Religiosity Predicts Evidentiary Standards

Article *in* Social Psychological and Personality Science · September 2019

DOI: 10.1177/1948550619869613

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Abstract

Research shows that religious and nonreligious individuals have different standards of evidence for religious and scientific claims. Here, in a preregistered replication and extension of McPhetres and Zuckerman, participants read about an effect attributed to either a scientific or religious cause, then assessed how much evidence, in the form of successful replications, would be needed to confirm or to reject the causal claim. As previously observed, religious individuals exhibited a bias for believing religious claims relative to scientific claims, while nonreligious individuals were consistent in their standards of evidence across domains. In a novel extension examining standards of evidence with respect to failures of replication, we found that religious individuals were consistent across domains, whereas nonreligious individuals indicated a lower threshold for rejecting religious claims relative to scientific claims. These findings indicate asymmetries in the evaluation of claims based on the presence versus absence of supportive evidence.

Keywords

religion, science, evidence, decision-making

Multiple lines of research find that religious believers and nonbelievers are likely to differ in their cognitive dispositions and reasoning abilities. For example, avowed believers, in comparison to nonreligious individuals, evince stronger tendencies to attribute agency and intentionality to natural processes (Crespi & Badcock, 2008) and show poorer abilities to understand nature in mechanistic terms (Baron-Cohen, 2002; Lindeman & Lipsanen, 2016). Similarly, strength of religious belief has been found to predict the likelihood of a person discounting base-rate information in favor of intuitions in reasoning problems (Pennycook, Cheyne, Barr, Koehler, & Fugelsang, 2014). Additionally, religious believers are less likely than nonbelievers to be able to consistently distinguish between good reasons and bad reasons for beliefs about the existence of God (Cardwell & Halberstadt, 2019).

Several researchers have suggested that, in general, religious individuals may be less inclined to evaluate information critically and may be more reliant than nonbelievers on an intuitive cognitive style and the use of cognitive heuristics than on a reflective, analytical cognitive style (Browne, Pennycook, Goodwin, & McHenry, 2014; Gervais & Norenzayan, 2012; Pennycook et al., 2014; Pennycook, Ross, Koehler, & Fugelsang, 2016; Shenhav, Rand, & Greene, 2012). However, it should be noted that studies using the Cognitive Reflection Test (Frederick, 2005) as a measure of participants' dispositions toward analytical thinking have not consistently replicated the association between religiosity and analytical cognitive style (see Finley, Tang, & Schmeichel, 2015; Sanchez, Sundermeier, Gray, & Calin-Jageman, 2017). Nevertheless, research generally converges on the finding that religious believers and nonbelievers differ in their cognitive dispositions.

Such differences in the cognitive dispositions of religious believers and nonbelievers may help explain why believers are generally less scientifically literate (Sherkat, 2011) and identify less with science (Rios, Cheng, Totton, & Shariff, 2015) than nonbelievers, despite the tendency for many scientists and members of the general public to believe there is no conflict between science and religion (Ecklund, Johnson, Scheitle, Matthews, & Lewis, 2016; Scheitle & Ecklund, 2017). The apparent disconnect between religiosity and scientific literacy or identification with science may be driven by differences in how religious and nonreligious individuals set evidentiary standards for claims about the world (McPhetres & Zuckerman, 2017).

Beyond differences in cognitive style, religious and scientific claims also inherently differ in their falsifiability. Scientific claims are evaluated in terms of their concordance with empirical observations (Popper, 2005) and scientists

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confronted with inconsistent data will eventually develop new theories (Kuhn, 1970). By contrast, religious beliefs that make factual claims appear equipped with epistemological escape clauses that reframe apparent contradictions in ways that preserve belief (Boudry & Braeckman, 2012; Friesen, Campbell, & Kay, 2015; Van Leeuwen, 2017).

Differences in the cognitive and reasoning abilities of religious believers and nonbelievers, as well as differences in the characteristics of religious and scientific claims, reveal a need to explore how people set evidentiary standards for believing a given claim. Exploring factors that influence how people evaluate religious and scientific claims in light of empirical evidence is important for contributing to an understanding of religious and nonreligious beliefs as well as scientific literacy.

