Psychological Anthropomorphism of Robots

Measuring Mind Perception and Humanity in Japanese Context

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Abstract. Using a representative sample, we explored the validity of measures of psychological anthropomorphism in Japanese context. We did so by having participants evaluate both robots and human targets regarding "mind perception" (Gray et al., 2007) and "human essence" (Haslam, 2006)" , respectively. Data from 1,200 Japanese participants confirmed the factor structure of the measures and their overall good psychometric quality. Moreover, the findings emphasize the important role of valence for humanity attribution to both people and robots. Clearly, the proposed self-report measures enlarge the existing repertoire of scales to assess psychological anthropomorphism of robots in Japanese context.

Keywords: Anthropomorphism, Robots, Japanese, Mind Perception, Human Essence.

1 Introduction

The vision that robot companions facilitate everyday life is not far-fetched, specifically not in Japanese society.. For one, this is due to demographic changes in society and a decrease in human work force. Second, robots are an important part of Japanese popular culture as evident in movies or manga. Previous research indicates that Japanese people hold a different attitude toward technology and robots compared to people from Western countries [1-3]. Especially, Japanese shows strong preference to robot-like robots but not to highly human-like robots compared to Americans [4]. That is, humanness of robots may be perceived differently by Japanese from Western people. Epley and colleagues [5] state that, "imbuing the imagined or real behavior of nonhuman agents with humanlike characteristics, motivations, intentions, and emotions is the essence of anthropomorphism" (pp. 864-865). Accordingly, psychological anthropomorphism goes beyond the mere attribution of "lifelikeness," "naturalness," "humanlikeness," [5] or "animism" [6, 7]. Existing research by Eyssel and colleagues

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has already focused on mind perception and human essence attribution to nonhuman entities [8-12], however, this has not been studied yet in Japanese context. Therefore, we extended the literature by validating these prominent meausures of anthropomorphism validated Japanese versions of scales measuring psychological and sought to explore culture-specific effects. This is the first step to understand anthropomorphisation of robots in Japan which may lead to deeper understanding of anthropomorphism in relation to collectivistic cultural background.

2 Related Works in Anthropomorphism

Gray, Gray and Wegner [13] have proposed two dimensions of "mind perception". *Agency* refers to the capacity to act, plan, and exert self-control. *Experienc*e, on the other hand, encompasses the capacity to feel pain, pleasure, and other emotional states. Moreover, Haslam [14] has suggested two distinct senses of humanness at the trait-level, namely "uniquely human" (*UH*) and "human nature" (*HN*) traits. *UH* traits imply higher cognition, civility, and refinement, and individuals who lack this sense of humanness are implicitly likened to animals. *HN* traits, however, reflect emotionality, warmth, desire, and openness. In this sense, Gray et al. [15] have emphasized that two dimensions of *agency* and *experience* parallel *UH* and *HN* traits, respectively.

To date, mind attribution and human essence attribution have been studied largely in the human interpersonal or intergroup context and only recently, Eyssel and colleagues have adapted these measures to assess psychological anthropomorphism in various robot prototypes [8-12]. The scale by [16] is also widely used in social robotics. However, in this case, participants are asked to report the extent to which they perceive a robot as "fake", "machinelike", "unconscious" or the like. Obviously, thus, the instrument focuses on the machine's human-likeness – a notion that is clearly distinguished from the process of psychological anthropomorphism as framed by Epley and colleagues [5].

Thus far, mind attribution and HN and HU traits have not been introduced as measures of psychological anthropomorphism to the large community of Japanese researchers who work in the domains of human-robot interaction and social robotics.

Therefore, this step is taken in the present research that sought to validate the respective constructs in Japanese context.

3 Evaluation of Robots in Japan

It is no news that robots are an important part of contemporary Japanese culture. Nevertheless, evidence shows that Japanese people exhibit relatively negative reactions towards robots, especially when they appear highly humanlike [4]. To date, there is no research that explores mind perception and the attribution to typically human traits [13, 14] to a variety of robot and human targets in a representative Japanese sample. Thus, the present research sheds light on the research question whether Japanese participants differentially attribute mind, human nature and uniquely human traits to robots that vary in humanlike appearance.

