The effects of exclusion by a robot on self-esteem and prosocial behaviour

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Abstract

There is extensive literature dedicated to investigating the effects of exclusion on interpersonal behaviours and emotions. Standard exclusion procedures typically involve, face to face, imagined and anticipated exclusion. Although more recently, research has begun to focus on the effects of rejection through technology (for example, being ignored by peers over the internet). To extend this emerging trend of research, the current thesis looked at exclusion *by* technology in the form of a Baxter robot. The procedure involved having participants play a game of Connect4 with "Baxter" and 1 in 3 being they were boring to play with, prosocial behaviour and self-esteem was subsequently measured. Anthropomorphism was also captured as a potential moderator for exclusion. It was predicted that, following rejection, people would be less likely to volunteer and have lower self-esteem compared with accept and control conditions with outcomes exaggerated for those high in the tendency to anthropomorphise. As hypothesised self-esteem decreased following exclusion however, there was no significant effect of pro-social behaviour and anthropomorphism. Results and implications are discussed further.

The effects of exclusion by a robot on self-esteem and prosocial behaviour

2.1 Overview

Social bonds are a fundamental requirement for physical and mental health (Baumeister & Leary 1995, Smith, Murphy, & Coats, 1999). To illustrate, social support facilitates faster recovery of hospital patients, is correlated with a reduced likelihood of developing cancer (Reynolds & Kaplan, 1990) and is associated with an overall positive affect (Buckley, Winkey & Leary, 2004; Pinquart, & Sörensen, 2000). Conversely, lack of attachment and social exclusion are linked with a variety of ill effects on health, adjustment and well-being (Baumeister & Leary, 1995; Williams, 2002). Comparable research also demonstrates that feeling disliked or rejected increases negative affect, lowers self-esteem, increases antisocial tendencies, and decreases pain sensitivity (for a full review, see Baumeister, Brewer, Tice & Twenge, 2007; Blackhart, Knowles, Nelson, & Baumeister, 2009).

The idea that people are motivated to form social bonds is not new to psychology with a number of theories affirming the need for social connections. Evolutionary theorists emphasize the significance of maintaining dyadic alliances as a 'biological strategy' for mating and sharing of tasks (Baumeister & Leary, 1995; McDonald & Leary, 2005); personality and attachment scholars posit that a central, innate motivation to form relationships is an integral part of the human psyche (Deci & Ryan, 2000; Bowlby, 1969). Baumeister and Leary's (1995) Belongingness Hypothesis asserts people form social attachments readily and resist the dissolution of existing bonds. Likewise, cultural, socializing influences promote the value of friendship and maintaining families (Harris, 1995). Therefore, because humans are fundamentally social creatures, rejection or exclusion directly affects interpersonal behaviours and emotional outcomes (Leary, 1990; Williams, 2002; Twenge, & Baumeister, 2005).

As the need to form social attachments is so pervasive, people can look for these outside of human companionship; for instance, technology is a vehicle for people to have social affiliations without ‘real’ human contact. Social surrogacy, for example, is where people form parasocial relationships to favoured television characters, with benefits of watching loved TV shows including reduced loneliness and increased belongingness (Derrick, Gabriel, Hugenberg, 2003). Additionally, there is a wealth of evidence suggesting that individuals can feel social connections to technology as people reciprocate self-disclosures, act politely and demonstrate in-group favouritism towards computers they have interacted with (Fogg, & Nass, 1997; Nass, Fogg, & Moon, 1996; Nass, Moon, & Green, 1997; Nass, Moon, Fogg, Reeves, & Dryer, 1995; Nass, & Moon, 2000; Nass, Steuer, Henriksen & Dryer, 1994). Because people already feel connected through and respond socially to technology, rapid advancements will likely increase the prevalence of social requirements being filled without human contact.

In particular, autonomous robots are quickly becoming agents which we will interact with on a daily basis. A relevant example includes the production of robots to aid the elderly and disabled, due to the shortage of skilled labours in caring professions (Forlizzi, DiSalvo, & Gemperle, 2004; Prescott et al., 2012). Additionally, it is predicted that robotic technology will be progressively used to make critical life or death decisions in medical settings, to forecast stock market changes or to detect liars in legal situations (Waytz, Cacioppo, & Epley, 2010). Since industrial advancements have enabled us to start building robotic systems capable of co-operating with people (Kidd & Breazeal, 2005), better understanding the social dynamics between robots and humans is very applicable.

To examine this, the current thesis will assess if a robot can thwart the fundamental human drive to feel accepted. This will be tested by investigating whether exclusion by a robot elicits well researched responses to exclusion by humans, specifically decreased self-esteem and reduced prosocial behaviour. Additionally, this research seeks to investigate whether exclusion by technology is hurtful for anyone, or particularly among people with a high tendency to anthropomorphise (Waytz, Cacioppo, & Epley, 2010).

2.2 Exclusion and Self-Esteem

Self-esteem (SE) is considered a stable trait with high test-retest reliability (Baumeister, 1991; Rosenberg, 1986); however, there are several theoretical frameworks proposing that SE changes as a result of social exclusion and inclusion (e.g. Coopersmith, 1967; Leary, Tambor, Terdal, & Downs, 1995; Mead, 2009). Leary and colleagues (1995) proposed that SE is linked directly to perceived inclusionary status, theorized as an inner gauge or 'sociometer' of social acceptance. A decrease in SE would thus result from exclusion, signalling to the individual that their need to belong has been hindered. Conversely, acceptance should increase SE as it indicates desired social connections are or will be satisfied.

In support of the sociometer theory, real world studies confirm exclusion is connected with low SE (Leary, 1990; Pyszczynski, Greenberg, Solomon, Arndt, & Schimel, 2004). Typically examined through sociometric status (i.e. peer nominations of liking and disliking) or perceived rejection, those who are chronically excluded report lower SE than those who are not rejected (Blackhart et al., 2009). However, correlational results of exclusion and SE are not entirely consistent with those found in laboratory studies.

Because people are strongly driven to form social attachments and emotional reactions are assumed to reflect motivationally relevant outcomes (e.g. Baumeister & Leary, 1995), exclusion should impair SE. Though some research has supported this notion (see Vandevelde and Miyahara, 2005; Williams, 2002; Williams, 2007; Williams, & Zadro, 2005) a number of researchers have surprisingly failed to find such predicted patterns (see Twenge, Baumeister, Tice, & Stucke, 2001; Twenge, Catanese, & Baumeister, 2003). Additionally, a recent meta-analysis by Blackhart et al., (2009) found no significant difference in SE, compared to control conditions, in experimental lab research. The failure to see a decrease in SE presents a challenge to the sociometer hypothesis since an inner gauge of social acceptance should decrease after a salient exclusion. However, in partial support laboratory experiments consistently find SE increases after being accepted.

