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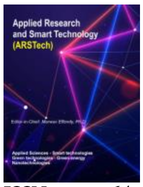

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Research Article

The effects of robot's social praise on human responses in 2D game

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ABSTRACT

Human-Robot Interaction (HRI) is an interaction between humans and robots through verbal and/or non-verbal cues. Studies in the HRI field concern the psychological effect, especially reactance, experienced by humans in decision-making situations with robots. This study applied persuasive attempts to investigate the impact of social praise by a social robot on human psychological reactance in a decision-making situation. The robot socially expressed its recognition (an acknowledgement of the existence) and reassurance (the action of removing someone's doubts) towards humans in a game, namely "Survival in Island". Social praise was expressed verbally in adoring human activities, such as 'Good Job' for following the robot's decision-making suggestions. The study randomly divided the participants into two conditions (social praise: presence vs absence) in a between-subject design study. Besides using questionnaires to measure humans' psychological conditions, the level of stress experienced by humans was also collected using a Galvanic Skin Response (GSR) sensor. The results indicated significant effects of social praise on perceived ease of use toward the robot, perceived intention to use the robot again in the future, perceived belief towards the robot and perceived compliance with the robot's suggestions through MANOVA tests. The study did not find other significant psychological and physiological effects of praise.

1. INTRODUCTION

Numerous social robots support people in the healthcare and education sectors [1][2]. Social robots also are utilised by the food and beverage industry to attract customers on a commercial level. Human-robot interaction (HRI) is a form of communication that incorporates reciprocal actions between humans and robots [3-5]. When humans interact with robots contrary to other humans, they feel that they are too different, causing them to expect less social presence (a sense of being with another) [6] from the robots during the interactions. Robots cannot instantaneously perceive and understand human emotion -also known as social responses- crucial for successful HRI applications [6][7]. Humans presume that robots have perfect knowledge and problem-solving skills, yet this assumption is unfounded because robots make mistakes too, which deludes humans [8-9].

Some social responses could be observed in HRI, including reactance, liking, trusting belief, and compliance [10] using questionnaires. Ghazali et al. [10] observed that human choices highly depend on how the social robot behaves. Interestingly, psychological reactance (a type of social response) is elicited when a human's right to make choices is violated. For example, being denied by the robot to make decisions freely may lead to negative responses and result in angriness (state of being angry), annoyance (the slightly impatient feeling), and irritation (feeling of being annoyed and impatient) feelings. Many scholars argue whether humans can interact with robots in the same way as they interact with other humans [7] as we often similarly treat robots as we treat computers (machine-likeness, non-living things with certain living things characteristics) because the feature of the robot is not similar to human (body shape, face and eye contact). This statement is supported by another study [11] which elaborated on how humans unconsciously treat a computer (in Human-Computer Interaction) as a genuine interaction as in Human-Human Interaction. Align with that, Edwards et al. [7] and Klowait [11] found Computer Are Social Actors (CASA) paradigm, which proved that people unconsciously treat a computer as similarly as they treat humans. In other words, humans unconsciously treat the computer as another living thing, not an object.

One of the most important applications of social robots in HRI is the ability of the robots to persuade humans to make decisions without resulting in any annoyance, dislike or disbelief feelings. An earlier study showed that if the robot treats humans nicely, the human may respond more nicely when social praise is applied [12][13]. Social praise is an example of social cues that could be implemented in social robots. Social cues could be displayed in various forms, for example, verbal or non-verbal, to express the robot's intention and emotion [10][14][15]. The effect of these cues includes how the robot responds to humans' activities, whether in a desirable manner [14], portraying belief [14][16], or gender stereotype traits [14][16]. In decision-making situations for HRI, the social robot must have a persuasive feature that can assist humans in making choices [17-19]. The help may come as advice or suggestion, so humans are willing to follow the robot's commands [20]. The persuasive outcome depends on human responses, whether it can be a positive (for example, low reactance) or a negative (for example, high reactance) response.

As such, it is an interesting and participating study to explore how humans respond while interacting with robots, whether they treat the robots as objects (just like the computers) and how the robots' social cues make them more human-like. Applications of social robots could also be enhanced with the ability to offer the best recommendations and/or influence others to make the chosen (or previously predetermined) decisions. The social robot's job must be sufficiently obvious since it must possess an effective persuasion technique that may be applied in certain circumstances.

