

## Does Poor Understanding of Physical World Predict Religious and Paranormal Beliefs?

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*Summary:* Although supernatural beliefs often paint a peculiar picture about the physical world, the possibility that the beliefs might be based on inadequate understanding of the non-social world has not received research attention. In this study ( $N = 258$ ), we therefore examined how physical-world skills and knowledge predict religious and paranormal beliefs. The results showed that supernatural beliefs correlated with all variables that were included, namely, with low systemizing, poor intuitive physics skills, poor mechanical ability, poor mental rotation, low school grades in mathematics and physics, poor common knowledge about physical and biological phenomena, intuitive and analytical thinking styles, and in particular, with assigning mentality to non-mental phenomena. Regression analyses indicated that the strongest predictors of the beliefs were overall physical capability (a factor representing most physical skills, interests, and knowledge) and intuitive thinking style. Copyright © 2016 John Wiley & Sons, Ltd.

Many people like to believe that breaking a mirror brings one 7 years of bad luck. Fortunately, we can stop the bad luck by burying the broken pieces under the light of the moon and by listening to the heartening signs of the universe because the universe understands that we are human. We can also carry a diamond with us because it is a stone of amplification, including thoughts and strengths.<sup>1</sup> That is, if we believe in supernatural phenomena.

Although the aforementioned examples illustrate a curious view of material objects and the cosmos, the possibility that supernatural (paranormal or religious) beliefs might be based on inadequate understanding of the physical world has received only little attention. While some researchers have brought up that supernatural beliefs may build on inadequate knowledge of the non-human world (Badcock, 2009; Crespi & Badcock, 2008), empirical evidence is scarce. Rather, attempts to explain the beliefs have so far focused mostly on the domain-general processes of analytical and intuitive thinking and on such domain-specific reasoning as mentalizing and related biases. Evidence for supernatural believers' high reliance on intuition, and especially for low analytical thinking, is robust (Gervais & Norenzayan, 2012; Jack, Friedman, Boyatzis, & Taylor, 2016; Pennycook, 2014; Shenhav, Rand, & Greene, 2012). Findings about mentalizing are fewer, but they indirectly indicate that believers' physical understanding might be impaired, as discussed next.

Earlier studies have shown that people assign intentionality to natural phenomena (Kelemen, Rottman, & Seston, 2013) and human characteristics to God and other supernatural agents, sometimes also to particular inanimate

targets such as volcanoes or fairies (Norenzayan, Hansen, & Cady, 2008; Purzycki et al., 2012; Shtulman, 2008). Moreover, paranormal and religious believers have been shown to take such statements as 'Earth wants water' or 'Force knows its direction' as more literally true than skeptics, who interpret the statements more metaphorically (Barber, 2014; Lobato, Mendoza, Sims, & Chin, 2014; Svedholm, Lindeman, & Lipsanen, 2010). These studies have addressed only specific mental attributes (e.g., anger, beliefs, and intentions) and only a few, occasional targets (e.g., God and Earth). The results nevertheless imply the possibility that supernatural believers have doubts as to what are the distinctions mental and physical overall because random events, volcanoes, or earth cannot have mental attributes like purpose or beliefs. For these reasons, and because superordinate concepts (e.g., 'mental') can be more fundamental, and learned even earlier than their subordinate, more concrete concepts (Medin, Lynch, & Solomon, 2000), we wanted here to ask the participants more directly and more comprehensively if they think that basic physical processes and inanimate objects are mental phenomena, akin to thoughts or human beings.

Another potential indication of believers' poor understanding of the physical world is a tendency for low systemizing. In the Empathizing–Systemizing theory, people who are poor at physical cognition are called low systemizers because they have poor abilities and low interests in such things as map-reading, mathematics, intuitive physics, or technical and motor systems (Baron-Cohen, 2002; Baron-Cohen, Knickmeyer, & Belmonte, 2005). We know only one study where intuitive physical skills and supernatural beliefs have been addressed: Jack, et al., (2016) found that belief in God was negatively correlated with scores obtained from the Intuitive Physics Test (Baron-Cohen, Wheelwright, Spong, Scahill, & Lawson, 2001). In addition, two studies have examined the relationship between systemizing and supernatural beliefs but both assessed systemizing only with a self-report questionnaire. In a set of studies, Norenzayan, Gervais, and Trzesniewski (2012) examined if systemizing mediates the relationship between autistic traits and a belief in God. The

