5-15-2019

ON THE ROLE OF FACIAL WIDTH-TO-HEIGHT RATIO OF HUMANOID ROBOTS FOR HUMAN-ROBOT INTERACTIONS

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Research in Progress

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Abstract

This research investigates consequences of robots' facial shape in human-robot interactions. More precisely, we draw on a topic from social psychology – the facial width-to-height ratio (fWHR). As prior research shows, wider faces (i.e., faces with high fWHR) of both humans and nonhuman entities are perceived as more dominant and physically imposing. Accordingly, we assume that individuals perceive humanoid robots with a higher fWHR (i.e., with a wider face) as more dominant than robots with lower fWHR (i.e., with a narrower face), resulting in increased compliance to recommendations given by robots with higher fWHR. An initial laboratory experiment revealed a significant relationship between robot's fWHR and humans' propensity to follow recommendations given by robots in such a way that humans tend to behave significantly more compliant to the recommendation given by a representation of a humanoid robot when the face of the robot has a high (vs. low) fWHR.

Keywords: Facial width-to-height ratio, Humanoid Robots, Human-Robot Interaction, Recommendations.

1 Introduction

More and more humanoid robots are entering the everyday life of ordinary people and provide assistance for humans in fields like patient care, housework, and manufacturing (e.g., Garun, 2018). In this regard, a topic that is of specific importance pertains to the consequences of humanoid robots' design features for human-robot interaction. One of the most important design areas for humanoid robots is the face, as faces of nonhuman artifacts in general and of robots in particular provide human interaction partners with a focal point of interaction (e.g., Blow et al., 2006). Prior research has examined several aspects of humanoid robots' faces such as shape or expressions, and their implications for human-robot interaction. These studies encompass facial characteristics of robots related to shape, gender cues, emotions, and expressions (e.g., Blow et al., 2006; Powers and Kiesler, 2006).

To further deepen the understanding about the consequences of robots' facial characteristics for human-robot interactions, this research focuses on one facial characteristic that has recently received ample attention in social psychology, that is, facial width-to-height ratio (fWHR; Mileva et al., 2014; Stirrat and Perret, 2010). For humans, fWHR is an important physiological facial characteristic indicative of a targets' social behavior (e.g., Carré et al., 2009). Furthermore, recent research shows that the fWHR of nonhuman entities such as, for example, physical products is predictive of their perceptions, as well (Maeng and Aggarwal, 2017). Our study seeks to extend these findings for the context of human-robot interactions and aims to investigate if the face ratio of a humanoid robot affects human-robot interactions. More specifically, our research tries to answer the question whether the fWHR of a humanoid robot influences whether humans obey the recommendation given by a humanoid robot.

Drawing on an experimental laboratory study with 98 individuals, the results of our research show that individuals behave significantly more compliant to the recommendation given by a representation of a humanoid robot when the face of the robot has a high (vs. low) fWHR. The reason for this finding may be due to a perception of increased dominance that is usually associated with faces of higher fWHR (e.g., Mileva et al., 2014). The result from our study contributes to the literature of human-robot interaction by applying knowledge from social psychology and extends extant research on facial design characteristics of humanoid robots by pointing to interaction-relevant non-expressive design characteristics.

2 Theoretical Foundation and Research Model

2.1 Anthropomorphism and Humanoid Robots

The theoretical foundation for this research is rooted in the literature on anthropomorphism. Anthropomorphism refers to "attributing humanlike properties, characteristics, or mental states to real or imagined nonhuman agents and objects" (Epley et al., 2007, p. 865). The extent of ascribing human characteristics to nonhuman entities is dependent on the degree of human-like appearance of the nonhuman agents (e.g., Kiesler et al., 2008; Waytz et al., 2010). Furthermore, neuroscientific evidence shows that making judgements about anthropomorphized objects activates the same neural systems that are activated when judging other humans (Gazzola et al., 2007). In summary, humans transfer their implicit knowledge about human characteristics on nonhuman entities when these entities look like humans.