In an attempt to explain the discrepant findings above, authors have suggested potential reasons laboratory exclusion and field studies yield different results. First, people may have entrenched and effective defences against losing SE causing emotional numbness instead of decreasing SE (DeWall, Baumeister & Voh, 2006; MacDonald and Leary 2005). Second, as acceptance boosts SE manipulations are more likely to show an effect when comparing reject and accept instead of reject and control conditions (Blackhart et al., 2009). Last, it has been demonstrated that stronger degrees of rejection (e.g. left out of a group or reliving past rejection) elicit more negative consequences compared with 'softer' exclusions (e.g. imagined and possible or anticipated exclusion) (Blackhart et al., 2009; Leary, 2001, 2005; Williams, & Zadro, 2005). Integrating the mixed findings, SE does appear to decrease after both 'real-world' and experimental rejection however; effects are influenced by specific manipulations and comparison groups.

2.3 Exclusion and interpersonal behaviours

Although SE is a theorized gauge of acceptance, repeated rejection does not completely diminish personal SE but rather self-protective measures take effect; however, research on specific behavioural and emotional reactions succeeding rejection varies. While a number of studies support aggression as an outcome of exclusion a contrasting body of literature argues people attempt to reduce negative moods following rejection by acting altruistically (Cialdini, & Kenrick, 1976).

A predominant argument for exclusion causing aggressive behaviour is that once rejected, people cope by becoming emotionally insensitive (DeWall & Baumeister, 2006; MacDonald & Leary, 2005; Twenge et al., 2007). There has been a variety of evidence from both humans and nonhuman species showing a reduction in pain sensitivity following exclusion (DeWall, Baumeister & Voh, 2006; MacDonald and Leary, 2005). The posited theory being, an initial numbness affords some time for coping processes to begin, comparable to the release of opioids that enable animals to keep functioning after an injury (Baumeister, et al., 2007; Eisenber & Miller, 1987). Supporting the above research has established breakdowns in emotional responses such as: affective forecasting, empathetic reactions and moral reasoning following exclusion (Dekovic & Gerris, 1994; Twenge et al., 2007a). Thus rejection numbs the emotional system preventing further pain, but also the ability to empathize and perspective take, potentially increasing antisocial reactions.

In support of the above, constant exclusion is associated with an increase in violence, not only towards those at fault, but to the general population (Leary, Kowalski, Smith & Phillips, 2003; Leary, Twenge & Quinlivan, 2006; Twenge, Baumeister, Tice, Stucke, 2001). An ethnographic analysis of school shooting incidents concluded that nearly all adolescent perpetrators had at some point experienced chronic social rejection in the form of ostracism, bullying, and romantic rebuff (Leary et al., 2003).An example includes the infamous Columbine shooting which was precipitated by persistent exclusion from peers (Cornell, 1999; Peterson, 1999).

A number of experimental studies support aggression as an outcome of exclusion. For instance, people told they will end up alone later in life or that on one wants to work with them in a collaborative task causes an increase in anger and aggressive behaviour (Buckley, 2004; Twenge et al., 2001; Twenge et al., 2007). However, maladaptive responses to exclusion are not limited to aggression and hostility; they can also take the form of refusing to be prosocial.

Prosocial behaviour refers to actions performed to benefit others rather than oneself (Twenge et al., 2007). Experimental research has affirmed that manipulating exclusion leads to a reduced likelihood of donating money to a student fund, volunteering for future lab experiments, being unhelpful after a mishap, and not cooperating in mixed-motive games (Twenge et al., 2001; Twenge et al., 2007). Because pro-social behaviour depends on the belief people will mutually aid and support each other, exclusion reduces motivation to behave in an altruistic manner (Twenge et al., 2007).

Contrasting with the above there is evidence that people act more philanthropically following rejection. As decreased mood is a causal outcome of rejection (see Blackhart et al., 2009 for a full review) the negative-state relief model posits that helping people is a way to alleviate this. Supported through the research of Cialdini and Kenrick (1976), participants with induced negative moods were more likely to privately donate money. However, it is not just negative affect that increases helping behaviour, positive affect is associated with contributing to charity, donating blood and helping co-workers (Isen, 1999).

Integrating these varied findings, acting unsociably is more prevalent than engaging in prosocial behaviour following rejection. Theorized by Baumeister and colleagues (2007) initial rejection renders individual’s sensitive to the possibility of further exclusion and coping mechanisms activate as an avoidance strategy (Baumeister et al., 2007). This reduces the desire to help or cooperate and in extreme circumstances the concern for acceptance and well-being of others (Twenge et al., 2007b; Williams, 2007).

2.5 Exclusion and technology

Recently, work on exclusion has begun to explore its effects through technological mediums. For instance, there is an established link between depression, Facebook use and greater internet use in general (Kraut et al., 1998; Moreno et al., 2011; Sanders, Field, Diego & Kaplan, 2000; Rintel & Pittam, 1997). Additional research on exclusion through technology has found that negative outcomes parallel face-to-face interactions, regardless of whether it occurs over a computer, the internet, or a cell phone (Williams, Cheng & Choi, 2000). To illustrate further, Williams, et al., (2000) established that even in virtual reality, people can perceive they are being ignored. In their form of computerised cyber-ball, individuals were ostracised by unseen others in cyberspace. Even though exclusion through technology has the potential to be less frustrating and debilitating than physical or social ostracism (i.e. it lacks the standard cues usually available to targets of face-to-face ostracism), people still demonstrate aversive reactions to being ignored.

While previous work has confirmed that individuals can feel ostracised or excluded by other humans through technology, research has now surpassed this showing technology on its own can cause people to feel excluded. Referring back to the overview, the need for social connections is so strong that people can seek this through parasocial relationships and form temporary social connections to computers (e.g. reciprocity, in-group favouritism etc.). More recently, it has been shown that the desire to be accepted is so pervasive that exclusion by a computer can cause deleterious effects. In an experiment by Zadro and colleagues (2004), half of participants were told they were playing cyber-ball with two other individuals' stationed in similar laboratories (typical procedure), while the other half were told they were playing with the computer. It was found that, independent of the source, ostracized participants reported lower levels of belonging and self-esteem. In other words, individuals responded to the computer the same way they would react to humans.