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<sup>1</sup> Examples are from <http://psychiclibrary.com/beyondBooks/broken-mirror-superstition/>, <http://www.gaiamtv.com/article/4-steps-knowing-what-universe-telling-you>, and <http://meanings.crystalsandjewelry.com/crystal-meanings/diamond>

mediating effect was either marginally or not significant. However, another study suggests that low systemizing may be common among supernatural believers. Lindeman and Lipsanen (2016) analyzed subgroups of religious believers and non-believers in terms of five personality and cognitive variables. The most consistent difference between believers and skeptics was that all believer subgroups were average or lower in systemizing, whereas all skeptic subgroups were average or higher in systemizing.

Finally, one hint in the same direction is scientific education. Supernatural believers are more often students of humanities and social science than science students (a review: Irwin, 2009), and they have more evolutionary misconceptions than skeptics (Hawley, Short, McCune, Osman, & Little, 2011).

As a whole, then, empirical evidence about believers' understanding of the physical world is indirect, scarce, and inconclusive. In the present study, we therefore examined how physical-world skills and knowledge of the non-social world predict religious and paranormal beliefs. We addressed self-reported systemizing, intuitive physics skills, mechanical ability, mental rotation, school grades in mathematics and physics, common knowledge about physical and biological phenomena, and the way the participants assign mentality to non-mental phenomena. Measures of intuitive and analytical thinking were also included for comparison. We hypothesize that all of these variables predict both religious and paranormal beliefs.

## METHOD

### Participants and procedure

Two hundred fifty eight Finnish participants (63.6% women) took part in the online study. Their mean age was 31.81 years ( $SD=9.89$ , range 18–65). Of the participants, 38.1% were working, 44.4% were students, and 17.5% were employed in activities other than those mentioned earlier; 1.2% had grammar school education, 44.2% had vocational or upper secondary school education, and 54.5% had polytechnic or university education. Religious affiliations were none (61%), Christian (37%), or other (2%).

The online data were collected in two stages. In the first stage, the participants were recruited via several open internet discussion forums and several student mailing lists. In this stage, data about religious and paranormal beliefs, systemizing, mechanical abilities, and core ontological confusions were collected. The rest of the data were collected 1.5 years later. The recruitment message was sent by email to all individuals who had participated in the first stage and who had given their email address for participating in further studies ( $N=1537$ ). Of them, 237 could not be contacted because of outdated email address, and 887 did not take part in the present study.

Of the 413 people who originally took part in the study, 155 were not included. Forty four participants were excluded because they responded to at least one of the six attention check items. We included two sets of 3-item attention checks at two points in the survey (e.g., 'I like to watch cloud shapes change in the sky') with the following instruction: 'The

following three statements have the same response scale as before. These are statements which you should not respond to at all. They are only involved because we want to check if you read the instructions and answer the questions carefully.' In addition, 111 participants were excluded because of missing data. The data contained much missing information because both surveys were long (they also included scales and tasks not reported here). In the present study, we even told the participants that they could skip some scales if they wish. Attrition analysis revealed that the 111 excluded participants were slightly less educated than the included participants,  $\chi^2(3)=7.67$ ,  $p=.053$ . Differences in age, gender, or religious affiliations were not found.

### Materials

#### *Religious and paranormal beliefs*

Eight items from the Supernatural Belief Scale (SBS,  $\alpha=.94$ , Jong, Bluemke, & Halberstadt, 2013) were used to assess religious beliefs (e.g., 'There exists an all-powerful, all-knowing, loving God'). Paranormal beliefs (e.g., astrology, telepathy, and precognition) were measured with 15 items from the Revised Paranormal Belief Scale (RPBS,  $\alpha=.94$ , Tobacyk, 2004). To avoid item overlap, two items were excluded from the original 10-item SBS, and five items (mainly from the Religious Belief subscale) were excluded from the original 26-item RPBS. Following the suggestions of Lindeman and Svedholm (2012), an additional six items were removed from the RPBS because they were too culture-specific (e.g., belief in the Loch Ness Monster) or dated (e.g., a black cat crossing brings bad luck). The participants indicated their opinion about the statements on a 5-point scale (1 = *strongly disagree*, 5 = *strongly agree*).

