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EMPIRICAL ARTICLE

Cognitive Reflection and Religious Belief: A Test of Two Models

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Abstract

Existing research suggests a negative correlation between reflective thinking and religious belief. The dual process model (DPM) posits that reflection diminishes religious belief by limiting intuitive decisions. In contrast, the expressive rationality model (ERM) argues that reflection serves an identity-protective function by bolstering rather than modifying preexisting beliefs. Although the current literature tends to favor the DPM, many studies suffer from unbalanced samples. To avoid this limitation, we recruited comparably large number of participants for both religious believers (n = 580) and non-believers (n = 594) and observed the relationship between reflection and two measures of religious belief: belief in God and disbelief in evolution. Our findings corroborate the negative associations found between higher levels of reflection and both types of belief, independent of religious affiliation. Our results align with the broader literature, supporting the DPM but not the ERM.

The dual process model (DPM) of human reasoning is a widely used, empirically backed theoretical framework that posits two unique forms of reasoning: intuitive (Type 1) and reflective (Type 2). Type 1 processes occur rapidly, automatically, and with little effort, while Type 2 processes unfold more deliberately, demanding greater effort and imposing more strain on working memory (Evans and Stanovich, 2013). The DPM suggests that Type 2 processes can sometimes inhibit and override Type 1 processes (Evans, 2007, 2019). In accordance with this framework, numerous studies have compared the effects of intuitive and reflective thinking across diverse domains (see Saribay and Yilmaz, 2024 for a review). The relationship between thinking style and religious belief, more specifically, belief in God, assumes a prominent position in this research agenda.

The accounts of religious belief as a "byproduct" argue that the emergence of religious beliefs hinges on the existence of several prevalent cognitive biases such as agency attribution, causality attribution, and mind-body dualism (Bering, 2011; Bloom, 2007; Boyer, 2001; Gervais, 2024). This cognitive makeup aids humans to intuitively acquire religious beliefs via cultural transmission (Barrett, 2000; White et al., 2021). According to the DPM, reflective and intuitive processes occur concurrently and

compete with each other. If reflective processes are sufficiently strong, they can override intuitive responses (Evans, 2019; Kahneman, 2011). Therefore, individuals who are more inclined to use reflection are likely to exhibit decreased religious belief, as they are more apt to revise or correct their intuitive outputs. This concept is central to the intuitive religious belief hypothesis, which suggests that a propensity for Type 2 thinking encourages the questioning of intuitively held beliefs, including religious ones (Norenzayan and Gervais, 2013).

Early studies supported the intuitive religious belief hypothesis, showing negative correlations between cognitive reflection as measured by the Cognitive Reflection Test (CRT; Frederick, 2005) and belief in God (Bahçekapili and Yilmaz, 2017; Pennycook et al., 2012; Shenhav et al., 2012; Yilmaz et al., 2016). A meta-analysis by Pennycook et al. (2016) found a significant negative correlation between belief in God and cognitive reflection among North Americans (N = 15.078). Similar findings are observed across most countries, but with significant variation in effect sizes (Gervais et al., 2018). However, the same study also showed a reversed trend in the United Kingdom, where there was a positive correlation between belief in God and reflection. As an explanation of this unexpected cross-cultural variation, Gervais et al. (2018) suggested that cognitive reflection could be motivating the questioning of not only religious but all existing cultural norms in general. This implies that reflection decreases belief in God in highly religious countries and increases religiosity in secular ones. However, subsequent studies failed to support this provocative argument: Stagnaro et al. (2019) demonstrated that the negative relationship between reflection and belief in God held in both the UK, a predominantly secular country, and India, a relatively religious one. Additional data from Germany, another predominantly secular country, exhibited the same negative pattern (Weiss et al., 2021). Furthermore, new cross-cultural data from two studies also support the cross-cultural generalizability of the negative relationship between religious belief and reflection (Ghasemi et al., 2024; Stagnaro and Pennycook, 2025).

Despite the relative consensus regarding the negative correlation, DPM is not the only framework employed to explain the relationship between reflection and religious belief. The expressive rationality model (ERM) argues that individuals use cognitive reflection to consolidate their already-held beliefs as a way to strengthen their social identity (Kahan, 2017). Rooted in motivated cognition, ERM predicts that reflection increases the endorsement of identity-protective beliefs. Accordingly, reflection is an identity-protective cognitive mechanism, motivating the selective embrace of evidence that strengthens the beliefs, attitudes, and values congruent with one's identity (Kahan, 2017). Conversely, skepticism increases when people are exposed to content that contradicts their established views (Kahan, 2013). Hence, within the realm of religious belief, ERM predicts that the belief of individuals who view religious beliefs as markers of their identity will get stronger when engaging in reflective thinking (Kahan and Stanovich, 2016). In short, while DPM predicts a negative relationship between cognitive reflection and religious belief for both believers and non-believers, the ERM anticipates different relationships depending on religious identity. Supporting ERM, Kahan and Stanovich (2016) found the relationship between cognitive reflection and disbelief in evolution to be contingent on religiosity level. With higher CRT scores, less religious participants showed reduced disbelief, whereas more religious people showed increased disbelief.

