How Does Encouragement in Human-Robot Interaction Affect People's Pro-Social Behavior? An Experimental Study on Human-Robot Interactions

DIMITAR POPOV, University of Twente, The Netherlands

Robotic technology is becoming increasingly prevalent and the science-fictional concept of having robot assistants and workers might become a widespread reality. Scientists and engineers all over the world are working diligently on expanding and perfecting the extent of the functionality of robots and considering how far technology has come just in the last 15 years, a future where robots are walking among us seems imminent This situation will have a massive impact on society and people individually. However, exploration of the topic of the effect of interaction with robots on human behavior is relatively limited.

This research steps on the solid base of previous related works and utilizes an experiment that puts participants in two distinct scenarios – one with an encouraging robot and one with a non-encouraging one. A statistical analysis of the gathered data is used to try to determine whether and how encouragement from a robot can facilitate pro-social behavior in people.

Additional Key Words and Phrases: human-robot interaction, experiment, robot, pro-social, pro-social behavior, encouragement

1 INTRODUCTION

Just a few years ago, having robots in our everyday lives was something seemingly impossible. However, with the exponentially growing industrial and technological capabilities of humanity, that reality seems more than achievable. Robots that are being implemented for industrial work, rescuing, conversation, and everyday necessities are already available and will only become more sophisticated. Nonetheless, as robot technology is far from reaching its full potential, roboticists are mostly focused on enhancing it. However, the topic of the effects of human-robot interaction is little thought of. People are already interacting with robots in healthcare, manufacturing, agriculture, the military, and even in website customer service chats. As robots enter our daily lives, we are getting acclimated to their increasing presence without thinking about how they affect us. Depending on the context, robots might affect people both positively and negatively. As more robots are developed, it is important to think about how human-robot interactions can benefit people. This raises the question – How do interactions with robots affect people and can they evoke pro-social behavior?

TScIT 37, July 8, 2022, Enschede, The Netherlands

To answer this question, one needs to be familiar with the terminology it contains. Pro-social behavior can be defined as the intent to benefit others, "altruism or generally any behavior that is positive and calculated to promote the interest of society" [7]. This definition shows that if robots were able to evoke such behavior in people, they would not only be very beneficial for society but would have more applications in jobs that require interactions with people.

Various studies have explored the effects interactions with a robot can have on a human [[1], [2], [3], [4], [8], [9], [12], [13], [15], [16]]. Some of them explore how robots affect people's thoughts and behavior, while others specifically investigate how certain robots' visual appearance and demeanor can facilitate pro-social behavior.

Despite robots not being living organisms, people seemingly are more affected by robots than other common technologies such as tablets [4]. This raises the very important question – what types of robots can affect people more? There are strong scientific leads that more human-like robots are more relatable to humans and can evoke a feeling of empathy [[9], [16]]. However, some sources suggest that factors like previous exposure to robots, pro-sociality or animateness of robots themselves as well as physical contact should also be considered when discussing the degree of influence on people [[2], [12]].

We can also observe that the positive effects of robots on people can be numerous – from improvement in team dynamics [1] to encouraging extroversion [13]. As is shown by some works, human-robot interaction can encourage pro-social behavior such as being empathetic and donating to charity or working towards a common goal when the robot is visually anthropomorphic or shows care and affection [[3], [4], [6], [15]]. In times of a pandemic and an uptight political atmosphere when people are becoming crescively divided, it is important to see how the use of encouragement in the continuously emerging human-robot interactions can make people in society more pro-social. Nevertheless, very little research has been done on implementing stimulation and encouragement in robots to provoke prosocial behavior in people.

In this research, we use an experiment to explore the relationship between encouragement from robots and prosocial behavior in people. The experiment is specifically designed from the ground up to elucidate the main question raised by this paper

- whether and how people's interaction with an encouraging robot facilitates pro-social behavior.

1.1 Problem Statement

Despite the existing research that shows the relationship between human-robot interaction and pro-social behavior, using encouragement in those interactions is underexplored. With the existing work indicating that robots can be more effective than other forms of technology in eliciting pro-social behavior [4], it is imperative to understand to which extent robots can encourage such actions. This research will inspect the effects of certain scenarios in human-robot interaction on people and will determine how some of those effects can lead to pro-social behavior.

