Cross-cultural support for a link between analytic thinking and disbelief in God: Evidence from India and the United Kingdom

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Abstract

A substantial body of evidence suggests that favoring reason over intuition (employing an analytic cognitive style) is associated with reduced belief in God. In the current work, we address outstanding issues in this literature with two studies examining the relationship between analytic cognitive style (as measured by performance on the Cognitive Reflection Test) and belief in God. First, prior research focused on Judeo-Christian cultures, and it is uncertain whether the results generalize to other religious systems or beliefs. Study 1 helps to address this question by documenting a negative correlation between CRT performance and belief in God, r = −.18, in a sample of 513 participants from India, a majority Hindu country. Second, among 150 participants from the United Kingdom, Gervais et al. (2018) reported the first and (to date) only evidence for a positive relationship between CRT and belief in God. In Study 2, we assess the robustness of this result by recruiting 547 participants from the United Kingdom. Unlike Gervais et al., using the same items, we find a negative correlation between CRT and belief in God (r = −.19). Our results add further support to the argument that analytic thinking undermines belief in God.

Keywords: analytic thinking, belief in God, Cognitive Reflection Test (CRT), cognitive style

1 Introduction

Religious identification is associated with a number of positive outcomes, from improved mental and physical health (Carrico et al., 2006; Ironson et al., 2006), to greater reported happiness (Ferriss, 2002), increased prosocial behavior (Stagnaro et al., 2018) and even a longer life (McCullough et al., 2000).[1] Yet, despite these potential benefits, religious belief has been steadily declining in recent years (Burkimsher, 2014). Scholars have increasingly directed their attention to why some people believe in God while others do not (Norenzayan & Gervais, 2013). Although several potential pathways to religious disbelief have been identified (Mercier et al., 2018), one pathway in particular has received much attention in the cognitive science of religion – that of analytic cognitive style (Gervais & Norenzayan, 2012; Pen-

nycook et al., 2012; Pennycook, Ross, et al., 2016; Shenhav et al., 2012).

This line of work is rooted in dual-process theory, in which human cognition is characterized by a distinction between processes that are autonomous and relatively fast ("Type 1" processes), and relatively slower processing that is deliberative and dependent on working memory ("Type 2" processes) (De Neys, 2012; Evans & Stanovich, 2013; Kahneman, 2011; Pennycook et al., 2015). According to dual-process theory, individuals vary in the extent to which they utilize Type 1 versus Type 2 processing (Stanovich & West, 2000, Stanovich, 2009) – that is, some people are more disposed to engaging deliberative Type 2 processing. One name for this individual difference is cognitive style; with those who engage in more Type 2 processing referred to as having a more analytic cognitive style (Pennycook et al., 2012).

Of the different measures of cognitive style, one of the most widely used is the Cognitive Reflection Test (CRT; Frederick, 2005). This measure involves a series of "trick questions" with intuitively compelling but incorrect answers. With some reflection, these incorrect answers can be identified and overridden by participants who engage in more analytic thinking. Consider the following item:

> A bat and ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?

This problem elicits a fast, intuitive response (10 cents) that on reflection can be identified as incorrect (if the ball costs 10 cents, the bat would cost $1.10 and thus total $1.20). Despite this, the incorrect *intuitive* response is typically the modal

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[1]However, some have challenged the overall health benefits attributed to religious belief (Sloan, 2006).

response (e.g., 65% in a Canadian undergraduate population; Pennycook, Cheyne, et al., 2016), indicating a common failure to engage in reflective reasoning (Pennycook & Ross, 2016).

