

## Religious diversity in science

Sharp, Carissa; Leicht, Carola; Rios, Kimberly; Zarzeczna, Natalia; Elsdon-Baker, Fern

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Religious Diversity in Science: Stereotypical and Counter-Stereotypical Social Identities

Carissa A. Sharp<sup>1</sup>

Carola Leicht<sup>2</sup>

Kimberly Rios<sup>3</sup>

Natalia Zarzeczna<sup>4</sup>

Fern Elsdon-Baker<sup>1</sup>

1. University of Birmingham
2. University of Kent
3. Ohio University
4. University of Amsterdam

Author Note:

Carissa A. Sharp, Science, Knowledge and Belief in Society Research Group, University of Birmingham; Carola Leicht, Business School, University of Kent; Kimberly Rios, Department of Psychology, Ohio University; Natalia Zarzeczna, Faculty of Social and Behavioural Sciences, University of Amsterdam; Fern Elsdon-Baker, Director Science, Knowledge and Belief in Society Research Group, University of Birmingham.

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Correspondence concerning this article should be addressed to Carissa A. Sharp, Department of Theology and Religion, ERI Building, University of Birmingham, Edgbaston, Birmingham, B15 2TT. Email: [c.sharp@bham.ac.uk](mailto:c.sharp@bham.ac.uk)

**Abstract**

Research shows that scientists tend to be less religious than the general population, and scientists' affiliation and religious participation has declined over time (Ecklund & Park, 2009; Ecklund, Park, & Veliz, 2008). Given the demographic differences between scientists and the general population, it was predicted that scientists who are religious would be regarded as having a counter-stereotypical combination of social identities. However, across five studies, we found that people's own religious identities played a moderating role in the perception of a religious scientist. Although atheist participants perceived religious scientists as being more counter-stereotypical than atheist scientists, the same was not consistently found for non-religious (but not atheist) or religious participants. These findings have important implications for debates around the underrepresentation of religious individuals in science. As religious individuals do not perceive these two identities to be incompatible, it may be stereotypes that others have about religious individuals and the culture of science more generally, rather than self-stereotypes, that are hurdles for religious individuals choosing a scientific career. Future research should take these findings into account and explore other potential barriers that lead to the underrepresentation of religious individuals within STEM fields.

*Key words: science, religion, STEM, stereotypes, counter-stereotypes, social identity, diversity*

### **Introduction**

How do people think about the relationship between science and religion? Do they associate religious identity negatively or positively with accepting scientific ideas or with the practice of science? This subject has been the topic of much historical debate and is more recently of increasing interest in social scientific research. There is certainly evidence that scientists at universities in the U.S., as well as scientists in the majority of international contexts that have been studied, tend to be less religious than the general population (Ecklund, Johnson, Scheitle, Matthews, & Lewis, 2016; Ecklund & Park, 2009), and that scientists' religiosity and religious participation have declined over time (Ecklund, Park, & Veliz, 2008). However, while some research suggests that this underrepresentation of religious scientists is rooted predominantly in an incompatibility of the two explanatory systems of thought of science and religion (e.g., Preston & Epley, 2009), other research conversely suggests that this may be oversimplifying a complex question and that there may be additional factors at play (Barnes, Truong, Grunspan, & Brownell, 2020; Legare, Evans, Rosengren, & Harris, 2012; Rios, Cheng, Totton, & Shariff, 2015). In this article, we explore the ways in which the conflict narrative between science and religion is represented in the types of identities that people see as being stereotypical or counter-stereotypical. Additionally, we aim to increase our understanding about how people's own social identities contribute to these views. In doing so we hope to shed light onto an underexplored area within the field of research investigating the understanding of the relationship between science and religion.

It is a commonly expressed narrative in Western society that science and religion necessarily conflict. At its extremes, the conflict narrative supposes that one may either

hold religious beliefs or conversely accept central tenets of science, but that the two cannot be combined (Elsdon-Baker, 2015; Elsdon-Baker, 2018). Taken at face value, this “conflict narrative” would suggest that scientists cannot be religious. On one hand, much psychological research on (non)religiosity takes this conflict narrative as an explicit or implicit starting point, focusing on issues such as the association between level of belief and thinking style (Gervais & Norenzayan, 2012; Shenhav, Rand, & Greene, 2012). This fits with the conceptualization of *science* and *religion* as being in a hydraulic system in which, as the perceived value of scientific explanations increases, individuals’ levels of religiosity decreases, and vice versa (Preston & Epley, 2009). However, this model fails to explain mainstream examples of compatibility between science and religion, the experiences of individuals who are both religious and who identify positively with science, or indeed the continued presence of scientists who are themselves religious within the scientific research community.