1.1.1 Research Question

This problem gives rise to the following research question:

> *Does encouragement in human-robot interactions evoke pro-social behavior in people and if so, how?*

To be able to answer that question, we must be able to answer those sub-questions:

1. Is people's pro-social behavior affected by their personality?
2. If people's personality affects their pro-social behavior, is that a more significant factor than the robot's encouragement (or lack thereof)?
3. How does pro-social behavior in a group of participants that were encouraged by a robot differ from that of a group of participants who weren't encouraged considering their initial pro-sociality?

Without knowing whether the lack of encouragement will lead to a certain decrease in pro-sociality, measured either via charity donations while considering certain indicators in a pro-social personality measuring questionnaire, compared to cases where there is encouragement, we cannot know for certain if it was the encouragement of the robot that facilitated the pro-social behavior. Also, regardless of the condition, it is vital to know whether the participants' general personality affected their behavior. Thus, it is crucial to answer all of the sub-questions – the answer to the main research question is an amalgamation of those answers.

2 RELATED WORK

Despite the research on the effects of human-robot interactions on the behavior of people being much less in comparison to the research on robotics technology as a whole, there is still a relatively large pool of information on the topic. The research papers can be split into 2 categories: those papers that look into what effects a certain demeanor or appearance of a robot has on a person [[1], [5], [9], [14], [16]], and those that explore how certain demeanor or appearance of a robot affects specifically the pro-social behavior of a person if such behavior is present at all [[2], [3], [4], [6], [8], [12]].

The papers from the first category provide very useful insight into how robots affect people in general and served as an inspiration for this paper [[1], [5], [9], [14], [16]]. One of those pointed out that people empathize more with more anthropomorphic robots [9]. To continue that train of thought, another paper indicated that people take a robot's visual perspective more when the robot is more human-like [16]. Using the information that those papers provide we can deduce that implementing more humanlike vocal expressions and mimics in an experiment can be used to facilitate empathy with the robot and take its perspective, which consequently might be useful for evoking pro-social behavior. Some research, however, suggests that sometimes other factors such as people's technological competence and their enthusiasm for technology may impact their perception, regardless of the robot's animated behavior [5], suggesting the experiment shouldn't rely solely on anthropomorphism.

The papers from the second category clarify to what extent pro-social demeanor as a result of interaction with a robot can be observed, as well as the implementation of which features in the robot might be useful to accomplish that goal [[2], [3], [4], [6], [8], [12]]. One research showed that a stimulated hug (one in which the robot moves and hugs the human as opposed to just staying motionless) has a direct correlation to prosocial behavior in people [12]. Furthermore, another paper showed that anthropoid behavioral clues in a robot raising money for charity increased donations [15]. Additionally, another work showed a direct link between interaction with social robots or virtual agents and pro-social behavior in people [6]. Those papers showcase that implementing social and anthropomorphic features in the robot for the experiment could have a direct effect on the pro-sociality of the participants.

Finally, a very important paper examined how participants put in a scenario involving the power of flight, either as a superpower or in a helicopter, and the saving of a child could trigger prosocial behavior [10]. This paper, despite not investigating a human-robot interaction and rather people's experience in virtual reality, served as an inspiration and was crucial to the creation of this paper.

All this information served as an inspiration, provided valuable insights, and served as guidance in the creation of this research.

3. METHODS OF RESEARCH

This research utilizes an experiment to try to answer the research questions. The experiment puts participants in two different conditions – one where the robot is highly encouraging and one where it is not, to see how encouragement affects people's pro-sociality, which in the case of the experiment is measured via charity donations. A pro-social personality measuring questionnaire is used as a covariate to take into account people's general personality when interacting with the robot.

