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The bionic blues: Robot rejection lowers self-esteem☆

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ABSTRACT

Humans can fulfill their social needs with fictional and non-living entities that act as social surrogates. Though recent research demonstrates that social surrogates have beneficial effects on the individual similar to human relations, it is unclear whether surrogates can also cause similar harm to humans through social rejection. After playing a game of connect-4 with a human-sized robot, participants were informed by the robot that it would like to see them again (acceptance), would not like to see them again (rejection), or told nothing regarding a future interaction (control). Data revealed that social rejection from a robot significantly reduced self-esteem relative to receiving no-feedback and social acceptance (the latter two did not differ from each other). However, robot rejection had no impact on negative attitudes and opposition to the use of robots in everyday life. These findings demonstrate that social surrogates have the potential to cause psychological harm.

1. Introduction

Social bonds are fundamental to human living (Baumeister & Leary, 1995). A wealth of psychological research demonstrates the ill effect of disrupting or removing these social bonds in the forms of ostracism, exclusion, and rejection (Baumeister & Leary, 1995; Baumeister, Brewer, Tice, & Twenge, 2007; Leary, Tambor, Terdal, & Downs, 1995; Williams, 2007). For example, ostracism and rejection cause emotional numbness (DeWall & Baumeister, 2006), activate pain centers in the brain similar to experiences of physical pain (Eisenberger, Lieberman, & Williams, 2003), promote aggressive behavior (Leary, Kowalski, Smith, & Phillips, 2003; Twenge, Baumeister, Tice, & Stucke, 2001), and reduce self-esteem (Williams, 2007; Zadro, Williams, & Richardson, 2004).

The desire for social bonds is so strong that people often create relationships with fictional characters and non-living entities (Horton & Richard Wohl, 1956; Rubin, Perse, & Powell, 1985). People readily perceive and interact with computers as social actors, for example (Nass, Steuer, & Tauber, 1994). Such relationships appear to fulfill belongingness needs by acting as social surrogates, according to the *social surrogacy hypothesis* (Derrick, Gabriel, & Hugenberg, 2009; also see; Knowles, 2013). This hypothesis is based on the idea that needs can be indirectly satisfied through alternate means. For example, we can satisfy hunger without eating through the use of diet pills. Social surrogates are thought to satisfy belonging needs without establishing a real human connection. Social surrogates may be found in books, TV shows, movies, music, and video games because they approximate a social narrative that people can immerse themselves in. People then identify with characters in these media and establish a sense of connection. Primarily, social surrogacy is theorized to be motivated by human rejection as an attempt to reestablish a sense of social connection and belonging. Research indeed shows that social surrogates buffer against drops in self-esteem and increases in negative affect commonly elicited by social rejection from other people (Derrick et al., 2009; Pfundmair, Eyssel, Graupmann, Frey, & Aydin, 2015). If social surrogacy is capable of fulfilling basic human needs like belonging, however, then does surrogacy also have the same potential to cause psychological harm as human rejection? Prior research hints that harm is possible. For example, people expecting to lose a favorite TV show character anticipate that they would feel distressed, mirroring emotional reactions to social dissolutions (Cohen, 2004). Ostracism from a computer diminishes a sense of belonging and harms self-esteem (Zadro et al., 2004). However, no work has directly examined whether rejection from a social surrogate can have the same negative consequences as human rejection. This question is becoming increasingly important in our current world. A robot 'revolution' looms, artificial intelligence is on

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the rise, and humans increasingly use technology to satisfy social needs.

1.1. Robots are coming

Worldwide, billions of dollars are spent annually on developing robots that will care for the elderly, assist doctors in surgery, work in factories, help people shop, and fight alongside human soldiers. Prominent roboticists argue that robots will become fully integrated into society within the next few decades in what is dubbed as the 'robot revolution' (Ripley, 2014). Given this significant societal change, it is important to examine the impact of such technology on human cognition, affect, and behavior. Robots are often programmed with artificial intelligence to act like humans. Unfortunately, such artificial intelligence has already been shown to have harmful consequences. For example, after just a few hours online, Microsoft's 'Tay' bot began to espouse genocide of Jews, Blacks, and Mexicans based on social learning from other people on twitter (Owens, 2016). Similarly, Google's photo app program began to classify Black people as gorillas based on human input into the machine-learning algorithm (Crawford, 2016).

The present research, therefore, examines the impact of both social surrogate acceptance and rejection on self-esteem from a real, life-sized robot in an interpersonal context. Additionally, the present research explored whether social surrogate acceptance and rejection had a carryover effect onto more general evaluations of robots. Previous research suggests that social rejection can increase aggression toward others (e.g., DeWall, Twenge, Gitter, & Baumeister, 2009; Leary et al., 2003; Twenge et al., 2001).