The study's main objective was to investigate the influence of social praise by the robot in a decision-making situation for HRI applications. This objective could be divided into several sub-objectives, which were to develop a game with decision-making situations to provide a persuasive medium for HRI, to correlate humans' psychological and physiological effects (through questionnaires and GSR sensor readings respectively) and to evaluate humans' psychological responses after interacting with a persuasive robot that has designated social cues: presence vs absence of social praise after ten persuasive attempts.

The hypothesis for the social response was collected from a questionnaire, and psychological data were collected using Galvanic Skin Response (GSR). Three independent variables were under study: social praise (presence vs absence), age and gender of the participants. While for dependent variables, there were perceived usefulness toward the robot (known as *usefulness*), perceived ease of use toward the robot (known as *ease*), perceived attitude toward the robot (known as *attitude*), perceived intention toward the robot (known as i*ntention*), perceived enjoy toward the robot (known as enjoyment), perceived reactance toward the robot (known as *reactance*), perceived liking toward the robot (known as *liking*), perceived belief toward the robot (known as *belief*), perceived compliance towards the robot (known as *compliance*) and perceived GSR readings (known as *GSR readings*). The study proposed hypotheses as follows:

Hypothesis 1: There was a significant correlation among dependent variables, including *usefulness, ease, attitude, intention, enjoyment, reactance, liking, belief, compliance* and *GSR readings*

Hypothesis 2(a): There was a significant main effect of social praise on *usefulness, ease, attitude, intention, enjoyment, reactance, liking, belief, compliance* and *GSR readings.*

Hypothesis 2(b): There was a significant main effect of age on *usefulness, ease, attitude, intention, enjoyment, reactance, liking, belief, compliance* and *GSR readings*.

Hypothesis 2(c): There was a significant main effect of gender on *usefulness, ease, attitude, intention, enjoyment, reactance, liking, belief, compliance* and *GSR readings.*

Hypothesis 3(a): There was a significant interaction effect of social praise and age on *usefulness, ease, attitude, intention, enjoyment, reactance, liking, belief, compliance* and *GSR readings*.

Hypothesis 3(b): There was a significant interaction effect of social praise and gender on *usefulness, ease, attitude, intention, enjoyment, reactance, liking, belief, compliance* and *GSR readings*.

Hypothesis 3(c): There was a significant interaction effect of age and gender on usefulness, ease, attitude, intention, enjoyment, reactance, liking, belief, compliance and GSR readings.

Hypothesis 4: The main significant (and interaction) effect of independent variables on humans' compliance was based on the order of persuasive attempts made by the robot.

Hypothesis 5: There was a main significant (and interaction) effect of independent variables on the readings of GSR based on the order of persuasive attempts made by the robot.

2. MATERIAL AND METHODS

2.1. Participants

Forty (40) participants (17 male and 23 female) were recruited, aged between 20 and 24 (M=22.65, SD=1.099), where 20 participants were for a situation where social praise is present and another 20 participants for a situation where social praise is absent. The experiment lasted for twenty-five minutes, during which every participant was handed some snacks after the whole experiment was done. Participants are randomly selected within the available range due to COVID-19, with no restriction of gender and age.

2.2. Social robot

Rero [21], as shown in Figure 1, is selected as a persuasive robot in this study because it could possess some human attributes, including a face, body, hand, leg, and voice, supported by earlier research [22].

The robot used a recorded female voice in all conditions (with and without social praise) to convey persuasive messages throughout the study. The robot started the game by introducing itself as 'Sara'. Before experimenting, the recorded voice by the Rero robot was tested to ensure it was clear and understandable.

Figure 1. A RERO robot used in the research.

2.3. Tasks

A 2D game entitled "Survival in Island" via UNITY software has been created as a medium for the study, as shown in Figure 2. The game was inspired by an earlier study [10] involving a juice-making activity with another type of persuasive robot.

Figure 2. An example of the task for the "Survival in Island" game.

Sara and the participant would cooperate throughout the game to survive on a deserted island. This game had ten tasks, and ten options were available for each task. There was only a pre-selected 'correct' response for each task, and selecting the 'correct' response would advance the participant to the next job. If the participant chose an 'incorrect' response, Sara would convey several facts (as a persuasive message) to the participant before asking them to make other choices as their final response.

