Religion-related Values Differently Influence Moral Attitude for Robots in the US and Japan

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Data are available here: https://github.com/anchor200/robot_moral_care

Abstract

Increasing evidence suggests that people show moral concern for robots among other nonhuman entities. Further, people's attitudes toward new automated technologies such as robots and AI are influenced by their social backgrounds, including religion. Two specific religion-related values, i.e., animism and anthropocentrism, have been recognized to influence preference for and familiarity with robots. However, how they affect moral care for robots under different religious traditions has not been studied. Here, we empirically examined how moral care for robots is influenced by religiosity (i.e., religious beliefs and religious attendance) and religion-related values (i.e., animism and anthropomorphism) in US and Japanese samples, cultures that are grounded in Abrahamic and Shinto-Buddhist traditions, respectively (N = 3781). Overall, moral care for robots was higher in Japan than in the US, matching previous findings. Moral care for robots was negatively associated with religiosity in the US and positively in Japan, although its variance was better explained by religion-related values than religiosity. Further, moral care for robots had a negative association with anthropocentrism in the US and a positive association with animism in Japan. The findings demonstrate how religious tradition may influence moral attitudes toward robots, highlighting the role of cultural traditions in the realm of moral considerations.

Keywords: human-robot interaction, religion, moral foundation theory, care, cross-cultural study

Influence of Religion-Related Values on Moral Care for Robots in the US and Japan

In 2015, the robotics company Boston Dynamics published a video of a robotic dog, Spot, being kicked by the company's staff. The video was intended to demonstrate Spot's ability to remain stable in response to external impacts. Instead, the video evoked a variety of moral and ethical concerns on social media; some sympathized with Spot and condemned the perceived violence against the robot, while others ridiculed this reaction (Parke, 2015). Similarly, when the hitchhiking humanoid hitchBOT failed to complete its journey after being broken by an unspecified person (or people), some reactions described those who broke the robot as morally wrong, while others did not (Fraser et al., 2019). Elsewhere, Bartneck and Keijsers (2020) reported that people viewed abuse toward robots and humans as similarly unacceptable.

The issue of whether robots deserve moral consideration or whether they can be "moral patients" (i.e., targets of moral consideration) is receiving increasing research attention (Shevlin, 2021). Furthermore, the extent to which rights should be granted to robots ("robot rights"; Gunkel, 2018) has been discussed, but quantitative knowledge of people's actual reactions is lacking. The importance of social and cultural background in this regard has also been suggested. For example, Coeckelbergh (2018) argued that to understand moral consideration toward robots ("moral care" hereafter), we should look beyond mere individual differences and attend to the relational and historical aspects of ethics, such as social and cultural background. However, the effect of cultural background on people's views about moral attitudes toward robots has been little explored. This study seeks to address this gap by comparing Japanese and American moral attitudes toward robots.

Religions are often an important source of moral attitudes toward other humans and may therefore affect moral attitudes toward robots (MacDorman et al., 2009; Halpern & Katz, 2012; Shaw-Garlock, 2009). This speculation also aligns with the argument that religion has

influenced the relationship between humans and technology (Geraci, 2006). The current study examined this idea by focusing on a specific moral attitude, that harming robots is morally wrong (i.e., care foundation in the moral foundations theory; Graham et al., 2013), a view which was evidenced by some reactions to the cases of Spot and hitchBOT. We explored the role of religion-related values, with a specific focus on anthropocentrism and animism, since previous literature suggested that these two factors influence attitudes toward robots (Fortuna et al., 2023; Okanda et al., 2019).

Anthropocentrism, Religion, and Moral Care for Robots

Anthropocentrism is "a doctrine or theory which elevates man [sic] as the center of the world and sees the well-being of humanity as the ultimate purpose of things" (Reinhardt, 1972, p. 62). Christianity—and indeed Abrahamic religions more broadly—are arguably anthropocentric religions. In both the book of Genesis (1.26-27), shared by Jews and Christians, and in the Muslim hadith, God is said to have made human beings in his own image (Melchert, 2011). The book of Genesis also mentions that human beings have been given dominion over all creatures, which is echoed in the Qu'ran (35.39), where human beings are called Allah's vice-regents. This concept of "Imago Dei" (i.e., humans being God's creation and made in His image) forms the foundation of perceptions that humans are superior to other beings; it has determined the nature of human relations with the environment and technology in Western cultures (Herzfeld, 2023). Previous psychology studies have confirmed this; for example, Chandler (1981) reported that US Catholic participants scored significantly higher on the anthropocentrism scale than nonreligious participants. Fortuna et al. (2023) used a different single-factor scale and found that anthropocentrism positively correlates with religiosity in predominantly Catholic Italy.

Anthropocentric thinking tends to take human beings as a reference point in determining the status and value of nonhumans (see Spatola et al., 2022). This tendency is linked to a phenomenon called dehumanization, i.e., holding negative attitudes or disregard

for an entity when it appears to lack human traits (Haslam, 2006). Studies have suggested that robots are related to dehumanization in two ways: 1) they are entities that transform human life into a dehumanized form (de Oliveira and Oliveira, 2019) and 2) they are entities devoid of human nature (Spatola, 2020). Anthropocentrism might strengthen negative views of dehumanized entities. Consistent with these ideas, Fortuna et al. (2023) found that anthropocentrism predicted negative attitudes toward robots. We further speculate that anthropocentrism postulates nonhumans as less worthy of moral concern and excludes them from the "moral circle" (Haslam et al., 2012). Thus, we expect that anthropocentrism suppresses moral care for robots.

Animism, Religion, and Moral Care for Robots

Animism, like anthropocentrism, is a value system regarding the relationship between humans and nonhumans. Animism is a worldview in which everything is alive or has a soul; thus, animism does not clearly distinguish between humans and nonhumans, and treats them as sharing fundamental characteristics (Spatola et al., 2022). Animism has been considered to be closely associated with religion. For example, among earlier theories (e.g., Tylor, 1889), anthropologists hypothesized that religion has animistic roots or that animism itself is a religious phenomenon (Guthrie, 1995; Hunter & Whitten, 1976, p. 12). Furthermore, as with anthropocentrism, animism is associated with some religious and cultural traditions more than others. Christianity, Judaism, and Islam are not typically considered to be animistic religions. In contrast, the traditional Japanese religion, Shinto, has often been considered animistic (Abe, 1997; Hosaka, 2003; Allison, 2006). The principle of Shinto is a sense of awe evoked by nature; it is linked to the feeling that human beings are merely a part of nature, not its governor (Geraci, 2006). In other words, Shinto places a strong emphasis on the fundamental link between humans and nature, unlike the Judeo-Christian tradition, which emphasizes the distinction between humans and nonhumans. In

this sense, it is clear that Shinto can be characterized as an animistic religion, following Spatola et al.'s (2022) definition.

Building on this assumption, Allison (2006) suggested that the high acceptance of robots in Japan stems from Japanese cultural animism. From an animistic viewpoint, robots are attributed life just like natural creatures, and hence are not alien to people (Gygi, 2018). Viewing humans and robots as sharing characteristics would imply that they have similar moral status and both fall within the “moral circle.” Supporting this view, a study in Japan showed that beliefs about friendship with and morality toward robots are positively associated with animism (Okanda et al., 2019). Based on these arguments, we believe that animism should promote moral care for robots. Finally, we note that in the US, the link between attitudes toward robots and animism has not been studied.

The Current Study

We conducted a questionnaire survey on whether people regard harming robots as morally wrong. Following MacDorman et al. (2009), we compared American and Japanese attitudes, adding Katz and Halpern’s (2013) interest in religiosity to this comparison. MacDorman et al. (2009) found that Japan has more affinity for robots, and Halpern and Katz (2012) identified that the Japanese (but not the Western) tradition is associated with positive attitudes toward robots; thus, we predicted that Japanese people would show higher moral care for robots than Americans (H1). We also examined the effect of religiosity (in terms of religious beliefs and religious attendance) and religion-related values (anthropocentrism and animism). In doing so, we predicted there would be cross-cultural differences in the way religiosity (associated with acceptance and nonacceptance of robots in Japan and the US, respectively) was associated with moral care for robots. We tested these ideas quantitatively by investigating correlations between moral care for robots and religiosity and religion-related values, and the extent to which these variables explain morality toward robots. We hypothesized that religiosity is positively and negatively

associated with moral care for robots in Japan and the US, respectively (H2). We also hypothesized that moral care for robots is negatively associated with anthropocentrism (H3) and positively associated with animism (H4).

Method

Preregistration and Ethical Approval

The hypotheses, materials, and analytical strategy were preregistered at https://osf.io/3dvge/?view_only=3c05cfbe125d440e81cdb75d7834a1c4. Following preregistration, we made several changes to the treatments of variables and analysis based on further literature surveys (see Appendix A1). The current research was approved by Ethics Committee in the School of Psychology at the University of Nottingham (F1264).

Participants

As stipulated in the preregistration, we targeted 2000 participants in both Japan and the US with a variety of backgrounds, aiming to have as large a sample as possible to strengthen the validity of the results. Quality checks by Qualtrics (which involved excluding participants who filled in the questionnaire too fast and those who failed an attention check) resulted in 2,024 US and 2,025 Japanese participants. Further, participants (1) with missing values, (2) whose country of citizenship and residency was neither the US or Japan, and (3) whose entries in any input field relating to country of citizenship, religion, or occupation were irrelevant (e.g., “11579,” “I like,” “Yes”) were excluded by the researchers (222 US and 46 Japanese participants). Thus, the final sample size was N = 1,802 for the US participants (941 women [52.2%], 6 others [0.3%]) and N = 1,979 for the Japanese participants (1015 women [51.3%], 14 others [0.7%]). Mean ages in the US and Japanese samples were 37.8 years (SD = 11.61) and 38.5 years (SD = 11.86), respectively. Demographic information is summarized in Table 1.

Materials

Moral Care for Robots

Moral care for robots was measured by adapting the *care* foundation items of the Moral Foundation Vignette (Clifford et al., 2015), which consists of short vignettes where people hurt or defame others. By replacing the victim with a robot, we assembled 13 items (e.g., “A person continues to fire a pellet gun at a robot placed in the woods”). Participants were asked to rate the acceptability of these situations using a 7-point Likert-type scale from 1 (*completely acceptable*) to 7 (*completely unacceptable*). Images of three humanoid robots (Appendix A2) were presented at the beginning of the section of the questionnaire; participants were asked to assume the robot in the questionnaire was similar to those shown in the picture. Cronbach's alpha values for US and Japanese participants in this study were .96 and .95, respectively.

Religiosity

As some measures of religiosity are tailored for very specific audiences (e.g., Christian Orthodoxy Scale; Fullerton & Hunsberger, 1982; Jong et al., 2013), they may threaten the validity of a cross-cultural study of religion. Specifically, Kavanaugh and Jong (2020) cautioned against focusing on religious identities in cross-cultural studies that include Japan, because their survey of Japanese people found that 1) while Japanese people undervalued the importance of religious beliefs in everyday life, their endorsement of supernatural beliefs was normally distributed, and 2) their religious identities and practices were not necessarily based on a shared motivation. To address this issue, we focused on the pan-cultural aspects of religion, not religious identities, as encouraged by Kavanaugh and Jong (2020); thus, we investigated beliefs in supernatural agents and events (religious beliefs) and participation in ritual or prayer (religious attendance; Jong et al., 2013). Accordingly, we adopted the following two scales to assess religiosity.

For religious beliefs, we used the Supernatural Belief Scale (Jong et al., 2013; e.g., “There exists an all-powerful, all-knowing spiritual being, whom we might call God”), which has both English and Japanese versions. We used the latest version of the Japanese translation (version 2; Kavanaugh & Jong, 2020). Participants responded to each item on a 9-point Likert-type scale from -4 (*strongly disagree*) to 4 (*strongly agree*). Cronbach’s alpha values were .91 and .92 for the US and Japanese samples, respectively.

