The influence of gazing and gestures of a storytelling robot on its persuasive power

Jaap Ham and Rene Bokhorst
Human-Technology Interaction Group, Department of Industrial Engineering and Innovation Sciences, Eindhoven University of Technology, Eindhoven, the Netherlands

John-John Cabibihan
Social Robotics Laboratory (Interactive and Digital Media Institute) & Department of Electrical and Computer Engineering, National University of Singapore, Singapore.

ABSTRACT
In this experiment we studied the combined and individual contribution of gestures and gazing to the persuasiveness of a storytelling robot. We had a robot tell a persuasive story about the aversive consequences of lying to 48 participants. The robots used persuasive gestures (or not) to accompany this persuasive story, and also used gazing (or not) while telling this persuasive story. We assessed persuasiveness y asking participants to evaluate the lying individual in the story told by the robot. We hypothesized that persuasiveness would increase with the inclusion of either gazing or gestures and that the combination of both would have even stronger persuasive effects. Results indicated that only gazing has a main effect on persuasiveness, while the use of gestures does not. Also, results suggested an interaction between gazing and gestures conforming the social agency theory, namely the combined effect of gestures and gazing on persuasiveness was greater than the effect of either gestures or gazing alone. However, results also indicate that without the presence of gazing, humanlike gestures lead to a decrease in persuasion. Overall, this research indicated that making a robot follow a human like gazing behavior improves the persuasive power of a robot. This study also suggests that adding multiple social cues can have additive persuasive effects. The implications of the current findings for theory and design of persuasive robots are discussed.

Author Keywords
Social robotics, human technology interaction, gazing, head movement, gestures, talking robot.

INTRODUCTION
The development of robotics in the past few years has shown that robots are capable of doing many things. For example, a lot of medical procedures are already being undertaken using the help of robots (Bloss, 2011). Research has shown that robots can be deployed for various dangerous tasks in the near future (Humphrey & Adams, 2009). Beginning as a discipline within electrical engineering, the research field of robotics has expanded into the field of psychology because of the increasing frequency of encounters between humans and robots. The growing interest in robotics in electrical and psychological fields allowed the field of robotics to enjoy a growing base. Robots are deployed in a variety of applications and fields and as a result have become more reliable and robust. Nowadays the level of development of robots has reached such high levels that practical applications in person care are being investigated. We now can entrust robots with the mundane tasks that we often do ourselves or ask another person to do for us. Robots can replace humans in those tasks.

But can a robot take over the care of elderly people as well as another person can? Part of answering that question lies in whether or not an elderly person will be persuaded by a robot as well as he or she would be persuaded by another person.

Two of the most crucial factors in human-human face-to-face communication that determine attention and comprehensibility are gazing (Kleinke, 1977) and gestures (Hostetter, 2011). In many forms of human-computer communication (Reeves & Nass, 2003) as well as human-robot communication, humans respond and interact with technology (computers or robots) just as if they were interacting with other humans. Therefore, we argue that the importance of gazing behavior and use of gestures in human-robot communication will also be very large.

Earlier research has investigated the effects on the information retention of participants when a storytelling robot shifted its gaze between two participants in different ways (Mutlu, Forlizzi, & Hodgins, 2006). That research indicated that gazing, or the way gazing was used, has an effect on information retention. People who were gazed at more significantly remember more of the story than people who were gazed at less. This research also suggested that men liked robots more when they were gazed at more, but women liked robots more when they were gazed at less.

In another study (Garau, Slater, Bee, & Sasse, 2001) that investigated the feeling of involvement and co-presence in a dyadic conversation, conversations between people using video conferencing, people using digital avatars with inferred gaze conversations, people using digital avatars with random gaze conversations and people using audio only conversations were compared. People rated the "video conference" condition to lead to the most involvement and co-presence. However the "digital avatars with inferred gaze" condition was a close second. Only "audio only" conversations scored higher on the co-presence scale than inferred gaze conversations. The above two studies show that the feeling of involvement in a conversation is largely dependent on the ability to see what our conversation partner is looking at.