Furthermore, there is evidence suggesting that people can hold onto both supernatural and scientific explanatory systems of thought, termed “explanatory co-existence.” For example, someone might understand that an illness is physically caused by germs, but also think that there is a reason why a particular person fell ill, such as being the target of witchcraft (Legare, et al, 2012; Legare & Visala, 2011). Also, even if religion or belief systems are considered to contradict science in some instances, people are capable of holding ambivalent attitudes, and such attitudinal ambivalence does not have to result in unpleasant feelings (van Harreveld, van der Pligt, & de Liver, 2009; van Harreveld, Rutjens, Rotteveel, Nordgren, & van der Pligt, 2009).

Research in the sociology of religion also indicates that scientists' levels of and views on religiosity are more complicated than the conflict narrative would suggest. In a survey of biologists and physicists across eight countries, Ecklund and colleagues found country-level differences in scientists' levels of religiosity, with more than half of scientists in many countries (India, Turkey, Taiwan, and Italy) identifying as religious. Even in the U.K., where less than half of the general population identifies as being religious (47%), it is not uncommon to be a scientist who is also religious (27%; Inglehart et al. 2014, as cited in Ecklund et al., 2016). Furthermore, only a minority of scientists (e.g. 35% in the UK) support the notion that science and religion are in conflict (Ecklund, et al., 2016).

Given these seemingly divergent findings regarding how people engage with science and religion – that is, whether explanations from these systems of thought are incompatible or can co-exist – we need to take a nuanced approach that can account for and integrate both lines of inquiry. Doing this can advance our understanding of what is driving the reported underrepresentation of religious individuals working in academic science roles and how we might better engage religious publics with scientific research or education.

One way to do this is by looking at religious and non-religious identification not only as a characteristic that contributes to one's personal beliefs (e.g., "I believe in God"), but also as a group membership or *social identity* (e.g., "I am a Christian"; Ysseldyk, Matheson, & Anisman, 2010). It has been shown that the extent to which people believe that religious individuals experience conflict between science and religion varies depending on the perceiver's religious identity (Elsdon-Baker, et al., 2017).

However, when asked directly about the compatibility or conflict between science and religion in general, atheists tend to show significantly higher support for the conflict narrative than religious individuals, who conversely tend to report that they see science and religion as being compatible (Leicht, Sharp, LaBouff, Zarzeczna, & Elsdon-Baker, 2020). This indicates that the understanding of the relationship between science and religion may depend on individuals' group memberships (either religious or non-religious).

Additionally, it has been shown that individuals are aware of stereotypes particular to religious individuals and scientists. For example, people view the average scientist as believing in God less than a non-scientist (Rutjens & Heine, 2016). Further, scientists are often perceived as robot-like, emotionless, and as pursuing knowledge obsessively (Rutjens & Heine, 2016), whilst Christians are stereotyped as being high on warmth, but low on competence (Fiske, Cuddy, Glick, & Xu, 2002). Recognition of these stereotypes is evident in recent research showing that American college students perceive bias against Christians in science, and that biology faculty are biased against evangelical Christians (but not Christians who are not described as evangelical; Barnes et al, 2020). Such stereotypes have negative consequences for religious individuals' intellectual performance. When Christian individuals are reminded of the stereotype about their scientific incompetence, they perform worse on science-relevant tasks than when this stereotype is not salient (Rios, Cheng, Totton, & Shariff, 2015). This type of effect has been widely described in the literature as stereotype threat (e.g., Steele & Aronson, 1995). Making stereotypes salient even via subtle cues affects Christians' interest in scientific careers as well as their scientific performance (Rios, Cheng, Totton,

& Shariff, 2015). This effect is particularly strong for Christians who identify strongly with science and thus worry about confirming negative stereotypes (Rios, 2020).

On the basis of the “conflict narrative” and findings pointing to the automatic opposition between science and religion, we suggest that people might perceive less compatibility between the social identities of a person identifying as *religious* and a *scientist* than the identities of someone identifying as *atheist* and a *scientist*. However, given group differences in how people think about the relationship between science and religion, it is unclear whether these presumptions would be dependent on participants’ own group memberships or social identities. In this paper, we aim to explore how group identities and group processes affect perceptions of others with social identities relevant to people’s views on the science-religion relationship. More specifically, we explore whether the group identification of the perceiver affects how the science-religion relationship is interpreted and whether this affects people’s perceptions of targets who identify *both* as a scientist and as either religious or an atheist.

### **Social Category Combinations, Stereotypes, and Counter-Stereotypes**

Research on social category combinations, stereotypes, and counter-stereotypes might shed more light onto people’s beliefs about dual identities of *religious scientist* and *atheist scientist*. When we meet someone who conforms to our stereotypic expectations about social identities, we tend to automatically process such information intuitively and without effort (Kunda, Miller, & Claire, 1990). This is because the stereotypes associated with the constituent components of that identity are complementary or overlapping. However, research on cross categorization and counter-stereotypic identities has shown that when we encounter an individual who contests our stereotypic assumptions, we



employ different mental processes. Rather than rely on heuristics or intuitive thinking, in these cases we tend to use causal reasoning in order to make sense of seemingly conflicting information (Hutter, Crisp, Humphreys, Waters, & Moffitt, 2009; Kunda, Miller, & Claire, 1990).