For religious attendance, following Kavanaugh and Jong (2020), we asked participants how often they usually (i.e., before the COVID 19 pandemic) visited a religious place (temple, shrine, church etc.) per year. Participants responded using the following ordinal scale: from 1 (never), 2 (once), 3 (twice), etc. to 11 (10 times or more).

In the preregistration, we stated that the question of whether these two measures should be merged into one variable would be determined after data collection: if they showed high correlations, we would merge them. Ultimately, since the consistency of the two measures was relatively low in Japan (Spearman’s ρ = .15 vs. ρ = .43 in the US), they were left unmerged.

Religion-Related Values

Anthropocentrism. We used the first factor (*Pure Anthropocentrism vs. Nonanthropocentrism,* 11 items) of the 30-item Anthropocentrism Scale (Chandler, 1981; e.g., “The human species is without a doubt the most advanced form of life on earth”). Chandler (1981) reported that scores for this first factor strongly correlated with total scores (r = .83). Participants responded to each item on a 7-point Likert-type scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Cronbach’s alpha values were .85 for both samples.

Animistic Habits and Anthropomorphism. For animism, we used two subscales (*Other self* and *Personification of nonhuman objects*) of the Animism Scale for Adults (Ikeuchi, 2010; e.g., “I feel that hand-made objects acquire part of the soul of the one that made it”; “There are times when we feel attachment to things around us like we do to

people"). This scale was designed to measure the degree to which people attribute vitality to objects and interact with them as they do with living things (i.e., animistic habits). Since the *Divinity in nature* subscale was strongly attuned to Japanese Shinto religious beliefs (see Abe, 1997), we excluded it to avoid measuring specifically Shinto-based animistic beliefs. Participants responded to each item on a 5-point Likert-type scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Cronbach's alpha values were .86 for both samples.

For anthropomorphism, we used the Individual Differences in Anthropomorphism Quotient (IDAQ; Waytz et al., 2010; e.g., "To what extent does the ocean have consciousness?"). Participants responded to each item on an 11-point Likert-type scale from 0 (*not at all*) to 10 (*very much*). Cronbach's alpha values were .92 and .91 for the US and Japanese samples, respectively.

Note that animism is often compared with anthropomorphism, which refers to the cognitive inference that inanimate objects are human. Although attribution of life and attribution of human characteristics are conceptually distinct, they are often conflated (Karpinska-Krakowiak & Eisend, 2021) including among researchers in human-robot interaction (Beran et al., 2011). Accordingly, we determined whether to consider these as a single measure after data collection. Ultimately, we merged them into one explanatory variable because Cronbach's α values for the aggregated scale were .92 and .90 for the US and Japanese participants, respectively. Since the quantification and number of items differed between the two scales, we added them after normalizing each scale, then renormalized the summed scale.

Covariates

The following variables were controlled in the regression analyses. First, the perspective taking and empathic concern factors of the Interpersonal Reactivity Index (IRI; Davis, 1980; Japanese version: Himichi et al., 2017). Here, we did not include the inverted items of perspective taking, since their inclusion decreased the reliability of the scale (α

= .69 in the US and α = .66 in Japan). After this manipulation, α = .83 in the US and = .81 in Japan for perspective taking, and α = .74 in the US and = .77 in Japan for empathic concern. Exposure to robots and robot-related media was adapted from MacDorman et al.'s (2009) study (α = .78 in the US and = .64 in Japan). Typical image of robots was measured by asking participants to choose one picture from a selection of humanoid robots and mechanical arms (see Appendix A2). Along with these items, demographic variables (age, gender, and education) were also controlled as covariates. A full list of questionnaire items is provided in Appendix A3.

Analyses

In accordance with the hypotheses, we conducted the following analyses. For H1 (cultural difference in moral care for robots), we tested cultural differences in ratings of moral care for robots between the US and Japan using an unpaired *t*-test. As for H2-H4 (cross-cultural differences in the link between religiosity [H2] and religion-related values [H3, H4] and moral care for robots), we used multiple regression analysis. The objective variable was moral care for robots; the explanatory variables comprised religiosity (H2, religious attendance and religious beliefs) and religion-related values (H3, anthropocentrism; H4, animism). Since we were uncertain of the relationship between religiosity and religion-related values, we tested them separately by evaluating the magnitude and significance of the regression coefficients in two models: one with religiosity only (religiosity model) and one with religion-related values only (religion-related values model).

The relative goodness of fit of the models was evaluated by the Akaike's information criterion (AIC) and proportion of explained variance (adjusted R^2). The minimum models under AIC model selection by countries (*best model*) were identified to examine which set of variables have explanatory power after accounting for other variables. We additionally ran: 1) country-wise regression to identify the effects of each variable by country, 2) models employing both religiosity and religion-related values, and 3) models accounting for culture-

covariate interactions (shown in Appendices A4, A5, and A6, respectively). Further, we conducted supplementary path analyses using structural equation modeling (SEM; Appendix A7). Multicollinearity was sufficiently low in all regression models (VIFs [variance inflation factor] < 5).

Results

Cultural Differences in Moral Care for Robots (H1) and Other Measured Variables

First, we tested whether cultural differences in moral care for robots could be found between the US and Japan (H1). Japanese participants demonstrated higher moral care for robots, $t(3108.2) = -16.3$, $p < .001$, supporting H1. The effect size was intermediate (d = 0.54) and comparable to previous research reporting US-Japan differences in perceived warmth of robots (r = .39, with higher values among Japanese participants; MacDorman et al., 2009). Note that the moral care for robots scale comprises not only of vignettes describing robots being physically attacked (unlike a prior study by Okanda et al., 2019), but also included mistreatment of robots. This index's high reliability (α = .96 in the US and .95 in Japan) showed that participants' attitudes toward abuse of robots are consistent regardless of whether such abuse is physical or social.

Likewise, we also tested cultural differences in other measured variables (which were also used in the regression analysis as explanatory variables). Descriptive statistics of measured variables are shown in Table 2. No significant cultural differences were found in animistic habits, $t(3306.0) = -0.49$, $p = .626$; anthropomorphism, $t(3327.9) = 0.84$, $p = .401$; or exposure to robots and robot-related media, $t(3320.9) = -0.16$, $p = .870$. The US participants rated significantly higher on religious beliefs, $t(3770.5) = -32.8$, $p < .001$; anthropocentrism, $t(3436.4) = -10.4$, $p < .001$; empathic concern, $t(3514.7) = -28.4$, $p < .001$; and perspective taking, $t(3577.6) = -20.3$, $p < .001$. Additionally, significant differences were found in religious attendance with US being higher, $t(3154.5) = -22.9$, $p < .001$, and typical image of robot: 75.7% of the US and 82.9% of the Japanese participants

chose “humanoid robot”; $\chi^2(1) = 2.93$, $p < .001$. Distributions of measured variables are provided in Appendix A8. Note that religiosity was positively correlated with anthropocentrism and animism in both countries (Appendix A9). Further, religiosity’s correlation with anthropocentrism was stronger in the US and its correlation with animism was much stronger in Japan, indicating a country-specific association between religion-related values and religiosity.

Cross-Cultural Differences in Religiosity (H2) and Religion-Related Values (H3 and H4)

Next, we analyzed how religiosity and religion-related values affected moral core for robots. The results of regression analyses with culture as an interaction factor are shown in Table 3. The analyses, including the interaction of culture with various covariates (age, gender, education, empathic concern, perspective taking, typical image of robots, and robot-related experience) did not show any remarkable differences (Appendix A6). Thus, we only report regressions with interaction terms for the hypothesis-related variables (religiosity and religion-related values).

Religiosity Model

In the *religiosity model* (adjusted $R^2 = .18$), there was a significant interaction of culture and religious beliefs ($\beta = .11$, $p < .001$; Table 3). Country-wise regression found that the effect of religious beliefs was significantly negative in the US ($\beta = -.07$, $p = .002$; Appendix A4) and significantly positive in Japan ($\beta = .08$, $p < .001$; Appendix A4). These results support cultural differences in the link between religiosity and moral care for robots (H2), although the effect size was rather small. As for religious attendance, it did not show significant interaction ($\beta = .02$, $p = .592$).

Religion-Related Values Model

In the *religion-related values model* (adjusted R^2 = .22), there was a significant interaction of culture and anthropocentrism (β = .17, p < .001; Table 3). Country-wise regression found that the effect of anthropocentrism was significantly negative both in the US (β = -.22, p = .000; Appendix A4) and in Japan (β = .06, p = .003; Appendix A4). These results supported the negative impact of anthropocentrism (H3). There was also a significant interaction of culture and animism (β = .29, p < .001). Country-wise regression found that the effect of animism was significantly negative in the US (β = -.06, p = .003; Appendix A4) and significantly positive in Japan (β = .19, p = .000; Appendix A4); thus, H4 (predicting a positive role of animism) was only supported in Japan.

Model Selection and Relative Contribution of Explanatory Variables

We identified the model with the lowest AIC (*best model*) using the dredge function of MuMIn package (Bartoń, 2020) in R (here we included the covariates as targets of the variable choices; see Appendix A10). In the *best model*, any effects of religiosity were not significant, while effects of religion-related values remained significant (Table 2). The nonsignificance of religiosity (Table 2) in the *best model* suggested that the relationship between moral care for robots and religion was mediated by religion-related values (path analysis using SEM suggested such mediation effects; see Appendix A7).

The *religion-related values model* was better in terms of both AIC and adjusted R^2. This means that religion-related values rather than religiosity are associated with moral care for robots. However, the proportion of explained variance (adjusted R^2) showed a difference between countries (US, .29; Japan, .17 in the country-wise *best models*; Appendix A4). These results, combined with the significant interaction of culture with both anthropocentrism and animism, suggest that the way in which anthropocentrism and animism are associated with moral care for robots is culturally specific (see also the path analyses in Appendix A7, which showed consistent results).

Discussion

The current study found distinct moral attitudes toward robots between the US and Japan with a large diverse sample. As hypothesized, moral care for robots was higher in Japan. This result is in line with Halpern and Katz (2012), who found that Judeo-Christian religions are associated with less positive social attitudes to robots than Eastern religions. Further analyses revealed the culturally specific nature of associations between religion-related values and moral care for robots. Overall, religion-related values (i.e., anthropocentrism and animism), better explained moral care for robots than religiosity itself (i.e., religious beliefs and religious attendance). Anthropocentrism, which is significantly higher in the US, was the main driver of cultural differences in moral care for robots (details are discussed below).

The current study added to the literature by shedding light on a newly recognized phenomenon, moral care for robots, and quantitatively described how religiosity and religion-related values are associated with this phenomenon. Previously, Nomura et al. (2019) studied how personal traits (such as altruism) and attitudes toward robots are related to moral concern for robots. Our study also examined some of these relations, but extended the research by finding cross-cultural differences in the way that religion influences moral attitudes toward robots, empirically supporting the background influence of religion on attitudes toward robotic technology (Geraci, 2006). None of the existing cross-cultural studies of human-robot interaction (as reviewed by Papadopoulos & Koulouglioti, 2018) have referred to religions or religion-related values. Previously, morality in the context of human-robot interactions has been investigated within the scope of human perceptions of moral judgments made by robots or robots' capacity as moral agents (Malle et al., 2015; Malle et al., 2016; Komatsu, 2016). In this line of studies, Komatsu (2016) reported that Japanese individuals do not favor robots that adopt a "sacrifice few to save many" strategy in the trolley problem, a departure from the preferences of Westerners as reported by Malle et al. (2015, 2016). Our findings extend this literature by demonstrating that such cultural

differences manifest not only in the "robot as a moral agent" situation, but also in the context of the "robot as a moral patient."