To reconcile these findings, Baimel et al. (2021) compared three models that aim to explain the relationship between reflection and disbelief: the DPM, the ERM, and thirdly, the Counter-Normative Rationality Model (CRM). This third model was suggested by Gervais et al. (2018) to explain the positive correlation between belief in God and cognitive reflection that was observed in the UK. CRM claims that reflection leads to the questioning of prevalent cultural convictions, including religious beliefs. It predicts that reflection will increase belief in God in highly secularized countries. However, the findings of Baimel et al. (2021) did not support CRM. Instead, they supported the DPM and, to some extent, the ERM. Belief in God was consistently and negatively correlated with cognitive reflection, and this was most pronounced among left-leaning (vs. right-leaning) participants. Although the relationship never turned out positive as expected by ERM, the finding that the negative correlation between reflection and belief in God tended to disappear among politically conservative participants,

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can be taken as partial support for ERM. This could mean that social identity, such as allegiance to a political ideology, moderates the negative relationship between belief in God and reflection. Therefore, we aimed to further distinguish between DPM and ERM in the context of systematic variation in another natural identity: belief in God.

Previous research on ERM faced challenges in recruiting an equal representation of identity groups for experiments (e.g., Baimel et al., 2021). This limitation hampered our ability to effectively compare these groups in a balanced and demographically matched manner. However, the emergence of online data collection platforms, such as Prolific, has significantly transformed this process. These platforms enable us to categorize participants based on the information they provide in advance. This advancement positions us to test ERM more precisely by incorporating specific groups like anti-vaxxers, atheists, or practicing Christians. Such groups were previously difficult to include in experiments on an equal footing.

In our preregistered study, we used a pre-selection procedure to recruit a demographically matched sample with a balanced number of religious believers and non-believers. We took an individual's self-reported religious affiliation as a marker of social identity, which we believe is particularly apt because participants had already expressed their religious orientations prior to data collection and hence could not have been influenced by our study (see Footnote 1). Our primary objective is to address and overcome prior methodological limitations while testing the DPM and the ERM. A second limitation within the existing literature pertains to the reliance on CRT as the measure of cognitive reflection at the expense of alternative measures. However, the CRT does not cover all facets of reflection, such as verbal reflection; it mainly focuses on arithmetic reasoning (Hertzog et al., 2018). Moreover, correct answers can be attained independently of reflective processes (Bago and De Neys, 2019; Raoelison et al., 2021). Therefore, CRT should not be regarded as a sufficient measure of reflection in isolation. Here, we use a more comprehensive array of cognitive style and cognitive ability measures: Raven's Progressive Matrices (Raven, 2000), the 4-Component Thinking Styles Questionnaire (Newton et al., 2023), and an improved performance-based measure of cognitive reflection (Isler and Yilmaz, 2023).

We preregistered two distinct hypotheses, testing the expectations of the two models. The DPM posits that reflection suppresses intuitions that enable and foster the formation of religious beliefs, increasing disbelief. ERM, on the other hand, predicts that reflection will lead to motivated cognition to protect and strengthen identity-related beliefs. We hypothesized in H1, following DPM, that non-believers (atheists and agnostics) would have higher reflection and lower intuition scores than believers. DPM predicts *negative* correlations between reflection and belief in God and disbelief in evolution for both believers and non-believers. However, the ERM predicts *positive (or less negative)* correlations between reflection and belief in God and disbelief in evolution for believers and *negative* correlations for non-believers. In H2, we tested both the predictions of DPM and the ERM.

H1: DPM expects that non-believers (agnostics and atheists) will have higher reflection and lower intuition scores than believers.

H2: DPM predicts that for both believers and non-believers, there will be negative correlations between the reflection-belief in God and reflection-disbelief in evolution associations, whereas ERM predicts that there will be positive (or less negative) correlations between reflection-belief in God and reflection-disbelief in evolution for believers (but not for non-believers).

1. Method

1.1. Participants

The sample size calculation for the dataset used here is based on a different project that focuses on the consistency of moral beliefs among religious believers and non-believers (the main study's OSF page: https://osf.io/rnzy9/), for which we recruited 1200 participants from Prolific. Using pre-screened religious affiliation data provided by Prolific, we recruited 600 believers and 600 non-believers to

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complete a randomly presented set of online tasks and a final demographic survey. US residents who were native English speakers were quota-matched based on prescreening criteria (i.e., religious affiliation and subjective socioeconomic status). The median age of participants was 37 (M_{age} = 39.86, *SD* = 14.9). 49.1% of the participants were male, 47.8% female, and 2.6% identified as non-binary, while 0.6% preferred not to report gender. Most participants (65.1%) reported having either an associate, bachelor's, or a higher degree. In case of any discrepancy between the pre-screened religious affiliation answers given to Prolific and their recent religious affiliation answers in our demographic form, we used the latter answer due to its recency. As a result, 26 participants (2.2% of all participants) who did not identify as Christian, atheist, or agnostic in the demographic form were excluded from the analyses.[1] We ran our analyses on the remaining 1174 participants (see Table 1 for a summary of participants' demographic information).

1.2. Materials

***4-Component Thinking Styles Questionnaire (4-CTSQ;* Newton et al., *2023*):** 4-CTSQ has four subscales: actively open-minded thinking (AOT), which measures one's tendency to assess new information that could be contrary to their beliefs (α = .92); close-minded thinking (CMT), which relates to how likely one is to attribute only one right and one wrong answer to the events in the world (α = .87); preference for effortful thinking (PET), which measures how prone one is to think deeply and analytically about matters (α = .90), and preference for intuitive thinking (PIT), which measures how likely one is to rely on intuition and gut-feelings when making decisions (α = .95). The validity of this scale was further corroborated in a Turkish sample (Bayrak et al., 2023).

