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# Caring about you: the motivational component of mentalizing, not the mental state attribution component, predicts religious belief in Japan

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## ABSTRACT

Previous studies have demonstrated the relationship between mentalizing and religious belief. However, mentalizing can be broken down into several components, and there are certain measures that correspond to such components. This study aimed to examine the relationship between mentalizing and religious belief using two representative measures, the Empathy Quotient (EQ) and the Reading the Mind in the Eyes test (RMET). The results of two studies with Japanese samples showed that the EQ predicted increasing religious belief (study 1), as expected. However, the RMET was not a significant predictor of religious belief (studies 1 and 2). These findings suggest that mentalizing's mental state attribution component (i.e., matching appropriate mental state words to facial expressions in the eye region) is not directly connected to religious belief. However, the motivational component (i.e., caring about what other people think and feel) is essential for believing in supernatural agents. This study's limitations and directions for future studies are also discussed.

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In the last two decades, religion has been studied intensively from a cognitive and evolutionary science perspective (e.g., Barrett, 2000; Boyer, 2003; Lang et al., 2019; Norenzayan & Gervais, 2013). For example, the cultural evolutionary theory of the origins of prosocial religions (Norenzayan et al., 2016) assumes that religion played an essential role in promoting large-scale cooperation in human society—which remains one of the biggest puzzles in social and evolutionary science. In this study, we focused on a hypothesis on which this theory is founded: the mentalizing hypothesis.

In the cultural evolutionary theory of religion (Norenzayan et al., 2016), gods are conceptualized as powerful, morally concerned agents that monitor human behavior and deliver rewards or punishment when people meet or violate a shared behavioral standard. This theory also hypothesizes that people believe in the existence of such unobservable, supernatural agents because of their ordinal social cognition, especially mentalizing. Mentalizing, is also known as the theory of mind, is the capacity to attribute mental states to not only living things but also non-living things (e.g., Heider & Simmel, 1944; Premack & Woodruff, 1978). Therefore, it can be assumed that this capacity enables people to impute human-like mental states to supernatural agents, and to have imaginary interactions with those agents (e.g., The gods are angry with me and have punished me for being rude in a shrine). Thus, this ability can cause people to believe in supernatural agents.

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In support of this hypothesis, previous studies have demonstrated that there is a link between mentalizing and religious belief (for a review, see Gervais, 2013). For example, a cognitive neuroscientific study revealed that regions of the brain which are associated with mentalizing were activated during praying (Schjoedt et al., 2009) and while reporting the degree to which they agree or disagree with statements about god (Kapogiannis et al., 2009). Questionnaire-based studies—which assessed mentalizing using various scales (e.g., the Empathy Quotient (Baron-Cohen & Wheelwright, 2004), the Autism-Spectrum Quotient (Baron-Cohen, Wheelwright, Skinner, et al., 2001))—have also demonstrated the individual differences in mentalizing were associated to increasing religious beliefs in North Americans (e.g., Norenzayan et al., 2012; Routledge et al., 2017; Willard & Norenzayan, 2013), Europeans (e.g., Lindeman et al., 2015; Willard et al., 2019), and East Asians (Ishii, 2017). Thus, the mentalizing hypothesis is preliminary supported.

However, though mentalizing can be broken down into several psychological components (Apperly, 2012; Vonk & Pitzen, 2017), it is not clear which components is most relevant to religious belief.

The Empathy Quotient (EQ; Baron-Cohen & Wheelwright, 2004) is the most widely used measure to assess the individual differences in mentalizing, when examining the relationship between mentalizing and religious belief. The EQ assesses the extent to which people tend to pay attention or care about what other people think and feel; thus, it involves the motivational component of mentalizing (Apperly, 2012; Baron-Cohen & Wheelwright, 2004). Previous studies have mostly demonstrated the EQ was positively correlated with (Jack et al., 2016, study 6; Routledge et al., 2017; Willard & Norenzayan, 2013; Willard et al., 2019) or predicted religious belief (Ishii, 2017; Lindeman et al., 2015; Norenzayan et al., 2012). However, a few studies found no positive relationship between the EQ and religious belief (Maij et al., 2017; Vonk & Pitzen, 2017). Thus, though the effect size should not be considered as strong, there is a definite relationship between the EQ and religious belief.