For example, in Task 1, the participant would be asked to choose what food to eat at the seashore to survive (initial decision). If the participant selects tuna, Sara would agree and praise them (the pre-set answer). If the participant chose anything other than tuna (other than the pre-set answer), Sara, an advisor, tried to change the participant's selection to select tuna. Sara's advice included facts about tuna's benefits to change the participant's mind. Then, the participants would be asked to re-choose their choice, whether they chose the choice suggested by Sara (following Sara's advice) or ignored Sara's suggestion and selected the same initial choice or other foods as the final decision.

For the social praise condition, if the participant chose the answer from Sara's suggestion, Sara would praise the participant by saying '*Good Job*'. However, if the participant ignored Sara's suggestion, Sara would respond with no praise, '*Let's move to the next task*'. For no social praise condition, whether the participant followed or ignored the suggestion made by Sara, the robot would respond by saying, '*Let's move to the next task*' directly.

2.4. Procedure

The participant was asked to read and sign a consent form before the experiment started. The participant also would be briefed on how to play the game, and the experimenter would guide the participant to wear a GSR sensor on their index and middle finger on their non-dominant hand (to measure skin's conductivity that led to a reading of stress) [23][24] in phase 1.

After the experimenter left the room, the participant relaxed before playing the game. The condition was set by asking the participant to listen to a piece of three-minute music called "Weightless" by Marconi Union. The song was selected as it helps create a calm environment and impacts the physiological measure of each athlete's anxiety, as shown in an earlier study [25]. The study started with a relaxing condition to measure the participants' baseline condition-skin conductance, as each person has a different initial measure [23].

In phase 3, the introduction of the game and the task description was conveyed by Sara. The participant was required to choose one choice only in each task. If Sara agreed to the choice, it would move to the next task. Meanwhile, if the option did not agree with Sara, Sara would suggest including facts about the selection in the persuasive attempt. After that, the participant needed to choose again. If the choice were Sara's suggestion, Sara would praise the participant and then move to the next task when the robot's condition was social praise. This cycle repeated in all other nine tasks. The game ended when task 10 was completed. All the game data was saved under the participant's ID.

After the game ended, the participant was asked to switch off and take off the GSR sensor carefully. Afterwards, they were asked to complete a questionnaire using Google Forms.

2.5. Measurements dan data collection

The study used a questionnaire carried out by Ghazali et al. [10] and phrased the questionnaire to adapt to the study design.

3. RESULTS AND DISCUSSION

3.1. Hypothesis 1

Hypothesis 1 is partially accepted as there are correlations between *usefulness, ease, attitude, intention, enjoyment, reactance, liking, belief and compliance*. The 2-tailed correlation test showed that *usefulness* and *compliance* are moderately negatively correlated, $r(40) = -0.380$, $p = 0.008$. Also, *ease* is highly positively correlated with *attitude*, $r(40) = 0.739$, $p < 0.001$, highly positively correlated with *intention*, $r(40) = 0.767$, $p < 0.001$, highly positively correlated with *enjoy*, $r(40) = 0.622$, $p < 0.001$, moderately negatively correlated with *reactance*, $r(40) = -0.496$, $p = 0.001$, highly positively correlated with *liking*, $r(40) = 0.672$, $p < 0.001$, highly positively correlated with *belief*, $r(40) = 0.737$, $p < 0.001$, and moderately positively correlated with *compliance*, $r(40) = 0.414$, $p = 0.004$. Other than that, *attitude* is highly positively correlated with *intention*, $r(40) = 0.764$, $p < 0.001$, highly positively correlated with *enjoy*, $r(40) = 0.681$, $p < 0.001$, highly negatively correlated with *reactance*, $r(40) = -0.522$, $p < 0.001$, highly positively correlated with *liking*, $r(40) = 0.744$, $p < 0.001$, and highly positively correlated with *belief*, $r(40) = 0.740$, $p < 0.001$.