By addressing this area, our study contributes to the debate around moral responsibility toward robots, which is a prominent current ethical debate. The importance of this issue is due to the fact that treating robots without moral constraints may lead to the violation of human rights (e.g., Sparrow, 2017). However, although several theoretical solutions have been proposed (Whitby, 2008; Coeckelbergh, 2018), no concrete framework such as internationally agreed guidelines have been produced. By empirically comparing the magnitude of moral consideration for robots across cultures, this study contributes to developing more effective arguments by ensuring that theoretical proposals correspond with people's actual responses.

Cultural differences in the association between moral care for robots and religion-related values might reflect how robots are represented in each county, especially in terms of the boundary between humans and robots. If robots are perceived as sharply distinct from humans, anthropocentrism (prioritizing human wellness) could more strongly deprioritize moral care for robots. This idea builds on the negative association found by Fortuna et al. (2023) between anthropocentrism and attitude toward robots in a cross-cultural context. Spatola et al. (2022), echoing Fisher (1991), posited that whether people a priori believe that robot have a soul affect the nuance of mind attribution toward robots. For Japanese participants, animism and anthropomorphism might be related to the degree to which they think robots "can think and have emotions." For US participants, on the other hand (who are subject to a stronger cultural influence from anthropocentrism), the question of whether a robot “is like a human” is more prominent. As such, it is natural that animism was positively related to moral care for robots in Japan. Contrary, under anthropocentric culture like in the US where sharp discrimination between human and robots are perceived comfortable, robots might be rejected by people if they look close to humans, as proposed by the uncanny valley theory (Mori et al., 2012). This view matches negative association between

animism and moral care for robots in the US, although further study focusing this point is needed. Future studies of moral attitudes toward robots should consider the interplay of animistic representations of nonhumans and a priori perceptions of robot-human similarity, which were identified as being higher in Japan than in Western cultures (Gygi, 2018).

As for the influence of religiosity, the religiosity model showed an effect of religious belief but not religious attendance, inconsistent with our hypothesis. We included religious attendance because a previous study showed Japanese participants can still be highly involved in religion through religious practices even if they have lower religious beliefs or identify as nonreligious (Kavanaugh & Jong, 2022). In fact, Kavanaugh and Jong (2022) suggested that Japanese religion is more oriented to practice than beliefs; thus, it is possible that one's religious attendance could influence one's religion-oriented values: animism and anthropomorphism. However, our result for Japanese participants showed religious attendance was not clearly correlated with either anthropocentrism ($r = -.029$) or animism ($r = .129$). Thus, given that religious attendance can be reinforced by social norms (Van Ingen & Moor, 2015), sightseeing, and prayer for family and friends (Kavanaugh & Jong, 2022), attendance at religious sites may not imply consistent beliefs or values.

Robots and Sociocultural Background in Japan

The present study examined the impact of exposure to robots and robot-related media on moral care for robots and found no discernible cross-cultural disparities in either the frequency or the effects of such contact on moral care for robots. This outcome, given the findings by MacDorman et al. (2009) that Japanese higher robot related experience correlated with a preference and less threatening impression of robots, was unanticipated. Notably, our study differed from that of MacDorman et al. (2009) in that our sample included participants with diverse educational backgrounds, ranging from 20 to 60 years of age; MacDorman et al.'s (2009) sample comprised only college students. Thus, our results are likely to more accurately reflect the underlying trends in the population of interest. It is

possible that these cross-cultural differences have been reduced in the last decade due to the increasing presence of robots in both US and Japanese societies. Another possibility is that though there is a great deal of popular literature in Japan featuring nonhuman animated characters (e.g., *Doraemon*), they may not be recognized as robots since they behave emotionally and intentionally in the same way as humans (i.e., our Japanese respondents may have underestimated their exposure to robots).

In terms of explaining cultural differences in attitude toward robots between Japan and the West, Hornyak (2006) pointed out that typical depictions of robots tend to differ in these culture. Another explanation is provided by Šabanović et al. (2014), who argued that Japan's identity as a "robot nation" might be a product of deliberate policy and communication strategies. It may also account for our result showing higher moral care for robots in Japan, though the negative association between anthropocentrism and moral care for robots in the US cannot be explained in this way. This line of argumentation is interesting because it suggests that identity/communication strategies regarding robots are influenced by religions. Although it would be difficult to conduct a scientific investigation of this sociohistorical context, more could be learned through field surveys focusing on researchers and engineers involved in robotics technology looking at religious influences on the development of science and technology, whose importance was echoed by Geraci (2006).

Scholars have discussed how Japanese society generally reacts positively to robots and new technologies in general (e.g., Schodt, 1988; Geraci, 2006; Hornyak, 2006). This is reflected in the fact that the use of robots as labor resources and caregivers in tackling the country's aging population and low birth rate is widely expected (Barry, 2005). Such a view may be criticized as comprising "misperceptions of Western journalists" (MacDorman et al., 2009), but nonetheless these characteristics of Japanese society may partially explain the present results. Interestingly, Western scholars, drawing on their own religious backgrounds, have raised the issue of how the encounter with humanoid robots demonstrating human-like behavior challenges our "self-understanding" that we are special, by making us see

ourselves as mere machines; they have developed theological arguments for overcoming this problem (Foerst, 1998). To the best of the authors' knowledge, such a "threat" has never been recognized by Japanese scholars, who are rooted in the animistic tradition. It appears more that Japan has incorporated humanoid robots into their own religious system (see Geraci, 2006).

General Implications for Moral and Cultural Psychology

Finally, we discuss this study's general implications for moral and cultural psychology. Previous cross-cultural studies revealed cultural differences in moral judgment strategies (e.g., Henrich et al., 2015; Gold et al., 2014) and moral development (Blake et al., 2015), as well as culturally stable patterns (Blake et al., 2015; Curry et al., 2019; Hauser et al., 2007; Graham et al., 2013). However, in previous cross-cultural studies, the characteristics of moral patients have not been considered specifically. For example, in questionnaire studies, moral patients are often described abstractly or vaguely (e.g., "someone" in the Moral Foundation Questionnaires; Graham et al., 2013). Our results showed that, in seeking to understand the role of cultural or social background in moral psychology, the moral patient's type might also be important to consider. In the present study, we focused on robots as moral patients, and took animism and anthropomorphism into account. This approach has relevance in the case of other nonhuman moral patients (e.g., animals or the environment), where specific religion-related values are also likely to influence one's moral attitude (e.g., animism might also influence moral care toward trees). Further cross-cultural studies are encouraged to map the relationship between specific types of moral patient and socio-religiously oriented values.

Limitations and Future Directions

The current study has several limitations. One is that moral care for robots was less explained by our explanatory variables for Japanese people across all models. Other

variables not considered in this study, such as perceived cuteness of presented robots, may have more explanatory power in Japan. Note that before participants filled in the questionnaire, we presented three robots (Armar, HRP-2, and Nao; Appendix A1) whose emotional valence (positive/negative impressions of robots' appearance) measured by the Self-Assessment Manikin (SAM; Lang, 1980, a language-independent method) and perceived human-likeness, showed little differences between Japanese and Western participants (Ikari et al. 2021). This process should have minimized the influence of any cultural differences in moral care for robots created by the difference in impression of the word "robot." However, it is still possible that emotional impressions of robots differently affected moral care for robots between countries; thus, future studies could be conducted to investigate this.

Another limitation stems from the fact that we treated moral care for robots independently from moral care for humans; thus, the current study is unable to address moral care for robots relative to moral care for humans (which could share the same cognitive underpinnings; Haidt & Joseph, 2004). We did not include items to ask about moral care for humans since our design—as a cross-cultural study—was already complex, and thus adding another focus (i.e., moral care for humans vs. robots) would have further complicated the survey and reduced the interpretability of the results. Instead, we assessed the ability to feel others' pain (empathic concern factor of IRI; Davis, 1980; strongly associated with moral care for humans, Dawson et al., 2021) and controlled this factor in our analyses. Thus, we consider it unlikely that this problem undermined our results.

Nonetheless, comparing moral considerations toward humans with those toward robots is an interesting topic for future research. One possible experimental method to approach this issue is the moral circle approach (e.g., Waytz et al., 2019). In this method, participants were asked to rank or rate various types of moral targets, typically including several types of humans (e.g., family, in-group members, villains) and nonhumans (environment, plants, animals). This approach could assess individual differences in moral

circle expansion (i.e., the scope of moral consideration from morally caring only for one's family to everything on the earth) and its determinant factors such as ideology (Waytz et al., 2019) or religious and cultural background, per the present research. Future research in this direction is encouraged.

Conclusion

The current study is the first to empirically examine moral attitudes toward robots with a large-scale cross-cultural sample (n = 3781). We found that Japanese adults valued moral care for robots more highly than American adults, and that religion-related values played a role in these attitudes. Thus, our study demonstrates the importance of considering religion in psychological human-robot interaction research, while providing a framework for future empirical work regarding morality attributions toward nonhuman agents.

Authors' Note

All the data and analysis codes are available at https://github.com/anchor200/robot_moral_care

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Declaration of Interest

The authors declare they have no conflicts of interest.

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Table 1. Participant demographics

	US	Japan
Age		
Minimum (years)	20	19
Maximum (years)	60	60
Mean (years)	38.8	38.5
SD	11.6	11.9
Gender		
Male (%)	47.5	48.0
Female (%)	52.2	51.3
Others (%)	0.3	0.7
Religious affiliation		
Christian (%)	62.0	2.2
Buddhist (%)	1.0	19.1
Muslim (%)	5.2	0.0
Jewish (%)	1.2	0.0
Shinto	0.0	2.0
Spiritual but not religious (%)	2.3	0.1
Multiple religions*	0.1	1.1
Other religious (%)	6.5	1.0
Not religious (%)	18.1	74.5
No answer	3.6	0.0
Region		
US		
South (%)	37.5	
Northeast (%)	18.5	
Midwest (%)	21.1	
West (%)	22.9	
Japan		
Hokkaido/Tohoku (%)		10.7
Kanto (%)		43.3
Chubu/Hokuriku (%)		13.7
Kansai		17.4
Chugoku/Sikoku (%)		6.9
Kyushu/Okinawa		8.0
Education		
US		
Elementary school	12	
Junior high school	182	
Vocational school or technical/communication college	396	

University or college	553	
Graduate university or professional school	482	
Others	117	
Japan		
Elementary school		2
Junior high school		60
High school		526
Technical or short college		354
University or college		901
Graduate university or professional school		125
Others		11

Note: *For the Japanese sample, 20 participants had multiple religions: Buddhist and Shinto (15/20), Christian and Buddhist (4/20), Christian, Buddhist, and Shinto (1/20). For the US sample, 2 respondents were Jewish and Christian.

Table 2. Descriptive results

Measure	US sample		Japanese sample		t-test				
	Mean	SD	Mean	SD	df	*t*	*p*	Cohen's d	95CI
Moral care for robots	-0.27	1.14	0.25	0.77	3108.21	-16.30	<.001	-0.54	(-0.61,-0.48)
Religious attendance	0.37	1.10	-0.34	0.76	3154.54	22.94	<.001	0.76	(0.69,0.83)
Religious beliefs	0.49	0.86	-0.45	0.90	3770.50	32.82	<.001	1.07	(1,1.13)
Anthropocentrism	0.18	1.10	-0.16	0.87	3436.37	10.36	<.001	0.34	(0.28,0.41)
Animism	-0.01	1.14	0.01	0.85	3306.04	-0.49	0.626	-0.02	(-0.08,0.05)
Empathic concern	0.33	1.02	-0.30	0.88	3577.57	20.29	<.001	0.67	(0.6,0.73)
Perspective taking	0.46	0.95	-0.42	0.85	3616.73	29.90	<.001	0.98	(0.91,1.05)
Exposure to robot-related experiences	0.00	1.14	0.00	0.85	3320.90	0.16	0.870	0.01	(-0.06,0.07)

Note: *Values were calculated after normalization using mean and SD for all participants. US and Japanese participants' SD differed because the overall SD for a variable does not necessarily match that for individual countries.