A lot of verbal tasks a person has to undertake greatly benefit from gaze or head movement. An earlier study (Bailenson, Beall, & Blascovich, 2002) showed that participants controlling an avatar in a virtual environment who can move their virtual heads, will like other avatars controlled by participants more and have a higher level of co-presence compared to conditions where no gazing or head movement was possible. In a different study (Vertegaal, Slagter, van der Veer, & Nijholt, 2001) it was found that a person's gaze is a very reliable source of input to establish whom the person is speaking or listening to. Head movement and gazing are shown to be very important factors in co-presence, likeability and determining direction. It was also found (Kleinke, 1977) that gazing can play an important role in compliance to unambiguous requests in human-human interaction.

However, to our knowledge, the effect of gazing on persuasion in human-robot communication has not been experimentally investigated. Therefore, in the current research, we will investigate the effect of gazing on persuasion in a conversation between humans and robots. We want to see how gazing and head movement will influence the persuasive power of a talking robot.

We will also be investigating the effect of gestures on persuasive power to see if the addition of extra social behavioral cues can lead to a further increase of persuasion. Various studies have investigated the role of gazing. Earlier research (Cabibihan, So, & Nazar, 2009) suggests that pointing gestures by a robot can significantly improve the speech comprehension of spatial information spoken by a human experimenter. In another study (Maricchiolo, Gnisci, Bonaiuto, & Ficca, 2009) it was found that in general, gestures that are linked to speech affect message evaluation and judgment about the speaker more positively than non linked to speech gestures or no gestures. Gestures also provided a moderate benefit to communication in another human-human interaction study (Hostetter, 2011).

We predict that gazing and gestures will both significantly improve the persuasive power of a talking robot. Social agency theory suggests that social cues can prime the social conversation schema in people, and cause people to act as if they were in a conversation with another person (Mayer, Sobko, & Mautone, 2003). More social cues lead to a stronger interpretation of said effect. But in a recent experiment on persuasiveness (Vossen, Ham, & Midden, 2009) it was suggested that combining social cues does not significantly improve persuasiveness compared to having just one cue. We hypothesized that according to the social agency theory our robot would show improved persuasive power when it uses more social cues.

The current research

In this study we investigated if a storytelling robot is more persuasive if it was gazing and using gestures in a human like manner. We manipulated gazing behavior and gestures as separate variables. We were measuring the persuasive power of the storytelling robot.

The experiment used four conditions. The first condition was the baseline condition that only has the persuasive story being told by the robot (gazing absent, gestures absent). The second condition had a robot that had gestures based on a storyteller telling a story (gazing absent, gestures present). Replicating methodology of earlier research (Mutlu, et al., 2006), we videotaped a storyteller. This storyteller was telling the exact same story as the one used in our experiment and we programmed the robot to mimic his gazing behavior and gestures. The third condition had a robot that only mimics the gazing behavior of the same videotaped storyteller (gazing present, gestures absent). The fourth condition had a robot that mimics the gazing behavior as well as the gestures of the videotaped storyteller (gazing present, gestures present).

Being able to measure how people perceive robots is vitally important in research such as this where we want to measure changes in participant's attitude across various scales. In an earlier study a standardized measurement tool for evaluation robots was introduced (Bartneck, Kulic, & Croft, 2009). They compiled a questionnaire (the godspeed questionnaire),that assesses people's judgments about the anthropomorphism, animacy, likeability, perceived intelligence and perceived safety of a robot. This standardized measurement tool was used to compare important aspects of human robot interaction between our four different conditions.

Hypotheses

Considering our research question and the available literature we had the following hypotheses.

H1: Participants who receive a persuasive message from a storytelling robot that employs human like gazing behavior will be persuaded more and have a more positive attitude about the robot.

H2: Participants who receive a persuasive message from a storytelling robot that employs human like gestures will be persuaded more and have a more positive attitude about the robot.

H3: The effect of adding either gazing behavior or gestures to the other will significantly increase on persuasion.

METHOD

Participants and Design

Sixty-four participants participated in this experiment of which 33 were female and 31 were male. Participants were students or researchers of the National University of Singapore or their friends or family. They were between the age of 13 and 32 (M = 22.50, SD = 2.63). For a participation of 20 minutes participants received a compensation of $10 SGD.