Evidence suggests that analytic cognitive style (as indexed by scores on the CRT) increases the probability of critically evaluating evidence that conflicts with previously held information (Pennycook et al., 2015). Some theories (Shenhav et al., 2012) have used this reasoning to argue that religious beliefs are particularly intuitive (Barrett, 2000; Kelemen, 2004) and, as such, would be accepted by most individuals save those who are particularly prone to detect conflicting signals and thus override initial beliefs. A different, but related theory (Pennycook, et al., 2012) posits that there is likely nothing special about religious beliefs per say – there is simply an asymmetry in belief and non-belief such that when an individual is exposed to and attempts to comprehend some claim, they must initially internalize it as true (Gilbert et al., 1993). Thus, individual who tend to be more "intuitive" in their reasoning are more inclined to simply internalize the initial belief as true (especially if the source is of high status, and or centrally connected in one's community; Henrich & Gil-White, 2001). Those who are more inclined to detect inconsistencies and, over time, reject, or reduce confidence, in such claims should show a decrease in such belief.

Critically for this work, evidence supports the hypothesis that people with a propensity to think analytically typically show lower levels of religious belief (Bahçekapili & Yilmaz, 2017; Gervais & Norenzayan, 2012; Pennycook et al., 2012; Pennycook, Ross, et al., 2016; Saribay & Yilmaz, 2017; Shenhav et al., 2012). A recent meta-analysis of 31 studies (N = 15,078) found that a propensity to think analytically (measured the number of correct responses on the CRT) is consistently and negatively associated with religious belief (Pennycook, Ross, et al., 2016). Furthermore, experimental work has provided mixed evidence that priming analytic thinking can decrease belief in God (Gervais & Norenzayan, 2012; Shenhav et al., 2012; Yilmaz et al., 2016), although some of the results from Gervais and Norenzayan (2012) have not replicated (Camerer et al., 2018; Sanchez et al., 2017).

Apart from the uncertainty of the experimental results, a clear shortcoming of research on the relationship between belief in God and cognitive style is that it has relied almost entirely on North American participants, a common problem in psychological research (Henrich et al., 2010). Although the negative relationship between CRT and belief in God has been replicated in a majority Muslim sample in Turkey (Bahçekapili & Yilmaz, 2017), the dearth of cross-cultural evidence, especially from non-Abrahamic/monotheistic cultures, has been a notable concern for claims that analytic thinking plays a role in the absence of belief.[2]

However, a recent cross-cultural study (N = 3,461) conducted across 13 religiously and culturally diverse societies has provided some evidence that the relationship between CRT and belief in God is in fact a culturally broad phenomenon (Gervais et al., 2018). The authors argued, as we do above, that the work supporting the claim for what they term "analytic atheism" (Norenzayan & Gervais, 2013) has overwhelmingly come from WEIRD populations (Henrich et al., 2010). Although Gervais, et al. *did* find a significant negative *overall* relationship between belief in God and CRT, this relationship interestingly appeared to hold for mostly *non*-WEIRD samples,[3] the magnitude (and confidence) of the effect varied across countries. In particular, the negative correlation appeared to be larger in countries that had strong religious traditions than in countries that did not. Based on the cross-cultural variability in magnitude, the authors argued that the negative relationship between CRT and belief in God previously observed among Americans (a WEIRD sample) may be cross-culturally "weak and fickle" (p. 5). Particularly troubling for the negative relationship between CRT and belief in God were Gervais et al.'s United Kingdom data (N = 150). This was the only country in which a significant *positive* correlation between CRT score and belief in God was found.

In the present work, we present two large sample studies which help address two key questions: First, does the previously observed negative relationship between performance on the CRT and belief in God maintain in non-monotheistic, non-Abrahamic majority culture? Study 1 used participants from India, a majority Hindu country.[4] Second, in contexts where belief is not the dominant cultural norm, is there the potential for a positive relationship between CRT and belief in God? Study 2 use participants from the United Kingdom, where Gervais et al. (2018) observed a positive relationship.

2 Study 1 — India

2.1 Methods

To assess the relationship between CRT and belief in God in a predominantly non-monotheistic, non-Western population,

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[2]There could be a concern that, due to historical divides between En-

lightenment Reason and Abrahamic monotheistic faiths, there may be a more pronounced and adversarial relationship between reason and faith for the Abrahamic traditions (Draper, 1875). It also could be that there is some effect of flexibility and diversity differentially experienced in polytheistic communities that may afford those higher on reason to be comfortable with holding some features of a faith-based system and not others. Whatever the case, the strong version of our argument would not predict some faiths sharing a relationship with reflection but not others; thus cross-cultural stability is necessary.