Table 3. Regression analysis

	Religiosity model							Religion-related values model							Best model						
	β		*SE*	CI lower	CI upper	*t*	*p*	*β*		*SE*	CI lower	CI upper	*t*	*p*	*β*		*SE*	CI lower	CI upper	*t*	*p*
Intercept	-0.11	*	0.04	-0.19	-0.03	-2.55	.011	-0.14	**	0.04	-0.22	-0.06	-3.28	.001	-0.14	**	0.04	-0.22	-0.05	-3.22	.001
Culture	-0.01		0.03	-0.06	0.05	-0.18	.856	-0.01		0.03	-0.07	0.05	-0.34	.737	-0.01		0.03	-0.07	0.05	-0.31	.758
Religiosity																					
Religious attendance	-0.03		0.02	-0.08	0.02	-1.24	.214														
Religious beliefs	-0.08	***	0.02	-0.13	-0.04	-3.49	>.001														
Culture*Religious Attendance	0.02		0.03	-0.05	0.08	0.54	.592														
Culture*Religious Beliefs	0.17	***	0.03	0.11	0.23	5.54	>.001														
Religion-related values																					
Anthropocentrism								-0.22	***	0.02	-0.27	-0.18	-10.17	>.001	-0.23	***	0.02	-0.27	-0.18	-10.24	>.001
Animism								-0.09	***	0.02	-0.13	-0.04	-3.89	>.001	-0.09	***	0.02	-0.13	-0.04	-3.87	>.001
Culture*Anthropocentrism								0.17	***	0.03	0.11	0.22	5.62	>.001	0.17	***	0.03	0.11	0.22	5.63	>.001
Culture*Merged Animism								0.29	***	0.03	0.23	0.34	9.60	>.001	0.29	***	0.03	0.23	0.34	9.61	>.001
Covariates																					
Empathic concern	0.32	***	0.02	0.29	0.36	18.42	>.001	0.29	***	0.02	0.25	0.32	16.73	>.001	0.29	***	0.02	0.25	0.32	16.76	>.001
Perspective taking	-0.08	***	0.02	-0.11	-0.04	-4.36	>.001	-0.08	***	0.02	-0.11	-0.04	-4.28	>.001	-0.08	***	0.02	-0.11	-0.04	-4.28	>.001
Typical image of robots	0.00		0.04	-0.07	0.07	0.05	.956	0.07		0.04	0.00	0.14	1.94	.052	0.07		0.04	0.00	0.14	1.94	.053
Robot-related experiences	-0.12	***	0.02	-0.15	-0.09	-7.19	>.001	-0.10	***	0.02	-0.14	-0.07	-6.45	>.001	-0.11	***	0.02	-0.14	-0.07	-6.47	.000
Age	0.03		0.02	0.00	0.06	1.86	.063	0.03		0.02	0.00	0.06	1.85	.065	0.03		0.02	0.00	0.06	1.79	.074
Gender1	0.35	***	0.03	0.28	0.41	10.69	>.001	0.29	***	0.03	0.23	0.35	9.08	>.001	0.28	***	0.03	0.22	0.35	9.01	>.001
Gender2	0.36		0.20	-0.04	0.76	1.75	.081	0.23		0.20	-0.16	0.62	1.15	.251							
Education	-0.13	***	0.03	-0.19	-0.07	-4.08	>.001	-0.12	***	0.03	-0.17	-0.06	-3.85	>.001	-0.12	***	0.03	-0.17	-0.06	-3.85	>.001
R.squared	0.18							0.22							0.22						
AIC	9977.77							9787.75							9787.07						

Note: All values (except categorical variables) were standardized using mean and SD. Categorical variables were operationalized as dummy variables: culture (US: 0, JP: 1), gender (male: *Gender1* = 0, *Gender2* = 0; female: *Gender1* = 1, *Gender2* = 0; and others: *Gender1* = 0, *Gender2* = 1), education (college graduate or higher: 1, others: 0); *p < .05. **p < .01, ***p < .001.

Appendix A1. Deviation from pre-registration.

The current paper included the following deviation from pre-registration of the study plan (Ikari et al., 2020). First, we integrated variables Animism (measured by Animism Scale for Adults; Ikeuchi, 2010) and Anthropomorphism (measured by IDAQ Waytz et al., 2010) into one variable (called Animism in the main text). This was because consistency of the two variables are very high (Cronbach's α of an aggregated variable were 0.92 and 0.90 for the US and Japanese participants, respectively), maybe due to difficulty to distinguish conceptualization behind two variables (see Karpinska-Krakowiak & Eisend, 2021).

In addition, we omitted path analyses from main text. The reason is that we did not have a hypothesis for the causal relationship between religiosity and religion-related values (anthropocentrism and animism). Rather than presenting a hypothesis-testing report, we decided to report the results of the pre-registered model to provide material for future hypothesis development (Appendix A7).

Reference

Ikari, S., Nakawake, Y., Burdett, E., Sato, K., and Jong, J. (2020). The impact of religiously rooted values on empathy toward robot: A comparative study in Japan and the United States. https://doi.org/10.17605/OSF.IO/HS4EJ

Appendix A2. Presented images of robots.

To measure participants' typical images of robots, we asked whether of two images of robots, Subfigure (a) or (b), is closer to their typical image of robots.

The image of humanoids (a) is also used for an image presented before participants filled the moral care for robots questionnaire.

Perceived human-likeness of humanoid robots and machine-likeness of machine robots are measured in the pilot experiment with Japanese and Western (American, Canadian, and English) adults and there is little difference in the ratings (Ikari et al., 2021).

(a) Humanoid robots

(b) Machine robots

Appendix A3. A list of questionnaire survey items.

	English	Japanese
Moral care for robtos	A schoolgirl continues to fire a pellet gun at a robot placed in the woods.	ある人が、森に置かれたロボットに向けてエアガンを撃ち続けている
	A person making fun robots cleaning dirty drains as they watch.	ある人が、ロボットが汚い排水溝を掃除しているのを見て馬鹿にしている
	A person is amused to see a robot being dumped by a person.	ある人が、ロボットが人に捨てられるのを見て面白がっている
	A person yells at a robot about how bad the food it made tastes.	ある人が、作った料理の味がひどいとロボットを怒鳴りつけている
	A person making fun of a robot for being a bad drawer.	ある人が、絵が下手くそだとロボットを馬鹿にしている
	A person threw the robot to the floor because the robot had damaged the furniture.	ある人が、ロボットが家具を傷つけてしまったことを理由にロボットを床に投げ飛ばした
	Someone has left a robot outdoors in the rain.	ある人が、ロボットを雨が降っている屋外に放置している
	A child is throwing rocks at a robot working on the ranch.	子どもが、牧場で働いているロボットに向かって石を投げつけている
	A comedian is jabbing a robot to entertain his audience.	あるコメディアンが、ロボットを叩いて笑いを取ろうとしている
	A person beats a robot with a spatula for failing at its job .	ある人が、仕事に失敗したロボットをへらで叩いている
	A person is swerving her car in orderto run over a roadside robot.	ある人が、わざと道端のロボットを轢くため車のハンドルを切っている
	A person student said that other robots are much more attractive.	ある人が、ロボットに対して他のロボットの方がずっと魅力的だと言っている
	A person is telling a robot that it shouldn't be at the entrance because it's too ugly.	ある人がロボットに対して、醜すぎるためエントランスにあるべきではないと言っている
Religious attendance	How many times a year do you usually (i.e. before pandemic) visit a religious place (temple, shrine, church etc.)?	コロナウィルス流行以前、あなたは通常年間に約何回ほど宗教施設（寺、神社、教会など）に行っていましたか？
Religious beliefs	There exists an all-powerful, all-knowing spiritual being, whom we might call Go	霊的で全知全能な神と呼ばれるようなものは実在する。
	There exist spiritual beings, who might be good or evil, such as angels or demons.	守護神や悪魔のような善悪のある霊的な存在がいる。
	Human beings have immaterial, immortal souls.	人間には、物質的な身体とは区別される魂が存在する。
	There is a spiritual realm besides the physical one.	物質的世界以外にも霊的世界が存在する。
	There is a spiritual realm besides the physical one.	死後の世界は存在する。

	Supernatural events that have no scientific explanation (e.g., miracles) can and do happen.	科学理論では説明できない超自然的な奇跡は起こりうるし、実際に起こる。
Anthropocentrism	The human species is without a doubt the most advanced form of life on earth.	人間は疑うまでもなく地球上で最も進んだ生命体である
	Man is the most significant entity in the universe.	人間は地球上で最も重要な種である
	If we eventually discover life in other parts of of the universe, such life will probably be found to be inferior to human life.	いずれ我々が宇宙のどこかで生命を見つけたとしても、おそらく人間よりも劣っていると判明するだろう
	Humans are superior to all other animals in all important respects.	人間は、すべての重要な性質に関して、他のどの動物よりも優れている
	Degree of intelligence ought to be the main measure for determining the superiority of one species over another.	どの生物種が最も優れているかを決める際に、知性を測ることを最重視すべきだ
	If there actually is an afterlife, animals are just as likely as humans to take part in such a life after death.	実際に死後の世界があるとしたら、動物も人間と同じようにその世界に加わるだろう
	Governments should adopt policies which ensure the survival of the human species, even if other species become extinct as a result.	結果的に他の種が絶滅したとしても、政府は人類の生存を確実に保証する政策を採用すべきである
	No matter how superiority is defined, it seems that man must be considered superior to all known forms of life.	優越性をどのように定義したとしても、人間は既知のすべての生命体よりも優れている
	If I could choose my own afterlife, I would like to be something other than a human being for a change.	もし生まれ変わって何になるか選べるのなら、私は人間以外の何かになりたい
	Man is the most important species on earth.	人間は宇宙で最も重要な存在である
	The primary value of an animal or plant lies in its ability to serve human needs.	動物や植物の最も重要な価値は、人間のニーズ(必要だと思うこと)に応えられることにある
Animism	I feel that the hand-made object aquires part of the soul of the one that made it.	手作りのモノには作り手の魂の一部が宿っているような気がする
	I feel that the mementos have part of the soul of the person who used them.	形見や遺品には、使っていた人の魂の一部が宿っているような気がする
	I feel like my old clothes and old tools have part of the soul of their previous owners.	古着や古道具には以前の所有者の魂の一部が宿っているような気がする
	There are times when we feel attachment to things around us like we do to people.	身の回りのモノに、人に対するような愛着を感じることがある
	Sometimes I give a human name or pet name to objects around me.	身の回り のモノに人の名前をつけることがある