For this experiment we employed a 2 (looking behavior present vs. absent) x 2 (gestures present vs. absent) between subject design.

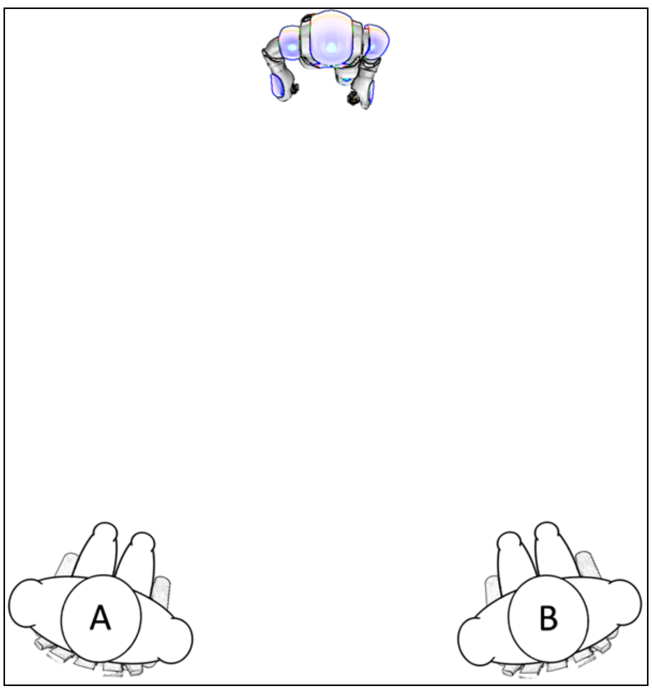

Figure 1. Participants listen to Nao's story in pairs

Materials and measures

The persuasive story told to the participant was combined with gazing, gestures, both or no manipulations. The persuasive story was told by a Nao robot. The persuasive story was "The boy who cried wolf" by Aesop. It is a moral story to teach children about the consequences of lying.

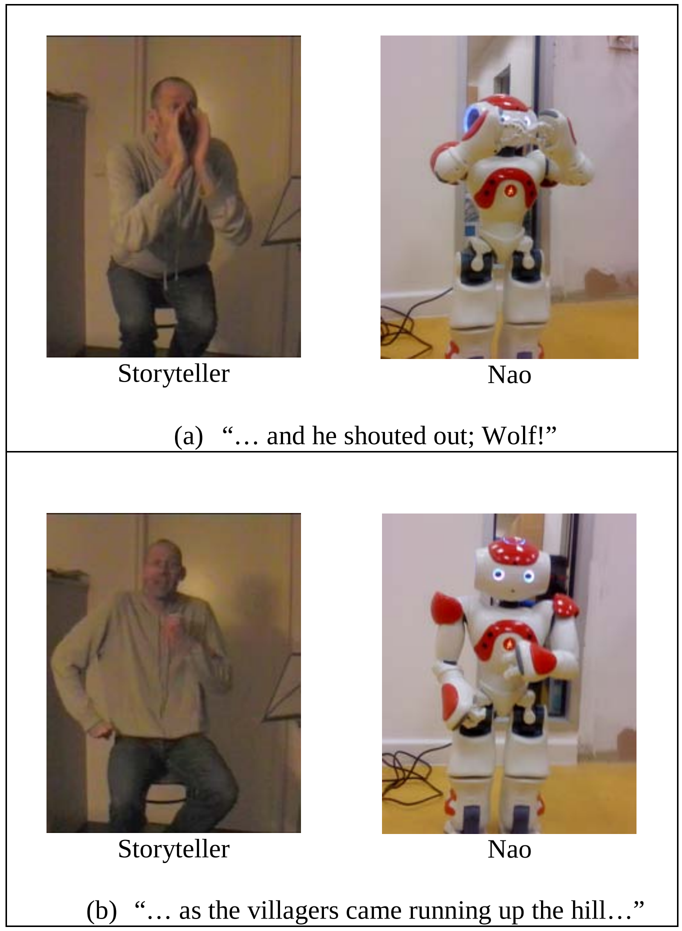

Figure 2. Two examples (a and b) of gestures as performed by a storyteller and Nao.