#### *Physical world skills and interests*

*Systemizing* was assessed with the 18-item version of the Systemizing Quotient scale (Ling, Burton, Salt, & Muncer, 2009). The items ( $\alpha=.84$ ) center on technicality, topography, DIY and structure (e.g., 'If there is a problem with the electrical wiring in my home I would be able to fix it myself'). The scale was scored using the normative weights (Baron-Cohen & Wheelwright, 2004): the response format (1 = *strongly disagree*, 2 = *slightly disagree*, 3 = *slightly agree*, 4 = *strongly agree*) was converted into scores of 0, 0, 1, and 2. The rationale for the scoring is that participants score 2 points only if they strongly display a systemizing response and 1 point if they slightly display a systemizing response.

*Intuitive physics skills* were assessed with the Intuitive Physics Test (Baron-Cohen, et al., 2001). The test includes 20 multiple-choice items consisting of drawings and questions of how the depicted objects work, for example, where on a boat to attach a rope in order to best pull the boat in the desired direction. Participants were given 10 min to complete the test. One point was scored for each correct response.

*Mechanical ability* was assessed using nine items from the Physical Prediction Questionnaire (Lawson, Baron-Cohen, & Wheelwright, 2004). The items consist of line drawings

of mechanical devices, and the participants' task is to infer how pressing a lever affects the movement of the other parts of the device by choosing one of five possible outcomes.

A Vandenberg-and-Kuse-type *mental rotation* test was created using stimuli from Peters and colleagues (Peters & Battista, 2008; Peters et al., 1995). A new test was used to avoid leaking the original test (Vandenberg & Kuse, 1978) to the Internet. As in the original test, each of the 10 items consisted of a target drawing of a figure made up of 10 cubes and four response options. Of the response options, two were correct answers that depicted the same figure rotated a random number of degrees around the vertical axis. For half the items, the other two options (distractors) were rotated mirror images of the target. For the rest of the items, the two distractors depicted a different figure in two different angles. The images were chosen so that no parts of the figures were completely occluded. The participants were instructed to find the two correct options and scored one point for each item only if both correct options were identified.

We developed a scale to assess *knowledge about physical and biological phenomena*. The statements were formulated to address the following: (i) the common misconceptions that physical processes resemble material objects or substances (Reiner, Slotka, Chi, & Resnick, 2000); (ii) misconceptions about evolutionary theory (Hawley et al., 2011); (iii) some of the most notable mistakes in the history of science; and (iv) common knowledge about the earth and the universe.

Eighteen statements were tested in a pilot study ( $N=33$ ). One item was deleted because it lowered the reliability and two items were rephrased because they turned out to be ambiguous. The final scale included 17 statements, for example, 'The universe stays still but the tectonic plates can move' (for the other statements, see Appendix). The participants were asked whether the statement was true (score=2) or not (score=1). Responses were given under speeded condition to prevent the participants from looking for the correct answer. The statement and the rating scale stayed on the screen for 10–12 s, followed by a blank screen for 1 s before the second statement was presented. The response time varied because the length of the statements varied. The task was preceded by two practice items with no speed limit; these responses were not included in the analyses. The response time correlated negatively with the amount of knowledge ( $r=-.24$ ,  $p<.001$ ). Other associations with the response time were trivial and non-significant, and therefore it was not included in the analyses.

We also examined how the participants *assign mentality*, or spirit, to various phenomena. We used the Finnish word 'henkinen' for mentality, which refers to mental beings (e.g., humans), to mental contents (e.g., thoughts), and in general, to the animating element of something. The participants were asked to rate on a five-point scale whether they regard 35 concepts as mental (1 = *not at all mental*, 4 = *mental*). The instructions also stipulated that 'by mental we mean anything that has some kind of spirit, or something which itself is mental. For example, thoughts and human beings are mental phenomena. Many people also consider God to be a mental being. A pen or a car, by contrast, is generally considered non-mental.'

