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Cognitive style and religiosity: The role of conflict detection

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Abstract Recent research has indicated a negative relation between the propensity for analytic reasoning and religious beliefs and practices. Here, we propose conflict detection as a mechanism underlying this relation, on the basis of the hypothesis that more-analytic people are less religious, in part, because they are more sensitive to conflicts between immaterial religious beliefs and beliefs about the material world. To examine cognitive conflict sensitivity, we presented problems containing stereotypes that conflicted with base-rate probabilities in a task with no religious content. In three studies, we found evidence that religiosity is negatively related to conflict detection during reasoning. Independent measures of analytic cognitive style also positively predicted conflict detection. The present findings provide evidence for a mechanism potentially contributing to the negative association between analytic thinking and religiosity, and more generally, they illustrate the insights to be gained from integrating individual-difference factors and contextual factors to investigate analytic reasoning.

Keywords Religiosity · Cognitive style · Dual-process theories · Base-rate neglect · Conflict detection · Individual differences · Inductive reasoning · Reasoning · Social cognition

The distinction between "Type 1" (intuitive, fast, automatic) and "Type 2" (analytic, slow, deliberative) processes has been used to ground well-known deviations from normative responding in processing terms (for reviews, see Evans & Over, 1996; Kahneman, Slovic, & Tversky, 1982; Stanovich & West, 2000). Specifically, many failures of rational thought are conjectured to occur because Type 1 processes produce rapid, highly salient intuitive responses that are difficult to override via slower Type 2 processing (Evans & Frankish, 2009; Kahneman, 2003; Stanovich, 2004).

Dual-process theories provide theoretical grounding for two individual-difference factors influencing reasoning performance: cognitive *ability* (i.e., intelligence, working memory capacity, etc.) and cognitive *style* (i.e., propensity/willingness to engage Type 2 processing; Stanovich, 2009). Empirical studies based on such theorizing have reported that individual differences in cognitive style predict reasoning performance over and above cognitive ability (Stanovich & West, 2000). Moreover, in a noteworthy example of independent convergence, three recent studies have shown that cognitive style has pervasive links not only with reasoning performance on highly constrained laboratory tasks, but with entire belief systems (Gervais & Norenzayan, 2012; Pennycook, Cheyne, Seli, Koehler, & Fugelsang, 2012; Shenhav, Rand, & Greene, 2012). Specifically, individuals who are *more* likely to engage in analytic processing during problem solving are *less* likely to hold specific religious and paranormal beliefs, regardless of cognitive ability and numerous demographic and personality variables (see also Cheyne & Pennycook, 2013; Pennycook, Cheyne, Koehler, & Fugelsang, 2013). Increasing analytic processing via experimental manipulation has also been shown to decrease religious belief (Gervais & Norenzayan, 2012; Shenhav et al., 2012).

Despite this growing body of convergent evidence, the cognitive mechanisms that underlie such individual differences remain unclear. Recently, Pennycook et al., (2013) demonstrated that nonreligious participants took more time to respond to deductive reasoning problems, suggesting that response slowing may be one mechanism that plays a functional role in sustaining Type 2 reasoning and decreasing religious belief. The problem of what prompts certain people to think

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analytically about religious beliefs, however, remains unaddressed. Do analytic thinkers engage Type 2 processing nonselectively, or do religious beliefs *in particular* elicit analytic scrutiny from them? A fundamental difficulty in addressing these questions is that it is not clear what determines the likelihood and extent of Type 2 processing (Evans, 2009; Stanovich, 2009; Thompson, 2009). Although researchers have begun to address this issue (e.g., Alter, Oppenheimer, Epley, & Eyre, 2007; Thompson, Prowse Turner, & Pennycook, 2011; Thompson, Prowse Turner, Pennycook, Ball, Brack, Ophir, & Ackerman, 2013), individual differences have not been considered alongside contextual factors thought to cue Type 2 processing. Thus, the goal of the present work was two-fold: (1) to integrate research on individual differences in reasoning with an investigation of task-specific manipulations of contextual factors that cue Type 2 processing, and (2) to test a possible mechanism that may underlie the negative relation between analytic reasoning and religious belief.

Religious belief and Type 2 engagement

Pennycook et al., (2012) hypothesized that Type 2 processing negatively affects religious beliefs because such beliefs are vulnerable to conflicts between the immaterial and material worlds (i.e., based on folk mechanics, folk biology, and folk psychology; Atran & Norenzayan, 2004). Atran and Norenzayan, for example, stated that "conceptions of the supernatural invariably involve the interruption or violation of universal cognitive principles that govern ordinary human perception and understanding of the everyday world" (p. 714). Thus, belief in beings that can pass through solid objects (such as angels) is a violation of folk mechanics (i.e., the belief that objects cannot pass through solid objects; see Boyer, 1994), and so on. It follows from this perspective that more-analytic people may be less religious, in part, because they are more efficient at detecting, or more responsive to, such conflicts. Implicit in this hypothesis is that religious believers will be less likely to detect conflict between two cognitive outputs even in a reasoning task that does not involve religious belief.