***Cognitive Performance Test (CPT;* Isler and Yilmaz, *2023*):** CPT is a measure of reflective thinking composed of five questions in a multiple-choice format. The original Cognitive Reflection Test (CRT; Frederick, 2005) constitute the first three questions. Answers to these three questions can be categorized as "reflective and correct", "intuitive and incorrect", or "non-intuitive and incorrect". In addition, the CPT includes a belief bias question and a conjunction fallacy question. These two questions have one "reflective and correct" and one "intuitive and incorrect" answer. The number of correct answers determines the reflection scores (CPT reflection), and the number of "intuitive and incorrect" answers determines the intuition scores (CPT intuition). The reliability of the reflective responses was α = .71 and the reliability of the intuitive responses was α = .68.

***Raven's Progressive Matrices (*Raven, *2000*):** We used Raven's Standard Progressive Matrices (Raven, 2000) as another measure of participants' reflection performance (Mellers et al., 2015). Following the procedure in Mani et al. (2013; Study 2), participants were presented with three 3×3 matrices with figures that make up a pattern, with one figure missing. Participants were asked to select the figure that completes the pattern correctly. The task had a reliability of α = .62.

Religious Belief: Although we prescreened participants based on their religious affiliation on Prolific, we used their most-updated religious identity as they answered in the demographic form during this study. Participants' religious affiliation was measured by a single question: "Please choose the option below that best describes your religious affiliation." Among the twenty-four religious affiliation options to this question were nine Christian affiliations (e.g., Anglican, Protestant, Catholic). We coded

[1]We excluded 6 participants who identified as Jewish and 20 participants who selected "other" in the religious affiliation question. This exclusion was not preregistered. However, when the complete sample is used (i.e., including the 26 participants), only a few results change. These new results are also in line with the direction of the results of our confirmatory analyses, supporting DPM. The rest of the results remain constant (See Supplementary Materials). The full data set, as well as the updated one, is available on the OSF page of the project.

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Table 1. *Demographic information of participants split by religious belief.*

	Christians (n = 580)	Atheists (n = 313)	Agnostics (n = 281)	Overall (N = 1174)
Age				
Minimum	18	18	18	18
Maximum	93	81	73	93
Mean	43.6	37.3	35	39.9
Gender (%)				
Male	50.3	48.2	47.3	49.1
Female	49.3	45.4	47.3	47.8
Ideology (with %)				
Conservative	198 (34.1%)	15 (4.8%)	20 (7.1%)	233 (19.8%)
Moderate	167 (28.8%)	46 (14.7%)	55 (19.6%)	268 (22.8%)
Liberal	175 (30.2%)	226 (72.2%)	184 (65.5%)	585 (49.8%)
Libertarian	19 (3.3%)	7 (2.2%)	9 (3.2%)	35 (3%)
Other	21 (3.6%)	19 (6.1%)	13 (4.6%)	53 (4.5%)

participants as Christian if they chose one of these nine options. We coded participants as non-believers if they chose the "agnostic" or "atheist" options. We also measured the strength of belief in God by a single item Likert-type question: "Do you believe in God?" (0: definitely not, 10 definitely yes).[2]

Disbelief in Evolution: The question "Do you believe in evolution?" measured participants' extent of belief in the theory of evolution (0: definitely not, 10: definitely yes). Results were reverse-scored to measure disbelief in evolution. Evolution is a topic that religious believers see related to their identity (Kahan and Stanovich, 2016). Therefore, measuring it allowed us to test the predictions of ERM more accurately for each identity group.

Balanced Inventory of Desirable Responding—Short Form (BIDR-16; Hart et al., 2015): It has been shown that religious individuals are more likely to respond in a more socially desirable manner (Sedikides & Gebauer, 2010, Trimble, 1997). To assess participants' tendency to respond to measures in ways that would make them feel better about themselves or meet social expectations, we used the BIDR-16 scale, which is composed of two subscales: the self-deceptive enhancement subscale (α = .78), which measures true but exaggerated positive responses, and the impression management subscale (α = .82), which measures how much one's responses are biased by concerns of impressing others. We used BIDR-16 scores in partial correlations to control for desirable responding tendencies.

2. Data analysis strategy

To test H1, we ran one-tailed independent samples t-tests between believers and non-believers on cognitive style and cognitive ability measures. To test H2, we ran correlation analyses with subsamples of religious believers and non-believers. For exploration, we ran partial correlations with socially desirable responses as a covariate. We also ran a Fisher's r-to-z transformation test to examine whether the correlation between cognitive reflection and belief in God and disbelief in evolution was significantly different for religious believers and non-believers.

[2]This binary classification corresponded to two clusters on the single item question, with believers having a mean score of 8.56, and non-believers having 1.20.

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Table 2. *Mean comparisons of believers and non-believers on cognitive ability and cognitive style measures.*

	Believer (n = 580)	Non-believer (n = 594)	
	M (*SD*)		*t*
AOT	3.69 (1.17)	4.94 (0.92)	−20.30**
CMT	3.26 (1.24)	2.38 (1.08)	13.05**
PIT	3.78 (1.18)	3.10 (1.17)	10.012**
PET	4.37 (1.20)	4.75 (1.09)	−5.710**
CPT reflection	1.88 (1.55)	2.67 (1.59)	−8.675**
CPT intuition	2.94 (1.50)	2.16 (1.50)	9.027**
Raven's	1.03 (1.06)	1.46 (1.12)	−6.754**

Note: **$p < .001$. Numbers outside parentheses represent group means and numbers within parentheses represent standard deviations.