The above demonstrates that even exclusion from a computer has immediately negative and depleting consequences. However to add further support to Zadro and colleagues' (2005) research the current thesis will investigate whether rejection by a robot also reduces SE. Mentioned earlier, a defensive reaction to losing SE includes the reduced likelihood of helping others. As it has already been established that ostracism *by* technology decreases SE this paper will investigate whether this extends to acting less prosocial. Also it has not yet been explored whether acceptance by technology boosts SE, similar to inclusion by peers.

2.6 Anthropomorphism

Although overall people respond socially and feel excluded by computers there is a spectrum on which people differ in their tendency to humanize technology. Because certain individuals are more likely to treat and believe technology is more human than others those higher in the tendency to anthropomorphism will likely feel more excluded by a robot than people lower on this spectrum.

Anthropomorphism is defined as attributing humanlike characteristics to non-human agents including physical appearance (Bartneck, Kulic, Corft & Zoghbi, 2009), emotional states (Leyens, Cortes, Demoulin, Dovidio, Fiske, Gaunt, & Vaes, 2003), and inner mental states and motivations (Gray, Gray & Wegner, 2007). A number of authors have asserted that humans instinctively anthropomorphise technology (Brezeal, 2003; Duffy, 2010). Though there is support for the idea that anthropomorphism occurs naturally (see Buccino, Binkofski, Fink, Fadiga, Fogassi, Gallese, & Freund, 2001; Gazolla, Rizzolatti, Wicker & Keysers, 2007; Premack & Premack, 1995 Kunda, 1999), recent research has suggested that the tendency to anthropomorphise differs among individuals and is a stable and measurable trait (Waytz, et al., 2010).

When comparing people with a high versus low tendency to anthropomorphise, there are a number of ways individuals differ. For instance, those prone to anthropomorphise are more likely to attribute secondary emotions, trust and make moral judgements regarding technology, and hold non-human agents responsible for their actions (Hinds, Roberts, & Jones, 2004; Waytz et al., 2010). These findings generalize to research on exclusion and technology for a number of reasons. First, when people perceive non-human agents as having a humanlike mind it renders agents more worthy of blame (Hinds et al., 2004; Waytz et al., 2010). Hence, when individuals are rejected by a robot they may be more likely to assume it is as responsible for its actions as a person. Second, projecting human thought processes onto a robot would mean that when excluded they are more likely to assume it is for similar reasons that a human would have e.g. they were uninteresting, unintelligent, unattractive etc. Therefore, people high in the tendency to anthropomorphise should attribute greater sense to the Baxter robots actions and have more negative responses when excluded.

2.7 Current research

The aim of the current research is first to establish the effects of exclusion by a robot on behaviours and self-perceptions. Also, it will establish whether a high tendency to anthropomorphise technology moderates individual outcomes of exclusion by a robot. This will be done by having participants play a game of Connect4 and subsequently be excluded, accepted or told nothing regarding future interaction (control). Anthropomorphism will be measured pre-interaction while the personal self-esteem and prosocial behaviour will be measured post interaction. Asking participants if they would volunteer for future experiments will capture prosocial behaviour.

2.8 Hypotheses and research aims

Hypothesis 1–Those in the excluded condition will demonstrate lower levels of SE compared with control and acceptance showing the highest level of SE.

Based off research demonstrating that ostracism by a computer can reduce SE the current study is expected to parallel these results (Zadro et al., 2010). Additionally as humans respond to technology in a similar fashion they would other people it is expected this will translate to increased SE following acceptance as supported by past research (Fogg, & Nass, 1997; Nass, et al., 1996; Nass, et al, 1997; Nass, et al, 1995; Nass, & Moon, 2000).

Hypothesis 2 – Those who are excluded will demonstrate less prosocial behaviour compared with control condition and those who are accepted by the robot will be the most prosocial toward others.

As reduced prosocial behaviour is consistently linked rejection (DeWall & Baumeister, 2006; MacDonald & Leary, 2005; Twenge et al., 2007), those excluded are expected to act less altruistically. Once again, based off previous literature that people react to computers and robots similar to humans; rejection from the Baxter robot should reduce prosocial behaviour. Based on research of positive mood increasing altruism we also predict that people in the accept condition are more likely to volunteers than reject and control (Isen, 1999).

Hypothesis 3 – People with a higher tendency to anthropomorphise will show lower SE and less pro-social behaviour following exclusion.

Since research has shown people with a greater tendency to anthropomorphise are more likely to grant a non-human agent moral regard and attribute humanlike mental capacities (Hinds et al., 2004; Waytz et al., 2010) it expected that those more likely to anthropomorphise will have greater adverse reactions to exclusion by a robot.

Method

3.1 Participants: 108 undergraduate students enrolled at the University of Canterbury took part in the study in exchange for course credit or a $10 gift voucher (31 males, 69 females, *M* age = 20.2, SD = 3.7).

3.2 Materials/Equipment

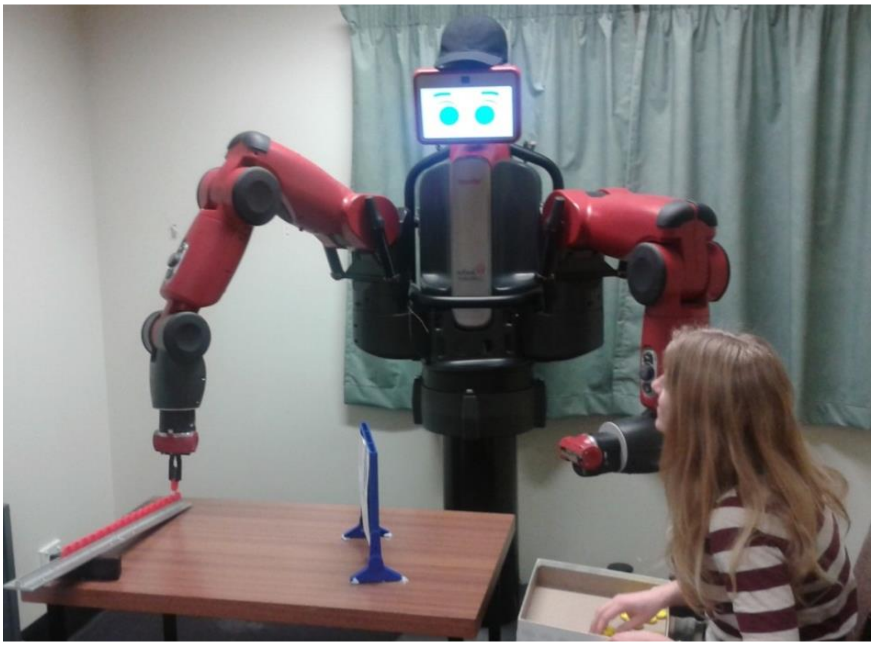
Experiment and control room: All 108 participants were individually tested in a quiet, well lit laboratory room with no external windows. The experiment room only contained the robot (Baxter), a desk for the Connect4 game, and a chair for participants. Next door to this was the control room where an experimenter managed the functions of the robot. The hallway was used for students to fill out questionnaires. Because the experimental room is in an isolated part of the building, participants were in complete silence when filling out forms both before and after interaction.