McPhetres and Zuckerman (2017) designed a novel method used across three studies to assess whether religious people differ regarding the amount of supporting evidence needed to believe either religious or scientific claims. In Study 1, participants read a brief vignette about a group of people trying to cure ill people using either a new medicine (i.e., a scientific method) or prayer (i.e., a religious approach). Participants read that this group has already tested their approach on one ill person who was subsequently cured. Afterward, participants were asked how many additional people would need to be cured before they could confirm the approach being used was responsible for the effect. McPhetres and Zuckerman found that, relative to nonbelievers, religious participants required fewer instances in which prayer coincided with recovery to confirm the efficacy of prayer. Religious participants also required less evidence to confirm a claim about prayer healing relative to a scientific claim about medication efficacy. By contrast, the standard of evidence required to believe scientific claims was not significantly different between religious and nonreligious participants. McPhetres and Zuckerman repeated this design to assess how people evaluated evidence for religious and scientific claims for predicting the outcome of coin tosses and for identifying a guilty suspect in a criminal investigation, finding similar patterns of results for both subsequent studies. These results are suggestive that religious believers are more credulous toward religious claims but not more doubtful of scientific claims, but these results are limited to evidence supporting a claim.

In a preregistered replication study (http://osf.io/evhzu), we aim to extend the results of the first study reported in McPhetres and Zuckerman (2017) by exploring how religious and nonreligious individuals treat disconfirming as well as supporting evidence. Disconfirming or contradictory evidence plays a central role in scientific discovery and advancement, driving the refinement or overturning of accepted scientific theories (Kuhn, 1970; Popper, 2005). In addition, in daily life, people regularly and immediately update their beliefs about mundane matters in response to contradictory evidence. By comparison, empirical religious claims do not typically get updated by believers in response to contradictory evidence (Van Leeuwen, 2017).

If there were a general bias by religious individuals to believe religious claims, we would expect results consistent with McPhetres and Zuckerman (2017) regarding supporting evidence. Moreover, we would also expect religious individuals to require a greater number of failed replications before discounting a religious claim relative to a scientific claim. As such, we hypothesized that religious individuals would require fewer successful replications to be certain of a religious claim than for being certain of a scientific claim. We further hypothesized that religious individuals would need more failed replications before discounting a religious claim than would be needed to discount a scientific claim.

Method

Participants

To account for possible overestimations of effect sizes in the original study, we set a target sample size per cell of 200% the sample size reported by McPhetres and Zuckerman. We initially recruited 847 participants through Amazon's Mechanical Turk, in exchange for US$0.60 per participant, although 78 were never finished, resulting in an initial sample of 769. Because of recent concerns that Mechanical Turk participants may be using scripts or bots to complete studies automatically (Dreyfuss, 2018), we preregistered exclusionary criteria to filter out data of questionable quality. Of the initial 769 participant data sets collected using these criteria, we further screened out data sets with missing responses, multiple data sets originated from the same Internet Protocol address, and data sets that failed attention check items. Our final sample included 703 participants ($M_{age} = 38.8$ years, $SD_{age} = 11.6$ years, male = 378, female = 325). There were 396 participants who reported being nonreligious and 307 who reported being religious.

Materials

We adapted vignettes created by McPhetres and Zuckerman for our replication. Participants were randomly assigned to read one of the four vignettes of a group of people trying to cure an illness. In the "science" domain condition, participants read about a group of scientists testing a medicine to see if it will treat an illness. In the "religion" domain condition, participants read about a group of people praying to God to see if it will treat an illness. In both conditions, participants are told that the group has tested the technique on one person who was cured. Then, participants are randomly assigned to respond to a question asking about how much evidence it would take before participants could be certain the medication or prayer did or did not work. In the "successful replication" condition, participants were asked how many additional people would need to be cured before they could be certain the medication or prayer was responsible for curing the illness. This condition recreates the design of McPhetres and Zuckerman (2017). In the "failed replication" condition extending the design of McPhetres and Zuckerman, participants were asked how many people would

need to remain ill before they could be certain the medication or prayer does not cure the illness.

Participants also responded to a 6-item religiosity measure used in McPhetres and Zuckerman's original studies and adapted from previous research on religiosity ($\alpha = .97$; Cohen, Shariff, & Hill, 2008). Participants rated how much they agreed or disagreed with statements such as "My faith or religion is an important part of my identity" on a 7-point Likert-type scale (1 = *strongly disagree*, 7 = *strongly agree*). In addition, participants responded to individual difference measures to explore possible moderation of evidentiary standards for confirming or rejecting a scientific or religious claim. These exploratory analyses are included in the Supplemental Online Material (SOM). The individual difference measures included (a) the Credibility of Science Scale (Hartman, Dieckmann, Sprenger, Stastny, & DeMarree, 2017), (b) a modified Political Issues Index (Dodd et al., 2012; Holbrook, López-Rodríguez, & Gómez, 2018), (c) the Conspiracy Mentality Questionnaire (Bruder, Haffke, Neave, Nouripanah, & Imhoff, 2013), and (d) a modified Inclusion of Other in Self Scale (Holbrook et al., 2018).