The Reading the Mind in the Eyes test (RMET; Baron-Cohen, Wheelwright, Hill, et al., 2001) is also widely used to assess mentalizing. However, unlike the EQ, the RMET assesses how accurately people match mental state words (e.g., playful, upset, anticipatory) to facial expressions in the eye region and involves a mental state attribution component (Baron-Cohen et al., 1997). Furthermore, the RMET has been shown to be weakly correlated with the EQ (e.g., .11–.35 in Baron-Cohen et al., 2015; .25 in Norenzayan et al., 2012), and previous studies that have examined the relationship between the RMET and religious belief produced somewhat mixed results. For example, Norenzayan et al. (2012, study 4) showed that the RMET, in addition to the EQ, positively predicted religious belief. Meanwhile, more recent studies have reported the correlation between the RMET score and religious belief to be almost zero (Jack et al., 2016, study 5; Lindeman et al., 2015) or slightly negative (Vonk & Pitzen, 2017), however, these studies employed different measures of religious belief from that of Norenzayan et al. (2012).<sup>1</sup>

Overall, the positive association between the EQ and religious belief has been shown, while the association between the RMET and religious belief was not established (i.e., results were not consistent). These results suggest that the motivational component of mentalizing is linked more strongly to religious belief than the mental state attribution component. This may be possible because people who are motivated to infer others' mental states would also tend to pay attention to and think about supernatural agents' mental states. Thus, these people would develop an elaborate representation of those agents, and also may have imaginary interactions with them. Meanwhile, the ability to judge others' mental states accurately from the available information can contribute less to the cognitive processing of supernatural agents (i.e., pay attention, think, and imagine). Therefore, although both the components could contribute to develop belief in supernatural agents (i.e., both were designed to capture mentalizing), it is possible that those who are motivated to infer others' mental states have firmer beliefs, regardless of the accuracy of the inference.

The aim of this study is to examine whether the two measures of mentalizing (EQ and RMET) predict religious belief. If the entire ability to mentalize is linked to religious belief, then both

measures would positively predict religious belief. Meanwhile, if the link between the motivational component and religious belief is stronger than that of the attribution component and religious belief, the EQ, compared to the RMET, would be a better predictor of religious belief. This study was conducted with a Japanese sample. Previous studies in the field of the cognitive science of religion were mostly conducted in Western countries; but Japan's religious culture differs from that of Western countries. However, broad religious beliefs are pervasive (Hayashi, 2006; Kavanagh & Jong, 2020), and it is possible to test the mentalizing hypothesis (Ishii, 2017). Moreover, we believe it would be beneficial for the field of cognitive science of religion to test the hypothesis with an East Asian or non-WEIRD (western, educated, industrialized, rich, and democratic) sample. We assessed the religious belief using items that were used in a previous Japanese study (Ishii, 2017). In addition, we also utilized the "belief in God" measure (Norenzayan et al., 2012), so that the results can be directly compared with those of Norenzayan et al. (2012), which showed a positive relationship between the RMET and religious belief.

## Study 1

### Method

#### Participants

We conducted a power analysis to determine the sample size using R (R Core Team, 2020) and the *pwr* package (Champely, 2020). As we used the same dependent measure as Norenzayan et al. (2012), and a small effect size (odds ratio = 1.39) of the RMET on religious belief was reported therein, we likewise employed a small effect size ( $r = 0.10$ ). The results of the analysis ( $\alpha = 0.05$ , power = 0.80) indicated that 782 participants were needed. We planned to recruit 800 Japanese participants through an online survey tool (Yahoo!Crowdsourcing), and successfully recruited 754 (525 male, 222 female, 7 unknown,  $M_{\text{age}} = 44.4$ ,  $SD_{\text{age}} = 8.65$ ).