The scale was tested in a pilot study ( $N=33$ ). Based on the results, one ambiguous item ('a book') was changed to 'a table' because most participants agreed that a book can be 'mental' (i.e., have mental contents). The final stimulus concepts belonged to seven categories. Four of the concepts assessed an unfounded assignment of mentality, and they were combined into a sum variable ( $\alpha=.91$ ) to be used in the analyses. They were basic physical processes (concepts: light, force, energy, electricity, and wind;  $\alpha=.82$ ), basic states of lifeless matter (stone, metal, water, oil, and air;  $\alpha=.84$ ), artificial objects (room, clock, table, clothes, and paper;  $\alpha=.81$ ), and living but inanimate phenomena (flower, algae, fungus, moss, and tree;  $\alpha=.97$ ). Three subscales were not used in the analyses as they were included to obscure the meaning of the scale. They were abstractions (concepts: justice, theory, race, concept, and freedom;  $\alpha=.81$ ), animates (dog, worm, bacteria, mosquito, and fish;  $\alpha=.94$ ), and mental phenomena (consciousness, goal, knowledge, desire, and purpose;  $\alpha=.87$ ). To assess the supposed mentality of these 40 concepts, the participants were given the same instruction and the 4-point rating scale as in the pilot study.

To ensure that we were able to tap more general mental–physical confusions than the specific core ontological confusions studied earlier, we used 14 statements from the Core Knowledge Confusions scale ( $\alpha=.85$ , Lindeman & Aarnio, 2007). Example statements are 'Earth wants water', 'A house knows its history', and 'A mind breaks when it is ill'. To acquaint the participants with the task, they were first presented with examples of metaphorical ('Friends are the salt of life') and literal statements ('Sibelius was a composer'). Then in the task, the participants were asked to rate on a five-point scale whether the statements were *fully metaphorical* (1) or *fully literal* (5). The scale also included six fillers, three metaphorical and three literal statements.

The participants also indicated their school grades in physics and mathematics. The grading scale used in Finland ranges from 4 (*failing grade*) to 10 (*excellent*).

#### *Intuitive and analytical thinking*

*Analytical thinking ability* was operationalized as the number of correct responses in the Cognitive Reflection Test (Frederick, 2005). CRT is a performance-based measure, which consists of three questions that cue intuitive but incorrect responses that must be resisted in order to calculate the correct answers. *Analytical thinking style* was assessed with the 12-item Need for Cognition, a.k.a., Rationality subscale ( $\alpha=.87$ ) from the Rational/Experiential Multimodal Inventory (REIm, Norris & Epstein, 2011). *Intuitive thinking style* was assessed with the 10-item Faith in Intuition subscale ( $\alpha=.82$ ) from the REIm. The items were rated on a four-point scale (1 = *strongly disagree*, 4 = *strongly agree*).

## RESULTS

Because the scores for paranormal beliefs, religious beliefs, and assigning mentality deviated from the normal distribution, the variables were transformed by taking a natural logarithm. After the transformations, skewness and

Table 1. Correlations between the variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Paranormal beliefs													
2. Religious beliefs	.78***												
3. Grade in mathematics	-.16**	-.10											
4. Grade in physics	-.17**	-.11*	.58***										
5. Systemizing	-.21***	-.27***	.13*	.18***									
6. Intuitive physics	-.19***	-.17**	.26***	.26***	.33***								
7. Mechanical ability	-.29***	-.24***	.26***	.27***	.43***	.53***							
8. Knowledge	-.33***	-.28***	.21***	.26***	.17**	.35***	.35***						
9. Mental rotation	-.13*	-.12*	.12*	.20***	.17**	.34***	.33***	.30***					
10. Assigning mentality	.60***	.45***	-.13*	-.20***	-.26***	-.23***	-.28***	-.37***	-.20***				
11. Intuition	.50***	.43***	-.29***	-.24***	-.22***	-.21***	-.27***	-.32***	-.09	.37***			
12. Need for cognition	-.33***	-.28***	.33***	.30***	.48***	.26***	.36***	.26***	.23***	-.30***	-.39***		
13. Cognitive reflection test	-.30***	-.23***	.31***	.29***	.25***	.38***	.46***	.41***	.19**	-.27***	-.32***	.39***	
Mean	0.20	0.23	8.18	8.15	13.69	12.73	4.74	12.95	5.89	0.19	2.58	3.05	1.87
Deviation	0.18	0.22	1.40	1.36	6.38	2.73	2.84	2.73	2.53	0.13	0.44	0.48	1.09

\* $p < .05$ .