In this paper, we focus on perceptions of religious scientist targets – a combination of identities that would be seen as an oxymoron if we were to take the conflict narrative and the “hydraulic relationship” research approach to the science-religion relationship as a starting point. We also examine perceptions of atheist scientists – a combination of identities that should be very stereotypical given that same starting point. Understanding whether these social identity combinations are seen as stereotypical or counter-stereotypical has the potential to help us understand the impacts of the “conflict narrative” within the scientific community and potentially on endorsement of, or engagement with, science or science education within wider society.

It is also important to recognise that there are differences in scientists’ levels of religiosity across disciplines. In a survey of UK biologists and physicists, biologists were significantly more likely to report that they never attend religious services, although they did not show significant differences on more private measures of religiosity (e.g., belief in God; Ecklund, Scheitle, & Peifer, 2018). Ecklund et al speculate that one potential explanation for this disciplinary difference may relate to norms resulting from the “history of public conflict surrounding issues like evolution and stem cell research, which are most clearly connected to the biological sciences” (p. 755).

Supporting the contention that evolution is a key issue in discussion of the relationship between science and religion, in an interview sample of 137 UK biologists

and physicists, 48 brought up the “celebrity scientist” and populariser of evolutionary theory Richard Dawkins, indicating his prominence in public narratives surrounding science and the relationship between science and religion (Johnson, Ecklund, Di, & Matthews, 2018). While Dawkins, who is a vocal proponent of the conflict narrative, was not always perceived positively, and was in fact described as “misrepresenting science” by some interviewees, the fact that he looms so large in public narratives about science and religion suggests scientists who study evolution might be perceived as being more likely to experience or see a conflict between science and religion. Therefore, in this research we ask about perceptions of both scientists (in general) and evolutionary scientists.

### **Hypotheses**

Given the starting point of the conflict narrative as well as Rios and colleagues’ (2015, 2020) stereotype threat research, our research question is, how do people perceive individuals who identify as being both religious and a scientist? Are such individuals viewed as counter-stereotypical? Given past findings suggesting that in the majority of countries surveyed, non-religious scientists tend to be more prevalent than non-religious individuals in the general population (Ecklund et al., 2016), our overarching hypothesis is that there will be a main effect of participants viewing religious scientists as being more counter-stereotypical than atheist scientists. That is, there will be *target differences* in perceptions of the stereotypicality/counter-stereotypicality of religious and atheist scientists. However, given previous research on explanatory co-existence (Legare & Visala, 2011) and the fact that religious respondents on average report compatibility between science and religion (Leicht et al, 2020), we hypothesize *group* differences in

perceptions of the religious and atheist targets, such that participants' (non)religious group identification (as "atheist," "nonreligious (but not atheist)," or "religious") would affect their views. In other words, atheists (who share an ingroup identity with the atheist scientist targets) would likely see religious scientists as being the most counter-stereotypical, and this effect would be attenuated for religious participants (and to a lesser extent, non-religious participants who do not identify specifically as atheist [e.g., "agnostic," "no religion"])).

### **Study 1: Religious Evolutionary Biologist – The Stereotypical Counter-Stereotype**

We can measure counter-stereotypicality through the assessment of emergent attributes. When we encounter a familiar or stereotypical combination of identities or traits, such as "male mechanic," the attributes that we use to describe that person tend to be words that are representative of one or both of the constituent identities (in this case, "male" and "mechanic"; Hutter & Crisp, 2005). This is because these identities can be easily conflated due to semantic overlap. Men are stereotypically perceived to be interested in cars, and mechanics share such interests in their professional work. When we are exposed to such concepts, we conceptually blend them such that they acquire each other's attributes (mechanics are not only interested in cars, they are also male [see Fauconnier & Turner, 1998; Zarzeczna, von Hecker, Proulx, & Haddock, 2020]). We therefore automatically understand what the concepts refer to and no further processing is necessary.

However, when we encounter an individual with a surprising, or counter-stereotypical combination of identities, such blending is no longer possible due to the absence of shared semantics. To make sense of such combinations, we use effortful

causal reasoning and create *emergent attributes* to describe that individual – attributes that are unique to that combination of identities (Hampton, 1997; Hastie, Schroeder, & Weber, 1990; Hutter, et al., 2009). For example, to make sense of a Harvard-educated carpenter, people need to come up with a reason why someone educated at a top university is a manual worker (Kunda, et al., 1990). Thus, the extent to which people use emergent attributes to describe a combined identity will likely indicate whether people perceive a pairing of identities as counter-stereotypical.