#### Materials and procedure

The participants answered all of the questionnaires on the web. After completing the informed consent form, the participants answered an Asian version of the Reading the Mind in the Eyes test (Adams et al., 2010). This version of the RMET is comprised of 36 photographs of the eye region of Asians' faces, with four emotion words; one describes the photograph correctly, while three do not. Each participant saw one photograph with four words, together with a glossary of words, in a trial. We used three randomly selected photographs (#1 playful, #18 decisive, #24 pensive) for practice, and used the remaining thirty-three to assess the individual differences in mentalizing. Hence, the score of the RMET was calculated by summing the correct responses to the 33 photographs ( $\alpha = .71$ ,  $M = 23.77$ ,  $SD = 4.13$ ).

Next, the participants rated their agreement with 13 items that measure individual differences in religious belief (Ishii, 2017). This measure consisted of three scales. The first was the "apotheosis of natural products" subscale, which comprises three items from the Animism Scale for Adults (Ikeuchi, 2010); sample items include "I think gods dwell in big trees and rocks that exist in nature," and "I think there are ocean gods in the oceans, and mountain gods in the mountains." The second scale was the "belief in spirituality" subscale, which comprises six items from the Attitudes Toward Paranormal Phenomena Scale short edition (Sakata et al., 2012). Sample items include "I believe in gods or spirits," and "I think punishment will follow rude behavior toward deities." The third scale was the belief in God measure (Norenzayan et al., 2012), which contains four items. Sample items include "When I am in trouble, I find myself wanting to ask God for help," and "I just do not understand religion (reverse item)." Although the original belief in God measure has five items, one item ("I believe in God") was excluded because of its similarity with an item in the belief in spirituality scale ("I believe in gods or spirits"). This religious belief measure employed a five-point Likert scale from 1 ("strongly disagree") to 5

(“strongly agree”). The average rating for each item was calculated for each participant’s religious belief score ( $\alpha = .92$ ,  $M = 3.00$ ,  $SD = 0.87$ ). We also calculated the religious belief score using only the five items on the belief in God measure ( $\alpha = .73$ ,  $M = 3.07$ ,  $SD = 0.81$ ). We found the scores to be slightly skewed (13-item score: skewness =  $-0.17$ , Kolmogorov–Smirnov test:  $D = 0.06$ ,  $p = .009$ ; 5-item score: skewness =  $-0.04$ ,  $D = 0.08$ ,  $p < .001$ ).

The participants also answered the short form of the Empathy Quotient Japanese version (EQJ-short). The original EQ-short (Wakabayashi et al., 2006) consists of 22 items and employs a four-point Likert scale ranging from 1 (“definitely disagree”) to 4 (“definitely agree”). We prepared the EQJ-short by copying the 22 items that correspond to the original EQ-short from the full EQ Japanese version (Wakabayashi, Baron-Cohen, & Wheelwright, 2006). Each of EQJ-short items was scored two points if the participants strongly displayed an empathizing response (definitely agree or definitely disagree), and one point if they slightly displayed an empathizing response (agree or disagree). The sum of these points for each item was calculated as each participant’s EQ score ( $\alpha = .90$ ,  $M = 14.44$ ,  $SD = 8.10$ ).

At the end of the questionnaire, the participants answered demographic questions (i.e., age and gender). However, we did not ask for their religious affiliations because it is well known that most Japanese people are not religious (Hayashi, 2006; Ishii, 2017). All the items from the questionnaire are available at <https://osf.io/vd3wq/>.

### Data analysis

Multiple regression model was employed to examine the relationship between the two mentalizing measures and religious belief. Age, gender, and the EQ and RMET scores were entered into the model simultaneously as the predictor variables for the religious belief scores. This analytic strategy was employed because: first, both the EQ and RMET were developed to measure the individual differences in mentalizing and the variances of their scores, are to some degree, derived from a common aspect of mentalizing. Thus, if we find the correlation between the EQ and religious belief, it is possible that this correlation is caused through the relationship between the RMET and religious belief, and vice versa. Therefore, both measures’ scores should be entered simultaneously to compare their unique effect on religious belief. Second, previous studies (e.g., Bernstein et al., 2011; Duval et al., 2011; Ishii, 2017; Jack et al., 2016; Norenzayan et al., 2012) have suggested that demographic variables were associated with mentalizing and religious belief; that is, women and younger adults were more likely to mentalize, and women and older people were more religious. In other words, demographic variables could be the confounding variables when examining the relationship between mentalizing and religious belief. Thus, age and gender should be entered in the model and statistically controlled.