The Nao robot by Aldebaran has a high level of stability and fluidity in its movements. This is made possible by its inertial sensors, force sensitive resistors, Hall effect sensors, infrared and sonar receivers coupled with its axes that give it 25 degrees of freedom. For this experiment we only used very basic movements and its audio speakers.

It should be noted that according to some definitions of gazing (Garau, et al., 2001), (Cassell et al., 1994), Nao is unable to gaze. With only two sunken LED lights giving shape as its eyes, Nao is unable to show any kind of focus other than pointing the front of its head in a specific direction. It cannot convey emotional information. However we argue that even this impaired form of gazing will yield significant results. To control for misinterpreted intentions of gazing we measured how participants experienced Nao's gaze.

This experiment used Nao as a pre-scripted storyteller. Scripting Nao was done using Choreographe. Choreographe allows the user to script the motions of the Nao with a flow diagram. The flow diagram maintains the overview of the entire script. Complex movements can be made by recording a movement in the simulator. For more refined adjustments and complicated logic we edited the Perl script underlying the diagram blocks.

The Nao storytelling script was based on a video recorded storytelling session by a professional stage actor. Three storytelling sessions were recorded. Each consecutive session the actor was asked to exaggerate the gestures and gazing he was doing. The most exaggerated version was used as a reference for Nao's motions. All the actor's motions were categorized (21 different gestures, 8 different gazing behaviors) and animated in Choreographe. The storytelling script that was constructed for Nao had a total running time of less than three minutes.

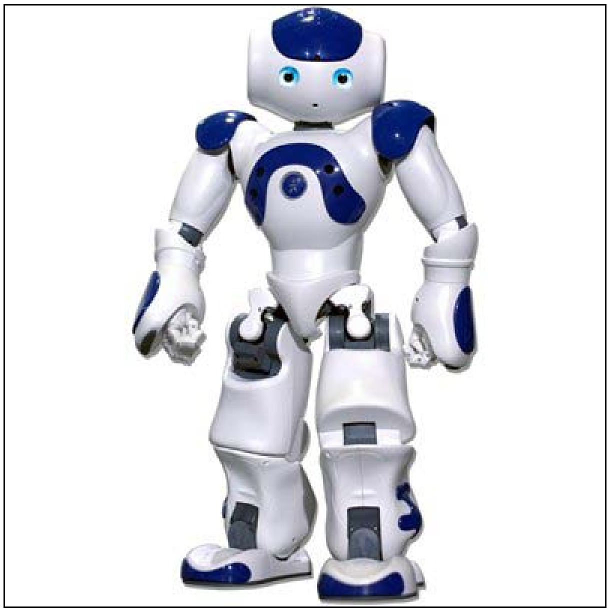

Figure 3. The Nao robot by Aldebaran

This experiment required a measure of persuasiveness and likeability. We measure persuasiveness by measuring changes in a participant's attitude about the subject of lying using the semantic differential technique (Osgood, Suci, & Tannenbaum, 1957). More specifically, we measured a participant's attitude towards a lying individual after having listened to the storytelling robot. We measured the three underlying dimensions found by Osgood (evaluation, activity and potency) by asking the participant to complete nine bipolar scaling assignments. Questions were constructed by employing synonyms to the three known underlying dimensions. Three questions of each dimension were used in the questionnaire, giving us a nine item questionnaire. Although, based on (Osgood, et al., 1957) we expected to find three underlying dimensions in these nine questions (evaluation, potency, activity), a factor analysis did not support these three dimensions. A reliability test gave us a Cronbach's alpha of $\alpha = 0.7$.

Procedure

Participants were invited to participate in the study. Similar to the experiment in an earlier study (Mutlu, et al., 2006), participants were asked to participate in pairs. Participants were asked to participate using invitations on social network sites and pamphlets that were strategically placed on campus.

Participants were welcomed in the lobby of the building, and were then escorted to a separate meeting room on the first floor where they were briefed about the experiment. The actual experiment would take place in the same meeting room. After the briefing either a red or a blue Nao robot was placed in the room at a set spot. Participants were asked to remain seated in their chairs throughout the whole experiment. The participants were (unbeknownst to them) randomly placed in one of four conditions. The condition determined how many (if any) and which cues (gazing or gestures) were used by the Nao robot while it told the story. Then the participants proceeded to listen to the story in which they were persuaded to condemn lying.