[3]Note that Gervais et al. (2018) also had a similar, albeit somewhat smaller, sample of Indian data (N = 224). This provides a good comparison with our sample in Study 1.

[4]Though this dataset does not indicate participant's religious identity, previous work has shown that the Indian population on AMT is predominately (~70%) Hindu (Groth, et al., 2016).

we pooled data from two studies that we had previously run on Amazon Mechanical Turk (AMT) that used Indian participants, collected in 2012, when it was still easy for Indian residents to open worker accounts on AMT, and thus a sizable number of AMT workers were Indian. IP addresses were used to confirm their location to be in India. Though not representative of the average Indian citizen (working on AMT implies a level of English proficiency and technical access which may not be broadly available), this convenience sample nonetheless allows us to test the question of interest. We identified *N* = 513 Indian individuals (185 female; mean age 28) for whom we had data on both belief in God and the original 3-item CRT. Both studies were under 15 min long, and all participants were compensated for their time in US dollars.[5]

Performance on the CRT was comparable to previous samples, *M* = 1.36, *SD* = 1.06, *Median* = 2, Cronbach's α = .634. Further, there was reasonable variation in performance, with over 15% answering all items correctly and less than 30% missing all three. Of those that gave no correct answers, 44% gave all three of the intuitively incorrect answers and over 97% giving at least one intuitive answer. The correlation between correct and intuitive answers was *r* = −.815. Thus, there is good evidence these participants understood and engaged with this measure as intended.

Belief in God was measured with the question: "*To what extent do you believe in the existence of God (or gods)?*", responding on a scale ranging from *1 (not at all)* to *10 (very much)*. Belief was high, *M* = 7.86, *SD* = 2.55, *Median* = 9, with over 40% using the maximum value on the scale and less than 5% using the minimum.

2.2 Results and Discussion

Using linear regression, with correct CRT scores as the independent variable predicting belief in God as the dependent variable, we found a significant, negative relationship (β = −.176, $F(1, 511)$ = 16.30, *p* < .001, 95% CI [−.63, −.22][6]; all coefficients represent standardized betas unless otherwise noted). See Figure 1. This relationship became slightly stronger when including a dummy code for study (β = −.185, $F(2, 510)$ = 9.33, *p* < .001, 95% CI [−.65, −.24]). Further, this relationship was robust to the inclusion of "upstream" demographic variables (those unaffected by belief in God: gender and age; β = −.171, $F(4, 507)$ = 11.33, *p* <

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[5]Both studies primarily investigated cooperative behavior, and did not contain any mention of religious belief except for the question about belief in God that is our dependent variable (and was embedded in the demographics portion of the surveys). Further, the experimental conditions used within these cooperation studies: (i) were not intended to have an effect on either CRT scores nor belief scores, (ii) in fact did not have a significant effect on belief (*p* = .458) nor CRT (*p* = .090), and (iii) do not produce a significant affect when interacted with CRT when predicting belief (interactions term: *p* = .142).

[6]This effect maintains when using an ordinal logistic model (treating belief as an ordinal variable, opposed to continuous), *b* = −.34, *p* < .001.
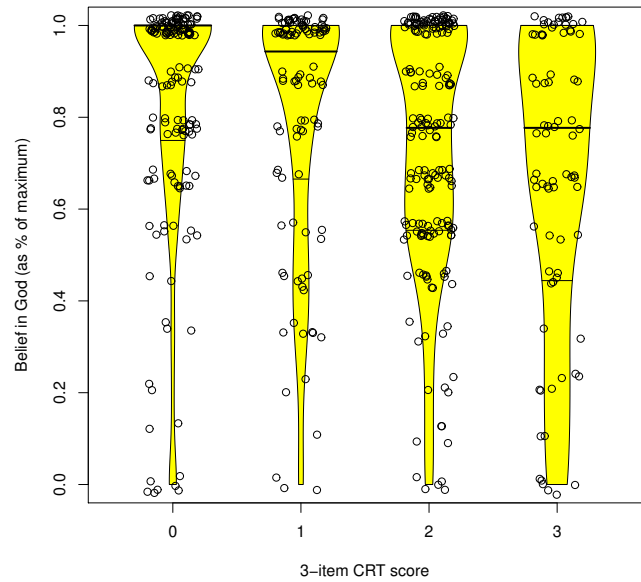