Procedure

The design and procedure of this study were adapted from Study 1 reported by McPhetres and Zuckerman (2017). Our study employed a 2 (domain: science, religion) × 2 (evidence type: successful replication, failed replication) × 2 (participant religiosity: religious, nonreligious) between-subjects design in which participants were randomly assigned to read a scenario describing a group of people curing an individual with either a scientific method (i.e., medicine) or a religious method (i.e., prayer; see SOM). After reading through the vignette, participants were asked to respond to one question about either (a) how many successful replications would be needed for them to confirm the proposed causal mechanism or (b) how many failed replications would be needed for them to reject the proposed causal mechanism.

Next, participants responded to (a) a question asking whether they consider themselves to be religious; (b) the 6-item religiosity measure (Cohen et al., 2008); and (c) a demographics form, presented in a fixed order. All of these constitute a direct reproduction of the procedure used by McPhetres and Zuckerman. Following the primary measures of interest, participants then completed the individual difference measures described above for preregistered exploratory analyses (see SOM). Importantly, the effects of religiosity reported in what follows obtain when controlling for covarying individual differences in political orientation and the other trait measures (see SOM for analyses).

Results

To test for differences in evidentiary standards, we conducted a 2 (domain: science, religion) × 2 (evidence type: successful replication, failed replication) × 2 (religiosity: religious, nonreligious) between-subjects analysis of variance (see Figure 1). The data were heteroscedastic, therefore we subjected the data to a nonparametric Kruskall–Wallis analysis as well. Except where noted, results were consistent across both parametric and nonparametric analyses (see SOM). Results revealed significant main effects of domain, $F(1, 695) = 37.28$, $p < .001$, $\eta_p^2 = .05$; and evidence type, $F(1, 695) = 15.85$, $p < .001$, $\eta_p^2 = .02$. These main effects were qualified by several significant interaction effects. Results revealed a significant domain by evidence-type two-way interaction, $F(1, 695) = 7.71$, $p = .006$, $\eta_p^2 = .01$; a significant evidence type by religious two-way interaction, $F(1, 695) = 27.07$, $p < .001$, $\eta_p^2 = .04$; and a significant domain by evidence type by religious three-way interaction, $F(1, 695) = 15.18$, $p < .001$, $\eta_p^2 = .02$ (see Table 1 for descriptive statistics). Sensitivity analysis conducted using G*Power (Faul, Erdfelder, Bucher, & Lang, 2009) with power set to .80 and α set to .05 revealed our analysis was powered sufficiently to detect effect sizes as small as $f = .10$, corresponding roughly to $\eta_p^2 = .01$.

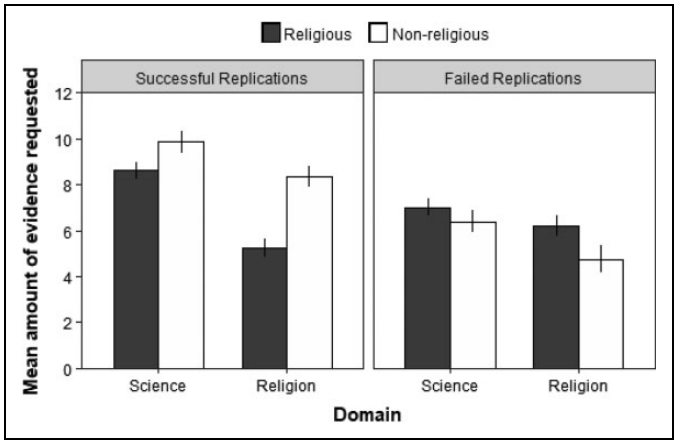

Figure 1. Interaction between domain, participant religiosity, and evidence type. Error bars represent 95% confidence interval. Responses were made on a scale from 1 (*one*) to 12 (*100+*).

Table 1. Mean (*SD*) Successful Replications/Failed Replications Requested for Scientific Versus Religious Claims by Religious or Nonreligious Participants.