Base-rate neglect and conflict detection

One example of a problem generating conflict between two cognitive outputs involves base-rate neglect. Consider the following (taken from De Neys & Glumicic, 2008; adapted from Kahneman & Tversky, 1973):

> In a study 1000 people were tested. Among the participants there were 995 nurses and 5 doctors. Paul is a randomly chosen participant of this study.
>
> Paul is 34 years old. He lives in a beautiful home in a posh suburb. He is well spoken and very interested in politics. He invests a lot of time in his career.
> What is most likely?
>
> (a) Paul is a nurse
> (b) Paul is a doctor

The personality description draws on a salient stereotype that suggests a response ("doctor") that conflicts with the extreme base-rate probability (99.5 % prior probability that Paul is a nurse). De Neys and Glumicic demonstrated that participants take longer to respond to conflict problems than to nonconflict problems (i.e., if there were five nurses and 995 doctors for the problem above), even when participants give the stereotypical response ("doctor"). The increased response times (RTs) for stereotypical responses for incongruent (conflict) problems relative to RTs for congruent (nonconflict) problems were taken as evidence that participants implicitly detected the conflict between base-rate and stereotype, despite giving a "biased" response (De Neys, 2012). In addition, activation in the anterior cingulate cortex (ACC), a well-known conflict detection center in the brain (Botvinick, Cohen, & Carter, 2004), has been shown to increase for incongruent trials in which stereotypical responses are given, relative to congruent problems (De Neys, Vartanian, & Goel, 2008). The latter finding is of particular interest, as there is evidence that religious belief is associated with lower levels of ACC activation under conditions of conflict (e.g., Inzlicht & Tullett, 2010).

Experiment 1

According to the account offered above, religious believers should show decreased conflict detection relative to nonbelievers. Specifically, individuals who are more religious should exhibit a smaller difference in RTs between incongruent stereotypical responses and congruent trials. We expected to find no relation between religious belief and RTs for congruent problems, as they do not elicit conflicting cognitive outputs. Similarly, no relation between belief and RTs for base-rate responses to incongruent problems was expected because, in such cases, the conflict has necessarily been detected (De Neys & Glumicic, 2008).[1] Finally, we expected to replicate previous research that has shown that religious believers give fewer base-rate responses (Pennycook et al., 2012).

Given that the connection between cognitive style and conflict detection during reasoning had not previously been

[1] Note that both base rates and stereotypes suggest the same response in congruent problems, and as such, participants would select the nonstereotypical/non-base-rate response for congruent problems very infrequently (De Neys & Glumicic, 2008). RTs for such "incorrect" congruent cases were therefore not considered for analysis.

established, to provide convergent validation of this relation, we also administered two self-report thinking disposition measures: the Need for Cognition scale, which is intended to measure one's general tendency to engage effortful cognition (Cacioppo, Petty, Feinstein, & Jarvis, 1996), and the Actively Open-Minded Thinking scale, which is intended to measure the willingness to engage analytic reasoning to critically and objectively evaluate arguments (Stanovich & West, 1998).

Method

Participants

A group of 78 University of Waterloo undergraduate students (53 females, 25 males; average age = 21 years) participated in a session lasting approximately 40 min. Participation was voluntary, and participants received course credit.

Measures

Base-rate problems Base-rate problems were taken from the work of De Neys and Glumicic (2008). Three types of problems were presented: (1) *incongruent* problems, containing stereotypes that conflicted with the large base-rate group (see above for an example); (2) *congruent* problems, containing stereotypes that matched the large base-rate group (i.e., if the example above included five nurses and 995 doctors); and (3) *neutral* problems, containing no stereotypical information (see De Neys & Glumicic, 2008). We included neutral problems in the study design to remain consistent with De Neys and Glumicic. They were excluded from the analysis.

Participants answered six questions of each problem type in a random order. Incongruent and congruent problems were counterbalanced across participants, such that the base-rate probability was consistent with the stereotype (congruent) for half of the participants and inconsistent with the stereotype (incongruent) for the other half. Thus, each item was congruent for half of the participants and incongruent for the other half. Three base-rate ratios were presented equal numbers of times: 995/5, 996/4, and 997/3.