FIGURE 1: Violin plots (with jittered individual data points) showing belief in God (represented by POMP scores) as a function of correct responses on the 3-item CRT. Width of each plot shows density. Horizontal lines show median (heavy line) and 25th and 75th percentile.

.001, 95% CI [−.62, −.21]), and potentially "downstream" demographic variables (those potentially affected by belief in God: education, income, and self-reported trust in others; β = −.167, $F(11, 500)$ = 5.10, *p* < .001, 95% CI [−.61, −.20]).[7] In addition, using the number of intuitive responses, rather than correct responses, as the independent variable yielded very similar results (see the supplement). Analyses are summarized in Table 1.

Thus, in a sample that is substantially larger than the Indian sample included in Gervais et al. (2018) (which had 224 Indian workers from AMT), we replicate the previously observed negative relationship between CRT and belief in God.

3 Study 2 — United Kingdom

We next turn to the surprising result reported by Gervais et al. (2018): of the 13 countries they studied, only the United Kingdom showed moderate evidence for a positive relationship between belief in God and CRT score. Here we collected a much larger sample from the United Kingdom to see if this result would replicate. The preregistered analysis protocol, survey items, and data can be found at https://osf.io/jb2mr/.

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[7]The upstream and downstream models referenced here include study controls; however, results are qualitatively identical when removing study from these models.

TABLE 1: Multiple regression analyses (standardized coefficients) predicting belief in God using the 3-item CRT and controlling for study, age, gender (Male = 1, Female = 2), income, trust, and education (dummy code). Standard errors are in parentheses.

	Model1	Model2	Model3	Model4
CRT3	−0.178***	−.185***	−.171***	−.167***
	(.105)	(.105)	(.104)	(.105)
Study		.067	.063	.072
		(.237)	(.232)	(.234)
Age			.191***	.198***
			(.014)	(.014)
Gender			.083	.072
			(.230)	(.232)
Income				−.094*
				(.064)
Trust				.066
				(.102)
Intercept	8.434***	8.226***	5.9***	4.96**
	(.180)	(.226)	(.525)	(1.801)
Edu dum	no	no	no	yes
N	513	513	512	512
R2	.031	.035	.082	.101
Adj R2	.029	.032	.075	.081

† p<0.1, * p<0.05, ** p<0.01, *** p<0.001.

3.1   Methods

We recruited participants using Prolific (https://prolific.ac/), an online marketplace where people can sign up to participate in paid academic studies (Irvine et al., 2018). Only participants with a UK-based IP address were eligible to respond to the study advertisement. Sessions lasted approximately 8 minutes and participants were compensated in pounds for their time. We preregistered an intention to request 550 participants from Prolific and to remove participants who a) reported their age as less than 18, or b) had a repeat IP address, suggesting that they may have previously completed the study. 548 participants completed the study and collected compensation. One participant was removed for reporting their age as 17, meaning that 547 participants (348 female; mean age 36) were retained for analysis.