Furthermore, in a collectivist society such as Japan, adherence to the ingroup's norms is of essential social value. Japanese, just like Western people distinguish quickly and automatically between ingroup and outgroup members. Clearly, social categorization of others in "us" versus "them" (i.e., positive versus negative) serves to strengthen ingroup trust. Collectivist societies in particular foster the notion that one should trust ingroup members only. To illustrate, Japanese people are more likely to give positive feedback to ingroup members than to out-roup members [17] because it is part of the collectivist norm that ingroupers are to be treated preferentially [18, 19].

It is therefore plausible that Japanese participants make predominantly valence-based jugments to distinguish socially acceptable characteristics from unacceptable ones when evaluating new robot targets.

We deliberately chose a variety of human and robot targets that differed in human-like appearance. We did so to obtain a relative large variance in ratings of mind perception and human essence attribution and to be able to generalize across a wide-range of stimuli.

4 Method

4.1 Targets for Evaluation

Eight targets (Fig. 1) were used to assess mind perception and human essence, covering various humanlike stimuli ranging from wakamaru [20], HRP-2 [21], HRP-4C [22], to Geminoid F [23] and Geminoid HI [24] . These robots clearly differ in perceived humanlikeness of appearance [25]. Additionally, we selected ASTERISK [26] and two humans (Models for Geminoid F and Geminoid H1-4, respectively) as control stimuli. Figure 1 shows photos that were used for the investigation with the expected levels of humanness presented.

Fig. 1. Target stimuli

4.2 Participants and Procedure

A representative sample of 1200 Japanese participants (50% female; mean age = 38.37, *SD* = 12.03) took part in our online study. In a between-subject design, 150 people per cell of the design were randomly assigned to rate one of the eight targets depicted in Figure 1. None of the participants worked in the engineering field or was a robot expert.

4.3 Measures

Anthropomorphism

To assess psychological anthropomorphism of the 8 targets, we used the items proposed by [13, 14]. The scales have already been tested and validated in the context of social robotics and therefore represent suitable measures of psychological anthropomorphism [8-12]. The self-report measures were originally developed in English language and were thus translated to Japanese, and back-translated into English to confirm the appropriateness of the translation. The first measure assesses mind perception [13] and comprises 18 items (Table1) of *Agency* and *Experience*. For both dimension of mind perception, we asked participants to rate how much the target was capable of each item on a 5-point scale from 1 (*not capable at all*) to 5 (*very capable*).

To measure human essence attribution [14], participants were presented with a list of 20 personality traits reflecting *UH* and *HN*. Each subscale contained 5 positive and 5 negative traits (Table 2). Participants rated how well each term describes the target on a scale from 1 (*not at all descriptive*) to 6 (*very descriptive*).

Humanlikeness as General Impressions of Robots

Even though the main goal of the present research was to explore the psychometric quality of the scales related to mind perception and human essence, we also assessed perceptions of humanlikeness by asking participants to complete three items taken from a Psychological Scale for General Impressions of Humanoid ([25]). The scale of general impressions measures general impressions of humanoids. For the purpose of the present research, we only used three items: "I could easily mistake the robot for a real person", "I am amazed at the progress of technology when I look at the robot" and "The robot looks like a human." Due to the fact that the item content does not apply to human targets, we utilized the scale of general impressions on the robot targets only, even including the machine-like robot ASTERISK. Participants' responses were collected using a scale from 1 (*totally disagree*) to 7 (*totally agree*)..The three items were highly reliable, $\alpha = .82$.

5 Results and Discussion

5.1 Perceived Humanlikeness of General Impression

We conducted an ANOVA on perceived humanlikeness of the six robots. The main effect was significant, F (5, 892) = 83.16, $p < .001$. Figure 2 shows results from multiple comparisons (Bonferroni method) and illustrates differences in perceived humanlikeness across the robot prototypes.