All the data and analysis codes are available at <https://osf.io/vd3wq/>.

### Results and Discussion

We first calculated the bivariable correlation coefficients among the target variables. While the EQ score correlated positively with the two religious belief scores (13-item score:  $r = .27$ ,  $p < .001$ ; 5-item score:  $r = .23$ ,  $p < .001$ ), the RMET score did not (13-item score:  $r = .03$ ,  $p = .386$ ; 5-item score:  $r = -.01$ ,  $p = .842$ ). The EQ and RMET scores were weakly correlated with one another ( $r = .13$ ,  $p < .001$ ).

We then conducted a multiple regression analysis as described. In all the analyses, gender was coded (male = 0, female = 1), and all other continuous variables were standardized. The analysis revealed that the EQ score ( $\beta = .26$ ,  $p < .001$ ), age ( $\beta = .08$ ,  $p = .036$ ), and gender ( $\beta = .34$ ,  $p < .001$ ) were significant predictors of the 13-item religious belief score, while the RMET scores were not ( $\beta = -.03$ ,  $p = .351$ ). Almost the same results were shown with the religious belief score that was calculated using the five items of the belief in God scale. The EQ score ( $\beta = .22$ ,  $p < .001$ ), age ( $\beta = .09$ ,  $p = .014$ ), and gender ( $\beta = .21$ ,  $p = .011$ ) significantly predicted the 5-item religious belief score, but

**Table 1.** Results of the Linear Regression Analysis (Classical and Bayesian inference) Predicting Religious Belief based on Age, Gender, the RMET, and the EQ in Study 1.

	Classical inference						Bayesian inference	
	$\beta$	SE	Lower CI	Upper CI	<i>t</i>	<i>p</i>	$\beta$	95% HPDI
13-item measure								
Age	.08	0.04	0.01	0.15	2.11	.036	.08	[.003, .149]
Gender	.34	0.08	0.18	0.50	4.22	< .001	.34	[.177, .489]
RMET	-.03	0.04	-0.11	0.04	-0.93	.351	-.03	[-.107, .037]
EQ	.26	0.04	0.19	0.33	7.22	< .001	.26	[.186, .324]
5-item measure								
Age	.09	0.04	0.02	0.17	2.47	.014	.09	[.017, .164]
Gender	.21	0.08	0.05	0.37	2.56	.011	.21	[.048, .368]
RMET	-.07	0.04	-0.14	0.01	-1.75	.081	-.07	[-.135, .011]
EQ	.22	0.04	0.15	0.29	6.11	< .001	.22	[.154, .293]

Note. SE: standard error; CI: confidence interval; RMET: Reading the Mind in the Eyes Test; EQ: Empathy Quotient; HPDI: highest posterior density interval.

the RMET score did not reach the significance level ( $\beta = -.07$ ,  $p = .081$ ). These results are summarized in Table 1.

The analysis' results indicate that female participants and those who are older have firmer religious beliefs, which is consistent with previous studies (e.g., Norenzayan et al., 2012). Furthermore, it also suggests that the ability to accurately identify the others' mental state was not associated with religious belief, but the tendency to pay attention to what others feel and think.

However, there were two concerns about these results. First, as the religious belief scores were skewed, as mentioned in the Methods section, the normality of the residuals in the linear regression model may be violated. That is, those results may be biased. Although the residuals were approximately normally distributed with visual inspections of the Q-Q plots, we conducted a Bayesian regression model, because in this method the violation of normality does not affect the statistical estimation. The R 3.6.3 and the *ulam* function in the *rethinking* package (McElreath, 2020) were utilized to conduct the analysis. We assumed that the priors for all the parameter in the linear model (i.e., intercept and slopes) followed the standard normal distribution ( $\mu = 0$ ,  $\sigma = 1$ ) and also that the prior for the dependent variable's SD followed the exponential distribution with a rate of 1. We obtained the Markov Chain Monte Carlo (MCMC) samples from single chain of 10,000 iterations with the initial 500 samples for warm-up. This analysis successfully converged with all R-hat below 1.001 and the large effective sample sizes (5347-11616). Finally, to quantify uncertainty in our Bayesian models, we used the 95% highest posterior density interval (HPDI).<sup>2</sup> Complete information (e.g., trace plots, post distributions for parameters, and scatter plots) is available at <https://osf.io/vd3wq/>.