3. Results

3.1 Confirmatory tests

All seven preregistered tests of H1, testing the predictions of DPM and ERM, across the 4-CTSQ subscales, the CPT, and the Raven's Progressive Matrices scores were carried out. The results are presented in Table 2 [3].

As predicted, believers ($M = 3.69$, $SD = 1.17$) had lower scores in the AOT subscale compared to non-believers ($M = 4.94$, $SD = 0.92$), $t(1172) = -20.30$, $p < .001$, Cohen's $d = -1.185$. Similarly, in the PET subscale, believers ($M = 4.37$, $SD = 1.20$) had significantly lower scores compared to non-believers ($M = 4.75$, $SD = 1.09$), $t(1172) = -5.710$, $p < .001$, Cohen's $d = -0.333$.

The performance-based reflection measures gave consistent results. In the CPT, believers' scores ($M = 1.88$, $SD = 1.55$) were lower than those of non-believers ($M = 2.67$, $SD = 1.59$), $t(1172) = -8.675$, $p < .001$, Cohen's $d = -0.506$. Believers ($M = 1.03$, $SD = 1.06$) also scored significantly lower on the Raven's Progressive Matrices compared to non-believers ($M = 1.46$, $SD = 1.12$), $t(1172) = -6.754$, $p < .001$, Cohen's $d = -0.394$.

As predicted, these differences were reversed for intuitive thinking tendencies. Believers had higher scores ($M = 3.78$, $SD = 1.18$) than non-believers ($M = 3.10$, $SD = 1.17$) on the PIT subscale, $t(1172) = 10.012$, $p < .001$, Cohen's $d = 0.584$. Believers also had higher scores ($M = 3.26$, $SD = 1.24$) on the CMT subscale compared to non-believers ($M = 2.38$, $SD = 1.08$), $t(1172) = 13.05$, $p < .001$, Cohen's $d = 0.762$. Similar results were obtained for the intuitive scores in the CPT: the intuition scores of believers ($M = 2.94$, $SD = 1.50$) were higher than those of non-believers ($M = 2.16$, $SD = 1.50$), $t(1172) = 9.027$, $p < .001$, Cohen's $d = 0.527$.

In H2, we tested the predictions of two alternative accounts. DPM predicts reflection to have a negative correlation with belief in God and disbelief in evolution for both believers and non-believers. On the other hand, ERM predicts reflection to have a positive or weak negative correlation with belief in God and disbelief in evolution for believers but a negative correlation with the same variables for non-believers. We used bivariate correlations to test this hypothesis. However, our primary variable, belief in God, exhibited a bimodal distribution (see Figure 1). To address the observed floor and ceiling effects, we devised a composite variable called "Total Reflection" and disattenuated the correlation coefficients using McDonald's Omega within each group to compensate for the unreliability of our measures. To

[3] A sensitivity power analysis revealed that, given our sample size, for a one-tailed t-test with $\alpha = .05$ and .95 power we could detect effect sizes equal to or greater than $d = .19$.

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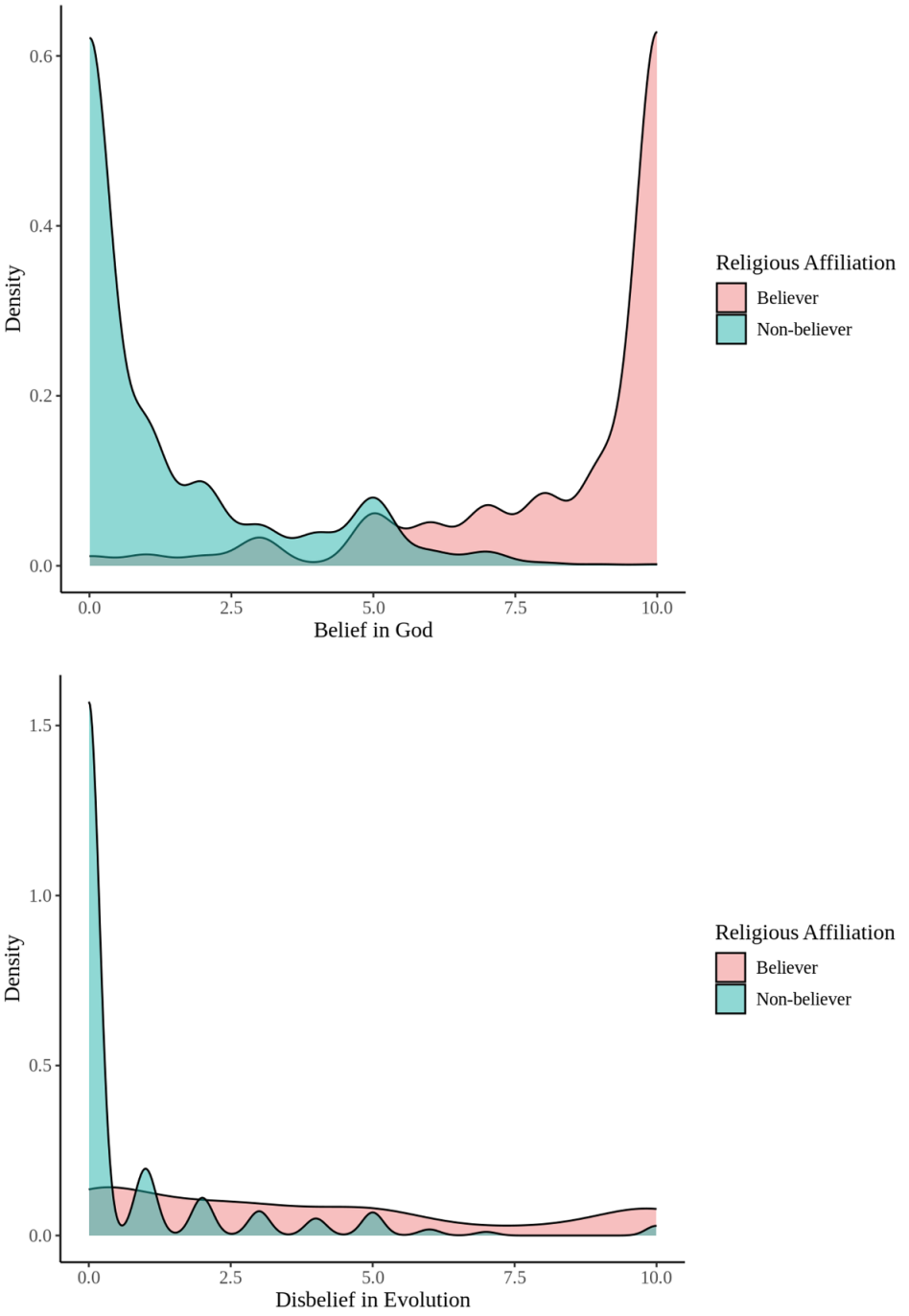