Analytic cognitive style was measured using the original 3-item CRT (Frederick, 2005) and a more recent 4-item CRT which was designed to rely less on numeracy (Thomson &
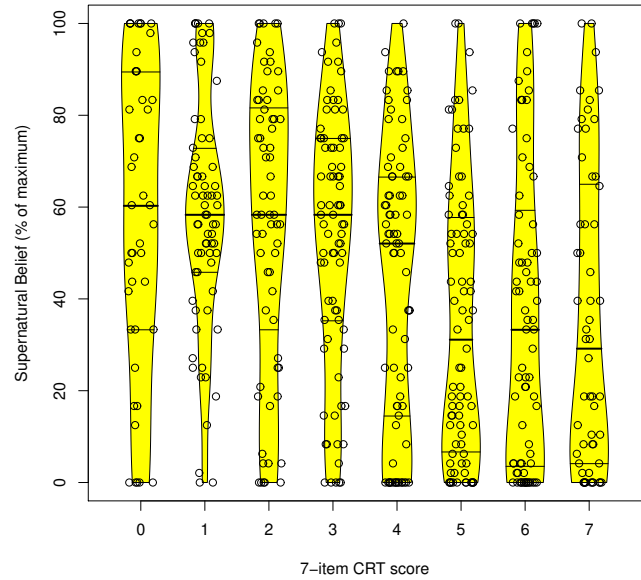

FIGURE 2: Violin plots (with jittered individual data points) showing supernatural belief (represented by POMP scores) as a function of correct responses on the 7-item CRT.

Oppenheimer, 2016).[8] These were combined into a single, 7-item CRT. Scores on the 3-item CRT were comparable to earlier studies, with 36.2% receiving a score of zero, 21.9% receiving a score of three, and a mean of 1.28 (SD = 1.17). The 7-item scale had a more normal distribution, with only 8% scoring zero, 10.24% scoring a full seven, a mean of 3.66 (SD = 2.13, Cronbach's α = .772). Belief in God (or gods) was measured used a single item measure anchored from 0 to 100.[9] Given the potential problem of relying on a single item measure, we also included a broader index of religious belief: Namely, the 6-item Supernatural Belief Scale (Jong et al., 2013; Jong & Halberstadt, 2016) which asks participants about their beliefs in religious supernatural concepts and has good psychometric properties.[10] We found that this scale had high reliability (Cronbach's α = .956). We also collected demographic variables: age, gender, education, ethnicity, income, political ideology (social and fiscal) and a measure of attention (an instructional manipulation check; Oppenheimer et al., 2009). Finally, we collected some additional variables for exploratory analysis that are not reported here.

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[8]3-item CRT: Cronbach's α = .690; 4-item CRT: Cronbach's α = .647

[9]The single item was taken from Gervais et al. (2018): "How strongly do you believe in God or gods (from 0–100)? To clarify, if you are certain that God (or gods) does not exist, please put '0' and if you are certain that God (or gods) does exist, then put '100'."

[10]Items include: There is some kind of life after death. There is a spiritual realm besides the physical one. There exists an all-powerful and all-knowing spiritual being, whom we might call God.
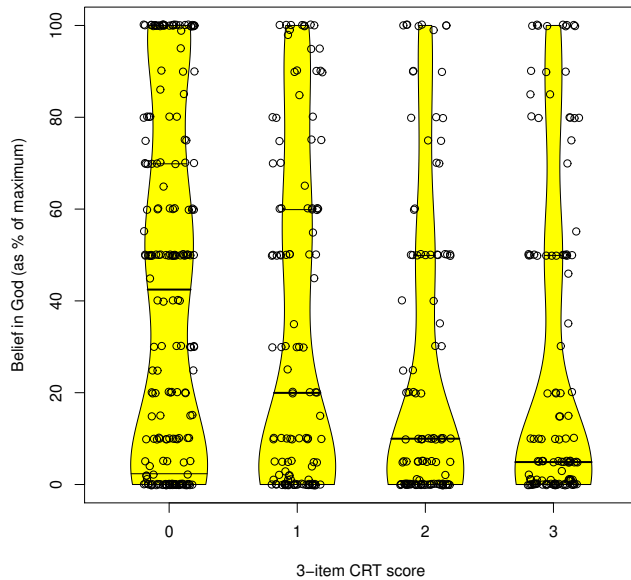
FIGURE 3: Violin plots (with jittered individual data points) showing belief in God (represented by POMP scores) as a function of number of correct responses on the 3-item CRT.