The aspect of anthropomorphism is inherent in interactions with robots (Duffy, 2003; Złotowski et al., 2015; Ghazali et al., 2018). A wide range of research has illustrated that humans draw on their knowledge about humans to categorize humanoid robots in several aspects (Eyssel and Kuchenbrandt, 2012). The results from this research show that humans ascribe human-like characteristics to humanoid robots based on their observable characteristics. For example, humans apply gender categories and stereotypes to humanoid robots depending on the robots' gender-specific appearances (Eyssel and Hegel, 2012; Powers et al., 2005). Furthermore, multiple physiognomic characteristics of humanoid robots affect people's perceptions of robots' personalities (Powers and Kiesler, 2006). Thus, prior research provides strong evidence for the principles of anthropomorphism in the context of human-robot interaction. We draw on these previous findings and argue that the same patterns of perceptions of fWHR of humans hold in the context of human-robot interaction as well.

2.2 Facial Width-to-Height Ratio

Humans are able to interpret facial information to derive impressions about persons within a first look (Willis and Todorov, 2006). One important facial cue in deriving impressions about others is the ratio of facial width to upper facial height (fWHR), measured as the ratio between bizygomatic width and upper face height. Empirical evidence exists that humans with a higher testosterone exposure have a larger face width (i.e., higher fWHR) and that this association is especially strong for men (Fink et al., 2005). Research has demonstrated that humans with a higher face ratio behave differently from humans with a lower face ratio. The behavior of men with wider faces is rather linked to power-related tendencies such as aggression or striving for achievements and dominance than the behavior of men with narrower faces (e.g., Carré and McCormick, 2008; Carré et al., 2009; Stirrat and Perrett, 2010). In part, this is because men with wider faces are more robust and formidable and are therefore superior in physical confrontations with other humans (Stirrat et al. 2012).

Moreover, the external perception of individuals with wider faces characteristically differs from the perception of individuals with narrower faces. A higher fWHR is rated more physically imposing, more dominant, and less sensitive to pain (Carré et al., 2009; Sell et al., 2009; Stirrat and Perrett, 2010; Messer et al., forthcoming; Deska and Hugenberg, 2018). From an evolutionary point of view, physical robustness and imposing appearance reduce consequences from antisocial behavior, thus incentivizing self-interested, confrontational behavioral tendencies and willingness to express anger towards others (Sell et al., 2009; Stirrat and Perrett, 2010). Observational learning processes led people to acquire implicit knowledge about common behavioral patterns of individuals with wider faces and fWHR became a physical marker of dominance. Learning processes created unconscious perceptual patterns that manifested in learned stereotypical assumptions (Reber, 1989; Sell et al., 2009).

Based on humans' capacity to assess other humans' abilities and intentions, individuals are able to adapt their behavior in social interactions based on their perceptions of facial characteristics. For example, when it comes to cooperation, individuals prefer to cooperate with individuals of lower fWHR due to an increased perception of trustworthiness (Stirrat and Perrett, 2010; Messer et al., forthcoming; Wölfl and Feste, 2018). In summary, prior research has provided evidence that fWHR is indicative of behavior of humans, that fWHR is used as a cue for assessing personality traits, and that finally the perception of facial ratios has an impact on behavior in social interactions.

2.3 Research Model

Based on the findings from prior research that facial ratios can act as cue in social interactions and that humans infer human characteristics on anthropomorphized nonhuman entities such as robots, we propose a research model that tests the impact of facial characteristics of humanoid robots on behavioral consequences in human-robot interactions. The proposed research model examines the impact of a robot's facial width-to-height ratio on a human's compliant behavior to a recommendation given by a humanoid robot. Following prior research (Powers and Kiesler, 2006), we select compliance to a recommendation as the dependent variable due to the relevance of obeying advices given by humanoid robots in a wide range of human-robot interactions. Numerous situations may occur in which following the recommendations and instructions given by humanoid robots make human-robot interactions useful, especially in the contexts of healthcare (e.g., De Graaf et al., 2015), rescue missions (e.g., Hong et al., 2015), or retailing (e.g., Foster et al., 2016). For example, humanoid robots can be used to remind elderly to take their medication (De Graaf et al., 2015).