Following previous research, we computed an RT difference score between congruent problems and stereotypical responses for incongruent problems (Pennycook, Fugelsang, & Koehler, 2012). Although differences in problem length were identical *across* participants because of the congruency counterbalance, item length variation could nonetheless affect the RT difference scores' reliability *within* participants. However, we noted that De Neys and Glumicic (2008) did not find any evidence for reading time differences across the incongruent and congruent problems that were presented here (see their Fig. 3, p. 1268).

Thinking disposition questionnaires Participants were given a thinking disposition questionnaire consisting of the 18 items from the Need for Cognition scale (NFC: Cacioppo et al., 1996) and 32 items from the Actively Open-Minded Thinking scales (AOT: Stanovich & West, 2006), presented in a randomly intermixed order. The thinking disposition scores were obtained by summing the responses across all the items individually for the two scales. Stanovich and West (2006) included a two-item "counterfactual thinking scale" in the AOT that was excluded from the analysis, as one of the two items asked specifically about religion. One of the items from a different AOT subscale ("openness-values") also referred explicitly to religion and was therefore excluded. Each item was scored such that higher scores represented a greater tendency toward analytic thinking. Both scales had good internal consistency: Cronbach's $\alpha = .87$ for NFC and .85 for AOT.

Religiosity Religious beliefs included five conventional beliefs held in varying degrees by religious people (Pennycook et al., 2012): heaven, hell, miracles, afterlife, and angels/demons. Participants rated their beliefs using the following 5-point scale: 1, *Strongly disagree*; 2, *Disagree*; 3, *Don't know*; 4, *Agree*; and 5, *Strongly agree*. We summed the responses to create a single religious belief measure. The scale had good internal consistency, Cronbach's $\alpha = .85$.

Results

Response times were transformed via $\log_{10}$ prior to the analysis, to reduce skewness (raw RTs are presented in Table 1). One participant had an outlying mean logRT (>3 *SD*s) in the "incongruent stereotype" cell that was replaced by the cell mean. The RT for the "incongruent base-rate" cell could not be calculated for participants who gave no base-rate responses and, likewise, RTs for the "incongruent stereotype" cell could not be calculated for participants who gave no stereotypical responses. The latter participants also did not have an RT difference score. This is the source of the varying *N*s in Table 2.

Means and standard deviations for the base-rate task are presented in Table 1A; correlations among variables are presented in Table 2. The difference in RTs between stereotypical responses for incongruent and congruent problems (i.e., the conflict detection effect) was correlated negatively with religious belief ($p = .053$; see the supplementary materials for scatterplots). This finding indicates a smaller conflict detection effect among religious believers than among nonbelievers. Religious belief was also marginally negatively correlated with RTs for stereotypical responses to incongruent

Table 1 Descriptive statistics for Experiments 1, 2 and 3

A – Experiment 1			B – Experiment 2			C – Experiment 3		
Performance	Mean	*SD*	Performance	Mean	*SD*	Performance	Mean	*SD*
Congruent	.95	.09	Congruent	.95	.10	Congruent	.96	.08
Incongruent	.48	.39	Incongruent	.36	.35	Incongruent	.44	.37
			CRT	.36	.37			
			WordSum	.65	.14			
RT (seconds)			RT (seconds)			RT (milliseconds)		
Congruent	17.0	6.4	Congruent	17.4	6.5	Congruent	794	375
Incongruent Base-Rate	18.7	7.8	Incongruent Base-Rate	21.8	12.4	Incongruent Base-Rate	1685	1251
Incongruent Stereotype	19.1	9.0	Incongruent Stereotype	19.1	7.0	Incongruent Stereotype	1353	924

CRT, cognitive reflection test. Note that performance for base-rate problems represents the proportions of base-rate responses selected. Performance for CRT and WordSum represents proportions of correct responses

problems ($p = .066$), but not with RTs for congruent problems or base-rate responses to incongruent problems ($ps > .19$). In addition, religious belief was correlated with performance on incongruent base-rate problems (i.e., proportions of responses consistent with the base-rate information, $p = .014$), and the self-report measure of actively open-minded thinking was negatively correlated with religious belief ($p < .001$). Actively open-minded thinking was also significantly positively correlated with the RT difference score ($p = .047$). Need for cognition, in contrast, did not significantly correlate with any performance or RT measures ($ps > .21$).

Experiment 2

Experiment 1 (E1) revealed a negative relation between conflict detection during reasoning and prevalence of general religious belief. However, participants were given the religious belief questionnaire directly following the base-rate task. This could potentially be problematic as participants may attempt to figure out why they are being asked about religious beliefs following a reasoning task. To guard against potential demand characteristics, in Experiment 2 we administered the religious belief questionnaire in a separate session as part of a large department-wide survey at the beginning of the semester. This survey also allowed us to obtain information on religious affiliation, used to divide the sample into religious and nonreligious groups based entirely on participant self-identification.