\*\* $p < .01$ .

\*\*\* $p < .001$ .

Note: The means for paranormal beliefs, religious beliefs, and assigning mentality are for log-transformed variables. The means and deviations for the original variables were as follows. Paranormal beliefs:  $M = 1.73$ ,  $SD = 0.83$ , scale 1–5; religious beliefs:  $M = 1.95$ ,  $SD = 1.04$ , scale 1–5; assigning mentality:  $M = 1.63$ ,  $SD = 0.51$ , scale 1–4.

kurtosis of the variables were less than one. The correlations of all variables are set out in Table 1.

Principal axis factoring with varimax rotation was used to identify the latent dimensions underlying the physical variables. Based on the eigenvalue greater than 1 criterion, two factors were extracted: Physical capability (accounting for 22.6% of the variance) and School grades (accounting for 15.7% of the variance). The factor matrix can be seen in Table 2.

Next, sequential multiple regressions were conducted with paranormal and religious beliefs as dependent variables (Table 3). The control variables age, gender, and education were entered in Step 1. Because intuitive and analytical thinking may be causally prior to physical world skills and interests, and may thus share some variance with them, they were entered in Step 2. The two factor scores, physical capability and school grades, were added in Step 3 to determine if they improve prediction of paranormal and

Table 2. Factor loadings for the variables related to physical world skills and interests

	Factor 1	Factor 2
Mechanical ability	.74	.14
Intuitive physics	.67	.22
Systemizing (SQ)	.50	.06
Mental rotation	.41	.14
Knowledge	.40	.29
Assigning mentality	-.40	-.17
School grades in physics	.19	.78
School grades in mathematics	.16	.66

religious beliefs beyond that afforded by differences in demographic variables and intuitive and analytical thinking.

For paranormal beliefs,  $R$  for regression was significantly different from zero both after step 1,  $F(3,238) = 12.59$ ,  $p < .001$ , after step 2,  $F(6, 235) = 17.11$ ,  $p < .001$ , and after step 3,  $F(8, 233) = 13.64$ ,  $p < .001$ . Although addition of physical variables to the equation improved  $R^2$  only marginally,  $F_{\text{change}}(2,233) = 2.55$ ,  $p = .08$ , physical capability had unique predictive value on paranormal beliefs when entered in the equation after all other variables. Of the background variables, intuitive thinking predicted paranormal beliefs. In addition, female gender, lower education, and analytical thinking style predicted the beliefs marginally. The total  $R^2$  value was .32.

Similarly, for religious beliefs,  $R$  for regression was significantly different from zero both after step 1,  $F(3,238) = 6.51$ ,  $p < .001$ , after step 2,  $F(6, 235) = 10.16$ ,  $p < .001$ , and after step 3,  $F(8, 233) = 8.62$ ,  $p < .001$ . Addition of physical variables improved  $R^2$  reliably,  $F_{\text{change}}(2,333) = 3.37$ ,  $p = .036$ . Physical capability had unique predictive value on religious beliefs when entered in the equation after all other variables. Of the background variables, only intuitive thinking style predicted religious beliefs. The total  $R^2$  value was .23.