3.1 Resources, Arrangement and Robot Implementation

A NAO robot was used for the experiment. Due to the tight schedule for the research, the robot was not walking around and communicated only verbally and using gestures that did not require any walking motion. The robot was physically about 40cm tall and was placed on a desk. Its size and appearance made the robot look non-intimidating, which helped with the interaction, especially with participants that were less familiar with robots. The NAO robot can be seen in Picture 1. The "Wizard of Oz" method was used for communication – an experimenter not visible to the participants controlled the robot during the physical activities. The experimenter was able to see the participants on a tablet's screen using its built-in camera. A silent mouse was used to further eliminate the awareness of the robot not being autonomous. The "Choregraphe" program was used for developing the robot's behaviors. In total, the NAO robot, a computer for controlling the robot, a blind screen, a tablet with a camera, questionnaires, consent forms, and an experiment conductor were needed. The experiment room can be seen in Fig. 1 on the next page.

Picture 1. NAO Robot

3.2 Participant recruitment

For the experiment, 16 participants were recruited by social contact as well as by asking people on campus to participate. The participants were not briefed on the nature of the experiment or its goal. This was crucial for the experiment – the participants were not manipulated to be pro-social, but rather not told that the goal of the experiment is to investigate the effect of human-robot interaction on pro-sociality to avoid any demand characteristics. During the recruitment, possible partakers were informed that to take part in the experiment, they would need to be able to do some very simple and unchallenging physical exercises, signifying that they should not have any health conditions that might put them at risk. Before the experiment, all participants were briefed on the task at hand – do a few exercises while the robot guides them.

3.2 Pre-experiment procedure

Participants were informed that they can ask the experiment conductor questions and withdraw at any point of the experiment. They were also made aware of the fact that they are monitored using the tablet and its camera, but no footage is recorded. Then, they were asked to sign a consent form concerted with the Ethics Committee. The entirety of the experiment was also presented before the Ethics Committee and was conducted with its approval.

3.3 Experiment Main Activity

The participants were arbitrarily divided into two even groups. Each participant from both groups was asked to do three rounds of some simple physical exercises – 10 sit-to-stand exercises using a chair, 10 squats, and some breathing exercises in a room with the robot. Those exercises were chosen as the experiment's activity because they are undemanding, which mitigates the risk of participants feeling self-conscious for not performing well, which could have happened if a harder task such as a difficult quiz or a board game was chosen as the main activity. During the experiment, participants from the first group were encouraged and supported by the robot – it told them to not give up and assessed their progress positively using various humanlike phrases that a supportive coach will do, such as "You are doing great!", "Keep up the great work!", "Impressive!" etc. Encouragement was provided regardless of the performance of the participants. Participants from the second group were not encouraged by the robot – its role was only to indicate when the set of a certain exercise is over and the partaker should move on to the next, as well as when the task is concluded. The encouraging version of the robot used a more high-pitched voice and "spoke" a bit faster than the passive robot to make it sound more compassionate and encouraging. Furthermore, it used more gestures and was generally moving more to further stimulate the feeling of encouragement.

3.4 Post-experiment Procedure

After the physical part of the experiment, each participant was asked some general questions about the experience such as whether they would say that the robot was sufficiently useful and functional, whether they enjoyed the experience, etc. If a participant asked what the point of the experiment was, they were told that its purpose is to see whether robots can be used successfully for more humanitarian uses such as coaching people to do exercises. After that, they were told the experiment was over and after thanking them for participating, they were free to leave. Right next to the exit there was a charity box, which