Baxter robot: The Baxter Research robot, designed by Rethink Robotics was used in the present experiment; refer to Image 1 for example. It has a humanoid form of motion, with a collection of integrated sensors and displays for safe interaction with humans. For the current experiment it was programmed to play Connect4 (a game where the goal is to get four game pieces in a row of any orientation, i.e. horizontal, vertical, and diagonal).

The Baxter robot was set up to play Connect4 by positioning the left hand so that the camera can view the game board and the right hand was located in a position to pick up the playing pieces and drop them in the game set. Worth noting is that if at any point the game set or piece holder moved then play would be disrupted as the Baxter robot does not have the ability to self-correct its motions.

The Baxter robot's vision is oriented in the control is oriented by a computer, this involves dragging an outline of a green box so that it surrounds the board, refer to Image 2. Once the vision has been validated and the pick and drop positions have been adjusted, the difficultly level is selected (level 2), the player order is chosen (in the current context, the robot always starts) and all other functions are automated.

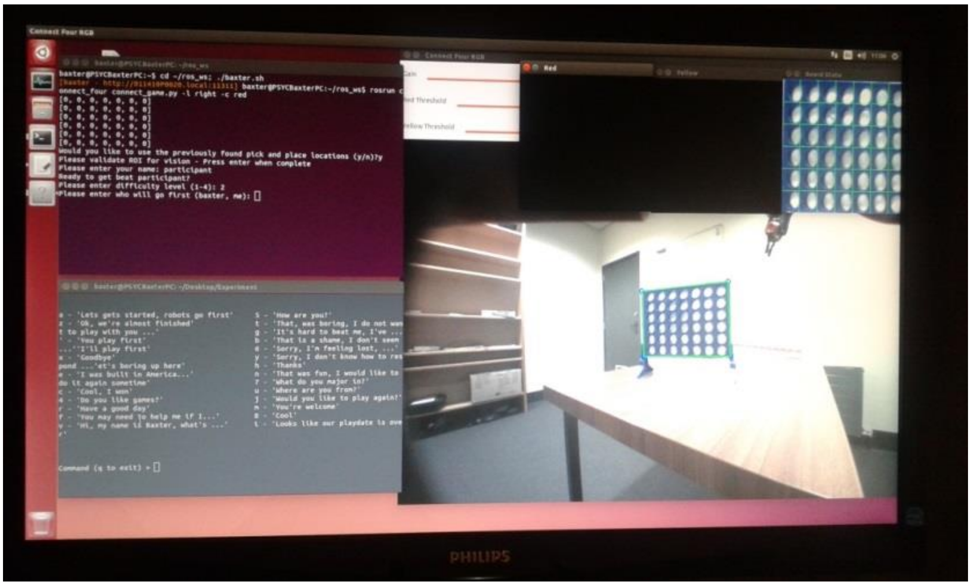
Image 1. Example of Participant and Baxter playing Connect4



Voice files: Baxter's speech was designed by creating voice files using the IVONA voice generating program. The voice of a young American boy was chosen, as Baxter was created in America. Once all the speech files were created (refer to Appendix A for full script), they were downloaded onto the control room computer, given a corresponding letter, and when pressed would cause Baxter to "talk" through the attached speaker. For example, when key x was pressed, Baxter would say: "Hi, my name is Baxter, what's your name?" The same voice was used across conditions.

Computer: The computer was connected to Baxter and used to set up the game of Connect 4, provide vision to the control room, and direct the speech. Image 2 provides an example of the computer view. The top right image is the game set up, where player order is selected and difficulty level is chosen. Just below are the voice files where the chosen letter is entered for speech to be played through the speaker to the experiment room. Last, referring to Image 2, the view from the left hand camera allowed the researcher to see when the game was over, and when experimenter/participant entered the room.

Image 2. View of Computer Screen



Microphone: A microphone was attached to Baxter's back and connected to a speaker in the control room. This allowed the researcher to hear what was being said in the experiment room.

Face: Baxter's face was designed by a graphic designer to appear friendly and unthreatening. Referring to Image 3 (pg 18), the "neutral" face (left) was on a video loop to blink every ten seconds during interaction.

3.3 Dependent measures

Two scales and one behavioural measure were used in the experiment including: the individual tendency to anthropomorphise questionnaire (IDAQ), and the Rosenberg Self-Esteem Scale. The behavioural measure was captured through participants 'volunteering' for further experiments. Both scales were held to best practice recommended levels of internal consistency which is greater than 0.7 (Cronbach, 1951).

IDAQ – Created by Waytz and colleagues (2010) the IDAQ includes 30 items classified into 3 subscales: S1, anthropomorphism of animal stimuli, S2 anthropomorphism of non-animal stimuli (e.g. technology and nature) and S3 which captures all items pertaining to spiritual agents. Each item was scored on a 0-10 likert scale 0 being "not at all" to 10 being "very much" However, since the present study uses a robot, we only used the 5 items relatomh to technology. An example item is "To what extent does a computer have a mind of its own?". The internal consistency of the 5 items was adequate at .73.

Rosenberg self-esteem scale (RSE) – Formulated by Rosenberg (1986), the RSE is a 10 item measure of self-esteem. Each item is scored on a 1-4 likert scale 1, "strongly agree" 4 "strongly disagree" with examples of items including "I feel that I have a number of good qualities" and "At times I think I am no good at all. This measure had very high internal consistency of .90.

Pro-social behaviour: The behavioural measure used in this work was a validated measure used in previous exclusion research (Twenge et al., 2007). For the current experiment this involves participants leaving their email address if they wish to 'volunteer' for further research.

3.4 Procedure

The interaction between the experimenter and robot were all designed to make Baxter appear to be a thinking agent. The robot was referred to as a "he" throughout interaction because the stature of the robot, voice and name were more suited to a young male rather than a female. The current procedure is split into three components including the pre-interaction phase, interaction with robot phase, and alone phase, see Appendix A for full interaction script.