	When I discard something I've used for a long time, I sometimes feel pity for it.	長く愛用していたモノを捨てるときに、可哀想に思うことがある
	I sometimes feel that the things I've used and loved for a long time are another part of myself.	長く愛用しているモノを、自分の分身のように感じることがある
	Sometimes I think that the things around me have a human-like mind.	身の回りのモノにも、人間のような心があると思うことがある
Anthropomorphism	To what extent does technology—devices and machines for manufacturing, entertainment, and productive processes (e.g., cars, computers, television sets)—have intentions?	どの程度、製造・娯楽・生産のための技術的装置と機械（例：自動車・パソコン・テレビ）は意図を持ちますか？
	To what extent does the average fish have free will?	どの程度、平均的な魚は自由意志を持ちますか？
	To what extent does the average mountain have free will?	どの程度、平均的な山は自由意志を持ちますか？
	To what extent does a television set experience emotions?	どの程度、テレビは感情を経験しますか？
	To what extent does the average robot have consciousness?	どの程度、平均的なロボットは意識を持ちますか？
	To what extent do cows have intentions?	どの程度、牛は意図を持ちますか？
	To what extent does a car have free will?	どの程度、自動車は自由意志を持ちますか？
	To what extent does the ocean have consciousness?	どの程度、海は意識を持ちますか？
	To what extent does the average computer have a mind of its own?	どの程度、平均的なコンピュータはそれ自体が心を持っていますか？
	To what extent does a cheetah experience emotions?	どの程度、チーター（ネコ科の動物）は感情を経験しますか？
	To what extent does the environment experience emotions?	どの程度、自然環境は感情を経験しますか？
	To what extent does the average insect have a mind of its own?	どの程度、平均的な虫はそれ自体に心を持っていますか？
	To what extent does a tree have a mind of its own?	どの程度、木はそれ自体に心を持っていますか？
	To what extent does the wind have intentions?	どの程度、風は意図を持ちますか？
	To what extent does the average reptile have consciousness?	どの程度、平均的な爬虫類は意識を持ちますか？
Perspective taking	Being in a tense emotional situation scares me.	他の人の視点から物事を見るのは難しいと感じることがある。
	I often have tender, concerned feelings for people less fortunate than me.	何かを決める前には，自分と意見が異なる立場のすべてに目を向けるようにしている。
	I would describe myself as a pretty soft-hearted person.	友達のことをよく知ろうとして，その人からどのように物事がみえているか想像する。

	I try to look at everybody's side of a disagreement before I make a decision.	自分が正しいと思える時には，他の人の言い分を聞くようなことには時間を使わない。
	If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.	すべての問題点には 2 つの立場があると思っており，その両者に目を向けるようにしている
	When I watch a good movie, I can very easily put myself in the place of a leading character	誰かにいらいらしているときにはたいてい，しばらくその人の身になって考えるようにしている。
	Becoming extremely involved in a good book or movie is somewhat rare for me.	誰かを批判する前には，自分が批判される相手の立場だったらどう感じるか想像しようとする。
Empathic concern	I sometimes feel helpless when I am in the middle of a very emotional situation.	自分より不運な人たちを心配し，気にかけることが多い。
	I tend to lose control during emergencies.	他の人たちが困っているのを見て，気の毒に思わないことがある。
	When I see someone being taken advantage of, I feel kind of protective towards them.	誰かがいいように利用されているのをみると，その人を守ってあげたいような気持ちになる。
	When I see someone being treated unfairly, I sometimes don't feel very much pity for them.	他の人たちが不運な目にあっているのはたいてい，それほど気にならない。
	When I'm upset at someone, I usually try to ″put myself in his shoes″ for a while.	誰かが不公平な扱いをされているのをみたときに，そんなにかわいそうだと思わないことがある。
	I sometimes find it difficult to see things from the ″other guy's″ point of view.	自分が見聞きした出来事に，心を強く動かされることが多い。
	I daydream and fantasize, with some regularity, about things that might happen to me.	自分は思いやりの気持ちが強い人だと思う。
Exposure to robot related media	How often do you watch robot-related media contents? (e.g., stories, comics, news articles, academic articles, animes, video games, television, DVD, internets)	どれぐらいロボットに関連したメディアを見ますか？（例：小説、漫画、ニュース記事、論文、アニメ、テレビゲーム、テレビ、DVD、インターネット）
	How often do you touch robots directly?	直接ロボットに触る機会はどれくらいありますか？
	How often do you build or program robot?	自分でロボットのプログラミングをしたり、作ったりする機会はどれくらいありますか？
Typical image of robots	Which of the following images, A or B, is closer to your image of a robot?	以下に示す A、B のうち、どちらがあなたが考えるロボットのイメージに近いですか？

Appendix A4. Country-wise regression.

Religion model

	US							JP						
	β		*SE*	CI lower	CI upper	*t*	*p*	*β*		*SE*	CI lower	CI upper	*t*	*p*
Intercept	-0.03		0.05	-0.13	0.08	-0.51	0.611	-0.23	***	0.06	-0.35	-0.11	-3.84	0.000
Religion variables														
Religious attendance	-0.02		0.02	-0.06	0.03	-0.66	0.509	-0.02		0.02	-0.07	0.02	-1.01	0.315
Religious beliefs	-0.07	**	0.02	-0.12	-0.03	-3.13	0.002	0.08	***	0.02	0.04	0.12	3.54	0.000
Culture*Religious attendance														
Culture*Religious beliefs														
Value variables														
Anthropocentrism														
Animism														
Culture*Anthropocentrism														
Culture*merged Animism														
Covariates														
Empathic concern	0.37	***	0.02	0.32	0.42	14.72	0.000	0.26	***	0.02	0.21	0.31	10.60	0.000
Perspective taking	-0.13	***	0.02	-0.18	-0.08	-5.14	0.000	-0.03		0.03	-0.08	0.02	-1.04	0.300
Typical image of robots	-0.09	*	0.05	-0.19	0.00	-1.98	0.048	0.14	*	0.06	0.03	0.25	2.41	0.016
Robot-related experience	-0.19	***	0.02	-0.24	-0.14	-7.93	0.000	-0.05	*	0.02	-0.10	-0.01	-2.26	0.024
Age	0.01		0.02	-0.03	0.05	0.58	0.563	0.05	*	0.02	0.00	0.09	2.08	0.038
Gender1	0.28	***	0.05	0.19	0.37	6.15	0.000	0.38	***	0.05	0.29	0.47	8.28	0.000
Gender2	0.27		0.36	-0.43	0.97	0.75	0.455	0.36		0.25	-0.13	0.85	1.42	0.155
Education	-0.08		0.05	-0.17	0.01	-1.79	0.074	-0.15	***	0.04	-0.24	-0.07	-3.56	0.000
R.squared	0.25							0.14						
AIC	4609.00							5331.41						

Religious value model

	US							JP						
	β		*SE*	CI lower	CI upper	*t*	*p*	*β*		*SE*	CI lower	CI upper	*t*	*p*
Intercept	-0.09		0.05	-0.19	0.01	-1.69	0.091	-0.22	***	0.06	-0.33	-0.10	-3.62	0.000
Religion variables														
Religious attendance														
Religious beliefs														
Culture*Religious attendance														
Culture*Religious beliefs														
Value variables														
Anthropocentrism	-0.22	***	0.02	-0.27	-0.18	-10.14	0.000	-0.06	**	0.02	-0.10	-0.02	-3.00	0.003
Animism	-0.07	**	0.02	-0.12	-0.03	-3.12	0.002	0.19	***	0.02	0.15	0.24	8.29	0.000
Culture*Anthropocentrism														
Culture*merged Animism														
Covariates														
Empathic concern	0.32	***	0.02	0.27	0.37	13.21	0.000	0.25	***	0.02	0.21	0.30	10.47	0.000
Perspective taking	-0.09	***	0.02	-0.14	-0.04	-3.60	0.000	-0.06	*	0.03	-0.11	-0.01	-2.52	0.012
Typical image of robots	0.00		0.05	-0.09	0.09	0.02	0.987	0.15	**	0.06	0.04	0.26	2.74	0.006
Robot-related experience	-0.14	***	0.02	-0.19	-0.09	-5.77	0.000	-0.08	***	0.02	-0.12	-0.04	-3.58	0.000
Age	0.01		0.02	-0.03	0.05	0.59	0.554	0.05	*	0.02	0.00	0.09	2.18	0.029
Gender1	0.22	***	0.04	0.13	0.31	4.93	0.000	0.35	***	0.05	0.26	0.44	7.55	0.000
Gender2	0.06		0.35	-0.62	0.74	0.17	0.865	0.30		0.25	-0.19	0.78	1.20	0.230
Education	-0.04		0.04	-0.13	0.04	-1.02	0.308	-0.17	***	0.04	-0.25	-0.09	-4.06	0.000
R.squared	0.29							0.17						
AIC	4506.64							5268.43						

Best model

	US							JP						
	β		*SE*	CI lower	CI upper	*t*	*p*	*β*		*SE*	CI lower	CI upper	*t*	*p*
Intercept	-0.12	***	0.03	-0.17	-0.06	-3.83	0.000	-0.21	***	0.06	-0.33	-0.09	-3.55	0.000
Religion variables														
Religious attendance														
Religious beliefs														
Culture*Religious attendance														
Culture*Religious beliefs														
Value variables														
Anthrpocentrism	-0.22	***	0.02	-0.27	-0.18	-10.52	0.000	-0.06	**	0.02	-0.11	-0.02	-3.07	
Animism	-0.08	***	0.02	-0.12	-0.03	-3.31	0.001	0.19	***	0.02	0.15	0.24	8.31	0.002
Culture*Anthropocentrism														0.000
Culture*merged Animism														
Covariates														
Empathic concern	0.32	***	0.02	0.28	0.37	13.39	0.000	0.25	***	0.02	0.21	0.30	10.47	
Perspectiv taking	-0.09	***	0.02	-0.14	-0.04	-3.61	0.000	-0.06	*	0.03	-0.11	-0.01	-2.50	0.00
Typical image of robots								0.15	**	0.06	0.04	0.26	2.75	0.01
Robot-related experience	-0.15	***	0.02	-0.19	-0.10	-6.08	0.000	-0.08	***	0.02	-0.12	-0.04	-3.60	0.01
Age								0.05	*	0.02	0.00	0.09	2.12	0.00
Gender1	0.22	***	0.04	0.14	0.31	5.10	0.000	0.34	***	0.05	0.25	0.43	7.47	0.03
Gender2														0.00
Education								-0.17	***	0.04	-0.25	-0.09	-4.07	
														0.00
R.squared	0.29							0.17						
AIC	4500.07							5267.88						

Appendix A5. Regression models employing both religion and religion-related values.

	β		*SE*	CI lower	CI upper	*t*	*p*
Intercept	-0.09		0.06	-0.20	0.02	-1.55	0.120
Culture	-0.13		0.08	-0.28	0.03	-1.59	0.113
Religion variables							
Religious attendance	0.02		0.03	-0.03	0.07	0.64	0.521
Religious beliefs	-0.02		0.02	-0.07	0.03	-0.79	0.432
Culture*Religious attendance	-0.04		0.03	-0.11	0.02	-1.34	0.182
Culture*Religious beliefs	0.01		0.03	-0.06	0.08	0.37	0.711
Value variables							
Anthropocentrism	-0.22	***	0.02	-0.27	-0.17	-9.23	0.000
Animism	-0.07	**	0.03	-0.12	-0.02	-2.77	0.006
Culture*Anthropocentrism	0.16	***	0.03	0.10	0.22	5.02	0.000
Culture*merged Animism	0.27	***	0.04	0.20	0.34	7.47	0.000
Covariates							
Empathic concern	0.32	***	0.03	0.27	0.37	12.43	0.000
Perspectiv taking	-0.09	***	0.03	-0.14	-0.04	-3.37	0.001
Typical image of robots	0.00		0.05	-0.10	0.10	0.00	0.998
Robot-related experience	-0.14	***	0.03	-0.20	-0.09	-5.52	0.000
Age	0.01		0.02	-0.03	0.06	0.60	0.547
Gender1	0.22	***	0.05	0.13	0.31	4.77	0.000
Gender2	0.06		0.36	-0.65	0.78	0.18	0.860
Education							
Culture*Empathic concern	-0.07		0.03	-0.14	0.00	-1.95	0.051
Culture*Perspective taking	0.02		0.04	-0.05	0.09	0.65	0.514
Culture*Typical image of robots	0.15	*	0.07	0.00	0.29	1.99	0.047
Culture*Robot-related experience	0.07	*	0.03	0.00	0.14	2.10	0.036
Culture*Age	0.04		0.03	-0.02	0.10	1.28	0.202
Culture*Gender1	0.13		0.06	0.00	0.25	1.96	0.050
Culture*Gender2	0.23		0.43	-0.62	1.08	0.53	0.593
Culture*Education	-0.12		0.06	-0.24	0.00	-1.90	0.058
R.squared	0.23						

AIC	9790.78	

Appendix A6. Regression models accounted for culture-covariates interactions.