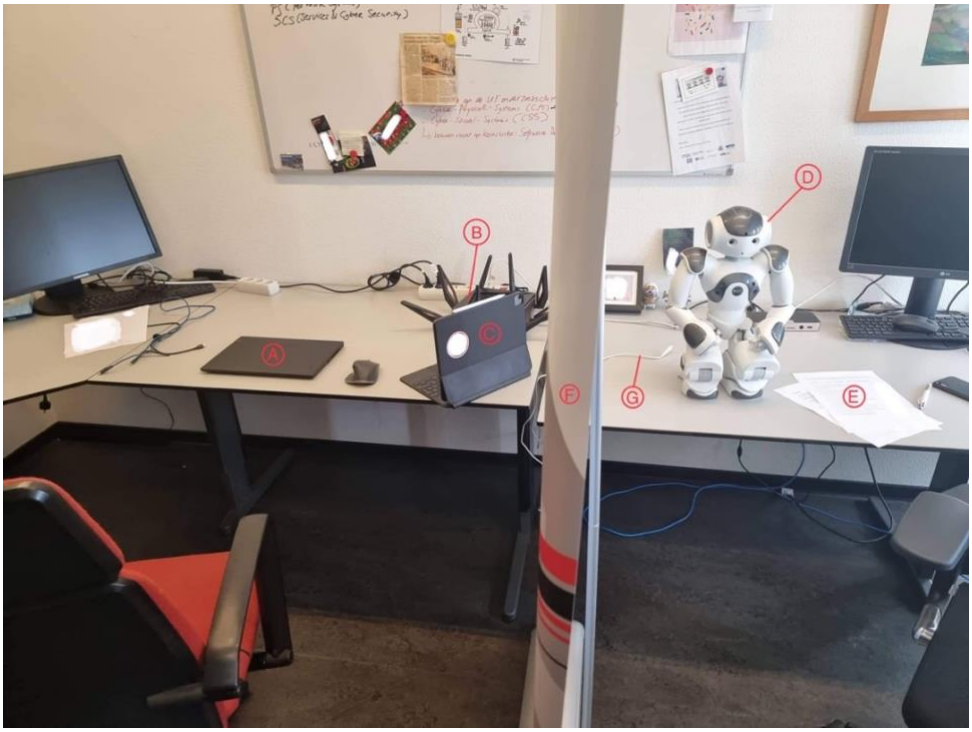


Fig. 1. Experiment room. This figure shows: (A) The laptop that is used to control the robot; (B) A high-speed router that ensures a seamless wireless connection between the computer and robot; (C) A tablet that is used to monitor the participants during the experiment; (D) The NAO robot (in sleeping position on the photo); (E) A questionnaire copy; (F) A privacy screen that is put between the experiment conductor and the participant. The participant is situated on the right side of the screen and can only see the robot and part of the tablet. The experiment conductor can control the robot with the laptop and can only see the participant on the screen of the tablet

can be seen in Fig. 2. The participants were casually informed about the box and the cause it represents during the briefing but were told that the box is not part of the experiment and therefore they should not feel pressured to donate. On their way out, participants were left to interact with the box. Since the Netherlands is a rather cashless county and many participants might not have cash on them, they will be told that there is the option to donate online by scanning the QR code on the box. If they scanned the QR code that was for donating, they were led to the website of the University of Twente and were informed that was some mistake with the code and were asked to wait for a minute until it was resolved.

Once a participant opened the door of the room to leave, the interaction with the charity box was certainly over, meaning they made their choice as far as donating goes. All participants that scanned the QR code for donating or physically inserted money in the box were counted as donators and were reimbursed right after the end of the experiment (if they donated via cash). Then, they were asked to come back and fill in a questionnaire. Its first part included demographic questions regarding the participants' age, sex, occupation, and previous experience with robots. Since whether people donated to charity is a performance metric for the experiment, an acclaimed and researched general pro-sociality measuring questionnaire [11] was used for the second part as opposed to one that measures the participants' current pro-sociality.

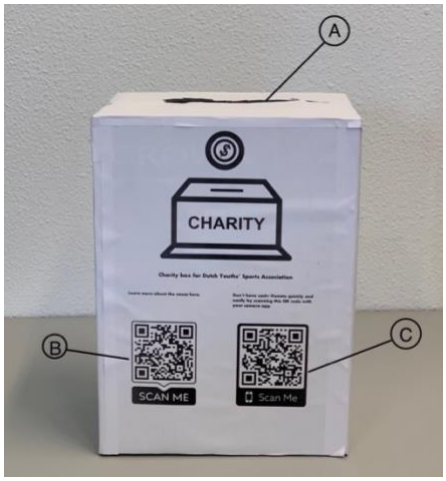


Fig. 2. Charity Box. This figure shows: (A) The hole in the box for cash donations; (B) QR code for getting more information about the cause; (C) QR code for donating money online

The questionnaire included general questions about whether the participant has already done some prosocial activities. For each of the points, participants were to give a numerical grade from one to five based on how often they did the activity. The

data from it was later used as a covariate for the statistical analysis.