We propose that humans are more likely to follow recommendations given by humanoid robots with a higher fWHR than with lower fWHR. As prior research shows, wider faces of both humans and non-human entities are perceived as more dominant and physically imposing (Alrajih and Ward, 2014; Maeng and Aggarwal, 2017). Thus, we assume that individuals may perceive a humanoid robot with a higher fWHR as more dominant than a robot with lower fWHR. Furthermore, prior research in social psychology has identified the perception of dominance as a key mechanism by which humans follow the instructions and recommendations of others (e.g., Ridgeway et al., 1994, 1995). The perception of dominance is linked to a subtle feeling of power imbalance, so that individuals perceiving others as dominant comply with their commands. Based on this reasoning, we assume that humans are more likely to follow recommendations when given by a humanoid robot with a higher fWHR than by a robot with a lower fWHR because of an increased perception of the dominance of the robot. More formally, our research hypothesis states: *The fWHR of humanoid robots has a positive impact on the propensity of humans to follow recommendations given by the humanoid robot.*

In the upcoming sections, we present an initial study to test our assumption.

3 Initial Empirical Study

3.1 Design, Stimulus, and Procedure

To examine the effect of a humanoid robot's fWHR on compliance to a recommendation given by this robot, we conducted an initial one-factorial (fWHR: low vs. high) between-subjects laboratory experiment with undergraduate and graduate students as a first step in investigating the relevance of robots fWHR for human-robot interactions. 98 participants took part in the initial experiment on a voluntary basis. Of the participants, approximately 52% were female. The mean age was 23.7 years (SD = 2.8).

Participants were randomly exposed to one of the two experimental conditions (i.e., robot with wide or narrow face).

We created two cardboard stand-ups displaying a manipulated picture of the face of a humanoid robot (i.e., NAO Evolution developed by Aldebaran Robotics) with facial features (e.g., nose, eyes, eyebrows, mouth) and with either a low fWHR or a high fWHR. In line with prior research, we manipulated fWHR of the robot's head by using vertical facial modifications. Specifically, we altered the vertical position of the mouth as a means of increasing or decreasing the facial height, which in turn alters fWHR (Costa et al., 2017). We disguised the experiment with a cover story so that participants were only told to take part in a generic students' survey. Therefore, participants were led individually into a room to fill out a questionnaire. In line with this, alternative influential factors such as other participants' comments were eliminated. After completing the questionnaire, the participants were led to two blind boxes (but with the same content in all conditions) without seeing the content of the boxes. Participants were then told that they can choose a reward (i.e., some candy; same in all conditions) for their participation in the study from one of the two blind boxes. The cardboard stand-up depicting one of the two robots' faces was positioned in the middle behind the two blind boxes (depending on the condition). A speech balloon from the robot recommended the participants to take their reward from the left box (same recommendation in all conditions). Figure 1 shows the stimulus depicted on the cardboard stand-up.