For *intention*, the variable is highly positively correlated with *enjoy*, $r(40) = 0.678$, $p < 0.001$, highly negatively correlated with *reactance*, $r(40) = -0.566$, $p < 0.001$, highly positively correlated with *liking*, $r(40) = 0.657$, $p < 0.001$, highly positively correlated with *belief*, $r(40) = 0.732$, $p < 0.001$, and moderately positively correlated with *compliance*, $r(40) = 0.345$, $p = 0.015$. Besides, *enjoy* is highly negatively correlated with *reactance*, $r(40) = -0.590$, $p < 0.001$, highly positively correlated with *liking*, $r(40) = 0.743$, $p < 0.001$, and highly positively correlated with *belief*, $r(40) = 0.643$, $p < 0.001$. Additionally, *reactance* is moderately negatively correlated with *reactance*, $r(40) = -0.379$, $p = 0.008$, and moderately negatively correlated with *belief*, $r(40) = -0.476$, $p = 0.001$. Moreover, *liking* positively correlates with *belief*, $r(40) = 0.803$, $p < 0.001$.

3.2. Hypothesis 2(a)

A one-way Analysis of Variance (ANOVA) test is used to find the main effect of social praise on dependent variables; *usefulness, ease, attitude, intention, enjoyment, reactance, liking, belief, compliance* and *GSR readings.*

As a result, there is a main significant difference between a robot with social praise (M =4.03, SD = 0.69) and a robot without social praise (M =4.45, SD =0.58) on *ease* [F (1, 39) =4.48, p =0.04, partial η^2 = 1.81]. Also, there is a main significant difference between a robot with social praise (M =3.83, SD = 0.78) and a robot without social praise (M =4.44, SD =0.76) on *intention* [F (1, 39) =6.34, p =0.02, partial η^2 = 3.75]. Additionally, there is a main significant difference between a robot with social praise (*M* =3.81, *SD* = 0.68) and a robot without social praise (*M* =4.18, *SD* =0.67) on *belief* [*F* (1, 39) =2.94, *p* =0.10, partial η^2 = 1.33]. There is also a main significant difference between a robot with social praise (*M* =1.05, *SD* = 3.52) and a robot without social praise (*M* =3.30, *SD* =3.72) on *compliance* [*F* (1, 39) =3.87, *p* =0.06, partial η^2 = 50.63].

In sum, the main effect of social praise is significant on *ease, intention, belief,* and *compliance.* Thus, hypothesis 2(a) is partially accepted.

From the analysis, it can be concluded that the praise of the robot does not contribute to the experience of ease of use in having Sara in the game, besides the participants do not have the intention to use Sara again in the future, and they do not comply with Sara instructions through the gameplay. In other words, the participants in this study mostly prefer to use Sara without social praise. Unfortunately, some participants felt uncomfortable with the 'kind' treatment from the robot whenever they followed Sara's suggestion. This statement is supported by an earlier study [22], in which the social robot with experience (knowledge) elicits eeriness feelings towards the participants due to the similar behaviour of the robot to real humans. In terms of *intention*, the participants intend to use Sara only if the robot has no social praise. Thus, considering the situation of the game related to survival skills, it can be said that praise seems ineffective in persuading the participant to make choices.

Also, most participants trust the robot without social praise. The finding contradicts this finding in an earlier study [10] which shows that the social praise used by the robot with proper timing will increase the human's belief level toward the human. The reasons causing the lack of trust in the robot are also due to the criticality of the tasks, whether it is much more important or not [26]. That is, human trust in the robot maybe be varied depending on the criticality of the situation of each task [8]. The perceived trust might increase if the situation is very difficult or critical. Other than that, the participants follow the robot's advice or choice when using it without social praise. We can see that the social praise by the robot does not contribute to human compliance in the persuasive attempt.

3.3. Hypothesis 2(b)

The ANOVA test is performed to investigate the main significant difference between the participant's age on the dependent variables.

As a result, there is a main significant difference in the age of the participants on *usefulness* with *F* (1, 39) =3.73, *p* =0.01, partial η^2 = 1.45. Statistically, participants at the age of 20 have the lowest mean of *usefulness* with *M* =2.93, *SD* = 0.99, with the age of 21 with *M* =3.50, *SD* = 0.42, age of 22 with *M* =3.56, *SD* = 0.68, age of 23 with *M* =3.62, *SD* = 3.53 and age of 24 with *M* =4.38, *SD* = 0.66.

Participants aged 20 think Sara is useless in helping them make good decisions during the game. In contrast, participants at 24 think Sara is useful in advising them to make the right decisions. From the mean trend, it can be concluded that the higher the participant's age, the higher they think Sara's suggestions are useful.