Here, we use emergent attribute analysis to determine whether people think that the “evolutionary biologist” identity is stereotypically combined with either religious or atheist identities. We chose the identity “evolutionary biologist” given the strong associations evolutionary science has with the conflict narrative. We hypothesized a priori that a sample of the general population in the UK would describe religious evolutionary biologists using more emergent attributes than would be used to describe atheist evolutionary biologists.

## Method

**Participants.** We recruited 251 participants (136 female, 114 male [1 missing];  $M_{age} = 29.5$ ,  $SD = 9.91$  [1 missing]; 86.4% White/European [1 missing]; all participants self-identified as being UK residents) via Prolific Academic, and participants received a payment of £3.50 for completing the survey. Given that this was a general population sample in the UK, there were a wide variety of religious and non-religious identities (27.1% Atheist, 19.5% Agnostic, 18.3% no religion, 4.4% Spiritual but not religious, 22.3% Christian, 5.6% other religious traditions, 2.4% “other”, and 0.4% missing). Additionally, participants were asked to indicate their own personal identification with

science and with religion/spirituality on a Likert scale. Using parallel items, we asked them to indicate on seven point scales (1, “not at all”; 7, “very much”) to what extent they felt that “[Scientific ideas or concepts]/[Religious Beliefs or spirituality] are important to my sense of who I am.” On average, participants were high in identification with science ( $M = 5.22$ ,  $SD = 1.55$ ), and low in identification with religion/spirituality ( $M = 1.75$ ,  $SD = 1.93$ ). We ran a sensitivity power analysis using G\*Power software (Faul, Erdfelder, Buchner, & Lang, 2009). For an independent samples t-test design, 80% power, and an alpha of .05, 100 participants was sufficient to detect a minimum effect size of  $d = .57$ .

**Design.** We used a one factor between-participants design. Our independent variable, *target*, had five levels. Participants were asked to form an impression of either “someone who is religious” (“R”), “an evolutionary biologist” (“EB”), “an atheist” (“A”), “an evolutionary biologist who is religious” (“R-EB”), or “an evolutionary biologist who is an atheist” (“A-EB”). Whilst the first three conditions were essential to identify the attributes associated with the singular constituent identities, the final two conditions, perceptions of the R-EB and A-EB targets were the primary focus of our study.

**Procedure.** Participants completed an attribute generation task for one of the five possible targets, following the instructions: “We would now like you to do an imagination task. Please imagine you are meeting [someone who is *religious*]. Please list 10 single *characteristics* or *traits* that come spontaneously into your mind that describe what this person is like.” After completing this task, participants were asked to complete a survey which included their personal identification with science and religion/spirituality, demographic measures, and a series of additional questionnaires not

presented here (a complete set of our materials and data are available on OSF:

<https://osf.io/w4pzj/>).

We first performed the analysis of emergent attributes by having the first author and a research associate combine similar words into composite “categories”.<sup>1</sup> The first author created these categories, and the research associate reviewed the data and made suggestions for revisions to the first author’s codes. They then discussed and resolved any disagreements. Where they could not come to an agreement, the second author was consulted. An undergraduate research assistant then identified any duplicates found in individual participants’ responses (i.e., if a participant had listed multiple words from the same category), and duplicates were removed from the final category counts.

## Results

Categories of adjectives were designated as being representative of the targets if they accounted for at least approximately 1% of the total number of words used to describe that target across all participants, after removing duplicates. The R-EB and A-EB lists of representative categories were compared to their constituent lists (“R” and “EB” for R-EB, and “A” and “EB” for A-EB), and were designated as either belonging to one constituent identity, belonging to both constituent identities (“overlapping”), or as being emergent (see Table 1).

**\*\*Table 1 about here\*\***

Using independent samples t-tests, we found that participants who answered for R-EB targets used a significantly higher percentage of emergent attributes (46.9%) than

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<sup>1</sup> For example, the category “well-spoken” for the A-EB target consisted of the responses “well-spoken,” “articulate,” and “good communicator.” Interestingly, both the R-EB and A-EB targets had well-spoken as an emergent attribute. This is because it was not used to describe any of the constituent categories (religious, atheist, or evolutionary biologist).

those who answered for A-EB targets (38.3%;  $t(98) = 2.56$ ,  $p < .012$ ,  $d = .53$ , 95% CI [.23, .82]). Additionally, participants who answered for A-EB targets used a significantly higher percentage of overlapping attributes (28.1%) than those who answered for R-EB targets (14.1%;  $t(98) = 5.90$ ,  $p < .001$ ,  $d = 1.19$ , 95% CI [1.55, .83]).

## Conclusions

We found that emergent attributes were used more frequently to describe religious evolutionary biologists than atheist evolutionary biologists. Moreover, there was more “distance” between the two constituent categories of “religious” and “evolutionary biologist” than between “atheist” and “evolutionary biologist”, given that there were fewer overlapping adjectives. Thus, it appears that religious evolutionary biologist targets are perceived as being more counter-stereotypical than atheist evolutionary biologist targets.