Stimulus in the low fWHR condition	Stimulus in the high fWHR condition

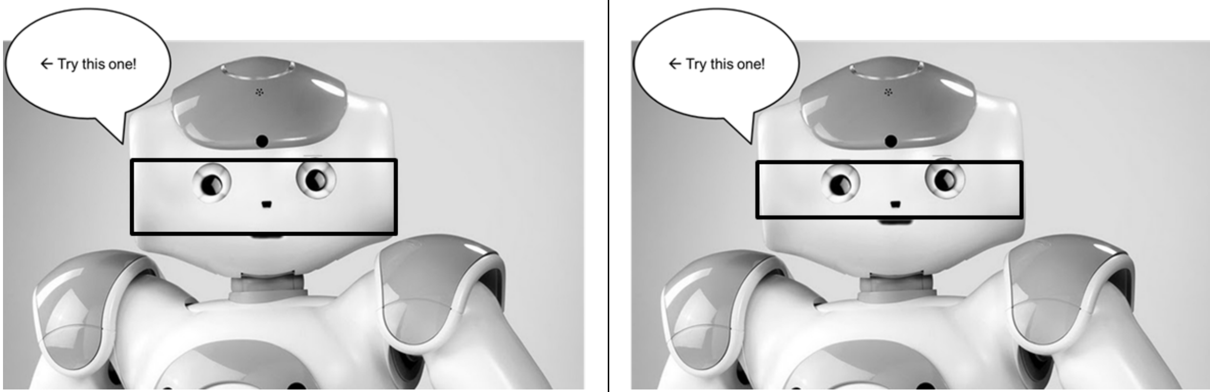

Figure 1. Experimental stimuli

3.2 Results

To measure compliant behavior, a research assistant blind to the hypotheses unobtrusively recorded the box from which the participants took their reward. When participants took their reward from the left box (which was recommended by the robot in all conditions), we coded this decision as compliant behavior. Thus, the dependent variable is a dummy variable indicating whether the participants followed the recommendation given by the robot or not.

To test whether the fWHR of the robot's head has a significant influence on whether participants follow its recommendation and take their study reward from the recommended blind box, we conducted a Chi²-test for association, as both dependent and independent variables are nominal-scaled. The Chi²-test for association revealed a significant relationship between the robot's fWHR and the propensity to follow the robot's recommendation ($\chi^2 = 5.29$, df = 1, $p < 0.05$, d = 0.48). Additionally, we calculated the cross-tabulation to evaluate the extent of the relationship between robot's fWHR and participants' compliant behavior. As shown in figure 2, approximately 71% of the respondents exposed to the robot with high fWHR followed its recommendation, while only 48% of the respondents exposed to the robot with low fWHR took their reward from the recommended box. In summary, the result of our study supports our assumption that facial ratio may act as a facial non-expressive cue of robots that has an impact on human behavior in human-robot interactions.

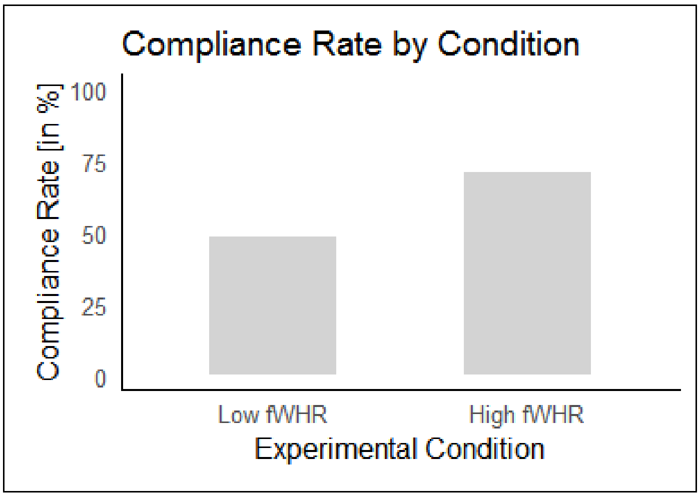

Figure 2. Compliance rate by condition

4 Discussion

4.1 Contributions of the Research

Research on facial ratios of humanoid robots provides important contributions to the literature. First, by considering fWHR as a non-expressive facial cue for the social categorization of humanoid robots and subsequent consequences in human-robot interactions, our research extends prior studies on facial design characteristics in a substantial way. While prior studies on design issues of humanoid robots' faces focus mainly on humanoid robots' dynamic emotional expressions (e.g., Blow et al., 2006; Craig et al., 2010; Lee and Breazeal, 2010) or overt design factors such as hairstyle (Eyssel and Hegel, 2012), research on more subtle but nonetheless powerful facial cues well known from social psychology is scarce. In this regard, only the study of Powers and Kiesler (2006) considered more subtle facial characteristics as determined by the design of forehead and chin to manipulate faces that can be perceived as either "baby faces" (Powers and Kiesler 2006, p. 220) or mature faces. We add to this kind of design studies by drawing on knowledge from social psychology and provide an evolutionary perspective for design decisions relating to humanoid faces. Thus, the facial width-to-height ratio of robots offers a systematic approach for design options of robotic faces.