Apart from school grades in physics and mathematics, the results thus supported the hypothesis that intuitive physics skills and interests predict supernatural beliefs. However, the results raise questions about the construct of assigning mentality because this variable correlated very strongly with paranormal beliefs (Table 1) but loaded only moderately

Table 3. Hierarchical regression analysis predicting paranormal and religious beliefs

	Paranormal beliefs			Religious beliefs		
	$\Delta R^2$	$\beta$ (95% confidence limits)	$p$	$\Delta R^2$	$\beta$ (95% confidence limits)	$p$
Step 1	.14		.00	.08		.00
Age		.063 (-.027-.123)	.27		.066 (.066-.066)	.28
Gender		-.118 (-.258-.022)	.06		-.065 (-.085-.045)	.33
Education		-.099 (-.113-.022)	.10		.009 (-.013-.031)	.88
Step 2	.16		.00	.13		.00
Intuition		.340 (.318-.362)	.00		.322 (.288-.356)	.00
Need for cognition		-.109 (-.129-.089)	.09		-.079 (-.107-.107)	.25
Cognitive reflection test		-.041 (-.045-.037)	.52		-.002 (-.008-.004)	.97
Step 3	.02		.08	.02		.04
Physical capability		-.151 (-.157-.145)	.03		-.179 (-.187-.171)	.02
School grades		.017 (-.017-.051)	.78		-.038 (-.046-.030)	.55

with the latent physical capability factor (Table 3). To disentangle if assigning mentality reflects poor understanding of the physical world, or whether it is just one form of ontological confusion, we ran an additional sequential regression analysis with assigning mentality as the dependent variable. Seven physical variables were entered as predictors in Step 1 (systemizing, intuitive physics skills, mechanical abilities, mental rotation, and two school grades and knowledge), and core ontological confusions were added in Step 2.  $R$  for regression was significantly different from zero after Step 1,  $R^2 = .19$ ,  $F(7,250) = 9.81$ ,  $p < .001$  and after Step 2,  $R^2 = .28$ ,  $F(8,249) = 13.26$ ,  $p < .001$ . Addition of core ontological confusions improved  $R^2$  reliably,  $F_{\text{change}}(1,249) = 29.54$ ,  $p < .001$ . The total  $R^2$  value was .30.

## DISCUSSION

The more the participants believed in religious or other paranormal phenomena, the lower their intuitive physics skills, mechanical and mental rotation abilities, school grades in mathematics and physics, and knowledge about physical and biological phenomena were; the less they reported interests and skills in systemizing; and the more they regarded inanimate targets as mental phenomena. These correlational results were specified with a factor analysis and regression analyses where age, gender, education, and thinking styles were controlled for. The results showed that the physical capability factor, representing most physical skills, interests, and knowledge, still had a unique effect on supernatural beliefs but the second factor, representing school grades in mathematics and physics, did not.

Earlier studies on supernatural believers' physical cognition have been limited mainly to self-reports of systemizing (Lindeman & Lipsanen, 2016; Lindeman, Svedholm-Häkkinen, & Lipsanen, 2015; Norenzayan et al., 2012). The present results are thus among the first to empirically demonstrate that several kinds of skills, interests, and knowledge that concern the physical world are poorer among supernatural believers than among other people. Although the unique explanatory power of the physical variables were not high, the results support Badcock's (2009) argument that if the physical world is not well understood, mental concepts such as agency and

intentionality expand to the whole universe, resulting in beliefs in demons, gods, and other supernatural phenomena. The results are important because the reasons why people find supernatural explanations compelling is poorly understood and because the role of physical cognition in encouraging supernatural beliefs has not been adequately addressed.

Of all variables, the strongest correlation was found between supernatural beliefs and assigning mentality to physical processes, lifeless matter, artificial objects, and living but inanimate phenomena. Although we exemplified 'mental' to the participants with the concepts of a thought, human beings, and God and non-mental with the concepts of a car and a pen, supernatural believers nevertheless assigned mentality to light, wind, metal, oil, clothes, paper, flowers, and other inanimate things, more than the skeptics did. When examined more closely, we found that assigning mentality to inanimate phenomena tapped both physical interests and abilities, and such specific ontological confusions as 'Stones sense the cold'. Assigning mentality is thus a construct, which bridges exaggerated mentalizing and impaired physical cognition. These results raise two important issues.