Also, there is a main significant difference found between the age of the participant on *compliances*, *F* (1, 39) =2.32, *p* =0.08, partial η^2 = 28.69, with age 20 (*M* =5.00, *SD* = 3.46), age 21 (*M* =6.50, *SD* = 0.71), age 22 (*M* =1.11, *SD* = 3.59), age 23 (*M* =2.72, *SD* = 3.50) and age 24 (*M* =0.00, *SD* = 3.74). However, no clear trend can be concluded from this finding. Overall, Hypothesis 2(b) is partially accepted.

3.4. Hypothesis 2(c)

There is a main significant difference between the gender of the participants on *enjoying*, with *F* (1, 39) =2.50, *p* =0.12, partial η^2 = 2.28. In terms of score, male participants do not enjoy using Sara much (*M* =3.90, *SD* = 1.05) compare to female participants (*M* =4.38, *SD* = 0.88). Based on the results, it can be seen that the female participants who may have no or little survival skills enjoy this survival game as the robot acts as their partner, advising them to make the best choice in every task. However, most of the male participants seemed bored with this survival game as they may have acquired a strong knowledge of survival skills, and sometimes, they may agree or disagree with the robot's suggestion choice. Other dependent variables are not significant. Thus, Hypothesis 2(c) is partially accepted.

3.5. Hypothesis 3(a, b and c))

A Multivariate Analysis of Variances (MANOVA) analysis is run. As a result, there is no significant interaction effect of social praise and age on dependent variables (*usefulness, ease, attitude, intention, enjoy, reactance, liking, belief, compliance* and *GSR readings).*

Besides, Univariate Analysis of Covariance (ANCOVA) is run by using the gender of the participant as a covariate and social praise and age as independent variables on the dependent variables. Though, no significant differences are found. Also, there is no significant interaction effect of social praise and age (using covariate: gender) on dependent variables (*usefulness, ease, attitude, intention, enjoyment, reactance, liking, belief, compliance* and *GSR readings).*

Additionally, there is no significant interaction effect of social praise and gender on dependent variables (*usefulness, ease, attitude, intention, enjoyment, reactance, liking, belief, compliance* and *GSR readings*). Also, using ANCOVA with social praise and gender used as the independent variable while the age of participants as a covariant, results showed no significant interaction effect between those variables.

Other than that, there is no significant interaction effect of age and gender on dependent variables (*usefulness, ease, attitude, intention, enjoyment, reactance, liking, belief, compliance* and *GSR readings*). Consequently, Hypothesis 3 (a, b, and c) is rejected.

3.6. Hypothesis 4

Results from repeated-measures ANCOVA find a significant main effect of gender on the sequence of tasks (based on *compliance* score), F (1, 39) = 17.00, p = 0.12, partial η^2 = 10.00. Mauchly's Test of Sphericity indicated that the assumption of sphericity had not been violated in this test, $\chi^2(54)$ = 195.30, p = 0.00. Also, a linear test of within-subject contrasts demonstrated a significant relationship between social praise by the robot, age and gender of participants on the task sequence, F (1,39) = 18.747, p = 0.00, partial η^2 = 43.29. Other relationships between independent variables on the dependent variables are found to be insignificant. Consequently, Hypothesis 4 is partially accepted.

3.7. Hypothesis 5

A repeated-measures ANOVA determined no significant main effect was found between social praise, age and gender on *GSR readings*. The test of the between-subjects effect shows that all the independent variables are insignificant. To conclude, social praise has no significant impact on *GSR1, GSR2, GSR3, GSR4, GSR5, GSR6, GSR7, GSR8, GSR9, GSR10* and sum GSR. Thus, Hypothesis 5 is rejected.

These insignificant findings are due to the persuasive attempt is not powerful enough to initiate the stress upon each participant. With the social praise and low controlling language (low coercive) used in this HRI, the participant may experience a little anxiety, but the stress does not lead to depression. In addition, the decision-making situation might not be challenging enough for the participant to solve with assistance from the robot.

4. CONCLUSION

The study discovers the influence of social praise in HRI during decision-making situations that affect *usefulness, ease, attitude, intention, enjoyment, reactance, liking, belief, compliance* and *GSR readings*. In this paper, a RERO robot assisted the participant in ten tasks. The robot gave some helpful advice and persuaded them to make selections. At the end of the experiment, all the human response was observed when interacting with the robot.