	Successful Replications		Failed Replications	
Participants	Science	Religion	Science	Religion
Religious	8.36 (3.83) $n = 61$	4.53 (3.88) $n = 77$	6.66 (4.03) $n = 102$	7.00 (4.40) $n = 67$
Nonreligious	9.48 (3.50) $n = 87$	7.76 (4.35) $n = 124$	6.96 (4.05) $n = 105$	4.54 (4.09) $n = 80$

Treatment of Supportive Evidence by Religious and Nonreligious Individuals

Follow-up pairwise comparisons revealed that our results mostly replicated the findings of McPhetres and Zuckerman

(2017) regarding the number of successful replications required before confirming scientific and religious claims (see Figure 1). We found that religious participants required fewer successful replications to confirm a religious claim than to confirm a scientific claim, $p < .001$, $\eta_p^2 = .04$. Religious participants needed fewer successful replications to confirm a religious claim than nonreligious participants did, $p < .001$, $\eta_p^2 = .04$. Likewise, our results showed that nonreligious participants and religious participants did not significantly differ in the number of successful replications needed before confirming a scientific claim, $p = .097$, $\eta_p^2 = .004$. However, whereas McPhetres and Zuckerman did not find that nonreligious participants needed significantly different numbers of successful replications for scientific or religious claims in spite of a trend in that direction, we found that nonreligious participants needed significantly more successful replications to confirm a scientific claim than to confirm a religious claim, $p = .002$, $\eta_p^2 = .01$ (nonparametric analyses produced a nonsignificant comparison between these groups, see SOM). This discrepancy between our results and those of McPhetres and Zuckerman (2017) is likely due to differences in power. Overall, participants needed more successful replications to confirm a scientific claim than a religious claim and the most evidence required was by nonreligious participants for a scientific claim. The pattern of results here is nearly identical to the pattern of results reported by McPhetres and Zuckerman, suggesting that when it comes to evaluating supporting evidence for a claim, there appears to be a bias favoring the believability of religious claims among religious individuals. Interestingly, there may be a similar bias toward believing religious claims among nonreligious individuals as well.

Treatment of Disconfirming Evidence by Religious and Nonreligious Individuals

Contrary to our hypothesis, religious participants did not need significantly more failed replications before rejecting a religious claim relative to the number of failed replications required before rejecting a scientific claim, $p = .589$, $\eta_p^2 < .001$ (see Figure 1). However, nonreligious participants reported needing significantly fewer failed replications before rejecting a religious claim relative to a scientific claim, $p < .001$, $\eta_p^2 = .02$. Furthermore, nonreligious participants and religious participants did not significantly differ in the number of failed replications required before rejecting a scientific claim, $p = .587$, $\eta_p^2 < .001$. These results suggest nonreligious individuals may have a bias in favor of rejecting religious claims.

Differences Between Supportive and Disconfirming Evidence Across Domains

We conducted exploratory follow-up pairwise analyses to further examine potential differences by religious and nonreligious participants in their treatment of supportive versus disconfirming evidence. Nonreligious participants needed more successful replications to confirm a scientific claim than failed replications needed to reject a scientific claim, $p < .001$, $\eta_p^2 = .03$. This same pattern was true for nonreligious participants' treatment of a religious claim, $p < .001$, $\eta_p^2 = .04$. This suggests that nonreligious participants may just generally be more skeptical, regardless of domain, and find less disconfirming evidence sufficient to reject claims.

By contrast, religious participants needed more successful replications to confirm a scientific claim than failed replications needed to reject a scientific claim ($p = .009$, $\eta_p^2 = .01$), whereas they needed fewer successful replications to confirm a religious claim than failed replications to reject a religious claim, $p < .001$, $\eta_p^2 = .02$. The evidentiary standard religious participants held for rejecting either claim fell between the high standard they had for believing a scientific claim and the low standard they had for believing a religious claim.

Discussion

We aimed to replicate and extend research by McPhetres and Zuckerman (2017) by examining how individuals treat supporting and disconfirming evidence relevant to either scientific or religious claims. Our results partially replicated their observation of a bias among religious individuals to believe religious claims. However, our results also suggested a similar bias among nonreligious individuals, albeit to a lesser degree. Importantly, our experiment extends work in this area by asking participants about how many failed replications are required to reject empirical claims. Contrary to our hypothesis, we did not find that religious believers needed more evidence to reject a religious claim than a scientific claim. Instead, our results showed a possible bias by nonreligious individuals to reject religious claims rather than a general bias by religious believers to protect religious claims despite disconfirming evidence. Thus, it appears as though evidence is treated differently for religious claims than for scientific claims. Evidence relevant for a scientific claim was handled similarly by our religious and nonreligious participants. By contrast, evidence relevant for a religious claim was treated by our participants in ways aligned with their identification as religious or nonreligious. Religious participants needed less evidence than nonreligious participants to confirm a religious claim, whereas nonreligious participants needed less evidence than religious participants to reject a religious claim.