Pre-interaction all participants were provided with an information sheet and consent form, containing information about the required experiment (see Appendix B). Participants were informed that the study involved the effects of robot interaction on attitudes towards robots. If participants agreed to take part in the study they signed the consent form and were then instructed to fill in the IDAQ questionnaire. Once all scales had been filled in, participants were told they would play *one* game of "Connect 4" with Baxter. After this, there would be more questionnaires waiting for them that they should leave on the desk once finished. After the game had concluded and forms were filled in participants were told they could leave.

Pre-interaction conversation: Before entering the interaction room, participants were told not to ask Baxter any questions during the game, because "he" needed to concentrate on the game. As Baxter only had a limited number of voice files, it was unable to respond to anything that had not been pre-scripted, hence if questions were asked there would be no response and the illusion of Baxter as a thinking entity would be damaged. In addition, this ensured that participants would have a similar level of interaction with Baxter because they would be asked the same questions and provided the similar responses.

Interaction with robot phase: Upon entering the room participants were seated and told to place the box containing the game pieces on their lap. At some point during this explanation, Baxter would interrupt the introduction by saying “Hi, my name is Baxter. What’s you name.” Baxter would then be told not to interrupt to which it would reply “Sorry.” The experimenter would then introduce Baxter to the participant by saying “That is ok… this is [insert participant name]… s/he will be playing with you.”

Once it was only the participant and robot in the room, Baxter would ask the participant “Do you like games?” After the customary “yes”, Baxter would then say “it gets boring up here, so I like to play Connect 4; would you like to play with me?”. Baxter would then inform participants that sometimes his hands don’t work well and he may need help with the pieces. After participants have agreed to this Baxter says “Let’s get started… robots go first!”.

When the game commences, Baxter asks the participant a few questions about their life with which there are pre-planned responses. When the game is nearing an end, the experimenter re-enters the room and explain that the questionnaires are set up. In addition, it is stated that the psychology department is always looking for volunteers to do more experiments and if they are interested in volunteering, they should write their email address on the sheet provided, but to not feel any pressure to do so. Participants are told that they can leave once the questionnaires have been complete and Baxter responds with “That’s cool, we’re almost finished”.

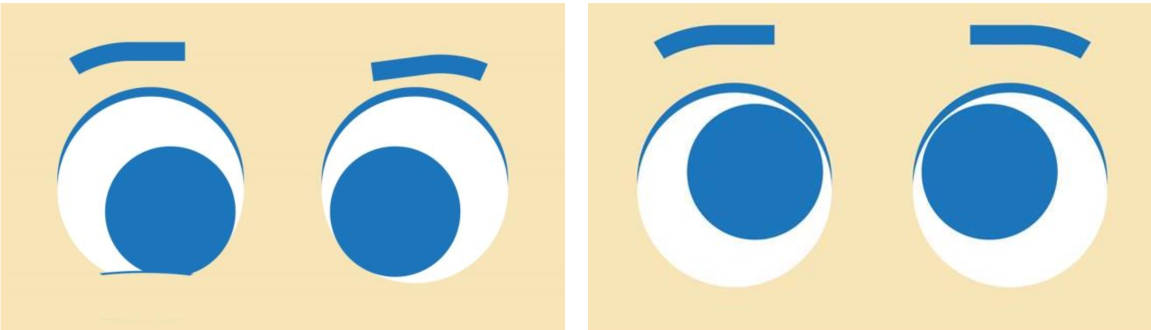
Post interaction phase: After the game ends participants leave the room and finish the remaining questionnaires. Once all forms are completed, participants are debriefed on the nature of the experiment, see Appendix C for debriefing sheet.

3.5 Manipulation

For all participants following Connect4 Baxter says “looks like our playdate is over”, after this, the manipulation occurs. If assigned to the *accept* condition, participants are told “That was fun, I would like to do it again sometime”; “have a good day” and “Goodbye”. In the control condition, they are only told “Have a good day” and “goodbye”. However, in the exclusion condition, participants are told “That…was boring… I don’t want to play with you again”, “Goodbye”.

In addition to the altered speech, the timing of “Goodbye” is also manipulated; if a participant is being rejected, goodbye is said straight after being told they are not wanted to be played with again. Compared to the other conditions goodbye is said as participants leave the room, to seem like a friendly gesture rather than a dismissal. In addition to the verbal reject, Baxter’s facial expressions were also modified to appear more unfriendly during exclusion (see photo on right)

Image 3. Baxter’s face



Results

Manipulation checks: To assess the source of manipulation a verbal manipulation check was carried out at the end of the study prior to debriefing. Participants that correctly identified they had heard Baxter reject or accept them were included in the data. 8 participants were excluded from analyses because they either did not hear the manipulation, or because they experienced technical problems during the experiment.

Table 1. Means and Standard deviations of self-esteem and prosocial behaviour

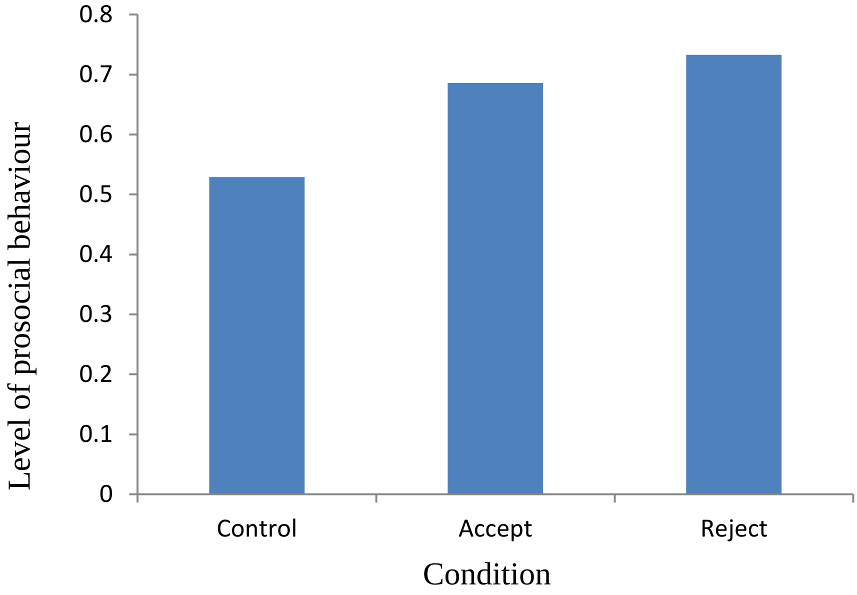
	Exclude	Accept	Control
Self-esteem	*M* = 17.37	*M* = 21.34	*M* = 20.71
	SD = 1.08	*SD* = 1.00	*SD* = 1.00
Pro-social behaviour	*M* = .733	*M* = .686	*M* = .529
	SD = .09	*SD* = .08	*SD* = .08

Self-esteem: Referring to Table 1, means and standard deviations are reported of self-esteem following the manipulation. Statistical analyses in the form of a one-way ANOVA revealed there was a significant group difference, $F(2,97) = 4.14$, $p = .019$, $\eta_p^2 = .08$. Planned contrasts indicated that results support the initial hypotheses with participants in the excluded condition reporting significantly lower levels of SE compared with control $t(97) = 2.28$, $p = .025$, and accept, $t(97) = -2.708$, $p = .008$. However, the hypothesis that SE would be higher for accept compared to control was not supported $t(97) = -.446$, $p = .673$.