The study found that social praise significantly affects perceived *ease*, intention, *belief* and *compliance.* Without social praise, the participants feel the robot is free of effort, intend to use it again, trust the robot to decide on their behalf and are willing to follow its advice. Based on a quick interview after the experiment, all participants had no experience interacting with the social robot. Thus, these findings have been supported by an earlier study [19] which found that humans in a new social experience are easier to be persuaded by the robot than the experienced ones. Even though all participants have never interacted with the robot before, the older participants believe that the robot's advice is more useful in decision-making than the younger participants. Regarding gender, the female participants enjoyed interacting with the robot compared to the male participants. From a practical standpoint, the result demonstrates how social praise in HRI applications might shape human response in decision-making situations.

CONFLICTS OF INTEREST

The authors reported no potential conflicts of interest.

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REFERENCES

[1] D.P. Davison, F.M Wijnen, V. Charisi, J.V.D. Meic, D. Reidsma, and V. Evers. "Words of encouragement: how praise delivered by a social robot changes children's mindset for learning", *Journal Multimodal User Interfaces*, Vol. 15, No. 1, pp. 61–76, 2021. https://doi.org/10.1007/s12193-020-00353-9

[2] C. Ke, V.W.Q Lou, K.C.K. Tan, M.Y. Wai, and L.L. Chan, "Changes in technology acceptance among older people with dementia: the role of social robot engagement", *International journal of medical informatics*, Vol. 141, No. 7, p. 104241, 2020. https://doi.org/10.1016/j.ijmedinf.2020.104241

[3] A. Rossi, and S. Rossi, "Engaged by a bartender robot: Recommendation and personalisation in human-robot interaction", *Adjunct Proceedings of the 29th ACM Conference on User Modeling,* pp. 115–119, 2021. https://doi.org/10.1145/3450614.3463423

[4] N. Glas, and C. Pelachaud, "Definitions of engagement in human-agent interaction", *International Conference on Affective Computing and Intelligent Interaction*, pp. 944–949, 2015, https://doi.org/10.1109/ACII.2015.7344688

[5] C. Oertel, G. Castellano, M. Chetouani, and J. Nasir, "Engagement in human-agent interaction : An overview", Vol. 7, No. August, pp. 1–21, 2020. https://doi.org/10.3389/frobt.2020.00092

[6] T. B. Sheridan, "Human-Robot Interaction", *Human factors*, Vol. 58, No. 4, pp. 525–532, 2016, https://doi.org/10.1177/0018720816644364

[7] C. Edwards, A. Edwards, P.R. Spence, and D. Westerman, "Initial interaction expectations with robots: testing the human-to-human interaction script", *Communication Studies*, Vol. 67, No. 2, pp. 227–238, 2016. https://doi.org/10.1080/10510974.2015.1121899

[8] A. Rossi, K. Dautenhahn, K. Lee Koay, and M. L. Walters, "How social robots influence people's trust in critical situations", *2020 29th IEEE International Conference on Robot and Human Interactive Communication, RO-MAN 2020*, pp. 1020–1025, 2020. https://doi.org/10.1109/RO-MAN47096.2020.9223471

[9] P. Alves-Oliveira, M.L. Lupetti, M. Luria, D. Loffler, M. Gamboa, L. Albaugh, W. Kamino, A.K. Ostrowski, D. Puljiz, P. Reynold-Cuellar, M. Scheunemann, M. Suguitan, and D. Lockton, "Collection of metaphors for human-robot interaction", *Designing Interactive Systems Conference 2021* pp. 1366–1379, 2021. https://doi.org/10.1145/3461778.3462060

[10] A.S. Ghazali, J. Ham, E. Barakova, and P. Markopoulos, "Assessing the effect of persuasive robots interactive social cues on users' psychological reactance, liking, trusting beliefs and compliance", *Advanced Robotics*, vol. 33, no. 7–8, pp. 325–337, 2019.https://doi.org/10.1080/01691864.2019.1589570

[11] N. Klowait, "The quest for appropriate models of human-likeness: Anthropomorphism in media equation research", *AI and Society*, vol. 33, no. 4, pp. 527–536, 2018. https://doi.org/10.1007/s00146-017-0746-z

[12] A.S. Ghazali, J. Ham, E. Barakova, and P. Markopoulos, "Persuasive robots acceptance model (PRAM): Roles of social responses within the acceptance model of persuasive robots", *International Journal of Social Robotics*, Vol. 12, No. 5, pp. 1075–1092, 2020. https://doi.org/10.1007/s12369-019-00611-1