Of particular note, our findings revealed that religious and nonreligious individuals generally treat evidence relevant for a scientific claim in a similar fashion. Both religious and nonreligious individuals needed more evidence to confirm a scientific claim than a religious claim, although this effect was smaller for nonreligious individuals. Further, religious and nonreligious individuals were not found to differ in the amount of disconfirming evidence needed to reject a scientific claim. These findings are noteworthy considering research showing that, compared to nonreligious individuals, religious individuals are less scientifically literate (Sherkat, 2011) and identify less with science (Rios et al., 2015). One explanation is that religious and nonreligious individuals differ on their stances

toward science in relation to their views on religion rather than in relation to the other group of people. That is to say, relative to religious individuals' credulity for religious claims, they may appear less receptive to scientific claims. Likewise, relative to nonreligious individuals' skepticism for religious claims, they may appear more receptive to scientific claims.

An alternative interpretation of our results is that both religious and nonreligious individuals process evidence in a similar fashion but differ in their priors regarding the possibility of religious and scientific claims. The possibility that individuals may be engaging in Bayesian-style reasoning was not explicitly studied in the present research and should be followed up explicitly in future research.

Whereas religious participants needing fewer replications to confirm a religious claim than a scientific claim aligns with the suggestion of a bias by religious believers to believe religious claims, our finding that nonreligious participants also needed fewer replications to confirm a religious claim than a scientific claim is curious. The comparable analysis reported in McPhetres and Zuckerman (2017) did not reveal such a significant difference, although the pattern of means was in the same direction as ours. One interpretation is that because the nonreligious individuals in our study live in a culture that is highly deferential to and protective of religiosity, particularly Judeo-Christian denominations, nonreligious individuals maintain a similar implicit pro-religion bias. Further, nonreligious individuals in our sample may have also previously been religious at some point in their lives, and explicit conversion to a nonreligious affiliation may not necessarily translate to abandoning implicit pro-religion biases easily.

Although our findings successfully replicate and extend prior research, the present study has several limitations that should be addressed in future research. The evidence we asked participants about was limited to a single type, either successful replications or failed replications. By contrast, claims made in the real world are frequently evaluated based on both supporting and disconfirming evidence of different types and qualities, ranging from testimony to systematic experimentation by multiple independent experts. Additionally, we asked participants to make evaluations about the certainty of the cause-effect relationship they were presented with. Future research should ask participants about the probability of scientific or religious causal claims being true on the basis of evidence of any sort, as an additional way to explore how people use evidence when deciding to accept or reject a claim. This approach could be useful in determining whether, as noted above, religious and nonreligious individuals treat evidence similarly but differ in the priors they assign to religious and nonreligious claims.

Generally, we found that nonreligious individuals are more skeptical when it comes to believing claims and have a lower threshold of disconfirming evidence for rejecting claims, particularly religious claims. Our study also showed that although religious individuals may be more credulous of religious claims and more skeptical of scientific claims, they are resistant to rejecting either kind of claim in the face of disconfirming evidence. Additional research is needed to understand the epistemological commitments of religious and nonreligious individuals. For instance, because the claims participants responded to in this study are hypothetical, future research may explore the treatment of evidence for real-world empirical claims by scientists and religious leaders. Research by Shtulman (2013) found that individuals tend to justify their beliefs about the existence or nonexistence of scientific and supernatural phenomena similarly. The most common type of justification participants in his study made was an appeal to an authority or worldview, with a substantially smaller proportion of justifications participants made including an explicit reference to evidence. Additionally, similar research by Lobato and Zimmerman (2019) found that individuals justified their beliefs about scientific issues that have become part of the sociopolitical landscape inconsistently, with only 11% of participants referencing evidence for their beliefs about all the topics they were asked about. This suggests that peoples' epistemological commitments for the believability of a claim vary from topic to topic rather than by domain. More research examining how people set evidentiary standards for specific claims, whether religious or scientific or some other empirical claim, may help reveal factors relevant for understanding how people develop and maintain their beliefs about what is real and what is possible. For a subset of individuals, it may simply be the case that extraordinary claims do not actually require extraordinary evidence.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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Supplemental Material

The supplemental material is available in the online version of the article.

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