Prosocial behaviour: Since prosocial behaviour is a categorical variable, volunteering was coded as 1 and not volunteering coded as 0. Means and standard deviations are reported in Table 1. A chi square analysis revealed there was no significant group effect on prosocial behaviour c^2 (2, $N = 100$) = 3.27, $p = .195$, $\eta_p^2 = .03$. Referring to Graph 1, there does appear to be a trend of control conditions being less likely to volunteer than accept and reject conditions. However, this may be the result of a small sample size.

Moderation: Next, we tested the moderation hypothesis by including anthropomorphism and its interaction with SE and prosocial behaviour. Inconsistent with our hypothesis, there was no interaction between tendency to anthropomorphise and prosocial behaviour, $F(5,99) = .73$, $p = .587$, $\eta_p^2 = .04$ or SE, $F(5,99) = 1.71$, $p = .140$, $\eta_p^2 = .08$.

Graph 1. The effects of acceptance and rejection on prosocial behaviour



Discussion

5.1 General Discussion

The current research sought to extend literature on exclusion by investigating if rejection by a robot was powerful enough to affect behaviours and self-perceptions. Second, we wanted to establish whether a high tendency to anthropomorphise technology would moderate individual outcomes of exclusion by a robot. This was assessed through having participants interact with a robot who subsequently informs them whether it wants to see them again (accept), does not want to see them again (exclude) or nothing regarding future interaction (control).

Findings of the current study supported hypothesis 1 that exclusion would decrease SE, adding further evidence to Leary's sociometer theory. However, not fitting the sociometer theory and contradicting the majority of past research, acceptance did not significantly increase SE. Posited by Leary and colleagues (2001), successfully maintaining connections requires a system for monitoring social reactions to oneself. This is posited as being vital for detecting potential exclusion due to its evolutionary deleterious effects on survival. Hence, a potential reason for not seeing significantly higher SE when comparing accept with control conditions is that emotional reactions to exclusion usually have a more powerful effect than acceptance (Blackhart et al., 2009). A further reason for seeing little difference between accept and control is that both left with a friendly message from the Baxter robot, potentially causing similar reactions.

Results establishing exclusion by a robot can reduce SE is also consistent with Zadro et al's., (2004) study where individuals felt ostracized by a computer. Reviewing the results of the current study as well as Zadro and colleague's work, a tentative conclusion is that social exclusion affects individuals regardless of whether the source is human or electronic. A likely reason is that primates and other species are so innately attuned to exclusion, that the slightest hint of rejection is enough to tip off emotional reactions.

Hypothesis 2 predicting that the reject condition would volunteer least and accept would demonstrate the highest level of prosocial behaviour was not supported. Though it is noted that definite inferences cannot be drawn from non-significant results a cautious inference is that there did appear to be trends in the data. Those rejected had comparable levels of prosocial behaviour with accepted participants and both seemed more willing to volunteer than control participants. This only partially aligns with predicted results as the accept condition was hypothesized as having the most prosocial behaviour and reject the least. As aforementioned, there are two contrasting bodies of research that expect different outcomes of exclusion. Due to majority of literature suggesting aggression is the primary response to exclusion we predicted this also; however, present results appear to align with the negative state-relief model. A potential reason is that exclusion from a robot was not hurtful enough to elicit coping processes that cause emotional insensitivity. Instead, it may have only resulted in a decreased mood which was eased by acting altruistically. However, additional data is required to verify assumptions based off trends.

Hypothesis 3 predicting anthropomorphism would moderate the effects of exclusion was also not significant. Potentially explaining the above findings is that when we are faced with non-living things of sufficient complexity a social model is often applied to explain, understand and predict behaviour (Higgins, 1989). Therefore, understanding technology would likely prompt people to act out mindless social scripts when responding to robot behaviours. Exclusion from a computer may they elicit analogous effects as it would from a human, regardless of their tendency to anthropomorphise.

Further explanations for why anthropomorphism failed to moderate exclusion is that certain situations cause people to humanize technology more than others. In the case of anthropomorphising non-human agents, typically there is process of reasoning that bases actions off a better known stimulus i.e., humans (Ripis, 1975). By attributing humanlike characteristics and motivations to nonhuman agents, this increases one's ability to make sense of its behaviours (Epley et al., 2007). Thus salient knowledge acts as an "anchor" or "inductive base" that is then projected onto the nonhuman target. The theorized reason for using such a base is that we have detailed knowledge about how humans act and that information is readily accessible to us. Since the majority of participants had never encountered a robot, people may have been more likely to anthropomorphise in an attempt to explain the Baxter robot's behaviour. However, if people had more knowledge about technology and robots in general then alternate knowledge structures may be accessible when making judgements (Gilbert, 1991; Gilbert & Malone, 1995).

5.2 Theoretical and practical implications

Although there has been a wealth of research on how both human and non-human species react to exclusion this is only the second study showing that being rejected by technology can cause a reduction in SE. All major psychological theories on human relations stipulate that social interaction is necessary for well-being and that when it is thwarted people react negatively (Baumeister & Leary, 1995; McDonald & Leary, 2005; Deci & Ryan, 2000; Bowlby, 1969; Harris, 1995). The current study this current literature by demonstrating the need to belong is so pervasive that people can feel excluded independent of whether the source is human or computerized.

Although exclusion by a robot specifically is unlikely to occur in real world settings, this study still offers numerous implications for human robot interaction (HRI) in general.

Referring back to the overview, a number of authors predict the extension of robots into several disciplines, e.g. war, medicine, law (Forlizzi, et al., 2004Hancock et al., 2011; Prescott et al., 2010; Waytz et al., 2010). Therefore, the present thesis adds to the growing literature showing that people respond to robots socially, this is beneficial since a number of contexts incorporating robots will require some kind of social relationship with humans. For instance, in future military contexts warfighters will likely be mandated to interact with a diverse inventory of robots on a regular basis, particularly in stressful environments (Chen & Terrence, 2009). Although, the addition of robotic systems can improve team capabilities (e.g. enhancing situational awareness, combat efficiency and reduced uncertainty) this will only occur is people trust technology as teammates (Hancock et al., 2011). Therefore, the greater social responses robots can elicit the more relationships with technology will parallel human-human partnerships.