Figure 1. *Density plots of belief in god and disbelief in evolution with separated believers and non-believers.*

calculate the composite variable, we excluded the CPT intuition scores due to their multicollinearity with CPT reflection scores and computed the mean of 4-CTSQ subscales (intuition-measuring subscales were reverse coded), CPT reflection scores, and Raven's Progressive Matrices scores based on their z-scores to ensure equal weighting. Subsequently, we disattenuated all correlations to mitigate

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Table 3. *Pooled sample correlations.*

	1	2	3	4	5	6	7	8	9	10
1. Belief in God	1	.54**	−.54**	.38**	.33**	−.17**	−.25**	.26**	−.17**	−.49**
2. Disbelief in Evolution	.54**	1	−.44**	.41**	.17**	−.19**	−.22**	.22**	−.17**	−.44**
3. AOT	−.56**	−.46**	1	−.40**	−.47**	.28**	.31**	−.31**	.21**	.72**
4. CMT	.41**	.44**	−.45**	1	.25**	−.21**	−.19**	.19**	−.15**	−.59**
5. PIT	.34**	.17**	−.50**	.27**	1	−.20**	−.30**	.29**	−.18**	−.65**
6. PET	−.18**	−.20**	.31**	−.24**	−.22**	1	.21**	− .20**	.16**	.55**
7. CPT reflection	−.30**	−.26**	.38**	−.24**	−.37**	.26**	1	−.96**	.37**	.64**
8. CPT intuition	.31**	.27**	−.39**	.25**	.36**	−.25**	−1.38**	1	−.35**	−.62**
9. Raven's	−.21**	−.21**	.28**	−.20**	−.23**	.21**	.55**	−.53**	1	.56**
10. Total reflection	−.52**	−.46**	.79**	−.66**	−.70**	.61**	.80**	−.79**	.74**	1

Note. **Correlation is significant at the 0.01 level (two-tailed). Values above the diagonal represent standard correlations, while values below represent disattenuated correlations. AOT: Actively Open-minded Thinking. CMT: Close-minded Thinking. PIT: Preference for Intuitive Thinking. PET: Preference for Effortful Thinking. CPT reflection and CPT intuition: Reflection and intuition scores calculated from the CPT, respectively. Raven's: Right answers in the Raven's Progressive Matrices. Total reflection: Composite variable created using all 4-CTSQ subscales, CPT reflection, and Raven's scores.

the impact of measurement errors, thus circumventing the limitations posed by floor and ceiling effects.

We first looked at the overall pattern of correlations without separating believers and non-believers. In line with DPM, the results show negative correlations between belief in God, disbelief in evolution, and all reflection measures. Moreover, belief in God and disbelief in evolution scores are positively correlated with all intuition measures. The results are presented in Table 3.

3.2 Correlations with reflection scores

To test H2, we investigated each correlation separately for believers and non-believers as preregistered[4]. Our analyses mainly supported the DPM. As shown in Table 4, Belief in God was negatively correlated with all the self-reported (AOT, PET) and performance-based (CPT reflection, Raven's) reflection measures for both believers and non-believers except for Raven's matrices. Similarly, the associations between disbelief in evolution and reflection measures were mainly negative for both believers and non-believers, consistent with the DPM.

3.3 Correlations with intuition scores

Intuition scores are the scores on the CMT and PIT subscales of 4-CTSQ and the sum of intuitive and incorrect responses on the CPT (Isler and Yilmaz, 2023). In general, these scores were positively correlated with both belief in God and disbelief in evolution scores. The directions of the correlations we found are mainly in line with the DPM. As Table 4 demonstrates that, for belief in God, the correlation between CMT, PIT, and CPT intuition scores was positive for believers, while for non-believers, CMT and CPT intuition were only weakly correlated. Further supporting the DPM, all intuition measures were positively correlated to disbelief in evolution for both believers and non-believers, except PIT for believers.