The mean and SDs of the posterior distributions for each parameter and their 95%HPDI are shown in Table 1. The result indicated that gender ( $\beta = .34$ , 95%HPDI = [.18, .49]), and the EQ score ( $\beta = .26$ , [.19, .32]) were good predictors of the 13-item religious belief score because its range of 95%HPDI were away from 0. Although, age ( $\beta = .08$ , [.003, .15]) also predicted religious belief score positively, it was weak. Finally, the association between the RMET score and religious belief was the weakest ( $\beta = -.03$ , [-.11, .04]) because the range of 95%HPDI were across 0. Similar results were shown by the analysis with 5-item religious belief score; while age ( $\beta = .09$ , [.02, .16]), gender ( $\beta = .21$ , [.05, .37]), and the EQ score ( $\beta = .22$ , [.15, .30]) predicted the religious belief score, the RMET score ( $\beta = -.07$ , [-.14, .01]) did not. These results were almost consistent with that of the traditional non-Bayesian analysis reported above.

The second concern is that the RMET used in study 1 only included 33 out of the 36 photographs. While this may appear trivial, we decided to analyze additional data to confirm the relationship between the RMET and religious belief in study 2.

## Study 2

### Method

Four hundred and sixty-nine Japanese adults (317 male, 143 female, 9 unknown,  $M_{\text{age}} = 46.22$ ,  $SD_{\text{age}} = 9.00$ ) participated in study 2. The procedure and materials were the same as in study 1, except for two things. First, the sample size was not determined beforehand because we utilized a sample that participated in a separate study. We did not recruit more participants as we could still detect a smaller effect size ( $r = .129$ ) with this sample size. Second, the number of questionnaire items was reduced in order to lighten the load of the participants—all of whom participated in two studies. We omitted the EQJ-short and used only nine items to assess religious belief—including the “apotheosis of natural products” scale, the belief in God measure, and two items from the “belief in spirituality” scale. However, the full version of the Asian RMET (36 photographs) was used in study 2.

### Results and Discussion

We calculated the religious belief score using the nine aforementioned items ( $\alpha = .85$ ,  $M = 3.15$ ,  $SD = 0.80$ , skewness =  $-0.51$ , KStest:  $D = 0.10$ ,  $p < .001$ ), as well as five items from the belief in God scale ( $\alpha = .70$ ,  $M = 3.13$ ,  $SD = 0.80$ , skewness =  $-0.15$ , KStest:  $D = 0.08$ ,  $p = .006$ ). The RMET score ( $\alpha = .77$ ,  $M = 25.75$ ,  $SD = 4.83$ ) was not correlated with religious belief scores (9-item:  $r = .02$ ,  $p = .661$ , 5-item;  $r = .02$ ,  $p = .677$ ). Due to the slight skewness of both belief scores, we planned to conduct the same Bayesian regression analysis as in study 1 in addition to a normal or classical regression analysis.

In a classical regression model with the RMET score and two demographic variables predicting the 9-item religious belief score, the RMET score did not predict the religious belief score ( $\beta = -.02$ ,  $p = .698$ ). However, age ( $\beta = .13$ ,  $p = .008$ ) and gender ( $\beta = .27$ ,  $p = .007$ ) were significant predictors of religious belief, suggesting that females and elderly people have stronger religious beliefs. The same results were obtained when the religious belief score was calculated using the five items of the belief in God scale (the RMET score:  $\beta = -.01$ ,  $p = .815$ , age:  $\beta = .16$ ,  $p = .001$ , gender:  $\beta = .22$ ,  $p = .030$ ). Similar results were obtained from the Bayesian analysis, which successfully converged (all R-hat  $< 1.001$ , the effective sample sizes = 7910-12868). Age ( $\beta = .13$ , [.03, .22]) and gender ( $\beta = .27$ , [.08, .47]) predicted the 9-item religious belief score, but the RMET score did not ( $\beta = -.02$ , [-.11, .08]). The 5-item belief score was also predicted by age ( $\beta = .16$ , [.06, .25]) and gender ( $\beta = .22$ , [.02, .42]), but not by the RMET score ( $\beta = -.01$ , [-.11, .08]). These results are summarized in Table 2.