Participants described the religious evolutionary biologist target with a particular set of emergent attributes, which is what we would expect from the counter-stereotype literature. These are a mix of positive (*open-minded*, *wise*) and negative words (*conflicted*, *confused*), each of which have particular connotations and significance in the science/religion public debate. However, the emergent attributes used for the atheist evolutionary biologist target tend to be academically focussed (*analytical*, *factual*) and personality-driven (*passionate*, *heavy handed*). The picture that emerges is that the religious evolutionary biologist target is something truly different than the constituent categories, while the atheist evolutionary biologist target functions more like a “super-scientist.” These results provide support for the hypothesis that religious scientists are perceived as more counter-stereotypical than atheist scientists.

However, as our sample was dominated by individuals who identified weakly with religion/spirituality and strongly with science, we could not disentangle whether the way in which the counter-stereotypic impression was formed was dependent on the non-religious/high science identity of our participants. A different sample, with different demographics, may have resulted in different attributes. Additionally, asking about an “evolutionary biologist” specifically, rather than “scientist” in general, may have contributed to a higher listing of counter-stereotypic attributes.

### **Study 2: Intergroup Differences in Perceptions of Religious and Atheist Scientists**

In Study 2, we attempted to assess perceived counter-stereotypicality with regards to more general targets: scientists. Additionally, we compared atheists (who share a common ingroup with “atheist scientists”), religious (who share a common ingroup with “religious scientists”), and non-religious but not atheist (“NR-NA”) participants (who do not have a common [non]religious ingroup with either target). The original design of this study did not include this religious identification variable, but because of the limitations of Study 1, we decided that it would be beneficial to look at the role of (non)religious identity and divide participants into these identity groups.

### **Method**

**Participants.** One hundred and thirty-four participants were recruited from the University of Kent in the UK (55.97% female, 43.28% male [1 “would rather not specify”]; 88.8% native English speakers, 11.2% fluent English speakers; 70.9% White/European); 91.1% of participants were currently students ( $M_{age} = 23$ ; range = 18-67). The final sample had 30 Atheists, 55 NR-NA (24 “Agnostic,” 23 “No religion,” and 8 “Spiritual but not religious”), and 45 Religious (30 “Christian,” 7 “Muslim,” and 8



belonging to other religious traditions). In a 2x3 ANCOVA design with one covariate, 80% power, and an alpha of .05, 134 participants were sufficient to detect a minimum effect size of  $f = .28$ .

Three participants who chose “Other” for their religious or non-religious identity were dropped from the analysis, leaving a final sample of 131. Participants received £15 Amazon gift certificates to complete a series of two studies in the lab (only the first of which is presented here).

**Design.** This study had two independent variables, using a 2 *target* (scientist who is religious [RS] vs. scientist who is atheist [AS]), by 3 *religious identification* (atheist vs. NR-NA vs. religious).<sup>2</sup>

**Procedure.** Participants completed a modified version of the attribute generation task from Study 1, in which they were asked to spend 120 seconds writing down as many attributes as they could that would describe their given target. Subsequently, participants were asked to complete a questionnaire including several measures of belief in and engagement with religion and science as well as their religious identification, which was

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<sup>2</sup> For this study, we used the same kind of attribute generation task as in Study 1, with a slight alteration—we administered the attribute generation task under cognitive load, which interferes with people’s ability to generate emergent attributes (Hutter & Crisp, 2006). In the low load condition, participants practiced counting the numbers 1-9 in sequential order, 1 per second, for 30 seconds along with a metronome, and then performed the attribute generation task and the counting task simultaneously. In the high load condition, participants performed the same combination of tasks, but were told to say the numbers 1-9 in random order rather than sequential order: “Please make sure not to say the same number twice in a row, or to say numbers sequentially.” However, unlike in previous research, we found no significant differences between the no load and cognitive load conditions in the percentage of emergent attributes produced,  $t(131) = -1.07$ ,  $p = .288$ . We did not have enough participants to be able to focus on both cognitive load and religious identity, so we collapsed across cognitive load for the remainder of the analyses.

used to group participants into one of three (non)religious identities, and other demographic information.

## Results

One participant who did not complete the attribution task was dropped from the analysis. Two undergraduate research assistants used the coding categories identified in pilot testing to identify duplicates in participants' responses (weighted kappa = .93). The research assistants then coded each adjective for being emergent (weighted kappa = .74, and coded for irrelevant responses (i.e., responses such as "shoes"; weighted kappa = .63). Where the research assistants agreed on the irrelevant answers, they were removed from the dataset. The total number of attributes used and the percentage of emergent attributes were calculated as an average of the two researchers' codes after removing the irrelevant responses.