In the context of human intergroup relations, research suggests that individual experiences with an outgroup member have the potential to carryover and impact global evaluations of the entire outgroup (e.g., McIntyre, Paolini, & Hewstone, 2016; Pettigrew, 1998; Pettigrew, Tropp, Wagner, & Christ, 2011). Therefore, in the current study, we explored whether social surrogate rejection and acceptance would impact more general attitudes towards robots, as measured with negative attitudes toward robots as well as support for public policies relating to the use of robots in everyday life.

2. Method

2.1. Participants

A total of 147 people from a large New Zealand university were recruited for the study in exchange for course credit or a $10 gift voucher. Our sample was collected from the University of Canterbury's psychology participant pool. In line with recommendations by Landers and Behrend (2015), our sample matches the bulk of past research on self-esteem and rejection allowing for easier comparison. Further, the effect of rejection on self-esteem from these samples is generalizable (Blackhart, Knowles, Nelson, & Baumeister, 2009). Previous studies examining the effects of social rejection used sample sizes ranging between 10 and 25 per condition (e.g., DeWall & Baumeister, 2006; Leary et al., 1995; Twenge et al., 2001; Zadro et al., 2004), Prior research demonstrates rejection has a moderate to large effect on self-esteem (Gerber & Wheeler, 2009). A power analysis based on these effect sizes in the G*power statistical package (*statistical test*: Many Groups ANOVA: One Way; *effect size* $f = 0.35$; α *level* $= 0.05$; *power* $= 0.80$; *number of groups* $= 3$) suggests a sample of 84 is needed to obtain 80% power. However, prior research also demonstrates that small differences between control conditions or rejection conditions can have a significant impact on effect sizes (Blackhart et al., 2009). Further, published research tends to inflate effect size estimates. Because of this, we followed a more rigorous heuristic from Simmons, Nelson, and Simonsohn (2013) and aimed to recruit 50 participants per condition for a sample of 150. At the end of the data collection year, we had 147 participants, of which, 6 failed the manipulation check (described below) and 2 others experienced technical difficulties during the study forcing us to cancel their sessions. Of the remaining 139 participants, 93 identified as female, 44 as male, and 2 as other. Participants were between the ages 17–46 years ($M = 20.14$; $SD = 4.30$).

2.2. Materials

Participants interacted with the Baxter robot designed by Rethink Robotics (http://www.rethinkrobotics.com/baxter/). Baxter is a 6-foot humanoid robot with a collection of integrated sensors and displays for safe interaction with humans. The robot is fitted with cameras to allow it to evaluate its surroundings and make judgments for where to move objects. Baxter was designed to handle a wide range of tasks in the manufacturing sector and is already working amongst humans in factories to complete various monotonous tasks. The robot's face itself is a screen where we installed neutral facial expressions with a periodic eye-blink. For the current experiment, the robot was programmed to play Connect 4 (Hasbro Inc.) with a participant (see Fig. 1). In addition, the robot was given speech using the IVONA voice generating program such that the participant could talk with the robot, controlled by a second experimenter, discreetly present in a neighboring control room.

2.2.1. Manipulation and procedure

Participants filled out a consent form and demographic information sheet (age, gender, nationality, education, and major) outside the main interaction room. Upon entering the room, participants were introduced to 'Baxter', a new member of the psychology department. Participants exchanged pleasantries with the robot, including their name, where they were from, and what they study. The robot then asked participants if they would like to play a game of connect 4 because it got bored on its own and enjoyed playing games when possible. All participants agreed to this request and were then left alone with the robot to play connect 4 while being covertly monitored by video camera (see Fig. 1). Although the video was not recorded, it was monitored to ensure participants properly interacted with the robot. The video camera was placed on the room ceiling and out of sight of the participants, while the video was streamed into the neighboring control room. Participants were only informed of the video monitoring as they were debriefed at the end of the study and were given the option to have their responses deleted if they felt uncomfortable with any aspect of the study. However, none asked to have their data deleted.

Toward the end of the game, the experimenter knocked on the door at which time the robot said: "Looks like our play-date is almost over." The experimenter briefly informed participants that they had left a form for them on the table outside that they can complete before finding them at the end of the hallway. The game was soon completed, at which time, participants were randomly assigned to hear one of three responses from the robot: in the acceptance condition, the robot said: "That was fun, I would like to play with you again sometime" followed by "have a good day" and "goodbye". In the control condition, participants heard "have a nice day" and "goodbye". However, in the rejection condition, participants were told "That was boring! I don't want to play with you again" immediately followed by "goodbye". The timing of the two statements was intentionally setup close together in this condition to sound like a dismissal. After participants left the robot room, they completed a package of questionnaires that was waiting on the table outside of the robot's room. The first measure was our