After the robot had finished the story the semantic differential technique (Osgood, et al., 1957) was used for measuring the participant's attitude towards lying. We measured their attitude towards a prime example of a "bad liar" (the shepherd boy) by using the questionnaire described in the previous section.

Next, the participant filled in the Godspeed questionnaire, after which they were also asked to answer some additional questions about the robot and the story ("Did Nao ever look at you during the story?", "Did you perceive Nao as male or female?", "Did you understand the story?"). Finally, participants were thanked, paid en debriefed.

RESULTS

A first analysis showed that 25% of participants in conditions in which Nao gazed at them did not indicate to have perceived that Nao had been gazing at them. The remaining 75% agreed that Nao had actually been gazing at them. Also, 25% of participants in conditions in which Nao never gazed at anyone claimed to have seen Nao gazing at them. Because for these participants our manipulation seems not to have been perceived as intended, the data from these two groups of 25% of our participants were excluded from further analyses. The remaining participants were 24 males and 24 females between the ages of 13 and 32 (M = 22.48, SD = 2.51)[1]. Participants' gender had no significant effects on persuasion or likeability, $F < 1$, neither independently or in interaction with our two manipulations (gazing and gestures) and was therefore not included in the analysis.

Persuasion

To assess the amount of persuasion, we analyzed the evaluation of the lying person in the story. Therefore, the average of the answers to the nine evaluation questions was submitted to a 2 (gazing: absent vs. present) x 2 (gestures: absent vs. present) MANOVA, in which both factors were manipulated between participants. This analysis indicated that participants who were gazed at by the storytelling robot evaluated the lying person in the story more negatively (M = 0.26, SD = 0.59) than participants who were not gazed at by the storytelling robot (M = 0.61, SD = 0.61), $F(1, 44) = 5.07$, $p = 0.03$. In confirmation with the first hypothesis, this analysis thereby suggested that participants who were gazed at by the storytelling robot were persuaded more by the persuasive message of the robot (indicating that lying is wrong).

Furthermore, this analysis presented no evidence that participants who had been told this persuasive message by a robot that used gestures were persuaded more (and evaluated the lying person more negatively) than participants who had been told this persuasive message by a robot that did not use gestures, $F < 1$. This finding does not provide evidence to prove our second hypothesis.

		Gazing	
		Absent	Present
Gestures	Absent	0.27 (0.29)$_a$	0.45 (0.59)$_a$
	Present	0.95 (0.66)$_b$	0.07 (0.56)$_a$

Note: The means between rows and columns with different subscript are significantly different; p < 0.05.

Table 1. The amount of persuasion by gazing present or absent and gestures used or not used

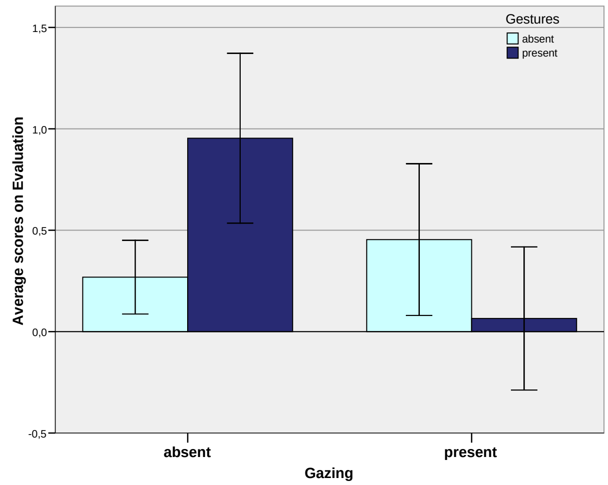

Figure 4. The amount of persuasion (as indicated by the average evaluation of a lying person) by gazing present or absent and gestures used or not used

Finally, this analysis suggested an interaction between gestures and gazing, $F(1, 44) = 11.82$, $p = 0.001$.[2] More specifically, participants who had been told this persuasive message by a robot that did not gaze at them evaluated the lying person more negatively when gestures were absent (M = 0.27, SD = 029) than when gestures were present (M = 0.95, SD = 0.66), $F(1, 45) = 8.82$, $p = 0.01$. In contrast, participants who had been told this persuasive message by a robot that gazed at them evaluated the lying person not different when gestures were absent (M = 0.45, SD = 0.59) than when gestures were present (M = 0.07, SD = 0.56), $F(1, 45) = 2.84$, $p = 0.10$.