Firstly, the strong association between exaggerated mentalizing and supernatural beliefs agrees with previous findings obtained in studies on anthropomorphism (Purzycki et al., 2012; Shtulman, 2008), promiscuous teleology (Kelemen & Rosset, 2009; Kelemen et al., 2013), and core ontological confusions (Barber, 2014; Lindeman et al., 2015; Lobato et al., 2014). What was new, however, was the broad and general scope of the phenomenon. Unlike the earlier studies, which have addressed only few specific targets and attributes, unfounded mentalizing was here apparent throughout a range of basic physical objects and processes, and at a higher level of abstraction, on the superordinate concept of mental. This kind of mental-physical confusion has been recognized mainly among ancient people and small children. Secondly, although supernatural believers' tendency to ascribe human characteristics to non-human phenomena is widely acknowledged (see the aforementioned studies, see also Barrett & Keil, 1996; Boyer, 1996; Guthrie, 1993), theoretical and empirical work has focused only on biased social information processing. However,

ascribing mental attributes to physical phenomena implies just as much biased physical cognition. The present results thus highlight the need to develop theoretical approaches for supernatural beliefs further and to systematically study the way the physical world is understood among the believers.

As a whole, the importance of poor understanding of physical phenomena and exaggerated mentalizing in supernatural beliefs suggest that believers are preoccupied with mentality and absent-minded in physical phenomena, in a similar way that some others are preoccupied with machines and other physical systems, but absent-minded on mental phenomena. Supernatural beliefs may thus reflect a broad, hyper-mentalistic cognitive phenotype, opposite to the hyper-mechanistic phenotype. Extreme forms of hyper-mechanistic phenotype can be found among individuals with Autism spectrum disorder, ASD (Baron-Cohen, 2002; Baron-Cohen et al., 2005). ASD individuals have a drive to analyze and construct mechanical, numerical, and other inanimate systems, but they can be mind-blind; they can have deficits in attribution of mental states to others, they can ignore the special significance of mental events, and their view of other people can be limited to external behavior rather than mental states (Baron-Cohen, 1989; Baron-Cohen, Ashwin, Ashwin, Tavassoli, & Chakrabarti, 2009). The ability to distinguish mental from physical seems to be impaired both among ASD individuals and supernatural believers, although its manifestation is reversed. Because findings from hyper-mentalistic and hyper-mechanistic cognition, as two opposite phenotypes, can help each other in the search for their underlying mechanisms, one promising approach for future studies might be to integrate research on this newly found ‘matter-blindness’ to research on ‘mind-blindness’.

Along with the domain-specific physical cognition, analytical and intuitive thinking predicted supernatural beliefs. Several previous studies have also found that people with low analytical thinking are sympathetic to various supernatural beliefs (Gervais & Norenzayan, 2012; Pennycook, Cheyne, Seli, Koehler, & Fugelsang, 2012; Shenhav et al., 2012; Swami, Voracek, Stieger, Tran, & Furnham, 2014). Together with endowing mental properties to inanimate phenomena, the strongest predictor of the beliefs in this study was, however, intuitive thinking. Although the role of high intuitive thinking in supernatural beliefs has been observed earlier (Kelemen et al., 2013; Shenhav et al., 2012), it has received far less attention than analytical thinking. This is surprising as most scholars of religion agree that supernatural concepts are intuitively plausible (Barrett, 2000; Boyer, 2003). One reason might be that low analytical thinking has been interpreted as indicating high reliance on intuition. This is not, however, always true. Intuition is a multifaceted construct, a label used for thinking styles and for different cognitive, affective, and even somatic outputs and processes, which do not necessarily exclude analytical processes but can operate side by side with them (Glöckner & Witteman, 2009; Gore & Sadler-Smith, 2011; Hodgkinson, Langan-Fox, & Sadler-Smith, 2008). It would therefore be important for future studies to clarify the relationship between intuitive thinking and supernatural beliefs in depth.

Nonscientific ways of thinking are resistant to formal instruction. Intuition-based, unfounded theories in astronomy, evolution, matter, mechanics, and other domains persist several decades beyond the acquisition of a mutually exclusive scientific theory (Shtulman & Harrington, 2015), and they affect individuals’ ability to act as informed citizens to make reasoned judgments in a world that is increasingly governed by technology and scientific knowledge (Impey, Buxner, & Antonellis, 2012). Being fundamental to understanding how human reasoning functions, we need theories that comprise the true breadth of supernatural beliefs and their determinants. We hope that the present results will stimulate further studies in this field.

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