As preregistered, we examined whether these correlations were weaker for believers than non-believers with Fisher's r-to-z transformation test using disattenuated correlations (Table 5). Some of the differences in correlation coefficients indicate support for the ERM. As the ERM predicts, reflection is

[4]A sensitivity power analysis revealed that, for bivariate correlation analyses, we could detect correlation coefficients equal to or greater than $r = .10$ for a $\alpha = .05$ and .95 power given our sample size.

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Table 4. *Correlations of study variables with separated believers and non-believers.*

	1	2	3	4	5	6	7	8	9	10
1. Belief in God	1	.31** (.18**)	−.24** (−.27**)	.23** (.02)	.14** (.23**)	−.03 (−.08*)	−.09* (−.06)	.10* (.07)	−.01 (.02)	−21** (−.18**)
2. Disbelief in evolution	.31**(.18**)	1	−.27** (−.30**)	.36** (.13**)	.01 (.14**)	−.10* (−.21**)	.10* (.19**)	.10* (.16**)	−.06 (−.15**)	−.26** (−.33**)
3. AOT	−.25** (−.29**)	−.29** (−.32**)	1	−.33** (−.19**)	−.45** (−.35**)	.20** (.31**)	.28** (.17**)	−.29** (−.15*)	.13** (.13**)	.67** (.59**)
4. CMT	.25** (.02)	.39** (.14**)	−.38** (−.22**)	1	.15** (.18**)	−.17** (−.15**)	−.14** (−.08)	.15** (.06)	−.07 (−.11**)	−.53** (−.49**)
5. PIT	.14** (.24**)	.01 (.14**)	−.49** (−.38**)	.16** (.20**)	1	−.18** (−.14**)	−.29** (−.20**)	.29** (.18**)	−.16** (−.11**)	−.63** (−.59**)
6. PET	−.03 (−.08)	−.11** (−.22**)	.22** (.35**)	−.19** (−.17**)	−.19** (−.15**)	1	.19** (.16**)	−.19** (−.14**)	.12** (.14**)	.54** (.56**)
7. CPT reflection	−.11** (−.07)	−.12** (−.23**)	.35** (.22**)	−.18** (−.10*)	−.35** (−.25**)	.24** (.20**)	1	−.95** (−.96**)	.37** (.31**)	.64** (.59**)
8. CPT intuition	.12** (.09*)	.12** (.20**)	−.38** (−.20**)	.20** (.08)	.37** (.23**)	−.25** (−.18**)	−1.38** (−1.41**)	1	−.36** (−.28**)	−.63** (−.55**)
9. Raven's	−.01 (.02)	−.08 (−.19**)	.17** (.18**)	−.10* (−.15**)	−.21** (−.14**)	.16** (.19**)	.56** (.47**)	−.56** (−.44**)	1	.52** (.56**)
10. Total reflection	−.22** (−.19**)	−.28** (−.36**)	.76** (.68**)	−.61** (−.57**)	−.69** (−.65**)	.61** (.63**)	.81** (.76**)	−.83** (−.73**)	.71** (.77**)	1

Note. Out parentheses represent believers, and within parentheses represent non-believers. *$p < .05$; **$p < .01$. Values above the diagonal represent standard correlations, while values below represent disattenuated correlations. AOT: Actively Open-minded Thinking. CMT: Close-minded Thinking. PIT: Preference for Intuitive Thinking. PET: Preference for Effortful Thinking. CPT reflection and CPT intuition: Reflection and intuition scores calculated from the CPT, respectively. Raven's: Right answers in the Raven's Progressive Matrices.

Table 5. *Fisher's Z transformation with significance tests.*

	Belief in God			Disbelief in evolution		
	Believers	Non-believers	Fisher's *Z*	Believers	Non-believers	Fisher's *Z*
AOT	−.25**	−.29**	0.73	−.29**	−.32**	0.56
CMT	.25**	.02	4.02**	.39**	.14**	4.63**
PIT	.14**	.24**	−1.77*	.01	.14**	−2.24*
PET	−.03	−.08	0.86	−.11**	−.22**	1.93*
CPTref	−.11**	−.07	−0.69	−.12**	−.23**	1.94*
CPTint	.12**	.09*	0.52	.12**	.20**	−1.23
Raven's	−.01	.02	−0.51	−.08	−.19**	1.92*
TotalRef	−.22**	−.19**	−0.53	−.28**	−.36**	1.51

Note. *$p < .05$; **$p < .001$. AOT: Actively Open-minded Thinking. CMT: Close-minded Thinking. PIT: Preference for Intuitive Thinking. PET: Preference for Effortful Thinking. CPTref and CPTint: Reflection and intuition scores calculated from the CPT, respectively. Raven's: Right answers in the Raven's Progressive Matrices. TotalRef: Total reflection score.

more strongly correlated with our outcome variables for non-believers than believers[5]. Although some of those correlations differ in magnitude depending on religious affiliation, the directions remained the same and in line with the DPM[6].

3.4 Exploratory analyses

We exploratorily compared the 4-CTSQ, CPT, and Raven's matrices scores of atheists and agnostics. Atheists ($M = 5.14$, $SD = 0.88$) scored higher in AOT than agnostics ($M = 4.71$, $SD = 0.91$), $t(592) = 5.858$, $p < .001$, Cohen's $d = .481$. Moreover, atheists ($M = 2.97$, $SD = 1.24$) scored lower on PIT than agnostics ($M = 3.23$, SD = 1.08), $t(592) = -2.758$, $p = .006$, Cohen's $d = -.24$. Atheists' scores ($M = 2.03$, $SD = 1.48$) were also lower on CPT intuition compared to agnostics ($M = 2.29$, $SD = 1.50$), $t(592) = -2.150$, $p = .032$, Cohen's $d = -.177$.