Finally, this specific analysis of the simple effects of this interaction also suggested that participants who had been told the persuasive message by a robot that used humanlike gestures evaluated the lying person more negatively when gazing was present (M = 0.07, SD = 0.56) than when gazing was absent (M = 0.95, SD = 0.66), $F(1, 45) = 16.23$, $p < 0.001$. Again in contrast, participants who had been told the persuasive message by a robot that did not use humanlike gestures evaluated the lying person not different when gazing was present (M = 0.45, SD = 0.59) than when gazing was absent (M = 0.27, SD = 0.29), $F < 1$.

Godspeed questionnaire results

The average answers to the questions on each of the five godspeed dimensions were submitted to a 5 (godspeed

[1] Analyses using all 64 participants showed a similar pattern of results, see Appendix A.

[2] An overview of all means and standard deviations can be found in Table 1.

dimension: anthropomorphism vs. animacy vs. likeability vs. perceived intelligence vs. perceived safety) x 2 (gazing: absent vs. present) x 2 (gestures: absent vs. present) MANOVA in which godspeed dimension was manipulated within participants. This analysis indicated no main effect of gazing $F < 1$, no main effect of gestures $F < 1$, nor an interaction of gazing x gestures, $F < 1$. This analysis indicated an (irrelevant) main effect of godspeed, $F(4, 176) = 95.70$, $p < 0.0001$, and also did not provide evidence for different effects of gazing or gestures on any of the godspeed dimensions, indicated by non-significant interactions of gazing x godspeed, $F(4, 176) = 1.25$, $p = 0.29$, and of gestures x godspeed, $F(4, 176) = 1.67$, $p = 0.16$. The three-way interaction of godspeed x gazing x gestures was also non-significant, $F < 1$.

DISCUSSION

Earlier research does not provide a clear answer to the question of whether more social cues would lead to an increase of persuasiveness in human-robot interaction. In this experiment we investigated the combined and individual contribution of gazing and gestures on the persuasiveness of a storytelling robot. We had a robot tell a persuasive story about the consequences of lying to 48 participants. The robots' gazing behavior and gestures were the independent variables. The participants' average evaluation of the lying individual in the story told by the robot was the dependant variable. A decrease in evaluation would indicate that the persuasive effect was stronger. For example, a decrease of evaluation in one condition would indicate that the participants were persuaded more in that particular condition. We hypothesized that persuasiveness and likeability would increase with the inclusion of either cue (H1 and H2) and that the combination of gazing and gestures would create a significant difference over having just one of them (H3).

In confirmation of H1 we found that gazing has a main effect on persuasiveness. That is, participants who were gazed at by the storytelling robot were persuaded more by the persuasive message of the robot than people who were not gazed at by the storytelling robot.

Disconfirming H2 we found that the use of gestures has no main effect on persuasiveness. Unlike previous literature on the topic of gestures and persuasiveness, we found no evidence to support our second hypothesis. Reasons for this might be related to the mechanical appearance and lack of fluidity of the motions of the robot. In line with this suggestion, additional analysis indicated that the use of gestures by the storytelling robot had no significant main effect on the animacy of the robot $F(1, 44) = 1.16$, $p = 0.23$. Therefore we suspect that the gestures used by the robot were insufficient in fluidity or were not recognized correctly. Another possible explanation is that participants felt that they were not being addressed by the robot because the robot was not looking their way in some of the conditions. This could lead to the participant not recognizing itself as the recipient of the message and therefore would not activate the social conversation schema sufficiently enough to be persuaded (Mayer, et al., 2003). This conflict could lead to an interaction that would explain the absence of a main effect of gestures being detected.