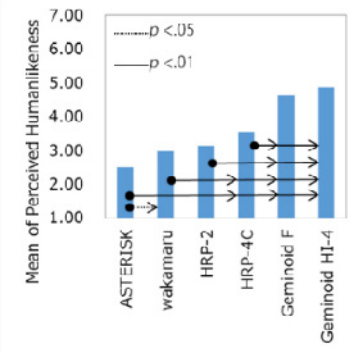

Fig. 2. Perceived humanlikeness as a function target

5.2 Factor Analyses on the Scales of Mind Perception and Human Essence

An exploratory factor analysis with promax rotation was conducted on mind perception and human essence items (Table 1, 2).

Table 1. Results of Factor Analysis on the scale of Mind Perception

	Factor 1 Experience (+)	**Factor3 Experience(-)**	**Factor 2 Agency**
Hunger	.244	**.568**	-.050
Fear	-.075	**.930**	-.019
Pain	-.077	**.972**	-.010
Pleasure	**.466**	-.049	.275
Rage	.398	**.532**	-.134
Desire	**.726**	.160	-.043
Personality	**.745**	-.022	.060
Consciousness	**.822**	-.008	.072
Pride	**.727**	.134	-.018
Embarrassment	.028	**.507**	.259
Joy	.378	-.024	.394
Self-control	-.135	.191	**.738**
Morality	-.101	.160	**.755**
Memory	-.052	-.189	**.831**
Emotion recognition	.253	.042	**.527**
Planning	.063	.000	**.694**
Communication	.115	-.156	**.698**
Thought	.145	.063	**.632**
α	**.875**	**.879**	**.894**

Table 1 shows that mind perception is composed of three subfactors, whereas, as predicted, the "experience" factor reflects positive and negative valence. The "joy" item had low and redundant loadings, but all other items corresponded to the factor structure observed previously [8], except that the experience factor was differentiated

by item valence. Factor 2 concerns agency, with items such as "self-control," "morality," "memory," and "emotion recognition." Agency appears to be a unidimensional, univalent construct.

Table 2. Factor analyses on human essence attribution items

	Factor 1 HN(+)	**Factor 3 HN(-)**	**Factor 2 UH(+)**	**Factor 4 UH(-)**
Curious	**.784**	.209	-.058	-.082
Friendly	**.820**	-.110	.149	.080
Fun-loving	**.864**	.087	-.026	-.048
Sociable	**.859**	-.016	.085	.074
Trusting	**.406**	.046	.391	.013
Aggressive	.158	**.747**	-.177	-.035
Distractible	.252	**.485**	-.126	.205
Impatient	.195	**.880**	-.062	-.100
Jealous	-.072	**.703**	.081	.062
Nervous	-.232	**.722**	.253	-.005
Broadminded	.504	-.112	.367	.099
Humble	.155	-.170	**.712**	.020
Organized	.129	.120	**.739**	-.123
Polite	.090	-.136	**.848**	-.067
Thorough	-.033	.126	**.825**	-.096
Cold	-.228	.356	.239	.274
Conservative	-.138	.162	**.545**	.239
Hard-hearted	-.085	.228	.042	**.604**
Rude	.083	.154	-.174	**.789**
Shallow	.049	.025	-.057	**.847**
α	**.90**	**.845**	**.86**	**.87**

Table 2 reveals that both *UH* and *HN* differentiate into positive (+) and negative (-) factors; however, "broadminded" and "cold" overlapped across factors. Factor 1 (*HN+*) includes positive human nature- related items, such as "curious," "friendly". Factor 2 comprises positive traits, e.g., "humble," "organized". One might argue that "conservative" represents a negative characteristic - however, from a collectivistic perspective, being conservative does not always have a negative meaning. Moreover, conservative people do not bother others or disturb situations. In this sense, being conservative is a positive trait within a collectivistic culture. All items in Factor 2 originally belonged to the *UH* factor; therefore, this factor was named *UH(+)*. Factor 3 included "aggressive," and so on. These items correspond to the negative components of HN. Factor 3 was thus termed *HN(-)*. Factor 4 comprised "hard-hearted," "rude", all reflecting the *UH* factor. This factor was labeled *UH(-)*.