We conducted a 3 *religious identification* (atheist vs. NR-NA vs. religious) x 2 *target* (religious scientist vs. atheist scientist) between-subjects ANCOVA with the number of valid responses on the attribute generation task as a covariate, which was necessary given the wide range of responses generated (range = 1-16.5).

We found a significant interaction between target and participants' religious identification,  $F(2, 123) = 3.50, p = .033, \eta p^2 = .054 [f = .24], 95\% \text{ CI } [.002, .121]$ . A simple effects analysis with Bonferroni corrections showed that religious participants described atheist scientists ( $M = .51; SE = .05$ ) as being significantly more emergent than religious scientists ( $M = .37; SE = .05, F(1, 123) = 4.13, p = .044, \eta p^2 = .032, 95\% \text{ CI } [.001, .098]$ , and atheist participants described religious scientists ( $M = .45; SE = .07$ ) as being marginally significantly more emergent than atheist scientists ( $M = .30; SE = .06$ ),

$F(1, 123) = 3.07, p = .082, \eta p^2 = .024, 95\% \text{ CI } [.001, .085]$ . However, we found no significant differences for NR-NA participants in their perceptions of religious scientist ( $M = .38; SE = .04$ ) and atheist scientists targets ( $M = .39; SE = .05$ ),  $F(1, 123) = .01, p = .905$ .

The “total number of attributes generated” covariate significantly predicted the percentage of emergent attributes generated,  $F(1, 123) = 7.42, p = .007, \eta p^2 = .057, 95\% \text{ CI } [.004, .150]$ . When controlling for this, we did not find significant main effects of target,  $F(1, 123) = .001, p = .988$ , and participants’ religious identification,  $F(2, 123) = 1.05, p = .353$ .

**\*\*Figure 1 about here\*\***

## **Conclusion**

The results of Study 2 suggest that “non-religious but not atheist” individuals, who do not share an ingroup with either religious scientists or atheist scientists, do not view either target as more or less counter-stereotypical, whereas atheist participants find religious scientist targets to be more counter-stereotypical and religious participants find atheist scientist targets to be more counter-stereotypical. While the commonly repeated conflict narrative between science and religion would suggest that religious scientists should be seen as counter-stereotypical, in this study we found that this was only the case for some participants – specifically for those who identify as *atheist*. The fact that even our NR-NA participants did not reproduce this model, in that they did not find either of the targets to be more counter-stereotypical, speaks to the limits of the conflict narrative and stereotypic perceptions to explain people’s beliefs about others.

However, emergent attribute analysis, while very useful in terms of gaining information about people's self-generated associations, is subjective in nature, given that researchers must sort the attributes into categories. Additionally, because of the post-hoc decision to investigate (non)religious identification, the study was underpowered due to small sample size, as indicated by the sensitivity analysis.

Interestingly, religious individuals in fact found *atheist scientists* to be more counter-stereotypical. A possible explanation for this finding is that participants are showing ego-centric bias (Ross & Sicoly, 1979). Research has shown that when forming impressions of a target, participants tend to anchor their impressions of that person on the self if that target shares an in-group (Cadinu & Rothbart, 1996). This might explain why we found that atheists and religious participants in this study both viewed the target who shared an ingroup with them to be less counter-stereotypical. Furthermore, the method we used may be particularly prone to producing ego-centric effects, given that it involves people coming up with adjectives to describe someone with whom they might share an ingroup identity. Thus, in Study 3, we wanted to run a conceptual replication, but with a larger sample size and a revised procedure that would be less prone to researcher subjectivity and ego-centric bias effects.

### **Study 3: Vignette Study of Counter-stereotypicality**

In Study 3 we developed a novel measure in order to investigate counter-stereotypicality in a standardized way not subject to researcher error. For this study we utilized vignettes about an individual (either a religious scientist or an atheist scientist). We then asked follow-up questions about the vignettes in order to investigate the extent to which the individual was considered to be stereotypical or counter-stereotypical.

Given the results of Study 2, we hypothesized that we would find evidence of ego-centric bias, such that atheist participants would find a religious scientist more counter-stereotypical (more surprising, less typical of other scientists, less similar to other scientists), while religious participants would find an atheist scientist more counter-stereotypical. We did not expect to find any differences in perceptions of the targets for participants who were not religious but not atheist. This hypothesis was preregistered on the Open Science Framework (OSF; <https://osf.io/8z5yp>).

## Method

**Participants.** Three hundred and thirty-six participants took part in this study (69.9% female;  $M_{age} = 40.93$ ; 92.3% White/European) via Qualtrics participant panels. We used a religious demographic question as a pre-screen in order to recruit participants who identified as atheist ( $n = 112$ ), religious ( $n = 114$ ), and “other non-religious [e.g., agnostic, no religion]” ( $n = 110$ ). Although this was a novel measure, previous research has utilized priming techniques to investigate counter-stereotypes. We calculated the necessary sample size for small to medium effect sizes based on two relevant studies (Zuo, Wen, Wang, & Wang, 2019). The results of the analysis suggested using sample sizes of 38 or 62 people per condition in order to achieve .80 of power, at an  $\alpha = .05$ ; we averaged these and recruited 50 participants per cell.