After filling out the questionnaire, the participants were debriefed. The debriefing procedure included revealing that some deception was used when it comes to the information given about the goal of the experiment. Participants were told about the actual goal of the experiment and were provided with thorough information regarding the idea and the conduction of the experiment. The participants were also given the opportunity to ask questions and withdraw from the experiment after they knew its real purpose.

After the experiment, the data gathered from the questionnaires was gathered and processed with SPSS v.27, a statistical software tool, to distinguish some statistical trends.

3.2 Variables

3.2.1 Condition variable

Encouraged. Each participant interacted either with an encouraging robot or a passive one. Both of those conditions were encoded in the nominal "Encouraged" variable with values of 2.00 for encoding the encouraging robot condition and 1.00 for the passive robot condition. Eight participants were in each condition.

3.2.1 Behavioral variable

Donated. For each participant, the choice regarding donation was recorded as an ordinal variable "Donated" with Boolean values – 1 for participants that donated and 0 for those that did not. Out of the 8 participants in the encouraging condition, 4 donated and 4 didn't. Out of the 8 participants in the non-encouraging condition, 1 participant donated and 7 did not.

3.2.1 Self-report variable

Altruistic Personality Scale. All participants filled out the Altruistic Personality Scale questionnaire [11]. It contains 20 items, each of which are activities that the participant should rate on a scale of 1 to 5 depending on how often the participant does them – never, once, more than once, often, or very often. The sum of numerical grades of all items was stored in the scale variable "QuestionnaireScore" for each participant and as instructed was scored as a continuous scale. The mean score of all participants was 53.375, with a standard deviation of 9.549 and a standard error mean of 2.387.

3.3 Statistical Analysis

The three variables mentioned above were used to perform an ordinal logistic regression and a multinomial logistic regression. This is a statistical analysis method that models the relationship between an ordinal outcome variable and one or more explanatory variables. In the case of the experiment, the "Donated" variable is a nominal outcome variable (in the case of the ordinal logistic regression it is set as an ordinal variable), "Encouraged" is a nominal factor variable, one which signifies the main difference between the data (in this case this is whether participants were encouraged), and "QuestionnaireScore", a covariate – an independent variable that can influence the outcome of the statistical trial, but which is not of direct interest. The variables' roles are appropriately chosen as we want to explore the outcome, whether people donated, in two different conditions, which are the main factor according to the hypothesis of this paper. Furthermore, since the questionnaire aims to measure the general personality of the participants rather than their current feeling, "Questionnaire" should be a covariate as opposed to a factor.

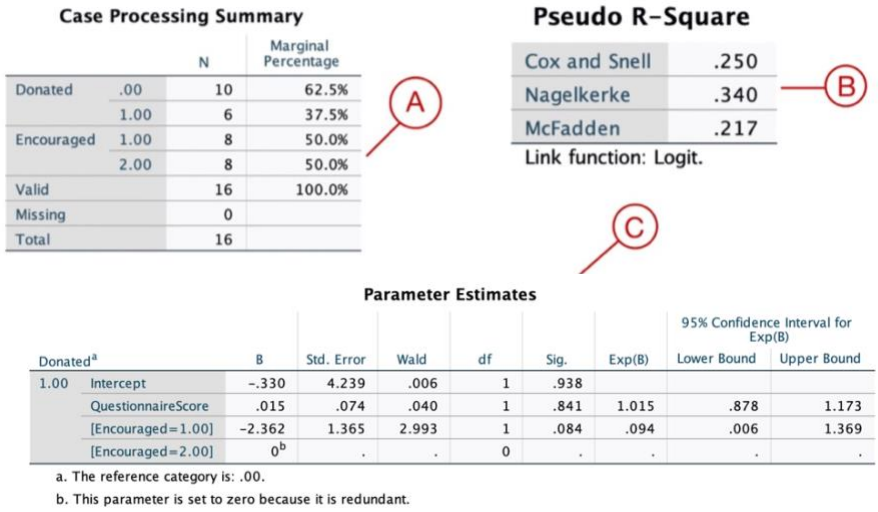
4.4 Hypothesis Statement

Based on related research [15] and the design of the experiment, this research hypothesizes that a positive relationship between encouragement from a robot and pro-social behavior in people will be observed. To put it formally, the hypothesis states: "*There is a positive correlation between encouragement from a robot and pro-social behavior in people*".