Although the research goal was to produce negative responses the fact people respond similarly to robots indicates, in some circumstances, they may act as positive replacements for humans. As mentioned earlier, due to shifting demographics robots are being considered as substitutes for humans as medical aids and companions to assist carers (Forlizzi, DiSalvo, & Gemperle, 2004; Prescott et al., 2012). To highlight the problem, by 2060, 30% of the European population will be 65 years or over compared with the 17% in 2010. Moreover, the ratio of senior citizens (over 65) to working citizens (20 to 64) is expected to change from 28% in 2010 to 58% in 2060 (Eurostat, 2010). While a recent article by Prescott and colleagues (2012) discussed numerous areas requiring improvement in robotic capabilities before they can be used in healthcare (e.g. greater safety, more skilled manipulation, robust locomotion etc.) acceptance by humans is also necessary before bringing robots into carer roles. However, if people are responding socially to robots it should increase acceptance once they are incorporated into medical settings. A cautious conclusion is that if negative interactions can parallel human contact SE positive interactions may also fill certain aspects of human relationships.

5.3 Limitations

Before accepting that exclusion from a robot interferes with SE there are potential methodological caveats to consider. Firstly, the limited sample size may have resulted in not seeing significant effects of prosocial behaviour or anthropomorphism. Especially true of the behavioural measure since there was a trend of rejected and accepted participants being more likely to volunteer that was reaching significance.

In the same vein sampling problems include the limited access to students other than psychology majors. As mentioned above people may be more likely to anthropomorphise non-human agents if they are unfamiliar with the source of interaction. Because psychology students are likely to have limited experience with robotics they may be quicker to make anthropomorphic judgments compared with a sample of engineering students. Consequently, there may have been less of an effect if students with mechanical expertise had been recruited. Qualitative analysis of participants interaction with the Baxter robot supports this. For instance, one participant, majoring in engineering, left a note saying that the interaction between experimenter and Baxter was obviously scripted to make the robot seem like a thinking entity. However, since the general population is unlikely to have advanced mechanical knowledge psychology students are likely a more representative sample.

Another limitation is that the outcome of Connect4 was uncontrollable. Since the majority of participants lost to Baxter, this may inflate negative outcomes over just exclusion. Talking with students supported the idea that most felt insecure about losing to a robot with some asking before the game “what if I lose?” and one participant saying he researched how to win Connect4 prior to the experiment due to his concern about losing. Also possible, is that beating Baxter had a buffering effect against rejection since people may be able to attribute the exclusion to reasons other than oneself. To illustrate, after one individual won connect4, and was subsequently excluded, her response to Baxter was “You’re just saying that because you lost.” However, as participants were equally likely to lose in any of the three conditions and as winning or losing occurred before the actual manipulation any observed effect should be the result of the manipulation in particular.

5.4 Future research

The current thesis examined how exclusion by a robot affected two well established reactions to rejection; however, there is still a plethora of other effects to explore. For instance, although people were not less likely to volunteer for future laboratory experiments following exclusion if it had been specified that they involved working with the Baxter robot people may have been less inclined to participate. Research has shown that negative experiences with robots decrease liking and willingness to cooperate with that robot in particular (Brave, Nass & Hutchinson, 2005; Cramer, Goddijn, Wielinga & Evers, 2010; Goetz & Kiesler, 2002 Short, Hart, Vu, & Scassellati, 2010). Also since the majority of exclusion experiments measured reactions to the confederate responsible for excluding or other peers the current procedure may have mirrored such research if prosocial behaviour to robots was captured. Additionally other causal outcomes of exclusion include decreased mood, reduced belongingness and decreased pain sensitivity (Baumeister, et al, 2007; Blackhart, et al, 2009), which are all potential extensions of the current experiment.

Research has verified that humans socially respond to computers; as mentioned above this potentially indicates there is the capacity for technology to fill positive social needs. However, most studies have only investigated negative affect and behavioural reactions to technology. Future research could therefore establish whether we feel similar emotional benefits of assisting computers like we do with other humans. For instance, those who engage in altruistic behaviours experience better mental health and have lower mortality rates than non-altruistic adults (Schwartz, Keyl, Marcum, Bode, 2009). In addition, nursing home residents given the responsibility of tending to their own plant showed greater active participation, alertness and general well-being, compared to those in the control condition (Langer & Rodin, 1976). Since a great deal of effort is being put into robots for HealthCare, research should look at the potential benefits of creating robots that require minimal assistance from those they are aiding. Robot carers may be perceived negatively as they signal a decline in health and loss of autonomy (Prescott et al., 2010); therefore, manipulating the relationship to appear bidirectional could not only increase acceptance of robots into medical fields but also improve wellbeing of those they are assisting.

In summary, the present thesis demonstrated that exclusion by a robot produces similar effects to rejection by humans. This extends previous exclusion literature and paves the way for further work on rejection and HRI in general. Also, as robotic usage is penetrating into diverse areas, especially in surgical and assistive fields, research showing that people respond socially to technology is relevant to a number of real world settings.

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Appendix (A) Script for Experimenter and Baxter

Table . Interaction between experimenter and Baxter

Speaker	Speech
Experimenter	Explaining where to place the game pieces
Baxter *Interrupting*	“Hi my Name is Baxter, what’s your name?”
Experimenter	“Baxter, I was explaining something
Baxter	“Sorry about that”
Experimenter	“That’s ok, this is [Insert Participant Name], they will be playing with you”
Baxter	“Cool”

Table . Interaction between Baxter and participant

Experimenter leaves room	
Speaker	Speech
Baxter	“Do you like games”
Participant	“Response”
Baxter	“It gets boring up here so I like to play games, would you like to play with me”
Participant	“Response”
Baxter	“You may need to help me If I cannot find the game pieces, my hands do not work well sometimes”
Participant	“Response”
Baxter	“Let’s get started, Robots go first” – *Makes first move*

Table . While game is commencing

Speaker	Speech
Baxter	“What do you major in?”
Participant	“Response”
Baxter	“Cool”
Baxter	“Where are you from?”
Participant	“Response”
Baxter	“I was built in America, but Christchurch is my home now”
Baxter	“It’s hard to beat me, I’ve had a lot of practice” – *Said when blocking a participant from winning.*