**Materials and design.** We used a between-subjects design with participants’ religious identity (atheist, religious, or NR-NA) and target religiosity (atheist or religious) as factors. To measure whether participants would find religious or atheist scientists more surprising, we presented participants with a description of a scientist (full text of all vignettes used in this article are available in Supplemental Material A). In the religious

scientist condition, we included the sentence, “Mo is also religious – he believes strongly in God and attends religious services regularly.” In the atheist scientist condition, we presented the same description, but the target was described as an atheist: “Mo is also an atheist – he strongly believes that there is no God, and regularly goes to lectures and discussions about atheism.”

**Procedure.** After being presented with these vignettes, participants were asked to judge how surprising they found the description of the target to be, how typical the target was of other scientists, and how similar the target was to other scientists on a scale from 0 (very unsurprising/atypical/dissimilar) to 10 (very surprising/typical/similar). We also asked about how well-respected by other scientists and successful the targets were considered to be on the same scale points. Finally, participants completed a survey including questions about their beliefs about science and religion not reported here.

## Results

We conducted 3 (participants’ religious identity: atheist vs. religious vs. NR-NA) x 2 (target religiosity: atheist vs. religious) between-subjects univariate ANOVAs for participants’ judgments of the targets.

For the surprise measure, in contrast to our expectations, the interaction between religious identity and target religiosity was not significant,  $F(2, 330) = .59, p = .556, \eta^2 = .004$ , 95% CI [.001, .02] (see Figure 2), and the main effect of religious identity was not significant,  $F(2, 330) = 1.83, p = .162, \eta^2 = .012$ , 95% CI [.001, .03]. Yet, target religiosity was significant,  $F(1, 330) = 15.50, p < .001, \eta^2 = .045$ , 95% CI [.015, .086], such that participants judged the religious scientist as more surprising than the atheist scientist.

**\*\*Figure 2 about here\*\***

As the typicality and similarity measures were highly correlated ( $r = .68$ ), we collapsed them. Target religiosity significantly interacted with religious identity,  $F(2, 330) = 6.07, p = .003, \eta p^2 = .033, 95\% \text{ CI } [.005, .079]$ . Specifically, religious participants did not perceive a difference in typicality/similarity between the religious and atheist targets,  $F(1, 330) = .001, p = .977$ . However, both atheist,  $F(1, 330) = 11.89, p < .001, \eta p^2 = .035, 95\% \text{ CI } [.006, .081]$ , and NR-NA participants,  $F(1, 330) = 22.61, p < .001, \eta p^2 = .064, 95\% \text{ CI } [.022, .121]$ , perceived the atheist scientist to be more typical/similar than the religious scientist. Finally, we found that the main effect of religious identity was not significant,  $F(2, 330) = .79, p = .457$ , but the main effect of target religiosity was significant,  $F(1, 330) = 22.35, p < .001, \eta p^2 = .061, 95\% \text{ CI } [.022, .120]$ . Overall, participants judged the atheist scientist ( $M = 6.35, SE = .16$ ) as significantly more typical/similar of other scientists than the religious scientist ( $M = 5.31, SE = .15$ ) (see Figure 3).

**\*\*Figure 3 about here\*\***

In addition to the main variables of interest (surprise, typicality, similarity), we also investigated participants' perceptions of how well respected the targets were by other scientists and how successful they were. For the respect perceptions, we found that the main effect of religious identity,  $F(1, 330) = .43, p = .652$ , and the religious identity by condition interaction,  $F(2, 330) = .05, p = .952$ , were not significant. However, the main effect of condition was significant,  $F(1, 330) = 6.71, p < .010, \eta p^2 = .020, 95\% \text{ CI } [.001, .059]$ , such that participants perceived the atheist scientist to be respected more ( $M =$

5.26,  $SE = .11$ ) than the religious scientist ( $M = 4.88$ ,  $SE = .10$ ). For the perceptions of success, we did not find any significant effects,  $ps > .414$ .

## **Conclusion**

In this study, we did not find an exact replication of Study 2 in terms of the “surprisingness” of the targets. This may have been because the question was too general – we asked about overall surprise, rather how surprising the descriptions were for a scientist. However, with the combined typicality/similarity ratings, which specifically asked the participants to compare the target to other scientists, we found that both atheists and non-religious but not-atheist participants rated the atheist scientist as being more typical of/similar to other scientists. For religious participants, we found that there was no difference in perceptions of the targets. This indicates that religious participants did not perceive religious scientists as being more counter-stereotypical, and also that there is no evidence of them showing ego-centric bias, as we had hypothesized given the results of Study 2. Additionally, our findings show that atheist scientists are perceived as being more respected than religious scientists. This may indicate a perception of bias against religion within the sciences.