5 RESULTS

We will first look at the results from the multinomial test, which can be seen in Figure 3.1 on the next page. The case processing summary shows the number of people that donated in each condition and validates that there are no missing entries in the data. The Nagelkerke value in the pseudo-R-square score table shows us that 34% of the variants that we observe in the outcome can be explained by the independent variables that we included in the statistical model, which shows that the model is good, but more data can make it more accurate.

The parameter estimates table gives us extensive information regarding the experiment. As we can see from the significance column, the intercept, a variable that is added to mitigate possible errors in the model, and the questionnaire score, are not predictive as their values are way above 0.05. This means that the questionnaire is not sufficiently predictive of the outcome. This is further observed when we see the B parameter value (the value that shows how the outcome value will increase for each increase of 1.0 of a certain variable) for the covariate – it is very close to zero and thus not significant. The B parameter for the condition of the encouraging robot is zero, meaning that the condition is redundant. That is because the factor (condition) variable has only two possible values - encouraged and not encouraged. As those values are mutually exclusive, once the algorithm has made a prediction about one of them, the other one doesn't provide any new unique information. Despite not being lesser or equal to 0.05, the significance value of the condition of the non-encouraging robot is 0.084, which means that the condition is sufficiently predictive. This is also reflected in the B parameter value – a numerical value of -2.362 means that it is estimated that the condition of the non-encouraging robot decreases the value of the outcome, essentially signifying that we should expect fewer people to donate in that scenario.



Case Processing Summary

		N	Marginal Percentage
Donated	.00	10	62.5%
	1.00	6	37.5%
Encouraged	1.00	8	50.0%
	2.00	8	50.0%
Valid		16	100.0%
Missing		0	
Total		16	

A

Pseudo R-Square

Cox and Snell	.250
Nagelkerke	.340
McFadden	.217

Link function: Logit.

B

C

Parameter Estimates

Donated[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
1.00	Intercept	-.330	4.239	.006	1	.938			
	QuestionnaireScore	.015	.074	.040	1	.841	1.015	.878	1.173
	[Encouraged=1.00]	-2.362	1.365	2.993	1	.084	.094	.006	1.369
	[Encouraged=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: .00.

b. This parameter is set to zero because it is redundant.

Figure 3.1. SPSS Results from performing a multinomial regression. This figure shows: (A) The parameter estimates of the model; (B) The Pseudo R-Square results that showcase how good the model is. (C) The Parameter Estimates – this is the most important part of the test that brings most of the results discussed in this section.

A

Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Threshold	[Donated = .00]	.330	4.239	.006	1	.938	-7.979	8.638
Location	QuestionnaireScore	.015	.074	.040	1	.841	-.130	.159
	[Encouraged=1.00]	-2.362	1.365	2.993	1	.084	-5.038	.314
	[Encouraged=2.00]	0[a]	.	.	0	.	.	.

Link function: Logit.

a. This parameter is set to zero because it is redundant.

B

Pseudo R-Square

Cox and Snell	.250
Nagelkerke	.340
McFadden	.217

Figure 3.2. SPSS Results from performing an ordinal regression. This figure shows: (A) The Parameter Estimates Table (B) The Pseudo R-Square Table; Both tables are analogous to the identically titled tables from Fig. 3.1

The data from the ordinal linear regression test seen in Fig. 3.2 is the same as the multinomial test except for the lower and upper bounds of the three variables. This shows that choosing whether the outcome variable is a nominal or an ordinal one doesn't affect the prediction, meaning the statistical model does indeed make a correct prediction, at least based on the provided data.