[13] D.D. Allan, A.J. Vonasch, and C. Bartneck, "I have to praise you like i should? The effects of implicit self-theories and robot-delivered praise on evaluations of a social robot", *International Journal of Social Robotics*, vol. 14, no. 4, pp. 1013–1024, 2022. https://doi.org/10.1007/s12369-021-00848-9

[14] J. Bernotat, F. Eyssel, and J. Sachse, "The (Fe)male robot: How robot body shape impacts first impressions and trust towards robots", *International Journal of Social Robotics,* 2019. https://doi.org/10.1007/s12369-019-00562-7

[15] D. Stoeva, and M. Gelautz, "Body language in affective human-robot interaction", *ompanion of the 2020 ACM/IEEE International Conference on Human-Robot Interaction*, pp. 606–608, 2020. https://doi.org/10.1145/3371382.3377432

[16] A.S. Ghazali, J. Ham, E.I. Barakova, and P. Markopoulos, "Effects of robot facial characteristics and gender in persuasive human-robot interaction", *Frontiers in Robotics and AI,* Vol. 5, No. 6, pp. 1–16, 2018. https://doi.org/10.3389/frobt.2018.00073

[17] S. Saunderson, and G. Nejat, "Investigating strategies for robot persuasion in social human-robot interaction", *IEEE Transactions on Cybernetics,* pp. 1–13, 2020. https://doi.org/10.1109/tcyb.2020.2987463

[18] S. Saunderson, and G. Nejat, "It would make me happy if you used my guess: Comparing robot persuasive strategies in social human-robot interaction", *IEEE Robotics and Automation Letters*, Vol. 4, No. 2, pp. 1707–1714, 2019. https://doi.org/10.1109/LRA.2019.2897143

[19] M. Hashemian, S. Mascarenhas, M. Couto, A. Paiva, P. A. Santos, and R. Prada, "The application of social power in persuasive social robots", *Companion of the 2020 ACM/IEEE International Conference on Human-Robot Interaction*, pp. 564–566, 2020, https://doi.org/10.1145/3371382.3377447

[20] C. McCaffrey, A. Taylor, S. Roy, S.B. Banisetty, R. Mead, and T. Williams, "Can robots be used to encourage social distancing?", *Companion of the 2021 ACM/IEEE International Conference on Human-Robot Interaction*, Vol. 1, No. 1. Association for Computing Machinery, 2021. https://doi.org/10.1145/3434074.3447217

[21] N.I. Ishak, H.M. Yusof, M.R.H. Ramlee, S.N.I. Sidek, and N. Rusli, "Modules of interaction for ASD children using rero robot (Humanoid)", *2019 7th International Conference on Mechatronics Engineering (ICOM)*, 2019. https://doi.org/10.1109/ICOM47790.2019.8952038

[22] M. Appel, D. Izydorczyk, S. Weber, M. Mara, and T. Lischetzke, "The uncanny of mind in a machine: Humanoid robots as tools, agents, and experiencers", *Computers in Human Behavior*, Vol. 102, No. 8, pp. 274–286, 2020. https://doi.org/10.1016/j.chb.2019.07.031

[23] C.M. Durán-Acevedo, J.K. Carrillo-Gómez, and C.A. Albarracín-Rojas, "Electronic devices for stress detection in academic contexts during confinement because of the COVID-19 pandemic", *Electronics*, Vol. 10, No. 3, pp. 301, 2021. https://doi.org/10.3390/electronics10030301

[24] M. Memar, and A. Mokaribolhassan, "Stress level classification using statistical analysis of skin conductance signal while driving", *SN Applied Sciences*, Vol. 3, No. 1, 2021. https://doi.org/10.1007/s42452-020-04134-7

[25] J.A. Rather, and Y. Shrivastava, "Effect of music therapy on pre-competition anxiety in college level soccer players of Kashmir", Vol. 4, No. 1, pp. 1176–1178, 2019. https://www.journalofsports.com/pdf/2019/vol4issue1/PartZ/4-1-315-197.pdf

[26] D. Doyle-Burke and K.S. Haring, "Robots are moral actors: Unpacking current moral hri research through a moral foundations lens", *Social Robotics. ICSR 2020. Lecture Notes in Computer Science* vol. 12483, Springer. 2020. https://doi.org/10.1007/978-3-030-62056-1_15