3.2 Results and Discussion

To test our primary hypothesis, we used linear regression to examine whether performance on the 7-item CRT predicts supernatural belief using the 6-item Supernatural Belief Scale. Secondarily, we used linear regression to examine whether performance on the 3-item CRT predicts belief in God using the single-item belief in God measure. This secondary analysis was performed to directly replicate Gervais et al.'s (2018) analysis.

As shown in Figure 2, we found a significant *negative* relationship between the number of correct responses on the 7-item CRT and Supernatural Belief Scale score ($\beta = -.291$, $F(1, 545) = 50.43$, $p < .001$, 95% CI $[-2.67, -1.52]$).[11] We also found a significant *negative* relationship between the number of correct responses on the 3-item CRT and the single-item belief in God measure, $\beta = -.189$, $F(1, 545) = 20.15$, $p < .001$, 95% CI $[-8.38, -3.28]$, Figure 3.[12]

To test the robustness of our analyses, we also conducted a number of post hoc analyses. Again, we found a significant negative relationship when controlling for demographics "upstream" of belief (age, gender and ethnicity dummies), using both the 7-item CRT and Supernatural Belief Scale score ($\beta = -.231$, $F(13, 533) = 10.15$, $p < .001$, 95% CIs $[-2.23, -1.09]$) and the 3-item CRT and single-item belief in God measure ($\beta = -.166$, $F(13, 533) = 7.28$, $p < .001$, 95% CI $[-7.63, -2.60]$). Further, this relationship

maintains when we added demographics that are potentially "downstream" of belief (education dummies, income, political ideology [social and fiscal], and failed comprehension), for both the 7-item CRT and Supernatural Belief Scale score ($\beta = -.197$, $F(22, 524) = 7.40$, $p < .001$, 95% CI $[-2.01, -.83]$), and the 3-item CRT and the single-item belief in God measure ($\beta = -.152$, $F(22, 524) = 5.64$, $p < .001$, 95% CI $[-7.28, -2.12]$). Analyses are summarized in Table 2.

4 General Discussion

In the present paper, we examined the relationship between analytic cognitive style and belief in God (or gods) in India and the United Kingdom. First, consistent with Gervais et al. (2018), we found a negative relationship between CRT and religious belief in our Indian sample. This further strengthens the evidence that this relationship between belief and analytic thinking does not occur only in WEIRD populations, but can also occur in non-Western cultures in which the majority follow a non-monotheist religion.[13]

Second, in contrast to the results reported by Gervais et al. (2018), we found a negative relationship between CRT and belief in God in our UK sample. In fact, the magnitude of the negative association we observed was very similar to that found in a recent meta-analysis of 31 studies, $r = -.183$ (Pennycook, Ross, et al., 2016). It is not clear why our results differ markedly from Gervais et al. (2018). However, our sample was recruited online, while Gervais et al. employed a college sample. It is possible that students at British universities show the opposite association to that of a more demographically diverse sample of the British population. This possibility would have to apply to British universities in particular, since studies using North American college samples have found a negative relationship (Gervais & Norenzayan, 2012; Pennycook, Ross, et al., 2016; Shenhav et al., 2012). Another possibility is sample size; our sample was substantially larger ($N = 548$ vs $N = 150$). Thus, it could be the case that Gervais et al.'s result was spurious (i.e., a type 1 error).

Gervais et al. (2018) observe that in their study the countries where the negative relationship between CRT scores and belief was weakest were also the countries where religious belief is less prominent. They suggest that cognitive reflection may be involved in the challenging of cultural norms – irrespective of their theological frame. Thus, if belief was the minority view, utilizing reflection could make individuals more likely to challenge this view and adopt or experiment with religious belief. The British data from the present study, however, are not consistent with this interpretation. Britain has particularly low levels of religious belief (59% in this sample which is representative of

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[11]This effect remins when using an ordinal logistic model (treating religious belief scores as an ordinal variable; $b = -.246$, $p < .001$).

[12]As above, this effect remains when using an ordinal logistic model and belief in God as the dependent variable ($b = -.278$, $p < .001$).

