabilities (e.g., carrying things), are categorized as socially assistive robots (Feil-Seifer & Mataric, 2005). These robots have already been used successfully in a variety of therapeutic applications (see Rabbitt, Kazdin, & Scassellati, 2015; for a review). In these applications, a robot's multimodal communication channels allow it to communicate verbally and non-verbally with humans, enabling humans to benefit from socially interacting with the robot, engage in personally meaningful relationships, and experience enhanced well-being as a result. For example, the baby seal robot PARO, which was designed to be held and touched, was deployed in a senior center. There, seniors interacting with it displayed increased levels of human-human interaction, as well as decreased levels of stress (Wada & Shibata, 2007). Robots have also been found to improve the social interaction skills of children with autism (Scassellati, Admoni, & Mataric, 2012) and help patients to recover from injury by adhering to activity recommendations (Gadde, Kharrazi, Patel, & MacDorman, 2011; Mataric, Eriksson, Feil-Seifer, & Winstein, 2007).

Research suggests that people tend to perceive robots as social actors and attribute to them human-like traits, including mental states and personality (e.g., Friedman, Kahn, & Hagman, 2003; Lee, Peng, Jin, & Yan, 2006). Studies also suggest that people are willing to play along with the illusion that the robot is a sentient creature appropriate for relational interactions. They are often willing to ignore the mechanical aspects of the robot and to treat it in a manner similar to how they would respond to a fellow human being (Turkle, 2007). For example, preschool children were as likely to share a secret with a robot that listened to them as with a human, given a similar amount of prompting questions, and interacted with the robot using similar social conventions (Bethel, Stevenson, & Scassellati, 2011). Adults who interacted with both a social robot expressing social behaviors, like turn-taking and emotional expressions, and a text-based assistant saw the robot as more empathic and trustworthy than the text-based assistant, and expressed more conversational behavior toward it (Looije, Neerincx, & Cnossen, 2010).

1.2. Robot responsiveness and humans' perceptions of attachment-related behaviors

Building on the literature that indicates that perceived partner responsiveness is the linchpin of human attachment processes, with positive effects on personal and relational well-being (Reis & Clark, 2013), we argue that responsiveness will be a crucial feature for any robot in order to be fully effective in a caregiving role. In particular, such a robot will need to display behavior that is psychologically sensitive to their care-receivers and behave in a manner that is attentive to and supportive of their needs. Furthermore, humans will have to be receptive to receiving responsive support from this robot. We sought to extend the literature on socially interactive robots by examining how human participants would respond to a robot that behaves as if it possessed responsiveness skills and whether humans who interact with such a robot would ascribe human-like traits and social intentions to the robot and benefit from doing so.

We proposed possibilities for designing responsive behaviors in non-anthropomorphic robots and investigated whether a robot's behavior could instill a sense of responsiveness and the effects of a robot's perceived responsiveness on humans' perceptions of the robot's appeal. Increased robot attractiveness could have implications for the robot's perceived value and thus for long-term relationships with a caregiving robot, including humans' willingness to interact with the robot and the amount of time they would want to spend with it. Because responsiveness is known to affect perceptions of attraction and mate value in human relationships (Birnbaum & Reis, 2012; Birnbaum, Ein-Dor, Reis, & Segal, 2014), we expected that similar social mechanisms would come into play between humans and the robot. However, given that the robot was not a potential romantic partner for the disclosers, we were interested in a broader notion of attraction to and impressions of the robot. We therefore evaluated attraction in a more general sense and combined this metric with measures that assessed people's impression of the robot's positive human-like character traits (sociability, competence, and attractiveness).

We also explored whether humans would display attachment-related behaviors while interacting with the robot (e.g., proximity and reassurance seeking) and might actually use the robot as a source of consolation and security in times of need. Such behaviors may indicate that the robot serves safe-haven and secure-base functions similar to those served by a human attachment figure. Indeed, a caregiver who is responsive when an individual experiences distress assists in emotion regulation (i.e., acting as a safe haven) and instills a sense of security (i.e., acting as a secure base), which promotes feelings of competence for coping with future stressful circumstances (Bowlby, 1969/1982). Accordingly, we expected that a responsive robot would be more likely than an unresponsive robot to be approached, to be viewed as a desirable companion in times of distress, and to promote self-perception under stress.

Specifically, in two studies, participants disclosed a personal event to a non-humanoid robot that responded either responsively or unresponsively across two modalities (simple gestures and written text). In Study 1, participants disclosed a negative event to the robot and, after interacting with the robot, rated its responsiveness and appeal as well as their desire for robot companionship in times of need (a manifestation of the safe-haven function in attachment theory terms; Bowlby, 1969/1982). These interactions were videotaped and coded by independent judges for self-disclosure and approach behaviors towards the robot. Study 2 examined whether a robot's responsiveness in a different context, the disclosure of positive events, would produce positive reactions in people interacting with it and improve their self-perception during a subsequent stress-generating task (a manifestation of the secure-base function in attachment theory terms; Bowlby, 1969/1982).

1.3. Hypotheses

Hypothesis 1. A responsive robot (versus an unresponsive one) will be perceived as more responsive and appealing (sociable, competent, and attractive).

Hypothesis 2. A responsive robot (versus an unresponsive one) will elicit more approach behaviors during the interaction.

Hypothesis 3. A responsive robot (versus an unresponsive one) will increase the desire for its companionship when alone or under stressful circumstances.

Hypothesis 4. A responsive robot will improve self-perception during a subsequent stress-generating task.

Hypothesis 5. Perceived robot responsiveness will mediate this effect of the robot responsiveness manipulation on self-perception.

2. Study 1

Study 1 was designed to examine the effects of a robot's