E1 also revealed a positive relation between RT difference and actively open-minded thinking, but not need for cognition. This finding reinforces previous research that indicates that the respective scales measure different aspects of analytic thinking disposition (Svedholm & Lindeman, 2013). As one might expect, the willingness to engage analytic thinking specifically to evaluate arguments, as measured by the AOT scale, is more strongly related to conflict detection than is the more general

Table 2 Pearson product–moment correlations among variables

	Disposition		Performance		Response Times			
	NFC	AOT	Congruent	Incongruent	Congruent	Incongruent Base-Rate	Incongruent Stereotype	RT Diff.
Religious belief	**−.32** $_{(78)}$	**−.49** $_{(78)}$	.07 $_{(78)}$	**−.28** $_{(78)}$	−.15 $_{(78)}$	−.05 $_{(59)}$	−.24 $_{(59)}$	**−.25** $_{(59)}$
NFC		**.44** $_{(78)}$	.02 $_{(78)}$	.11 $_{(78)}$	.09 $_{(78)}$	.08 $_{(59)}$	.06 $_{(59)}$	.17 $_{(59)}$
AOT			−.06 $_{(78)}$	**.31** $_{(78)}$	.09 $_{(78)}$	.17 $_{(59)}$	.23 $_{(59)}$	**.26** $_{(59)}$
Congruent				−.12 $_{(78)}$	**.26** $_{(78)}$	.17 $_{(59)}$	.14 $_{(59)}$	−.19 $_{(59)}$
Incongruent					−.19 $_{(78)}$	−.15 $_{(59)}$	.17 $_{(59)}$	.19 $_{(59)}$
Congruent RT						**.75** $_{(59)}$	**.72** $_{(59)}$	**−.32** $_{(59)}$
Incongruent base-rate RT							**.60** $_{(40)}$	−.02 $_{(40)}$
Incongruent stereotype RT								**.42** $_{(59)}$

Performance indicates proportions of base-rate responses. Disposition, thinking disposition questionnaires; NFC, Need for Cognition; AOT, actively open-minded thinking; RT Diff., difference between incongruent stereotype logRT and congruent logRT. Coefficients in bold are significant, $p \leq .05$. *N*s are in subscripts

tendency to think analytically, as measured by the NFC scale. However, given that these are both self-report measures of thinking disposition, a performance measure would represent a stronger test of the hypothesized relation between conflict detection and analytic cognitive style. Thus, we administered the cognitive reflection test (CRT; Frederick, 2005), a more direct behavioral measure of analytic style (Toplak, West, & Stanovich, 2011). Finally, we assessed verbal intelligence using the WordSum task (Huang & Hauser, 1998) to investigate whether conflict detection is selectively correlated with cognitive style or, potentially, both cognitive ability and style.

Method

Participants

A group of 200 University of Waterloo undergraduate students (136 females, 64 males; average age = 19.9 years) participated in a session lasting approximately 30 min. Participation was voluntary, and participants received course credit.

Measures

Base-rate problems Base-rate problems were administered as in E1.

Cognitive reflection test The CRT consists of three quasi-mathematical problems that generate implicit misleading intuitions that require analytic processing to override, for example:

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

WordSum The WordSum task is a vocabulary test that is used as a brief measure of verbal intelligence. It correlates well with full-scale measures of intelligence (Huang & Hauser, 1998). Participants were presented a list of ten target words in capital letters and asked to choose the option that most closely matches the meaning of the target word. For example, CAPRICE was presented alongside the following options: (1) value, (2) a star, (3) grimace, (4) whim, (5) inducement, and (6) don't know.

Religiosity We extended the religious belief questionnaire used in E1 to include eight conventional religious beliefs: heaven, hell, miracles, afterlife, angels, demons, soul, and the devil/Satan. The scale had good internal consistency: Cronbach's α = .94. Participants were also presented a list of religious affiliations and asked to select the option that they most strongly identified with. The list included the following options: Agnostic, Atheist, Buddhist, Chinese traditional, Christian, Christian (specifically Catholic), Christian (specifically Protestant), Hindu, Muslim, No religion, Sikh, and Other/not listed. In total, 25.5 % of the sample selected the agnostic or the atheist option, and 15 % selected "no religion" or declined to answer. A large proportion of the sample (49.5 %) chose "Christian," "Christian (specifically Catholic)," or "Christian (specifically Protestant)." The remaining 10 % selected a non-Christian religious affiliation.