[13]Though Islam is the second largest religious tradition in India, the population is still overwhelmingly (80.5%) Hindu polytheistic (Indian Census Commissioner, 2001).

TABLE 2: Multiple regression analyses (standardized) predicting a) belief in God using the 3-item CRT and b) supernatural belief using the 7-item CRT while controlling for age, gender (Male = 1, Female = 2), income, social conservatism, fiscal conservatism, performance in an attention check, ethnicity (dummy coded), and education (dummy coded). Standard errors are in parentheses.

	CRT3 predicting belief in God			CRT7 predicting Sup Nat belief		
	M1	M2	M3	M1	M2	M3
CRT	−.189***	−.166***	−.152***	−.291***	−.231***	−.197***
	(1.3)	(1.28)	(1.31)	(.295)	(.291)	(.298)
Age		.160***	.160***		.127**	.116**
		(.118)	(.121)		(.049)	(.05)
Gender		.01	.020		.157***	.177***
		(3.11)	(3.11)		(1.28)	(1.283)
Income			−.069			−.042
			(.844)			(.348)
Social con			.153*			.114
			(2.18)			(.90)
Fisc con			.031			.053
			(2.203)			(.907)
attention ck			.046			.049
			(7.172)			(2.970)
Intercept	40.990***	17.780*	20.110	35.975***	19.064***	16.000*
	(2.25)	(6.95)	(15.40)	(1.25)	(6.17)	(6.44)
Ethnic dum	no	yes	yes	no	yes	yes
Edu dum	no	no	yes	no	no	yes
N	547	547	547	547	547	547
R2	.036	.151	.191	.085	.198	.237
Adj R2	.034	.130	.158	.083	.179	.205

* p<0.05, ** p<0.01, *** p<0.001.

current trends; Evans & Baronavski, 2018), yet we found a negative association between CRT and religious belief. Still, the level of religious belief in British universities might be particularly low.

A more general explanation for this pattern could be that, in populations of low belief, there is simply less of a signal being sent between reflection and non-belief. Since many individuals relying on intuition would normally adopt a religious world view as a sort of default belief in religious societies, here, it is not a common or easily accessible worldview and thus we should not expect individuals to be defaulting to belief. Thus this lower overall level of belief makes detecting relationships much harder (due to the constrained variance).

Our results from the British sample also support a (per-

haps obvious) speculation about methodology made by Pennycook, Ross, et al. (2016): The effect size of the correlation between religious disbelief and analytic thinking depends on the measures that are used. Gervais et al. (2018) referred to the association as "weak", but they used a 3-item measure of analytic thinking and a single-item measure of belief in God. Using these same measures, we found a correlation $r = -.19$ in our UK sample. However, using a 7-item CRT measure and a 6-item religious belief measure, this correlation increased to $r = -.29$. Gignac and Szodorai (2016) found that correlations of $r = .11, .19,$ and $.29$ represent the 25th, 50th, and 75th percentiles (respectively) for effect sizes in individual differences research in social psychology. Thus, the effect size for the correlation between analytic

thinking and religious beliefs appears to be medium using extremely short measures and relatively large when using longer (but nonetheless fairly short) measures (see also Pennycook, Ross, et al., 2016).

In conclusion, recent work has raised questions about the robustness and function of analytic processing in the context of belief in God (Camerer et al., 2018; Gervais et al., 2018; Sanchez et al., 2017). Here, we report results that further reinforce the evidence for a negative relationship between religious belief and analytic thinking in a non-Abrahamic, non-monotheistic, and non-Western population — in this case, India. Furthermore, we have also shown that the negative relationship maintains even in a population where religious belief is much weaker — in this case, the United Kingdom. This suggests that analytic thinking is not motivating people to merely challenge whatever the default norm happens to be (be it belief or non-belief), but is rather motivating people to specifically question religious belief. Although there appears to be cross-cultural variability in the association between analytic thinking and religious disbelief (Gervais et al., 2018), the causes of this variability are still unknown.

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