5 DISCUSSION

There are multiple aspects of the analysis results that need to be discussed, starting with the prosocial personality measuring questionnaire. Surprisingly, the scores from the questionnaire weren't statistically significant for the result. This could be mainly because as the questionnaire measures the prosocial personality characteristics of the participants, it includes mainly items that are activities such as "I have helped push a stranger's car". Such statements can be indicative of a pro-social personality, but they are based on experience, which brings bias as people could simply not have had the opportunity to participate in such experiences, regardless of their pro-sociality. Still, in the context of this experiment, according to the model participants' personality measured in this way did not affect their choice, which answers the first and second sub-questions – people's personality doesn't affect their pro-social behavior and it is not a more significant factor than the encouragement condition.

The B parameter value for the non-encouraging condition showed that people who are not encouraged are predicted to donate less than those who are. This answers the third sub-question and consequently supports the research hypothesis – as charity donation is a valid way to measure pro-social behavior, the statistical model's predictions indicate a positive correlation between encouragement from a robot and pro-social behavior in people. Note that it is really important for the reader to make the distinction between correlation and causation here – the results from the statistical analysis don't mean that there is a cause-and-effect relationship between robot encouragement and pro-social behavior in the encouraged people, but rather a correlation.

Despite the experiment results supporting the research hypothesis, there are a few remarks to be made. Firstly, due to time constraints, the experiment provided a relatively small number of participants. A bigger sample would have been beneficial as the statistical model is more accurate when more data is provided, which would have led to more legitimate results. Furthermore, all the participants were either students or employees at the University of Twente and were of similar age,

meaning the population diversity was not sufficient. Recruiting participants from more different backgrounds would lead to more solid results when making conclusions about people in general. Finally, a questionnaire that wasn't so reliant on participants' life experiences arguably would have been a better covariate and subjective measure of their personalities.

6 CONCLUSION

In this paper, we investigated a relatively unexplored part of the sphere of human-robot interaction – interaction with an encouraging robot. With the implementation of the robot, we created two distinct scenarios, one with an encouraging robot and one with a passive one. To answer the research question and sub-questions, we used an experiment that employed participants' choice to donate to charity as a performance metric, while taking into account the encouragement condition and utilizing a pro-social personality measuring questionnaire as a covariate. The statistical analysis' results answered the sub-questions and collectively showcased that there is a correlation between encouragement from a robot and people's pro-social behavior.

I hope that by creating this research I have shone a light on one of the many topics related to human-robot interaction and this work can be used to aid and inspire future research.

7 SUGGESTIONS FOR FUTURE RESEARCH

For any future researchers that might try to tackle the same topic, it is suggested not to use a general pro-sociality personality measuring questionnaire. Rather, a pro-sociality measuring questionnaire that measures the participants' current feelings might be a better fit as it won't bring the drawback of participants' results being dependent on their life experiences. Of course, that would bring a conflict for the choice of outcome variable since both the questionnaire and the choice regarding donation will measure pro-sociality. The best solution then would be to still use the donation variable as an outcome variable and the questionnaire score variable as a covariate – the donation variable will still be the main metric of pro-social behavior and the condition variable will be the main factor, while the questionnaire will provide information about any potential additional influence on the participants' decision.

Furthermore, the charity box could be coupled with a contactless payment terminal positioned next to it. In a cashless country such as the Netherlands, participants don't usually carry cash and thus cannot donate in this way. Moreover, donating online is a concept many participants aren't comfortable with, and donating online brings further complications to the donating process, which in turn may discourage people from donating. This problem would be mitigated if a cashless terminal is introduced.

Finally, it is advised to include some questions that measure the participants' satisfaction with the robot and the experience in general. This could provide some additional data regarding the people's perception of the robot. Data gathered from such questions should be stored in a separate covariate variable.

Concerning the recruitment process, a more diverse and larger group of participants should be gathered. This would significantly improve the data needed for the statistical analysis.

Finally, researchers are advised to plan at least six months for the conduction of the experiment and creating a paper. As previously mentioned, research could struggle with short time frames allocated for the experiment and that could result in limited data and consequently more ambiguous results.