Results

RTs were transformed via $\log_{10}$ prior to the analysis. Two participants had outlying mean logRTs (>3 *SD*s) that were replaced by the cell means; one in the "incongruent stereotype" cell and one in the "incongruent base-rate" cell. Additionally, one participant had an outlying logRT difference score that was replaced by the mean prior to analysis.

Means and standard deviations are presented in Table 1B; correlations among variables are presented in Table 3. Religious belief was negatively correlated with performance on incongruent base-rate problems, the CRT, and the WordSum ($ps \leq .001$). However, in contrast to E1, there was no significant negative correlation between religious belief and the RT difference score (p = .151). Performance on the CRT was correlated positively with both RT for stereotypical responses to incongruent problems (p = .001) and the RT difference score (p = .049), suggesting that those who have a more analytic cognitive style are more likely to detect and respond to the conflict between stereotypes and base rates (see the supplementary materials for scatterplots). Consistent with the hypothesis that cognitive style (and not ability) relates specifically to conflict detection, WordSum performance was not correlated with any RT measure ($ps > .28$). However, WordSum and CRT were both independent predictors of incongruent base-rate performance, both r_ps > .26, $ps < .001$. Thus, it may be the case that cognitive ability plays a role in recognizing the importance of the base rates, but does not relate to increases in analytic reasoning as a function of conflict detection.

An alternative test of the conflict detection hypothesis would be to determine the extent to which self-identified agnostic and atheists differed from the religiously affiliated in terms of the conflict detection effect. To do this, we created three groups based on religious affiliation (agnostics/atheists, no religion, and religiously affiliated) and compared the magnitudes of the conflict detection effect (i.e., the RT difference score). Three participants who declined to answer the affiliation question were excluded from this analysis. A one-way ANOVA revealed a significant difference across the three groups, $F(2, 168) = 3.53$, SE = .01, p = .032, η_p^2 = .04 (Fig. 1A; see the supplementary materials for a figure with raw RTs). A follow-up independent-samples t test revealed a difference between agnostics/atheists and the religiously

Table 3 Pearson product–moment correlations among variables

	Performance				Response Times			
	CRT	WordSum	Congruent	Incongruent	Congruent	Incongruent Base-Rate	Incongruent Stereotype	RT Diff.
Religious Belief	**–.26** (198)	**–.23** (198)	.04 (200)	**–.29** (200)	–.02 (200)	–.04 (144)	–.04 (174)	–.11 (174)
CRT		**.40** (196)	.02 (198)	**.46** (198)	.03 (198)	.07 (142)	**.25** (172)	**.15** (172)
WordSum			–.02 (198)	**.40** (198)	–.01 (198)	.06 (142)	.07 (172)	.08 (172)
Congruent				.01 (200)	.07 (200)	.08 (144)	.07 (174)	.07 (174)
Incongruent					–.13 (200)	**–.26** (144)	**.35** (174)	**.28** (174)
Congruent RT						**.75** (144)	**.78** (174)	**–.23** (174)
Incongruent Base-Rate RT							**.55** (118)	–.04 (118)
Incongruent Stereotype RT								**.40** (174)

Performance for the base-rate problems represents proportions of base-rate responses selected. Performance for the cognitive reflection test (CRT) and WordSum represents proportions of correct responses. RT Diff., difference between incongruent stereotype logRT and congruent logRT. Coefficients in bold are significant, $p \leq .05$. *N*s are in subscripts

affiliated, $t(149) = 2.69$, $SE = .02$, $p = .008$, $\eta_p^2 = .05$. We found no difference between those who selected "no religion" and either of the two other groups, ts < 1.02. Separate one-sample t tests indicated that the RT difference score was different from zero for agnostics/atheists, $t(39) = 4.15$, $SE = .06$, $p < .001$, and marginally different from zero for the religious affiliated, $t(111) = 1.76$, $SE = .02$, $p = .081$.

Experiment 3

Experiment 2 (E2) provided further evidence of the proposed relation between analytic cognitive style and conflict detection by demonstrating a positive correlation between CRT performance and the RT difference score. We also refined the results by assessing potential effects of verbal intelligence. Importantly, we found that those who self-identified as being atheist/agnostic produced a larger conflict detection effect than did the religiously affiliated. The degrees to which our participants agreed/disagreed with a number of standard religious beliefs were not correlated with conflict detection, however, in contrast to results for E1.