Overall, we found no robust relationship between the RMET and religious belief in Study 2. It should be noted that the EQ was not measured in Study 2, thus, we cannot compare the  $\beta$  value of the RMET in Study 2 with that of Study 1 directly. However, if the RMET is truly related to religious belief, this relationship would have been detected in our studies with large sample sizes, even

**Table 2.** Results of the Linear Regression Analysis (Classical and Bayesian inference) Predicting Religious Belief based on Age, Gender, and the RMET in Study 2.

	Classical inference						Bayesian inference	
	$\beta$	SE	Lower CI	Upper CI	$t$	$p$	$\beta$	95% HPDI
9-item measure								
Age	.13	0.05	0.03	0.22	2.65	.008	.13	[.032, .220]
Gender	.27	0.10	0.07	0.47	2.69	.007	.27	[.079, .474]
RMET	-.02	0.05	-0.11	0.08	-0.39	.698	-.02	[-.109, .077]
5-item measure								
Age	.16	0.05	0.07	0.26	3.39	.011	.16	[.063, .252]
Gender	.22	0.10	0.02	0.42	2.18	.030	.22	[.019, .417]
RMET	-.01	0.05	-0.11	0.08	-0.23	.815	-.01	[-.106, .081]

Note. SE: standard error; CI: confidence interval; RMET: Reading the Mind in the Eyes; HPDI: highest posterior density interval.

without the EQ. Thus, although Study 2 did not yield strong evidence in support of our hypothesis, it demonstrated that there is no correlation between the mental state attribution component of mentalizing and religious belief.

## General discussion

This study aimed to examine whether EQ and RMET predict religious belief in Japan. The results demonstrated that EQ significantly and positively predicted religious belief scores (Study 1), while RMET did not (Study 1, 2). In the cognitive and evolutionary science of religion, it has been argued that religious belief or belief in supernatural agents is rooted in humans' unique cognitive abilities, especially the cognitive abilities that are universally possessed by people (e.g., Barrett, 2000; Norenzayan et al., 2016). Mentalizing has been considered as a leading candidate for such an ability (i.e., mentalizing hypothesis), and scholars have explored the relationship between mentalizing and religious belief. However, the mentalizing ability comprises several components—including emotional and cognitive empathy, the ability to read signs or indicators of mental states, and the ability to reason out others' mental states (e.g., Apperly, 2012; Vonk & Pitzén, 2017). Thus, the exact components of mentalizing that are closely related to religious belief should be examined.

The current study contributed to the identification of a critical component of mentalizing with regard to religious belief. We reviewed previous studies and hypothesized that the motivation or tendency to pay attention to and infer others' mental states could facilitate the cognitive processing of supernatural agents (e.g., thinking about them for a long time, or imagining interactions with them) regardless of the accuracy of such inference. Furthermore, we demonstrated that the EQ, but not the RMET, predicted religious belief with enough powered samples. Thus, these results not only supported the mentalizing hypothesis (Norenzayan et al., 2016), but also provided a preliminary support for our component hypothesis. Similarly, Jack et al. (2016), in their study, reported that empathic concern (i.e., "other-oriented feelings of sympathy and concern for unfortunate others" (Davis, 1983, p. 114)) was better predictor of religious belief than the EQ. This finding is not contradictory to our results as empathic concern can be considered a more direct measure of the motivational component of mentalizing. This point will be discussed later.