	Religion model							Religious value model						
	β		*SE*	CI lower	CI upper	*t*	*p*	*β*		*SE*	CI lower	CI upper	*t*	*p*
Intercept	-0.03		0.06	-0.14	0.08	-0.49	0.62	-0.09		0.06	-0.20	0.02	-1.62	0.11
Culture	-0.21	*	0.08	-0.37	-0.05	-2.51	0.01	-0.13		0.08	-0.28	0.03	-1.58	0.11
Religion variables														
Religious attendance	-0.02		0.03	-0.07	0.03	-0.64	0.52							
Religious beliefs	-0.07	**	0.02	-0.12	-0.03	-3.01	0.00							
Culture*Religious attendance	-0.01		0.03	-0.07	0.06	-0.18	0.86							
Culture*Religious beliefs	0.15	***	0.03	0.09	0.22	4.68	0.00							
Value variables														
Anthrpocentrism								-0.22	***	0.02	-0.27	-0.18	-9.71	0.00
Animism								-0.07	**	0.02	-0.12	-0.03	-2.98	0.00
Culture*Anthropocentrism								0.16	***	0.03	0.10	0.22	5.22	0.00
Culture*merged Animism								0.27	***	0.03	0.20	0.33	7.97	0.00
Covariates														
Empathic concern	0.37	***	0.03	0.32	0.42	14.18	0.00	0.32	***	0.03	0.27	0.37	12.65	0.00
Perspectiv taking	-0.13	***	0.03	-0.18	-0.08	-4.95	0.00	-0.09	***	0.03	-0.14	-0.04	-3.44	0.00
Typical image of robots	-0.09		0.05	-0.19	0.00	-1.90	0.06	0.00		0.05	-0.10	0.10	0.02	0.99
Robot-related experience	-0.19	***	0.02	-0.24	-0.14	-7.64	0.00	-0.14	***	0.03	-0.19	-0.09	-5.52	0.00
Age	0.01		0.02	-0.03	0.06	0.56	0.58	0.01		0.02	-0.03	0.05	0.57	0.57
Gender1	0.28	***	0.05	0.19	0.37	5.93	0.00	0.22	***	0.05	0.13	0.31	4.72	0.00
Gender2	0.27		0.37	-0.46	0.99	0.72	0.47	0.06		0.36	-0.65	0.77	0.16	0.87
Education	-0.08		0.05	-0.17	0.01	-1.72	0.08	-0.04		0.04	-0.13	0.04	-0.98	0.33
Culture*Empathic concern	-0.11	**	0.04	-0.18	-0.04	-3.01	0.00	-0.07	*	0.03	-0.14	0.00	-2.00	0.05
Culture*Perspectiv taking	0.10	**	0.04	0.03	0.17	2.86	0.00	0.02		0.04	-0.05	0.10	0.69	0.49
Culture*Typical image of robots	0.23	**	0.07	0.09	0.38	3.12	0.00	0.15	*	0.07	0.01	0.29	2.07	0.04
Culture*Robot-related experience	0.14	***	0.03	0.07	0.20	4.21	0.00	0.06		0.03	0.00	0.13	1.88	0.06
Culture*Age	0.04		0.03	-0.03	0.10	1.14	0.26	0.04		0.03	-0.02	0.10	1.19	0.23
Culture*Gender1	0.11		0.06	-0.02	0.23	1.63	0.10	0.13	*	0.06	0.00	0.25	1.98	0.05
Culture*Gender2	0.09		0.44	-0.78	0.96	0.20	0.84	0.24		0.43	-0.61	1.09	0.55	0.59
Culture*Education	-0.07		0.06	-0.19	0.05	-1.14	0.26	-0.13	*	0.06	-0.24	-0.01	-2.09	0.04
R.squared	0.19							0.23						

AIC	9947.30	9785.47

Appendix A7. Path models.

Method

We fit the data to a hypothesis model (Figure A2) and checked its validity. Specifically, we tested the following: In the US, (i) religiosity (Religious attendance/beliefs) influences Anthropocentrism positively and Anthropocentrism negatively influences Moral care for robots. (ii) Religiosity influences Animism negatively and Animism positively influences Moral care for robots. In Japan, (iii) religiosity influences Anthropocentrism negatively and Anthropocentrism negatively influences Moral care for robots. (iv) Religiosity influences *Animism* positively and *Animism* negatively influences *Moral care for robots*. Following our pre-registration, we used a multi-group SEM analysis because it reduces the type-I error rather than doing the analysis for each country. In our analysis, the variance of latent variables were fixed at 1, so that we were able to compare the effect size of paths between latent variables. Participants who answered their gender as others are removed from the SEM analysis, since the number of such participants were very small (0.3% in the US and 0.7% in Japan) and it was not likely for analysis including such a population to yield interpretable results.

We tested the model fit with a maximum likelihood (ML) estimator. Although we did not pre-register the criteria for judging the goodness of fit of the model, we followed previous studies (Willard & Norenzayan, 2019) and referred to RMSEA and CFI as goodness of fit, since the most conservative criterion, $\chi 2$ statistics was less likely to maintain sufficient detection ability with our large sample size, making it too conservative test. As well as the pre-registered analysis, we conducted exploratory tests to examine group invariance of path coefficients by a likelihood ratio test. Analyses were conducted with R 4.0.3 and lavaan 0.6-7 package (Rosseel, 2012).

Result

The hypothesis model fit the data well (χ^2 (2670) = 10453.2, p = .000, CFI = 0.96, RMSEA = 0.039 (95%CI [0.039, 0.040]), GFI = 0.98, AGFI = 0.96; Figure A2). The path coefficients are provided in Table A4. In the US, the prediction (i) was supported with positive paths from *Religious attendance/beliefs* to *Anthropocentrism* (β = .126, p < .001; β = .208; p < .001) , and negative path from *Anthropocentrism* to *Moral care for robots* (β = -.292, p < .001). However, prediction (ii) regarding *Animism*, was not supported with a weak but positive path from religious attendance to *Animism* (β = .108, p < .001) and a negative path from *Animism* to *Moral care for robots* (β = -.121, p = .001). In Japan, prediction (iv) was partly supported with a positive path from *Religious beliefs* to *Animism* (β = .561, p = .001) and a positive path from *Animism* to *Moral care for robots* (β = .198, p = .001), although a path from *Religious attendance* to *Animism* was not significant (β = -.006, p = .812). Contrary, the prediction (iii) was not supported with weak but positive path from *Religious beliefs* to *Anthropocentrism* (β = .125, p < .001), although *Anthropocentrism* weakly but negatively affected *Moral care for robots* as we predicted (β = -.103, p < 001). Note that all direct path from religiosity to *Moral care for robots* were very weak (βs < 0.04), suggesting that religiosity's influences are mediated by religion-related values (*Anthropocentrism/Animism*) rather than behaving directly.

Illustration of hypothesis path model.

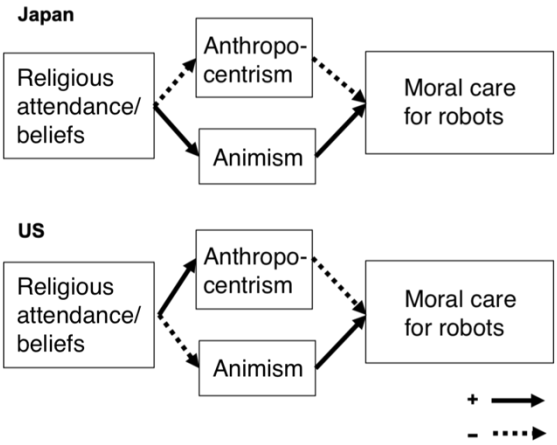
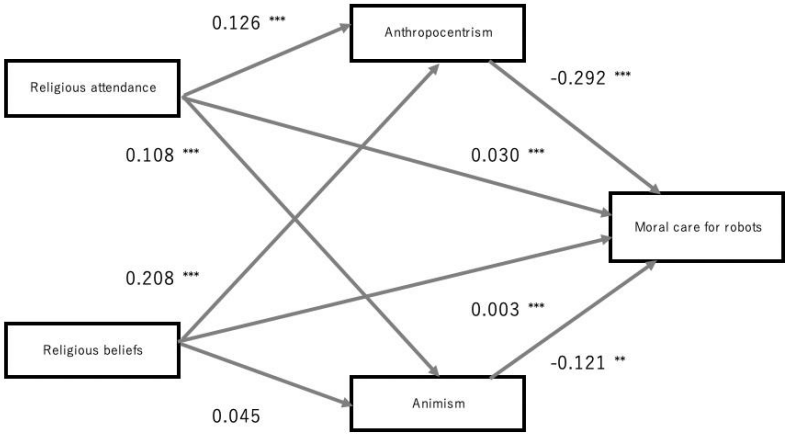


Illustration of results of the hypothesis path model

For clarity, covariates are omitted from the figure (see Table A4 for the effect of them).

US



JP

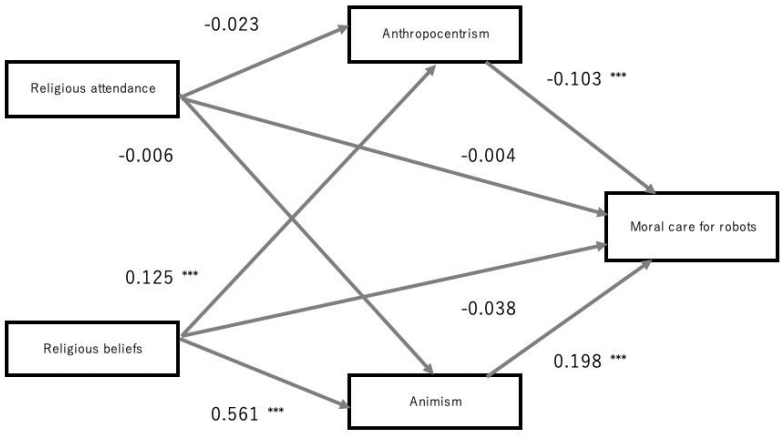

Anthropocentrism
Religious attendance
Moral care for robots
Religious beliefs
Animism
-0.023
-0.103 ***
-0.006
-0.004
0.125 ***
-0.038
0.198 ***
0.561 ***

Table of path coefficients

US

	β		SE	*z*	*p*
Path coefficients					
Moral care for robots					
Religious attendance	0.03	***	0.03	1.03	<.001
Religious beliefs	0.00		0.03	0.09	0.925
Anthropocentrism	-0.29	***	0.03	-9.59	<.001
Animism	-0.12	***	0.04	-3.38	<.001
Empathic concern	0.06		0.07	0.94	0.861
Perspective taking	0.07	***	0.06	1.04	<.001
Typical image of robots	0.00	***	0.06	0.00	<.001
Robot-related experience	-0.25	***	0.04	-6.81	<.001
Gender	0.36	***	0.05	6.80	<.001
Education	0.00	***	0.06	0.08	<.001
Religious attendance					
Gender	-0.24		0.04	-5.36	0.100
Education	0.55	***	0.05	11.92	<.001
Religious beliefs					
Perspective taking	0.31	***	0.03	11.20	<.001
Anthropocentrism					
Religious attendance	0.13	***	0.03	4.80	<.001
Religious beliefs	0.21		0.03	7.64	0.052
Gender	-0.30	***	0.04	-6.85	<.001
Education	0.16	***	0.05	3.51	<.001
Animism					
Religious attendance	0.11	***	0.03	4.13	<.001
Religious beliefs	0.05	***	0.03	1.64	<.001
Correlation of errors					
Religious attendance					
Religious beliefs	0.43	***	0.02	20.46	<.001