REFERENCES

[1] Correia, Filipa, Samuel F. Mascarenhas, Samuel Gomes, Patrícia Arriaga, Iolanda Leite, Rui Prada, Francisco S. Melo, and Ana Paiva. "Exploring prosociality in human-robot teams." In 2019 14th ACM/IEEE International Conference on Human-Robot Interaction (HRI), pp. 143-151. IEEE, 2019.

[2] Hayes, Bradley, Daniel Ullman, Emma Alexander, Caroline Bank, and Brian Scassellati. "People help robots who help others, not robots who help themselves." In The 23rd IEEE International Symposium on Robot and Human Interactive Communication, pp. 255-260. IEEE, 2014.

[3] Kühnlenz, Barbara, Kolja Kühnlenz, Fabian Busse, Pascal Förtsch, and Maximilian Wolf. "Effect of explicit emotional adaptation on prosocial behavior of humans towards robots depends on prior robot experience." In 2018 27th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN), pp. 275-281. IEEE, 2018.

[4] Lo, Shih-Yu, Yueh-Yi Lai, Jen-Chi Liu, and Su-Ling Yeh. "Robots and sustainability: Robots as persuaders to promote recycling." International Journal of Social Robotics (2022): 1-12.

[5] Nitsch, Verena, and Thomas Glassen. "Investigating the effects of robot behavior and attitude towards technology on social human-robot interactions." In 2015 24th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN), pp. 535-540. IEEE, 2015.

[6] Oliveira, Raquel, Patrícia Arriaga, Fernando P. Santos, Samuel Mascarenhas, and Ana Paiva. "Towards prosocial design: A scoping review of the use of robots and virtual agents to trigger prosocial behaviour." Computers in Human Behavior 114 (2021): 106547.

[7] "prosocial behaviour." Oxford Reference. ; Accessed 1 May. 2022. https://www.oxfordreference.com/view/10.1093/oi/authority.20110803100350224.

[8] Peter, Jochen, Rinaldo Kühne, and Alex Barco. "Can social robots affect children's prosocial behavior? An experimental study on prosocial robot models." Computers in Human Behavior 120 (2021): 106712.

[9] Riek, Laurel D., Tal-Chen Rabinowitch, Bhismadev Chakrabarti, and Peter Robinson. "How anthropomorphism affects empathy toward robots." In Proceedings of the 4th ACM/IEEE international conference on Human robot interaction, pp. 245-246. 2009.

[10] Rosenberg, Robin S., Shawnee L. Baughman, and Jeremy N. Bailenson. "Virtual superheroes: Using superpowers in virtual reality to encourage prosocial behavior." PloS one 8, no. 1 (2013): e55003.

[11] Rushton, J. P., Chrisjohn, R.D., & Fekken, G. C. The altruistic personality and the self-report altruism sale. Personality and Individual Differences, 1, 292-302. (1981)

[12] Shiomi, Masahiro, Aya Nakata, Masayuki Kanbara, and Norihiro Hagita. "A hug from a robot encourages prosocial behavior." In 2017 26th IEEE international symposium on robot and human interactive communication (RO-MAN), pp. 418-423. IEEE, 2017.

[13] Tapus, Adriana, and Maja J. Mataric. "Socially Assistive Robots: The Link between Personality, Empathy, Physiological Signals, and Task Performance." In AAAI spring symposium: emotion, personality, and social behavior, pp. 133-140. 2008.

[14] van Wynsberghe, Aimee. "Social robots and the risks to reciprocity." AI & SOCIETY (2021): 1-7.

[15] Wills, Paul, Paul Baxter, James Kennedy, Emmanuel Senft, and Tony Belpaeme. "Socially contingent humanoid robot head behaviour results in increased charity donations." In 2016 11th ACM/IEEE international conference on human-robot interaction (HRI), pp. 533-534. IEEE, 2016.

[16] Zhao, Xuan, and Bertram F. Malle. "Spontaneous perspective taking toward robots: The unique impact of humanlike appearance." Cognition 224 (2022): 105076.