Furthermore, by drawing on the well-known concept of fWHR, designers can select from a variety of impressions that have been shown to relate to fWHR and that can be implied by manipulating specific facial characteristics. Besides dominance (e.g., Alrajih and Ward, 2014; Maeng and Aggarwal, 2017), among these impressions that relate to facial ratios is, for example, trustworthiness (Stirrat and Perrett, 2010), which can be relevant in contexts where humans have to cooperate with robots, for example in work environments (e.g., Goetz et al., 2003). Thus, depending on the tasks for which humanoid robots are built and depending on the "personality" impressions they shall convey to human interaction partners, the concept of fWHR and its related knowledge may provide guidance for the design of facial characteristics.

In summary, our research implies that knowledge about impressions derived from subtle facial characteristics may also be useful when investigating further relationships between robots' facial attributes and human-robot interaction. Our study may thus act as a next stepping-stone in the journey dedicated to the exploration of the relationships between robots faces and human-robot interactions.

4.2 Avenues for Further Research

Although our study lends initial support to the hypothesis that fWHR of humanoid robots' faces can impact human behavior, our study is nonetheless just an initial step in enlightening the exciting relationship between humanoid robots' facial design and human response. Thus, to better understand the role that facial ratios can play in human-robot interaction, a series of further experimental studies should be conducted to fully explore the relationship between humanoid robots' fWHR and human-robot interactions.

First, further experimental studies should investigate the process by which robots' facial ratios influence compliance (i.e., mediators). In this regard, measurement-of-mediation experimental design (Spencer et al., 2005) may be an appropriate approach to assess the impressions that humans derive (e.g., perceived robot dominance) from the perception of robot faces of different face ratios. Such knowledge can assist in the design of robots when the robots are intended to elicit specific impressions and evaluations. Second, it could be an interesting topic of follow-up studies to examine interactions between robots' fWHR and further facial morphologies, such as the baby-facedness (e.g., Powers and Kiesler, 2006). Third, further studies should provide insight into the role of the type of robot for the relationship between facial ratio and human-robot interaction. As prior studies show, the context in which human-robot interaction takes place plays a significant role for the relevance of specific design characteristics (e.g., Joosse et al., 2013). For example, a rescue robot should be strong but unthreatening and an advisor robot should be knowledgeable but approachable (Powers and Kiesler, 2006). The intended consequences of robots' facial characteristics may depend on their tasks. Thus, further studies considering the context of human-robot interaction should use animated illustrations of robots as a means of providing information on the purpose of the robot. Third, since social information is less salient in online environments (Messer et al., 2017) further studies could transfer our findings to online shops and social media platforms and investigate how fWHR of virtual agents affects users compliance in a computer-mediated environment. Furthermore, the sample used in this study is rather homogeneous concerning participants' age, level of education or cultural affiliation. To make our results more generalizable, further studies should validate our findings using a more heterogeneous sample structure. Finally, to validate the effect of facial ratios on human-robot interactions, further studies might use real humanoid robots and experimentally manipulate face ratios. As our study has been conducted rather in the context of a robot-like agent (Kiesler et al., 2008) than in the context of real interactions with a humanoid robot, the necessity to further validate our initial findings in a real world setting exists.

References

Alrajih, S.and J. Ward (2014). "Increased facial width-to-height ratio and perceived dominance in the faces of the UK's leading business leaders." *British Journal of Psychology* 105 (2), 153−161.

Blow, M., Dautenhahn, K., Appleby, A., Nehaniv, C. L. and D. Lee (2006). "The art of designing robot faces: dimensions for human-robot interaction." In: *Proceedings of the 1st ACM SIGCHI/SIGART Conference on Human-Robot Interaction*. Salt Lake City: UT, 331−332.

Carré, J. M. and C. M. McCormick (2008). "In your face: facial metrics predict aggressive behaviour in the laboratory and in varsity and professional hockey players." *Proceedings of the Royal Society B: Biological Sciences 275 (1651),* 2651−2656.

Carré, J. M., McCormick, C. M. and C. J. Mondloch (2009). "Facial structure is a reliable cue of aggressive behaviour." *Psychological Science* 20 (10), 1194−1198.