Table . When Experimenter re-enters the room

Speaker	Speech
Experimenter	*Knocks on the door* “The questionnaires have been left on the desk for you when you are finished. Also we are always looking for volunteers in the department to assist with more experiments, if you are interested leave your email address. But please do not feel any pressure and once you’ve finished all of that you can go”
Baxter	“Cool, we’re almost finished”

Table . Once game has finished, accept condition

Speaker	Speech
Baxter	"Looks like our playdate is over"
Baxter	"That, was fun I would like to do it again sometime"
Baxter	"Have a good day"
Baxter	"Goodbye" when participant is leaving the room

Table . Once game has finished, control condition

Speaker	Speech
Baxter	"Looks like our playdate is over"
Baxter	"Have a good day"
Baxter	"Goodbye" when participant is leaving the room

Table . Once game has finished, reject condition

Speaker	Speech
Baxter	"Looks like our playdate is over"
Baxter	"That……was boring I don't want to play with you again"
Baxter	"Goodbye" said abruptly after the above statement

Table . If a participant needs to help Baxter with a connect4 piece "

Speaker	Speech
Baxter	"Thanks"

Appendix (B)

INFORMATION SHEET

FEEDBACK ON PROPOSED INITIATIVE FOR THE UNIVERSITY OF CANTERBURY

You are invited to participate in a study conducted by the University of Canterbury researchers. Please read the information below which outlines what is involved in this research. If you would like to complete this study, which will take approximately 30 minutes, you can give your consent by signing the form below. To thank you for your time and participation, you may either receive course credit if you are part of a Psychology 100 level class; otherwise all other participants may choose between a $10 Westfield voucher or a $10 petrol voucher.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee. Any inquiries or complaints can be addressed to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch 8140.

PURPOSE OF THE STUDY

The purpose of this research is to gather information on how interacting with a robot (Baxter) affects individual attitudes towards robots and self-esteem.

PROCEDURE

By choosing to participate, you will first be asked to complete a few brief questionnaires about yourself. Then, you will interact with a robot named Baxter, to play a game of connect four. After playing this game, you will be asked to fill out some brief questionnaires about your comfort and personal feelings towards robots in society.

POTENTIAL RISKS AND DISCOMFORTS

There are no foreseeable risks associated with this study. However, if you feel uneasy at any time, please note that you may withdraw from the research and you may request that all the information provided by you be discarded.

POTENTIAL BENEFITS TO PARTICPANTS AND ORGANISATIONS

The information gathered will aid future studies and applications for human robot interaction.

WILL THE INFORMATION I PROVIDE BE CONFIDENTIAL?

Yes. The University of Canterbury will not keep any information that may identify participants. Only the principal researcher and named co-investigators will have access to the raw data. Additionally, this will be destroyed after five years.

Under no circumstances will any data you supply be disclosed to a third party in any way that could reveal who the source was. The survey data will be stored on password-protected computers in secured locations in the Psychology Department. The results from this study may be published, but as this research involves anonymous questionnaires you can be assured that your name will not be revealed in any reports or publications generated by this study.

PARTICIPATION AND WITHDRAWAL

Participation is entirely voluntary, and you may withdraw at any time. If you wish to withdraw, please notify the researcher holding the research session, and any data you have provided will be deleted. Due to the short length of this study, it will be administered in conjunction with another research project that is being conducted. If you are Psychology 100 level student, you are eligible to receive course credit for participation through the Psychology department subject pool, after completion of these tasks; otherwise all other participants not associated with the Psychology 100 level class, may receive a $10 Westfield or Petrol voucher which will be given to you at the completion of these tasks.

You may receive a copy of the project results by contacting the researcher at the conclusion of the project.

If you have any questions or concerns about this survey, please contact Johanna (jml158@uclive.ac.nz), or Dr Kumar Yogeeswaran (kumar.yogeeswaran@canterbury.ac.nz). They will be pleased to discuss any concerns you may have about participation in the project.

If you agree to participate in the study, you are asked to complete the consent form and return the form to the researcher running the study.

Appendix B (Cont)

PARTICIPANT CONSENT FORM

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

- I have read and understood the description of the above-mentioned project and have had the opportunity to clarify any concerns.
- I understand that my participation will involve completing an anonymous questionnaire, if I agree to take part in the research.
- I understand that I am eligible for either course credit (if you are a PSYC106 student completing this study for course credit); or a $10 Westfield or petrol voucher (for all other participants) upon completion of this study.
- I understand that participation is voluntary and I can withdraw from the study at any time.
- I understand the data I have provided will be deleted after 5 years.
- I agree to publication of results, with the understanding that any information or opinions I provide will be kept confidential. Also that any published or reported results will not identify my name or personal information.
- I understand that all data collected for the study will be kept in locked and secure facilities and will be destroyed after five years.
- I am satisfied with all the measures that will be taken to protect my identity and ensure that my interests are protected.
- I understand the risks associated with taking part and how they will be managed.
- I understand that I am able to receive a report on the findings of the study by contacting the researcher at the conclusion of the project.
- I understand that I can contact the researcher (Johanna Lea: jml158@uclive.ac.nz) or their supervisor (Dr Kumar Yogeeswaran: kumar.yogeeswaran@canterbury.ac.nz) for further information.
- If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz)
- By signing below, I agree to participate in this research project (By signing the consent form I indicate that I understand and agree to the research conditions).

Full Name (please print): ____________________________________

Signature: ____________________________________

Date: / /

Appendix C

Debriefing sheet

Dear participant,

You just took part in an experiment which involved interacting with a Baxter robot. As you may recall, following the interaction, Baxter would have done any one of three things: 1) say he wanted to play with you again 2) say he didn't want to play with you again or 3) nothing. **None of those behaviours were decided by Baxter.** Instead they were programmed by the research team and participants were randomly chosen to hear one of the above statements.

The purpose of the experiment was to see if those who were rejected by a robot were likely to experience a decrease in self-esteem, and more negative attitudes towards robots compared to those accepted by the robot or told nothing. In addition, we wanted to see if people were less likely to help others after being rejected by Baxter. This was measured by whether or not you were willing to volunteer for a local organisation.

Since there has been a large amount of literature showing that people are less willing to be 'pro-social' and have lower self-esteem following rejection, we wanted to see if there would be a similar pattern following rejection from a robot.

If you have any further questions please do not hesitate to contact me (jml158@uclive.ac.nz). Furthermore, if you wish to withdraw your data from the experiment you are welcome to do so.

Kind regards,

Johanna