Furthermore, we explored which reflection measure was more strongly correlated to belief in God and disbelief in evolution in the overall sample. We compared correlations from dependent samples using disattenuated correlations. Results demonstrated that AOT was more strongly negatively correlated to belief in God than CPT reflection ($t = -9.53$, $p < .001$), PET ($t = -13.13$, $p < .001$), Raven's matrices ($t = -11.82$, $p < .001$), and Total Reflection ($t = -2.57$, $p = .01$). Similarly, Total Reflection had the strongest negative correlation with belief in God compared to all other measures except AOT. CPT reflection was more strongly negatively correlated to belief in God than PET ($t = 3.54$, $p < .001$) and Raven's scores ($t = -3.40$, $p < .001$). For disbelief in evolution, AOT's negative correlation was stronger than CPT reflection ($t = -6.88$, $p < .001$), PET ($t = -8.44$, $p < .001$), and Raven's ($t = -7.95$, $p < .001$). Total reflection had the same correlation coefficient as AOT. CPT reflection's correlation with disbelief in evolution was not significantly different from PET's ($t = -1.75$,

[5]The results show that, for non-believers, disbelief in evolution was more strongly negatively correlated to PET (Fisher's $Z = 1.93$, $p = .027$), CPT reflection (Fisher's $Z = 1.94$, $p = .026$), and Raven's matrices (Fisher's $Z = 1.92$, $p = .028$) compared to believers. Moreover, the positive correlation between belief in God and CMT was stronger for believers than non-believers (Fisher's $Z = 4.63$, $p < .001$) and the positive correlation between disbelief in evolution and CMT was stronger for believers than non-believers (Fisher's $Z = 4.02$, $p < .001$). However, the positive correlation between disbelief in evolution and PIT was stronger for non-believers than believers (Fisher's $Z = -2.24$, $p = .013$). Moreover, the negative correlation between disbelief in evolution and PET was stronger for non-believers than believers (Fisher's $Z = 1.93$, $p = .027$).

[6]To make a direct comparison with Kahan and Stanovich (2016), we ran the same analyses by taking median-split ideology as an identity-based grouping variable instead of religious belief. Exact same pattern of correlations emerged, reflection scores were negatively correlated (and intuition scores were positively correlated) with belief in God and disbelief in evolution, for both liberals and conservatives. Some results that were not significant before, became significant but the directions of these correlations were in line with the predictions of DPM (see Supplementary Materials).

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$p = .08$) and Raven's ($t = -1.87$, $p = .06$). PET's correlation strength did not differ from Raven's ($t = 0.28$, $p = .78$).

We also ran partial correlation analyses using BIDR-16 subscales. The results mainly remained constant.

4. Discussion

We tested the predictions of two models, the DPM, and the ERM, in explaining the cognitive origins of religious belief. In particular, we investigated the relationship between cognitive style and ability on the one hand and belief in God and disbelief in evolution on the other. The DPM predicts that reflection will be negatively correlated to belief in God and disbelief in evolution, regardless of social identity or religious belief. On the other hand, the ERM predicts that reflection will serve an identity-protective purpose, strengthening existing beliefs on topics related to social identity. In other words, it predicts that for religious believers, reflection should be positively correlated to belief in God and disbelief in evolution. We found that, on average, believers rely more on intuitive thinking and less on reflective thinking compared to non-believers. We also showed that reflective cognitive style and cognitive ability are negatively correlated to belief in God and disbelief in evolution, which mainly supports the DPM. The separate examination of believers and non-believers also supported the DPM, although the magnitudes of some of the correlations were different for believers and non-believers. For example, reflection measures (except for AOT) were more strongly negatively correlated with disbelief in evolution for non-believers compared to believers. This implies that the relationship between reflective thinking and support for an identity-marker topic is weaker for believers. Although the expected positive relationship between reflection and belief in God/disbelief in evolution by the ERM was not evident in our data, findings from our study suggest a moderating role of social identity, which is in line with the ERM's prediction.

Overall, our analyses mainly support the DPM, as almost all reflection measures were negatively correlated with belief in God and disbelief in evolution (though not all reached statistical significance). These findings suggest that both models have some explanatory power, although the DPM's power seems to be generally higher than the ERM's, at least in our dataset with a comparable number of participants for each identity group. In other words, it appears that in our sample, identity-protective cognition is also at play for some participants. Our results converge with Baimel et al.'s (2021), who also did not find clear support for the ERM.

Our study had several strengths that enabled us to overcome the limitations of previous correlational investigations. First, unlike previous studies, we did not solely depend on the CRT to measure cognitive reflection. Instead, we used both self-report and performance-based measures of reflection and intuition. Second, by recruiting a demographically matched sample of believers and non-believers, we provided a more controlled test of the relationship. Previous studies that lacked comparable sample sizes also mainly recruited college students from WEIRD cultures (Henrich et al., 2010). Arguably, the liberal-leaning composition of these studies' samples may result in undersampling of identity groups more susceptible to motivated reasoning. In these previous studies, participants were not demographically matched but categorized based on arbitrary criteria, such as a median split, or they had unequal representations of target groups rather than being prescreened based on criteria like equal numbers of identity groups. Hypotheses were tested accordingly (e.g., Baimel et al., 2021). Hence, the mixed results in prior studies might have been artifacts of sampling differences. Lastly, an overwhelming number of studies in this field were not preregistered and were underpowered. By complying with open-science practices and aiming at high statistical power, this study builds a reliable ground for future studies. One limitation our study had is that while we measured disbelief in evolution, the question used did not specify what was meant by "evolution" (i.e., human evolution via natural selection). Consequently, although the question was contextually appropriate within the study, it may have suppressed or inflated the correlation coefficients.