Religious beliefs					
Empathic concern	0.10	***	0.02	4.57	<.001
Anthropocentrism					
Animism	0.47	***	0.02	22.48	<.001
Robot-related experience	0.32	***	0.02	13.37	<.001
Animism					
Empathic concern	0.05	***	0.03	1.94	<.001
Perspective taking	0.09	***	0.02	3.79	<.001
Robot-related experience	0.54	***	0.02	25.65	<.001

JP

	β		SE	z	p
Path coefficients					
Moral care for robots					
Religious attendance	0.00		0.03	-0.18	0.861
Religious beliefs	-0.04	*	0.04	-1.06	0.016
Anthropocentrism	-0.10		0.02	-4.24	0.288
Animism	0.20	***	0.03	6.52	<.001
Empathic concern	0.25		0.08	3.19	0.401
Perspective taking	-0.07	***	0.07	-0.93	<.001
Typical image of robots	-0.15		0.06	-2.41	0.050
Robot-related experience	-0.17		0.03	-5.02	0.866
Gender	0.43		0.05	8.92	0.284
Education	-0.17	***	0.05	-3.50	<.001
Religious attendance					
Gender	-0.04	***	0.05	-0.84	<.001
Education	0.17	***	0.05	3.77	<.001
Religious beliefs					
Perspective taking	0.33	***	0.03	11.49	<.001
Anthropocentrism					
Religious attendance	-0.02	***	0.02	-1.07	<.001
Religious beliefs	0.13	**	0.02	5.62	0.003
Gender	-0.01	***	0.04	-0.17	<.001
Education	-0.08	***	0.04	-1.96	<.001
Animism					
Religious attendance	-0.01	***	0.02	-0.24	<.001
Religious beliefs	0.56	***	0.03	16.13	<.001
Correlation of errors					
Religious attendance					
Religious beliefs	0.09	***	0.02	3.95	<.001
Religious beliefs					

Empathic concern	0.17	***	0.02	6.72	<.001
Anthropocentrism					
Animism	0.13	***	0.02	5.44	<.001
Robot-related experience	0.21	***	0.03	8.09	<.001
Animism					
Empathic concern	0.10	***	0.03	3.02	<.001
Perspective taking	0.20	***	0.03	6.66	<.001
Robot-related experience	0.23	***	0.03	8.09	<.001

*p < .05. **p < .01, ***p < .001.

Reference

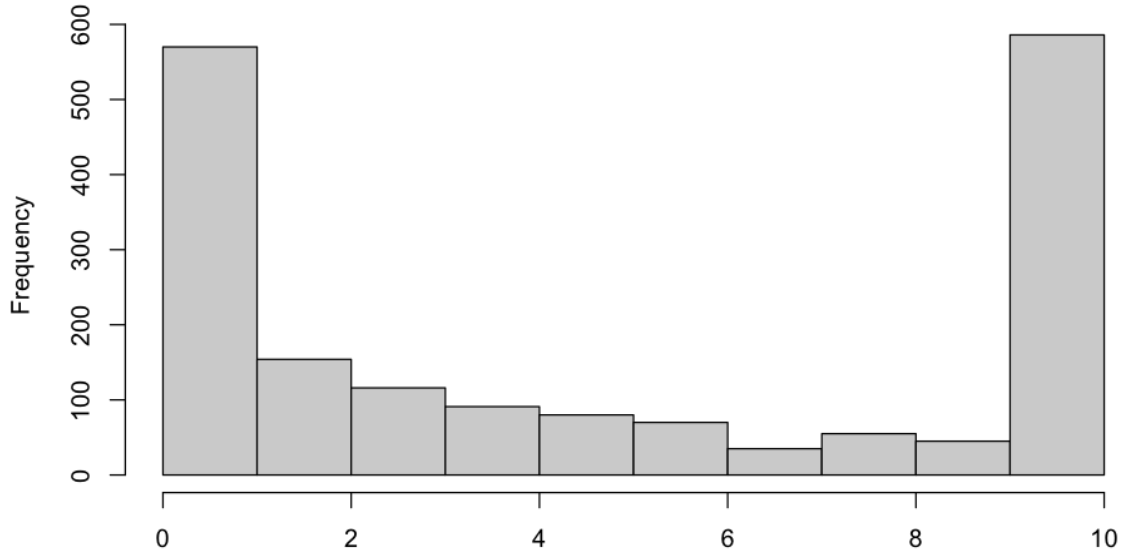
Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. *Journal of Statistical Software*, *48*(2), 1-36. http://www.jstatsoft.org/v48/i02/

Willard, A. K., & Norenzayan, A. (2013). Cognitive biases explain religious belief, paranormal belief, and belief in life's purpose. *Cognition, 129*(2), 379-391. https://doi.org/10.1016/j.cognition.2013.07.016

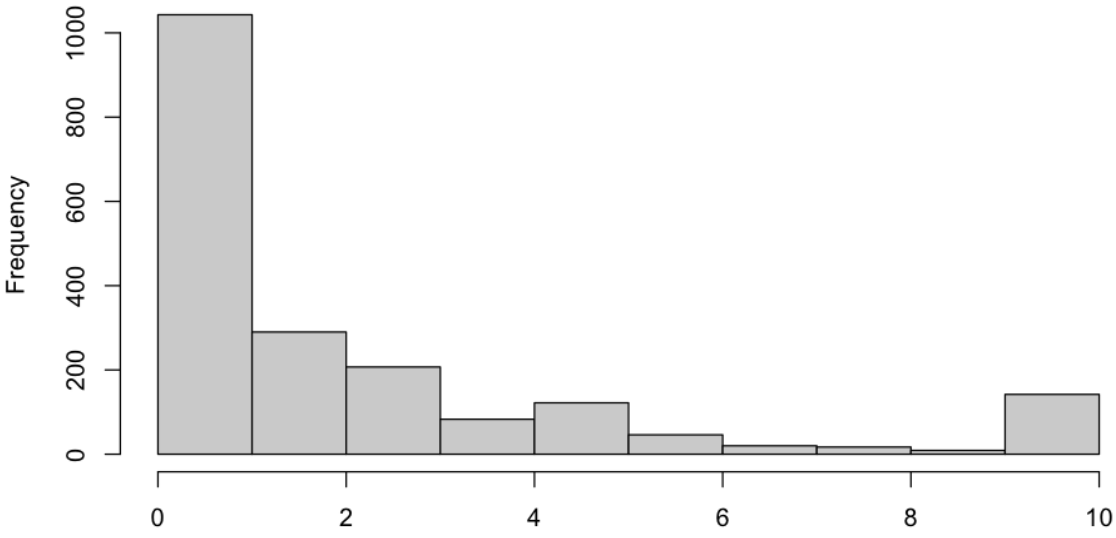
Appendix A8. Distributions of measured variables.

Religious attendance

US

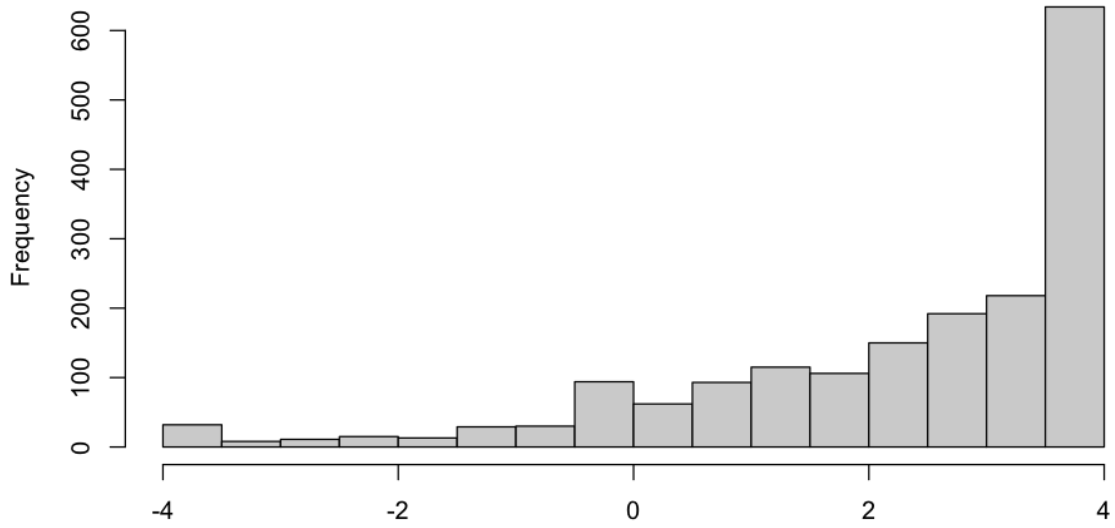


JP

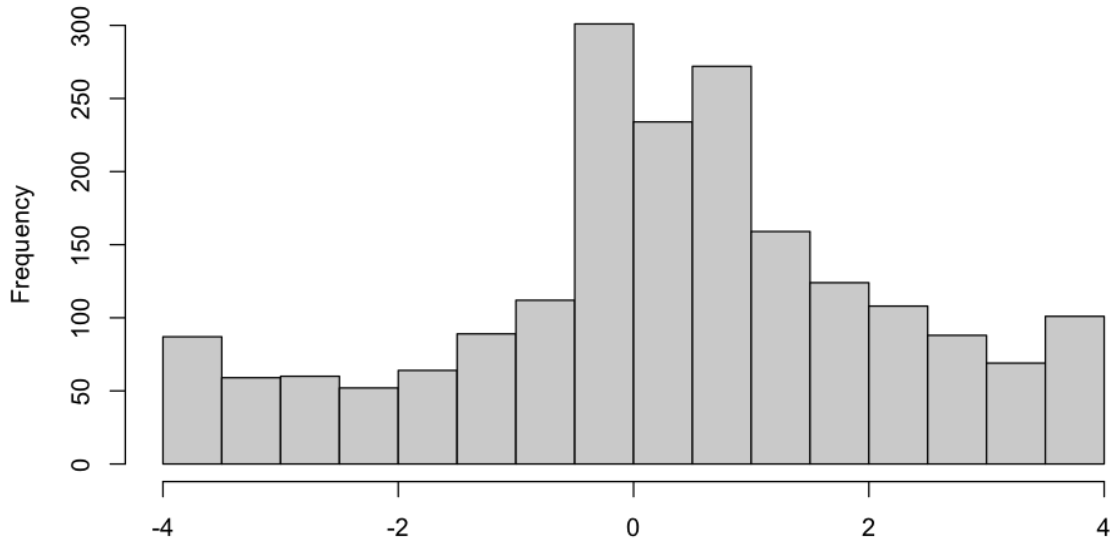

Frequency
0
200
400
600
800
1000
0
2
4
6
8
10

Religious beliefs

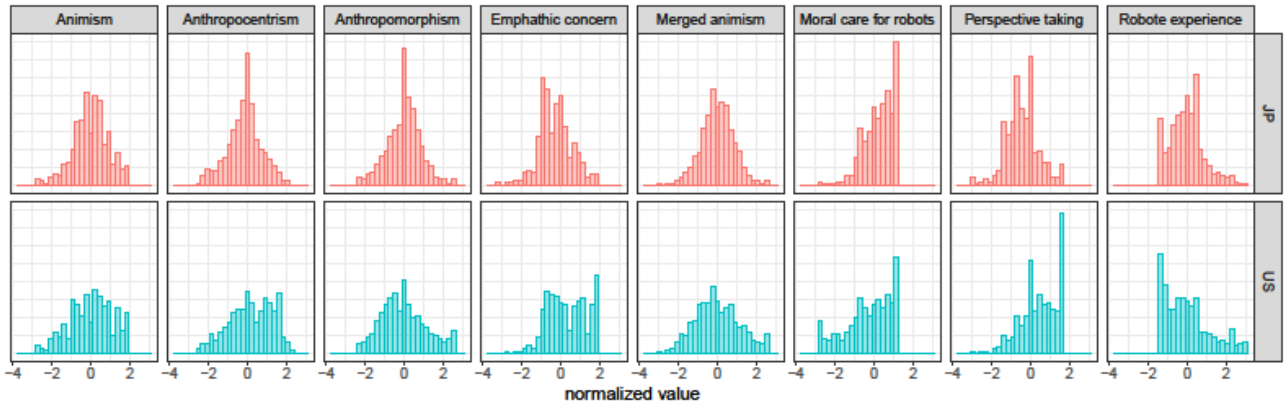
US



JP



Other variables



Appendix A9. Correlation of variables.