One explanation for our failure to replicate the negative correlation between degree of religious belief and conflict detection was the large variability in RT difference scores that arises from giving participants only 12 problems to answer. To counteract this problem, we used a novel rapid-response version of the base-rate task developed by Pennycook et al., (2013), which allowed us to present participants with a large number of problems, thus giving us more stable measures of RT. As in E2, participants were asked about their

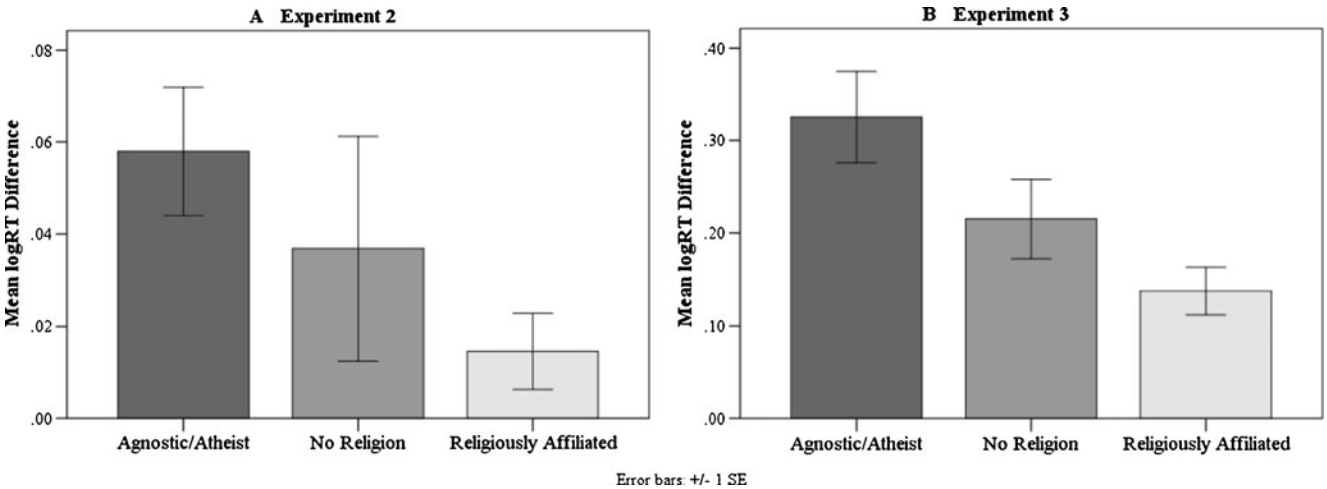

Fig. 1 Mean response time (RT) differences between stereotypical responses to incongruent problems and congruent problems, as a function of religious affiliation for Experiments 2 and 3. The values represent RTs transformed via $\log_{10}$

religious belief and affiliation at an earlier date as part of a mass-testing survey.

Method

Participants

A group of 90 University of Waterloo undergraduate students (69 females, 21 males; average age = 20.7 years) participated in a session lasting approximately 30 min. Participation was voluntary, and participants received course credit.

Measures

Rapid-response base-rate task As for traditional base-rate problems, the items consisted of two paired professions that were highly dissimilar in terms of the selected personality traits in a pretest (see Fig. 2 for an example; Pennycook et al., 2012, 2013). We created 132 items that were presented in two blocks of 66. Participants were given a short break between blocks. Three extreme base-rate probabilities were used equal numbers of times: 995/5, 996/4, and 997/3. Congruency was counterbalanced by changing the personality traits for each pair across blocks. For example, "995 politicians and 5 nannies" was paired with "kind" (indicating that the person was likely a nanny, on the basis of the stereotype) in Block 1 (see Fig. 2), and with "dishonest" in Block 2 (indicating that the person was likely a politician, on the basis of the stereotype). In the former case, the problem was incongruent because the base-rate probability (i.e., 99.5 % chance the randomly selected person was a politician) conflicted with the stereotype (i.e., that the person was a kind nanny). In the latter case the problem was congruent, because the base rate and stereotype pointed to the same response (i.e., that the person was a dishonest politician).

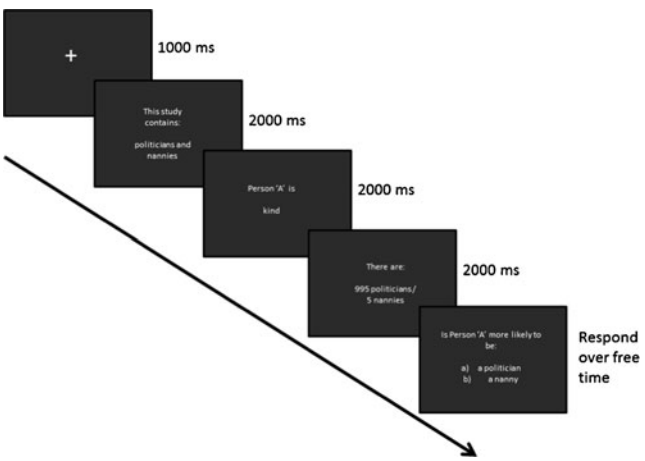

Fig. 2 Procedure for the rapid-response base-rate task

The procedure for the rapid-response base-rate task is depicted in Fig. 2. The content for each of the items was broken up such that participants were first presented the groups in question, followed by the stereotype, the base rates, and finally, the prompt. The items were presented to participants in a random order.