Figures 3-5 show mind perception as a function of target type – evidently, this scale clearly distinguishes between the different robot prototypes, although mind attribution occurs at relatively low level in the present research study [27]. Moreover, of the subscales of mind perception and human essence show high internal consistencies. In sum total, the developed scales are usable for evaluation of anthropomorphism in Japan.

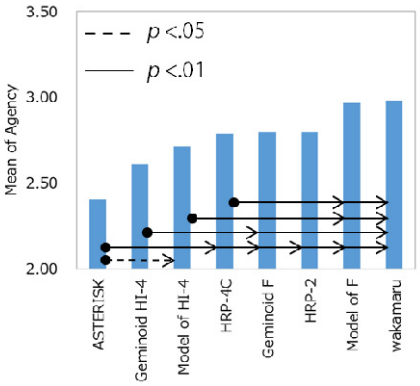

Fig. 3. Mean attribution of agency as a function of target type

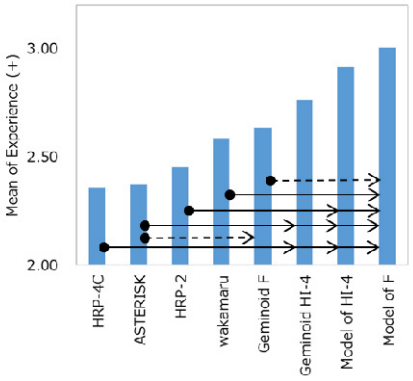

Fig. 4. Mean attribution of experience (+) as a function of target type

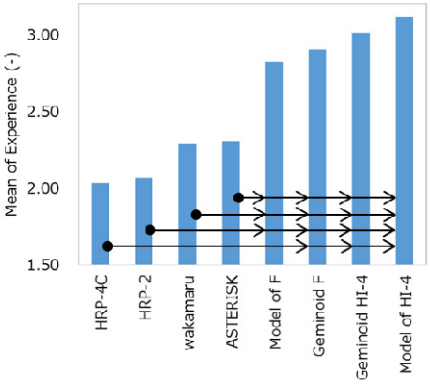

Fig. 5. Mean attribution of experience (-) as a function of target type

6 Conclusion

The goal of the present research was to validated two new Japanese measures of of psychological anthropomorphism, namely, mind perception and human essence attribution. These have been shown to be useful tools to assess the attributions of typically and essentially human characteristics to nonhuman entities [12-15]. We did so by asking participants from a representative Japanese sample to rate a variety of targets - a machinelike robot, several humanoids, and target persons. Broadly, we replicated the findings regarding dimensionality of the measures as in research from Western countries. Equally important, the measures showed high internal consistencies which, too, confirm the good psychometric properties of the scales. Furthermore, the scales differentiated according to valence . We interpret this in light of the fact that in collectivist societies. social categorization may be particularly crucial [17, 18]. The collectivists trust in-group members. According to collectivist social norms, ingroupers should maintain mutually beneficial partnerships with each other. Therefore, anthropomorphism in Japan is based on not only dimensions revealed in previous studies but also on social acceptability. As previously shown [1-2, 4], Japanese citizens display negative reactions toward new creatures, like robots or highly human-like robots, suggesting that Japanese are unsure whether such robots would be acceptable in-group members.

In this sense, it is also possible that the factors would not be separated into positive and negative even in Japan, if the all targets were well-known in-group members. It is necessary to investigate this possibility in future research. The current study had a satisfactorily large sample, and the data seem to be highly representative of Japanese people. However, one limitation was the use of photographs as stimuli and not real robots or humans and it is necessary to employ real robots or humans as stimuli.

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