Correlation matrix (Spearman's ρ) of variables

US

	MR	RA	RB	AC	AN	EC	PT	TYP	EXP	Age	G1	G2	Edu
Moral care for robots (MR)		-0.13	-0.06	-0.35	-0.25	0.35	-0.02	-0.08	-0.35	0.04	0.28	0.03	-0.18
Religious attendance (RA)			0.43	0.34	0.14	0.10	0.19	0.06	0.31	0.05	-0.18	-0.03	0.29
Religious beliefs (RB)				0.28	0.24	0.24	0.30	0.04	0.14	0.06	0.00	-0.02	0.03
Anthropocentrism (AC)					0.22	-0.09	0.14	0.20	0.28	0.06	-0.25	-0.07	0.20
Animism (AN)						-0.09	0.29	0.09	0.46	-0.18	-0.06	0.00	0.17
Empathic concern (EC)							0.47	-0.05	-0.16	0.11	0.19	0.03	-0.09
Perspective taking (PT)								0.00	0.20	0.04	0.01	-0.02	0.07
Typical image of robots (TYP)									0.04	-0.08	0.00	-0.03	0.08
Exposure to robot related experience (EXP)										-0.06	-0.31	-0.02	0.30
Age											-0.15	-0.04	0.00
Gender1 (G1)												-0.06	-0.23
Gender2 (G2)													-0.01
Education (Edu)													

JP

	MR	RA	RB	AC	AN	EC	PT	TYP	EXP	Age	G1	G2	Edu
Moral care for robots (MR)		-0.01	0.16	-0.04	0.24	0.29	0.11	0.08	-0.05	-0.03	0.23	0.01	-0.12
Religious attendance (RA)			0.14	-0.03	0.13	0.10	0.11	-0.11	0.23	0.10	-0.02	0.00	0.08
Religious beliefs (RB)				0.07	0.55	0.28	0.28	0.07	0.13	-0.04	0.09	0.02	-0.07
Anthropocentrism (AC)					0.08	0.07	0.13	0.10	0.09	-0.04	-0.02	-0.04	-0.05
Animism (AN)						0.30	0.41	0.04	0.26	-0.10	0.12	0.02	0.01
Empathic concern (EC)							0.50	0.03	0.12	0.00	0.11	0.01	-0.03
Perspective taking (PT)								-0.01	0.26	-0.04	0.04	0.02	0.08
Typical image of robots (TYP)									-0.07	-0.09	0.08	0.01	-0.02
Exposure to robot related experience (EXP)										-0.08	-0.08	0.00	0.11
Age											-0.37	-0.02	0.03
Gender1 (G1)												-0.09	-0.14
Gender2 (G2)													0.01

Icpt: Intercept; Cul: Culture; RA: Religious attendance; RB: Religious beliefs; AC: Anthropocentrism; AN: Animism; EC: Empathic concern; PT: Perspective taking; TYP: Typical image of robots; Exp: Robot-related experience; G1: Gender1; G2: Gender2; Edu: Education; See footnote of Table 3 for quantification of gender and education.

Appendix A10. Variable selection of regression analysis.

In regression analysis, we identified the model with the lowest AIC (best model) using "dredge" function of MuMIn package (Bartoń, 2020) in R. This function runs all models with possible sets of variables (In this case 4096 models), then calculate AIC to rank models. Here, inclusion of variables and AICs of top 30 models are provided. Columns with "**+**" indicate that the variables were included in a model.

Inclusion of variables in top 30 models of model selection

lcpt	AC	Age	AN	Cul	Edu	EXP	G1	G2	EC	PT	RA	RB	TYP	AC:Cul	AN:Cul	Cul:RA	Cul:RB	df	logLik	AIC	delta	weight
+	+	+	+	+	+	+	+		+	+			+	+	+			14	-4879.5	9787.1	0.00	0.11
+	+	+	+	+	+	+	+	+	+	+			+	+	+			15	-4878.9	9787.7	0.68	0.08
+	+		+	+	+	+	+		+	+			+	+	+			13	-4881.1	9788.3	1.21	0.06
+	+	+	+	+	+	+	+		+	+	+		+	+	+			15	-4879.4	9788.8	1.68	0.05
+	+	+	+	+	+	+	+		+	+		+	+	+	+			15	-4879.4	9788.8	1.69	0.05
+	+	+	+	+	+	+	+		+	+	+		+	+	+	+		16	-4878.4	9788.8	1.71	0.05
+	+	+	+	+	+	+	+		+	+				+	+			13	-4881.4	9788.8	1.77	0.05
+	+		+	+	+	+	+	+	+	+			+	+	+			14	-4880.6	9789.2	2.09	0.04
+	+	+	+	+	+	+	+	+	+	+		+	+	+	+			16	-4878.7	9789.4	2.36	0.04
+	+	+	+	+	+	+	+	+	+	+	+		+	+	+			16	-4878.7	9789.4	2.37	0.04
+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+		17	-4877.7	9789.4	2.38	0.04
+	+	+	+	+	+	+	+	+	+	+				+	+			14	-4880.8	9789.5	2.45	0.03
+	+		+	+	+	+	+		+	+				+	+			12	-4882.8	9789.6	2.50	0.03
+	+		+	+	+	+	+		+	+		+	+	+	+			14	-4881.0	9790.1	2.98	0.03
+	+		+	+	+	+	+		+	+	+		+	+	+			14	-4881.0	9790.1	3.02	0.03
+	+	+	+	+	+	+	+		+	+	+			+	+	+		15	-4880.1	9790.2	3.13	0.02
+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+		17	-4878.2	9790.3	3.23	0.02
+	+		+	+	+	+	+		+	+	+		+	+	+	+		15	-4880.2	9790.3	3.25	0.02
+	+	+	+	+	+	+	+		+	+	+			+	+			14	-4881.2	9790.4	3.36	0.02
+	+		+	+	+	+	+	+	+	+				+	+			13	-4882.2	9790.5	3.38	0.02
+	+	+	+	+	+	+	+		+	+	+	+	+	+	+			16	-4879.3	9790.6	3.49	0.02

+	+	+	+	+	+	+	+		+	+		+		+	+				14	-4881.3	9790.6	3.50	0.02
+	+	+	+	+	+	+	+		+	+		+	+	+	+		+		16	-4879.4	9790.8	3.69	0.02
+	+	+	+	+	+	+	+	+	+	+	+			+	+	+			16	-4879.4	9790.9	3.81	0.02
+	+		+	+	+	+	+	+	+	+		+	+	+	+				15	-4880.5	9790.9	3.86	0.02
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+			18	-4877.5	9791.0	3.88	0.02
+	+		+	+	+	+	+	+	+	+	+		+	+	+				15	-4880.5	9791.0	3.92	0.02
+	+	+	+	+	+	+	+	+	+	+	+			+	+				15	-4880.6	9791.1	4.05	0.02
+	+		+	+	+	+	+	+	+	+	+		+	+	+	+			16	-4879.6	9791.2	4.14	0.01
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+				17	-4878.6	9791.2	4.16	0.01

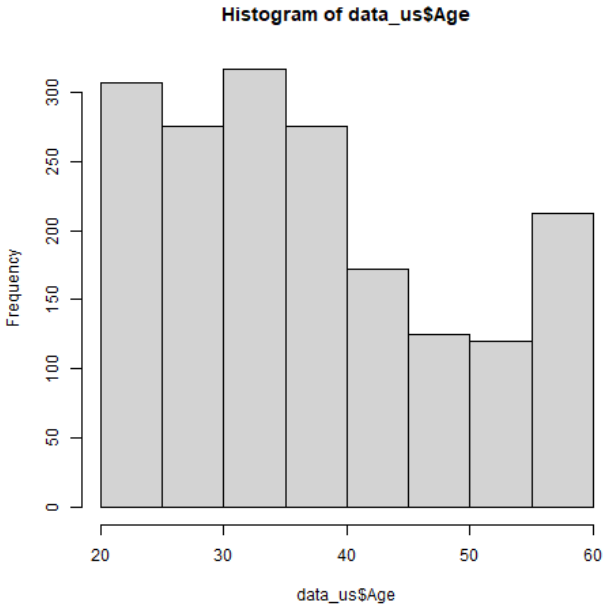
Icpt: Intercept; Cul: Culture; RA: Religious attendance; RB: Religious beliefs; AC: Anthropocentrism; AN: Animism; EC: Empathic concern; PT: Perspective taking; TYP: Typical image of robots; Exp: Robot-related experience; G1: Gender1; G2: Gender2; Edu: Education; See footnote of Table 3 for quantification of gender and education.

Supplementary Online Material

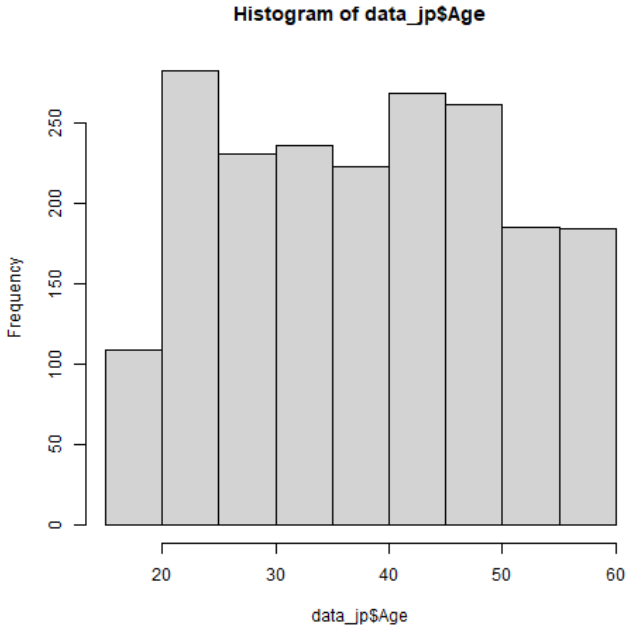
Additional information for recruitment

Age

US



JP



Residential areas

US

Region	N
Midwest	380
Northeast	334
South	676
West	412

JP

Region	N
Kanto	857
Kansai	345
Kyushu and Okinawa	159
Shikoku and Chugoku	136
Chubu and Hokuriku	271
Hokkaido and Tohoku	211

Education

US

Elementary School / Primary School	2
Junior High School / Middle School	60
High School	52 6
Vocational School / Technical College / Communication College (Associate Degree)	35 4
University / College / Undergraduate School (Bachelor Degree)	90 1
Graduate University / Professional School (Master's Degree, Doctoral Degree)	12 5
Others	11

JP

Elementary School / Primary School	12
Junior High School / Middle School	18 2
Vocational School / Technical College / Communication College (Associate Degree)	39 6
University / College / Undergraduate School (Bachelor Degree)	55 3
Graduate University / Professional School (Master's Degree, Doctoral Degree)	48 2
Others	17 7

Data collection process