Costa, M., Lio, G., Gomez, A. and A. Sirigu (2017). "How components of facial width to height ratio differently contribute to the perception of social traits." *PloS One* 12 (2).

Craig, R., Vaidyanathan, R., James, C. and C. Melhuish (2010). "Assessment of human response to robot facial expressions through visual evoked potentials." In: *Proceedings of the 10th IEEE-RAS International Conference on Humanoid Robots (Humanoids)*. Nashville: TN, 647−652.

De Graaf, M. M., Allouch, S. B. and T. Klamer (2015). “Sharing a life with Harvey: exploring the acceptance of and relationship-building with a social robot.” *Computers in Human Behavior* 43, 1−14.

Deska, J. C. and K. Hugenberg (2018). „Targets' Facial Width-to-Height Ratio biases Pain Judgments.” *Journal of Experimental Social Psychology* 74, 56−64.

Duffy, B. R. (2003). “Anthropomorphism and the social robot.” *Robotics and Autonomous Systems* 42 (3-4), 177−190.

Epley, N., Waytz, A. and J. T. Cacioppo (2007). “On seeing human: a three-factor theory of anthropomorphism.” *Psychological Review* 114 (4), 864−886.

Eyssel, F. and F. Hegel (2012). “(S)he’s got the look: gender stereotyping of robots.” *Journal of Applied Social Psychology* 42 (9), 2213−2230.

Eyssel, F. and D. Kuchenbrandt (2012). “Social categorization of social robots: anthropomorphism as a function of robot group membership.” *British Journal of Social Psychology* 51 (4), 724−731.

Fink, B., Grammer, K., Mitteroecker, P., Gunz, P., Schaefer, K., Bookstein, F. L. and J. T. Manning (2005). “Second to fourth digit ratio and face shape.” *Proceedings of the Royal Society B: Biological Sciences* 272 (1576), 1995−2001.

Foster, M. E., Alami, R., Gestranius, O., Lemon, O., Niemelä, M., Odobez, J. M. and A. K. Pandey (2016). “The MuMMER project: engaging human-robot interaction in real-world public spaces.” In: *Proceedings of the 8th International Conference on Social Robotics*. Kansas City: MO, 753−763.

Garun, N. (2018). *Pepper the Robot Is Working at the Smithsonian for Free*. URL: https://www.theverge.com/tldr/2018/4/24/17277350/softbank-pepper-the-robot-smithsonian-museum, visited April 30th 2018.

Gazzola, V., Rizzolatti, G., Wicker, B. and C. Keysers (2007). “The anthropomorphic brain: the mirror neuron system responds to human and robotic actions.” *Neuroimage* 35 (4), 1674−1684.

Ghazali, A. S., Ham, J., Barakova, E. I. and P. Makopoulos (2018). “Effects of Robots Facial Characteristics and Gender in Persuasive Human-Robot Interaction.” *Frontiers in Robotics and AI* 5, 73.

Goetz, J., Kiesler, S. A. and A. Powers (2003). “Matching robot appearance and behavior to tasks to improve human-robot cooperation.” In: *Proceedings of the 12th IEEE International Workshop on Robot and Human Interactive Communication*. Millbrae: CA, 55−60.

Hong, S., Lee, Y., Park, K. H., Lee, W. S., Sim, O. and J. H. Oh (2015). “Development of an experimental humanoid robot and dynamics based motion optimization for rescue missions.” *Journal of Institute of Control, Robotics and Systems* 21 (8), 753−757.

Joosse, M., Lohse, M., Pérez, J. G. and V. Evers (2013). “What you do is who you are: the role of task context in perceived social robot personality.” In: *Proceedings of the 2013 IEEE International Conference on Robotics and Automation*. Karlsruhe: Germany, 2134−2139.

Kiesler, S., Powers, A., Fussell, S. R. and C. Torrey (2008). “Anthropomorphic interactions with a robot and robot–like agent.” *Social Cognition* 26 (2), 169−181.