Largely in confirmation of H3, analyses also suggested that participants who had been told the persuasive message by a robot that used humanlike gestures were more persuaded when the robot incorporated gazing behavior. This partly confirms our third hypothesis and is in line with social agency theory (Mayer, et al., 2003) which suggests that the combination of gestures and gazing should have the strongest effect on persuasiveness.

Analyses also showed that whenever the robot did not use humanlike gazing behavior, participants evaluated the lying person in the story more negatively (indicating stronger persuasion) when the robot used no humanlike gestures. In contrast, the absence of gazing seems to have made the introduction of humanlike gestures less persuasive. But when the robot did use humanlike gazing, the effect of humanlike gestures on the average evaluation of a lying person became non significant. We argue that the use of gestures without the company of gazing is so rare in social context, that it greatly diminishes the natural feel of the storytelling experience. As mentioned when discussing the absence of a main effect of gestures, the absence of gazing could lead to the social conversation schema not sufficiently being primed. It should be noted that when the participant was being told the story by the robot and the robot would not use human like gazing behavior, it would not appear as if it was looking at anybody else.

It is interesting to involve the uncanny valley (Mori, 1970) effect as an explanation of the interaction in this discussion as well since we have the measure of anthropomorphism. In the evaluation of a robot as a social agent, the more humanlike (anthropomorphic) the robot appears, the more positive the emotional response of the observer becomes. Until it reaches a certain point where a feeling of revulsion kicks in. Unfortunately there was no main effect of gestures or gazing on anthropomorphism. Also, for the uncanny valley to support these findings, the participants would have to rate the storytelling robot as highly anthropomorphic in the observed storytelling experiences. Our anthropomorphism measured on the godspeed scale

(Bartneck, et al., 2009) for the used conditions do not come close to the scores surrounding the uncanny valley[3].

Regarding the measures of persuasion used in this experiment, the main effect of gazing found in the average of the questionnaire scores is interesting because there was no significant effect in the underlying questionnaire score groups. The questionnaire consisted of items closely resembling the three underlying dimensions originally found (Osgood, et al., 1957) (evaluation, potency and activity). The main effect was found in the average of all the questionnaire items, rather than only the evaluation related questionnaire items. We argue that participants did not analyze every item separately but answered questionnaire items peripherally. At a glance the questionnaire does appear to have all the negative evaluations on the left and all the positive evaluations on the right side.

No main effect or interaction effect of gender was found on either gazing or gestures contradicting the findings in a very similar earlier experiment (Mutlu, et al., 2006) where women reported to like robots more when looked at less, and men reported to like robots more when looked at more.

Different from earlier research (Bailenson, et al., 2002) we found no main effect of gazing on likeability. A reason for this may be found in small difference in how gazing was used in Baileson's research versus our research. In the experiment of Bailenson, et al (2002), participants interacted as virtual avatars with virtual avatars (instead of interacting with robots) in a virtual environment and the participant controlled avatar's head movements was bound to the participant's actual movement (instead of mimicking the movements of a pre recorded stage actor). These differences may explain the discrepancy between results.

As mentioned earlier, the social agency theory proposed by Mayer et al. (2003) would lead to believe that in this experiment the combination of gazing and gestures being employed by the storytelling robot will prime the social conversational schema in participants the most out of all conditions. Our results show an increase of persuasion when gazing and gestures are combined and appear to be in the same trend as the social agency theory.

CONCLUSION

We couldn't provide evidence that people interact with computers just as they would with humans (Reeves & Nass, 2003). Our results follow the same trends, but are not as conclusive or as strong as similar research done in human-human interaction. We provided evidence that gazing can significantly improve persuasion, similar to research done in human-human interaction (Kleinke, 1977). However, incorporating gestures into the storytelling robot showed no significant difference in persuasion, unlike what we thought to find based on earlier research (Hostetter, 2011). It would be interesting to investigate if people would be persuaded by a human storyteller that uses gestures but does not look at the person when telling a persuasive story, to compare those results with the results by this experiment. We argue that the persuasive effect would greatly diminish there also.