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While our findings support the DPM, the precise cognitive processes underlying these results remain unclear. Past research has predominantly focused on the default interventionist version of the DPM, which posits that reflection can override the intuitive processes that would otherwise further religious belief, leading to disbelief among those inclined towards reflection. However, the DPM does not explain why the strength of these correlations varies among different identity groups. Future research should concentrate on refining the predictions of the DPM to address these nuances.

Moreover, dual-process theories do not address what motivates individuals to engage in reflective thinking that ultimately distances them from religious beliefs. For instance, Nevertheless, it is plausible that various other cognitive processes associated with reflection, but not directly involved in the suppression of intuitions, could potentially be underlying the support we found for the DPM. For example, actively open-minded thinking is closely associated with but conceptually different from cognitive reflection (Baron, 2020; Baron et al., 2023). In particular, reflection predominantly emphasizes the depth and thoroughness of inquiry, but it does not assess the specific direction or path of the inquiry (Baron et al., 2015). Consistent with this distinction, Pennycook et al. (2014) observed a robust negative correlation between actively open-minded thinking and religious belief, while finding a relatively weaker negative correlation between cognitive reflection (i.e., CRT scores) and religious belief (but see Stanovich and Toplak, 2019). In addition, the dual process theory itself has received substantial criticism and calls for refinement in recent years (De Neys, 2017, 2023; De Neys and Pennycook, 2019; Pennycook et al., 2015; Thompson et al., 2018). Future research should, therefore, focus on pinpointing the precise mechanism by which reflection culminates in disbelief.

The distinction between religious believers and non-believers often stems from their differing epistemic norms. Non-believers generally rely on empirical evidence and scientific reasoning, whereas believers may prioritize sacred texts and religious experiences as their primary knowledge sources. Consequently, reflection does not uniformly lead to disbelief, as its impact varies based on the epistemic norms individuals adhere to. This variation suggests that future research could delve deeper into these differences, and experimental studies might investigate the effects of combining reflection with manipulations of epistemic norms (see also Metz et al., 2023; Baron, 2020). Notably, atheists and agnostics exhibit distinct psychological profiles (Karim and Saroglou, 2023). However, we argue that, unlike religious believers, the concept of God plays a minimal role in the lives of both these groups. In other words, supernatural monitoring and punishment exert less influence on atheists and agnostics compared to religious individuals (Gervais, 2024; Norenzayan, 2013). This distinction underpinned our decision to group atheists and agnostics together in our study. Future research could explore the potential differences between atheists and agnostics in more depth.

The counter-normative rationality model presents an explanation of the relationship between reflection and belief that is alternative to both the DPM and the ERM (see the Introduction). Despite its promise, our dataset did not allow testing of this model, which requires systematic cross-cultural variation. To date, the only study that attempted to test this model did not find empirical support for it (Baimel et al., 2021). It remains challenging to explore the reasons for the varying relationships between reflection and disbelief across nations based on data from Gervais et al. (2018). Future research should first clearly demonstrate whether there are, in fact, countries where we observe a positive correlation between reflection and belief in God. The role of potential moderating factors in this relationship would then warrant further investigation, with cultural norms being a plausible candidate. For example, cultural upbringing can influence whether someone engages in reflection or not. In highly religious countries, questioning religious beliefs weakens conformity to cultural norms and is therefore discouraged in society. This would underscore the need for broader cross-cultural tests of the same association, drawn from representative samples across a more diverse set of countries.

One could also argue that the relationship between reflection and disbelief may be specific to WEIRD countries (e.g., Caldwell-Harris et al., 2020), and our study, based on a US sample, would fit this characterization. Yet, as previously mentioned, evidence of a similar relationship also exists for non-WEIRD countries (Bahçekapili and Yilmaz, 2017; Gervais et al., 2018; Stagnaro et al., 2019). While further research is necessary, preliminary findings suggest the potential cross-cultural generality of

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this relationship. Two recent large cross-cultural studies corroborate the negative association between religious belief and reflection (Ghasemi et al., 2024; Stagnaro and Pennycook, 2025).

5. Conclusion

Our findings confirmed that the correlational relationship between cognitive reflection and belief in God is negative for both believers and non-believers, consistent with the predictions of the DPM. Identifying robust cognitive phenomena, such as the negative correlation between reflection and belief in God facilitates the elimination of alternative theories, the identification of boundary conditions, and the generation of new testable predictions (Borsboom et al., 2021; Haig, 2018). The DPM has a long-standing presence in the literature, but it remains primarily descriptive. The precise mechanisms by which intuition and reflection works is not yet well understood, with unresolved debates about the specific processes and mechanisms they refer to (De Neys, 2017, 2023). Hence, as an initial step toward refining the DPM, it is vital to detect these robust phenomena and subject them to rigorous empirical scrutiny to define boundaries of plausible interpretations. The present study contributes to this ongoing effort.

Data availability statement. Preregistration, data, and all materials used in the study are openly available on the OSF project page (https://osf.io/5964s/).

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Competing interest. The authors declare none.

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