Lee, J. K. and C. Breazeal (2010). “Human social response toward humanoid robot's head and facial features.” In: *Proceedings of of the CHI'10 Conference on Human Factors in Computing Systems*. Atlanta: GA, 4237−4242.

Maeng, A. and P. Aggarwal (2017). “Facing dominance: anthropomorphism and the effect of product face ratio on consumer preference.” *Journal of Consumer Research* 44 (5), 1104−1122.

Messer, U., Leischnig, A., and E. Distler (2017). „Proof or Pressure? How Visitor Traffic Disclosure Impacts Online Shopper Behavior.” *Proceedings of the 38th International Conference on Information Systems*, Seoul, South Korea.

Messer, U., Wölfl, S., and J. Feste (2019). “Creating a Sincere Look: Face Ratios of Brand Mascots Affect Social Categorisation and Trust.” *Marketing: ZFP–Journal of Research and Management*, forthcoming.

Mileva, V. R., Cowan, M. L., Cobey, K. D., Knowles, K. K. and A. C. Little (2014). “In the face of dominance: self-perceived and other-perceived dominance are positively associated with facial-width-to-height ratio in men.” *Personality and Individual Differences* 69 (10), 115−118.

Powers, A. and S. Kiesler (2006). "The advisor robot: tracing people's mental model from a robot's physical attributes." In: *Proceedings of the 1st ACM SIGCHI/SIGART Conference on Human-Robot Interaction*. Salt Lake City: UT, 218−225.

Powers, A., Kramer, A. D., Lim, S., Kuo, J., Lee, S. L. and S. Kiesler (2005). "Eliciting information from people with a gendered humanoid robot." In: *Proceedings of the 14th IEEE International Workshop on Robot and Human Interactive Communication*. Nashville: TN, 158−163.

Reber, A. S. (1989). "More thoughts on the unconscious: reply to Brody and to Lewicki and Hill." *Journal of Experimental Psychology: General* 118 (3), 242−244.

Ridgeway, C. L., Diekema, D. and C. Johnson (1995). "Legitimacy, compliance, and gender in peer groups." *Social Psychology Quarterly* 58 (4), 298−311.

Ridgeway, C. L., Johnson, C. and D. Diekema (1994). "External status, legitimacy, and compliance in male and female groups." *Social Forces* 72 (4), 1051−1077.

Sell, A., Cosmides, L., Tooby, J., Sznycer, D., Von Rueden, C. and M. Gurven (2009). "Human adaptations for the visual assessment of strength and fighting ability from the body and face." *Proceedings of the Royal Society B: Biological Sciences* 276 (1656), 575−584.

Spencer, S. J., Zanna, M. P. and G. T. Fong (2005). "Establishing a causal chain: why experiments are often more effective than mediational analyses in examining psychological processes." *Journal of Personality and Social Psychology* 89 (6), 845−851.

Stirrat, M. and D. I. Perrett (2010). "Valid facial cues to cooperation and trust: male facial width and trustworthiness." *Psychological Science* 21 (3), 349−354.

Stirrat, M., Stulp, G., and T. V. Pollet (2012). "Male Facial Width is associated with Death by Contact Violence: Narrow-faced Males are more likely to die from Contact Violence." *Evolution and Human Behavior* 33(5), 551−556.

Waytz, A., Gray, K., Epley, N. and D. M. Wegner (2010). "Causes and consequences of mind perception." *Trends in Cognitive Sciences* 14 (8), 383−388.

Willis, J. and A. Todorov (2006). "First impressions: making up your mind after a 100-ms exposure to a face." *Psychological Science* 17 (7), 592−598.

Wölfl, S. and J. Feste (2018). "Do You Trust Me? Facial Width-to-Height Ratio of Website Avatars and Intention to Purchase from Online Store." *Proceedings of the 39th International Conference on Information Systems*, San Francisco, USA.

Złotowski, J., Proudfoot, D., Yogeeswaran, K. and C. Bartneck (2015). "Anthropomorphism: opportunities and challenges in human–robot interaction." *International Journal of Social Robotics* 7 (3), 347−360.