Despite robots taking over many tasks of human beings already (Bloss, 2011), (Humphrey & Adams, 2009), it may still be a bit too early to start deploying robots as social agents in social settings. This study has indicated that making a robot follow a human like gazing behavior improves at least the persuasive power of a robot. This study also leads to suggest that adding multiple social cues can increase the persuasive power even more. This research has made clear that there is a lot potential in incorporating social cues when trying to improve the social agency of a robot.

REFERENCES

Bailenson, J.N., Beall, A.C., & Blascovich, J. (2002). Mutual gaze and task performance in shared virtual environments. *The Journal of Visualization and Computer Animation, 13*, 313-320.

Bartneck, C., Kulic, D., & Croft, E. (2009). Measurement Instruments for the Anthropomorphism, Animacy, Likeability, Perceived Intelligence and Perceived Safety of Robots. *International Journal of Social Robotics, 1*(1), 71-81.

Bloss, R. (2011). Your next surgeon may be a robot! *Industrial Robot: An International Journal, 38*(1), 6-10.

Cabibihan, J.J., So, W.C., & Nazar, M.A. (2009). *Pointing Gestures for a Robot Mediated Communication Interface.* Paper presented at the International Conference on Intelligent Robotics and Applications, Singapore.

Cassell, J., Pelachaud, C., Badler, N., Steedman, M., Achorn, B., Becket, T., . . . Stone, M. (1994).

[3] Even when assuming significant difference between conditions on anthropomorphism and persuasion, the uncanny valley explanation would contradict the social agency theory in this particular case.

Animated conversation: rule-based generation of facial expression, gesture & spoken intonation for multiple conversational agents. Paper presented at the SIGGRAPH '94 Proceeding of the 21st annual conference on Computer graphics and interactive techniques, New York.

Garau, M., Slater, M., Bee, S., & Sasse, M.A. (2001). *The impact of eye gaze on communication using humanoid avatars.* Paper presented at the The CHI 2001 Conference on Human Factors in Computing Systems, Seattle, Washington.

Hostetter, A.B. (2011). When Do Gestures Communicate? A Meta-Analysis. *Psychological Bulletin, 137*(2), 297-315.

Humphrey, C. M., & Adams, J.A. (2009). Robotic Tasks for Chemical, Biological, Radiological, Nuclear and Explosive Incident Response. *Advanced Robotics, 23*(9), 1217-1232.

Kleinke, C.L. (1977). Compliance to requests made by gazing and touching experimenters in field settings. *Journal of Experimental Social Psychology, 13*(3), 218-223.

Maricchiolo, F., Gnisci, A., Bonaiuto, M., & Ficca, G. (2009). Effects of different types of hand gestures in persuasive speech on receivers' evaluations *Language and Cognitive Processes* (pp. 239-266): Psychology Press.

Mayer, R. E., Sobko, K., & Mautone, P. D. (2003). Social Cues in Multimedia Learning: Role of Speaker's Voice. *Journal of Educational Psychology, 95*(2), 419-425

Mori, M. (1970). Bukimi No Tami, The Uncanny Valley. *Energy, 7*, 33-35.

Mutlu, B., Forlizzi, J., & Hodgins, J. (2006). *A Storytelling Robot: Modeling and Evaluation of Human-like Gaze Behavior.* Paper presented at the IEEE-RAS Conference on Humanoid Robots (Humanoids'06), Genova, Italy.

Osgood, C.E., Suci, G.J., & Tannenbaum, P.H. (1957). The measurement of meaning.

Reeves, Byron, & Nass, Clifford. (2003). *The Media Equation: How People Treat Computers, Television, and New Media Like Real People and Places (Center for the Study of Language and Information - Lecture Notes)*: Center for the Study of Language and Inf.

Vertegaal, R., Slagter, R., van der Veer, G., & Nijholt, A. (2001). *There is more to Conversational Agents than meets the Eyes.* Paper presented at the The CHI 2001 Conference on Human Factors in Computing Systems, Seattle, Washington.

Vossen, S.H., Ham, J., & Midden, C. (2009). *What Makes Social Feedback from a Robot Work? Disentangling the Effect of Speech, Physical Appearance and Evaluation*. Human Technology Interaction Department. Eindhoven University of Technology. Eindhoven.