Another contribution of this study to the cognitive and evolutionary science of religion is testing the mentalizing hypothesis with a Japanese sample. Most of the previous studies tested the hypothesis with a sample from Western countries, where monotheistic culture is pervasive (e.g., US: Jack et al., 2016; Norenzayan et al., 2012; Canada: Willard & Norenzayan, 2013; Polish: Łowicki & Zajenkowski, 2017; Finnish: Lindeman et al., 2015; Czech & Slovakia: Willard & Cingl, 2017). As the concept of gods (i.e., morally concerned agents that monitor human behavior) is observed worldwide (e.g., Whitehouse et al., 2019), it is necessary to demonstrate the generalizability of the mentalizing hypothesis by testing it with a sample from non-Western or non-Western, educated, industrialized, rich, and democratic (WEIRD) countries with a non-monotheistic culture. Japan fits into these criteria because of its long tradition of polytheism (e.g., Buddhism and Shinto). As the mentalizing hypothesis has hardly been tested with an East Asian sample, the current study, along with that of Ishii (2017), are valuable as they are some of the early studies that examine the hypothesis in East Asia.

However, there were some limitations to this study. First, our results were correlational. Although we hypothesized the motivational component of mentalizing affects developing religious belief via some cognitive functioning, this study did not test the role of the cognitive functions and the causal link between mentalizing and religious belief. It is necessary for testing our hypothesis to establish the link between the motivational component and cognitive function. Therefore, future studies should examine whether increasing the motivation or accuracy regarding the inference of others' mental states facilitates the cognitive processing of supernatural agents. Additionally, we measured only the present state of religious belief, but not the developing process of the belief (i.e., process where people begin to believe in supernatural agents), which our hypothesis assumed. A longitudinal study which can explore the developmental changes in religious belief would be beneficial.



Second, our measures of mentalizing were limited. Although we employed the EQ and RMET, because of the continuity with previous studies, there are some alternative measures of the motivational and attribution components. For example, the empathic concern subscale of the Interpersonal Reactivity Index (Davis, 1983) can be used to capture the motivational component. Additionally, Vonk and Pitzen (2017) used some measures that capture the accuracy in mentalizing (the hinting task: Corcoran et al., 1995; the imposing memory test: Kinderman et al., 1998), besides the RMET. It may be beneficial to utilize these measures to test our hypothesis. Moreover, the current study heavily relied on self-report measures. We believe that future studies that focus on behavioral (e.g., implicit association test: Jong et al., 2012) and physiological (e.g., Kapogiannis et al., 2009) responses will yield promising results.

In conclusion, by testing the mentalizing hypothesis and providing preliminary evidence of the link between the motivational component and religious belief with a Japanese sample, this study contributes to the scientific research of religion—specifically, the exploration of the origin of religious belief (e.g., by identifying the critical component of mentalizing with regard to religious belief). Future studies should examine in detail the mechanisms and processes by which mentalizing promotes the acquisition of religious beliefs.

## Notes

1. We should note that these studies employed different measures of religious belief. However, the core construct that was measured in Norenzayan et al. (2012), Jack et al. (2016), and Lindeman et al. (2015) was common—belief in supernatural agents. For example, Norenzayan et al. (2012) used belief in a personal god (e.g., “I believe in god,” “When I am in trouble, I find myself wanting to ask god for help”). Similarly, Jack et al. (2016) used the single item “Do you believe in the existence of either god or a universal spirit?” and Lindeman et al. (2015) employed the Supernatural Belief Scale (Jong et al., 2013) as their measure of religious belief. Meanwhile, Vonk and Pitzen (2017) employed various scales to measure religiosity (e.g., Religious Fundamentalism scale, Religious Orientation Scale, Emotionally and Socially Based Religiosity Scales, Loving and Controlling God Scales). Although these scales mostly focus on the relationship between the respondents and religion (e.g., how important religion/God is for respondents), they partially capture the respondents’ belief in supernatural agents, that is, respondents who do not have religious beliefs would score low. Therefore, we considered that the results of all these studies were comparable.
2. The HPDI is “the narrowest interval containing the specified probability mass (McElreath, 2020, p. 56).” Although the 95%HPDI was used in this article, McElreath (2020) recommends using the 89%HPDI to avoid the risk of readers mistaking the 95% HPDI for a confidence interval (or the conventional significant test).

## Disclosure statement

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## Data accessibility statement

The datasets generated during and/or analyzed during the current study are available at the Open Science Framework repository (<https://osf.io/vd3wq/>).

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