This task was created as part of a larger ongoing study that is focused specifically on conflict detection during reasoning (Pennycook et al., 2013). The task is arguably a more sensitive measure of conflict detection because RTs are collected *only* at the decision stage, and therefore are not likely to be strongly influenced by reading time or other sources of variability that would surely arise with 10- to 15-s RTs (see Pennycook et al., 2013, for a similar discussion). In this way, it is more akin to traditional cognitive (nonreasoning) paradigms that assess conflict processing, such as the Stroop task (as discussed below), than are typical reasoning and decision-making tasks.

Religiosity Our religious belief measure was identical to that from E2. As in E2, the scale had good internal consistency in this sample: Cronbach's α = .95. In total, 21.1 % of the sample self-selected as being agnostic or atheist, and 16.7 % selected "no religion" or declined to answer. Another 42.3 % chose "Christian," "Christian (specifically Catholic)," or "Christian (specifically Protestant)," and the remaining 19.9 % selected a non-Christian religious affiliation.

Results

RTs were transformed to $\log_{10}$ prior to the analysis. All participants had logRTs that were within three standard deviations of the cell means.

The means and standard deviations for the base-rate task are presented in Table 1C; correlations among the variables are presented in Table 4. As predicted, and replicating E1, religious belief was negatively correlated with the RT difference score (p = .034), indicating increased conflict detection as a function of decreasing religious belief (see the supplementary materials for scatterplots). In addition, as in E1, religious belief was also negatively correlated with the RT for stereotypical responses to incongruent problems (p = .048). The proportion of base-rate responses selected was not, however, correlated with religious belief (p = .158). It is possible that under heavy repetition, attention may be called to the base rates (Novemsky & Kronzon, 1999), thereby undermining the influence of individual differences in cognitive style. We note, however, that the accuracies for incongruent items did differ between agnostics/atheists (M = .62, SD = .35) and the religiously affiliated (M = .39, SD = .36), $t(72) = 2.49$, SE = .10, p = .015, η_p^2 = .07.

Table 4 Pearson product–moment correlations among variables

	Performance		Response Times			
	Congruent	Incongruent	Congruent	Incongruent Base-Rate	Incongruent Stereotype	RT Diff.
Religious belief	.10 $_{(89)}$	−.15 $_{(89)}$	−.07 $_{(89)}$	.06 $_{(89)}$	**−.22** $_{(84)}$	**−.23** $_{(84)}$
Congruent		−.13 $_{(90)}$	−.12 $_{(90)}$	−.05 $_{(90)}$	.02 $_{(85)}$	.17 $_{(85)}$
Incongruent			.07 $_{(90)}$	**−.51** $_{(90)}$	**.61** $_{(85)}$	**.81** $_{(85)}$
Congruent RT				**.66** $_{(90)}$	**.71** $_{(85)}$	−.03 $_{(85)}$
Incongruent base-rate RT					**.21** $_{(85)}$	**−.39** $_{(85)}$
Incongruent stereotype RT						**.69** $_{(85)}$

Performance indicates proportions of base-rate responses. RT Diff., difference between incongruent stereotype logRT and congruent logRT. Coefficients in bold are significant, $p \leq .05$. *N*s are in subscripts

As in E2, we created three groups based on religious affiliation (agnostics/atheists, no religion, and religiously affiliated) and compared the magnitudes of the conflict detection effect (i.e., the RT difference score). Two participants who declined to answer the affiliation question were excluded from this analysis. A one-way ANOVA revealed a significant difference across the three groups, $F(2, 81) = 7.00$, $SE = .04$, $p = .002$, $\eta_p^2 = .15$ (Fig. 1B; see the supplementary materials for a figure with raw RTs). Replicating E2, an independent-samples *t* test revealed a difference between agnostics/atheists and the religiously affiliated, $t(69) = 3.61$, $SE = .05$, $p = .001$, $\eta_p^2 = .16$. In addition, and also replicating E2, no difference emerged between those who selected "no religion" and agnostics/atheists, $t(30) = 1.59$, $SE = .07$, $p = .123$, $\eta_p^2 = .08$, or the religiously affiliated, $t(63) = 1.39$, $SE = .06$, $p = .171$, $\eta_p^2 = .03$. Separate one-sample *t* tests indicated that the RT difference scores were different from zero for all three groups, all ts > 5.00, ps $< .001$.

Discussion

Previous research has shown that conflict between salient stereotypes and extreme base-rate probabilities reliably cues deliberative thought processes, as indexed by increases in RTs (e.g., De Neys & Glumicic, 2008). In addition, previous research has shown that participants with an analytic cognitive style are more likely to override intuitive stereotypical responses (e.g., Stanovich & West, 1998). Here we integrated these two previously independent accounts by providing evidence consistent with the hypothesis that participants with an analytic cognitive style are more likely to detect conflicts during reasoning. In contrast, verbal intelligence as measured by the WordSum task was not significantly correlated with any RT measure (E2). Apparently, two separable consequences of being an analytic thinker in disposition are (1) recognizing implicitly when Type 2 processing is needed (indexed here by RT differences) and (2) selectively employing it (indexed here by base-rate responses). This finding, paired with recent evidence that has indicated that cognitive style affects entire belief systems (e.g., Shenhav et al., 2012), highlights the importance of individual differences in the propensity for analytic thought for psychology in general.

Possible sources of conflict detection and religiosity

Numerous studies have established that activation in the anterior cingulate cortex (ACC) is associated with cognitive conflict (see Bush, Luu, & Posner, 2000, for review), such as occurs with tasks like the color-naming Stroop task (MacLeod, 1991). For incongruent Stroop trials, the conflict is between a word and a color response, thereby leading to increased ACC activation relative to congruent trials (Carter & van Veen, 2007). This cognitive conflict is potentially similar to the conflict assessed in base-rate tasks. Indeed, using base-rate problems similar to those employed here in E1 and E2, De Neys et al. (2008) found increased activation in the ACC in cases in which participants gave the stereotypical response to incongruent problems, relative to congruent problems. This suggests that the role of the ACC in conflict detection is generalizable across both basic cognitive tasks and higher-order reasoning tasks and indicates that religious believers should show evidence of decreased ACC activity as a result of lowered conflict detection relative to the nonreligious.

In a series of experiments, Inzlicht and colleagues reported such a result (Inzlicht, McGregor, Hirsh, & Nash, 2009; Inzlicht & Tullett, 2010). For example, the degree of ACC activation on incongruent Stroop trials was negatively related to the degree of religious zeal, belief in God (Inzlicht et al., 2009), and religious service attendance (Inzlicht & Tullett, 2010). This research, in conjunction with the results reported here, converges on the conclusion that part of the reason why some people are nonreligious may be because they are better at detecting and responding to conflicts during reasoning and decision making. It should be noted, however, that this is not the interpretation of the ACC–

religiosity association that Inzlicht and colleagues adopted (Inzlicht, Tullett, & Good, 2011a). Rather, the authors posited that religiosity *decreases* ACC activation as a way to alleviate anxiety. It is not clear, however, how anxiety and distress relate specifically to making stereotypical decisions about group membership or color-naming judgments. Indeed, the increased ACC activation as a function of conflict detection during base-rate neglect reported by De Neys et al. (2008) was localized to the dorsal portion of the ACC, suggesting a more cognitive and less emotional source of activation (Bush et al., 2000). However, it may be the case that the relation between religiosity and ACC function is dynamic and bidirectional, not only because those who have lower ACC function are more likely to be religious, but also because *increased* religiosity may subsequently further inhibit ACC function (for further discussion, see Bulbulia & Schjoedt, 2011; Inzlicht, Tullett, & Good, 2011b; Schjoedt & Bulbulia, 2011). Clearly, future work will be required to further elucidate the various cognitive and affective factors that lead to, and result from, religious belief and participation.

Implications for the science of religious belief

Although previous research has shown a negative relation between the propensity for analytic thought and supernatural belief (Cheyne & Pennycook, 2013; Gervais & Norenzayan, 2012; Pennycook, Cheyne, et al., 2012; Shenhav et al., 2012), the possible mechanisms underlying this relation, apart from general response slowing (Pennycook et al., 2013), are unknown. The present results suggest that one reason why less-analytic people are more religious is that they are less efficient at detecting and/or reacting to conflict when reasoning about beliefs. Thus, one need not explicitly decide to critically examine religious beliefs. Rather, one's disposition toward analytic thought may determine the likelihood of implicitly detecting conflict between nonmaterial religious beliefs and our understanding of the material world. Under the present hypothesis, the persistence of religious and paranormal claims over history is no surprise; as long as a significant proportion of the population does not reliably detect or react to reasoning conflicts, particularly those as salient as the type used in our base-rate task (Pennycook, Fugelsang, et al., 2012), religious beliefs should remain prominent even as Western society continues to be permeated by scientific naturalism.

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