## **Study 4: The Intuitiveness of Combined Identities**

Studies 1-3 addressed the perceived counter-stereotypicality of religious and atheist scientists. In Studies 4-5b we decided to change the lens through which we approached our research question. Rather than looking at perceived counter-stereotypicality, we aimed to investigate how *intuitive* combinations of identities were in people’s minds. We therefore decided to use an adaptation of the conjunction fallacy task (Tversky & Kahneman, 1983), providing insights into the intuitive links in people’s



minds. The standard conjunction fallacy problem is to present someone with a description of a person and ask whether it is more likely that the person is either (a) a “[neutral identity]” or (b) an “[identity of interest] and a [neutral identity].” The correct answer to a conjunction fallacy task will always be (a), and the proportion of people who choose (b) is indicative of the intuitive link between the description and the identity of interest. This method has been used to assess stereotyping in similar contexts, with regards to both atheists (Gervais, et al., 2017) and scientists (Rutjens & Heine, 2016).

The strength of using this kind of method in combination with the methods assessing counter-stereotypical perceptions in Studies 1-3 is that it is addressing a similar question through different mental processes. The emergent attributes method assesses the extent to which people have to use causal reasoning to make sense of two identities in combination, with surprising combinations inducing more causal reasoning. The conjunction fallacy method assesses the extent to which a description is seen as representative of different groups and is based on intuitive reasoning. For identities that are more strongly linked in people’s minds (and are thus less surprising), people will make the conjunction fallacy to a greater extent.

In this study, similarly to Study 1, we used evolutionary scientist targets. Given the results of the previous studies, we hypothesized a priori that overall, the combination of atheist and evolutionary scientist identities would be perceived as more intuitive. Additionally, we hypothesized that we would find the same interaction between participant and target (non)religious identity as in previous studies, with atheist participants finding the combination of atheist and evolutionary scientist identities more intuitive, and religious participants finding the combination of religious and evolutionary

scientist identities more intuitive. We did not expect to find any differences in perceptions of the targets for participants who were not religious but not atheist.

## Method

**Participants.** We recruited 218 UK residents via Qualtrics participant panels (62.8% female;  $M_{age}$  = 44.9; 91.7% White/European). We used a religious demographic question as a pre-screen in order to recruit participants who identified as atheist ( $n = 91$ ), religious ( $n = 63$ ), and “other non-religious [e.g., agnostic, no religion]” (“NR-NA”;  $n = 64$ ). In a between-subjects 2x3 ANOVA design, 80% power, and an alpha of .05, 218 participants was sufficient to detect a minimum effect size of  $f = .19$ .

**Design.** Based on the moderating role of (non)religious social identities in study 2 (which was subsequently supported by study 3), we used a 3 *religious identification* (atheist vs. NR-NA vs. religious) x 2 *target* (atheist evolutionary scientist [A-ES] vs. religious evolutionary scientist [R-ES]) between subjects design for this study, with a modified version of the original conjunction fallacy task (described below).

**Procedure.** Participants first completed an adapted conjunction fallacy task, in which they were given a generic description of an evolutionary scientist, and then asked to respond to two questions. In the R-ES condition, they indicated how likely (on a scale from 0-10) they thought it was that (a) “Mo is an evolutionary scientist” *and* (b) “Mo is an evolutionary scientist and is religious”. In the A-ES condition, they indicated how likely they thought it was that (a) “Mo is an evolutionary scientist” *and* (b) “Mo is an evolutionary scientist and is an atheist.” The intuitiveness of the combinations of these identities was measured by the difference between their two likelihood answers. Given that the “correct,” or more likely, answer is “Mo is an evolutionary scientist”, smaller

values on this difference measure indicate that the combination of identities is seen as more intuitive or stereotypical, and larger values indicate that the combination of identities is seen as being less intuitive or more counter-stereotypical. Participants then completed a series of measures of belief in and engagement with science and religion and a demographic measure.

## Results

We first computed the conjunction fallacy difference scores. Subsequently, we ran a 2 (target religiosity: R-ES vs. A-ES) x 3 (participants' religious identification: atheist vs. NR-NA vs. religious) between-subjects ANOVA (see Figure 4). We found an interaction between the target religiosity and participants' religious identification,  $F(2, 212) = 4.36, p = .014, \eta p^2 = .04 [f = .20]$ . Simple effects with Bonferroni corrections indicated that atheist participants saw the combination of atheist and evolutionary scientist identities as being more intuitive,  $F(1, 212) = 12.68, p < .001, \eta p^2 = .056$ , that NR-NA participants' perceptions were in the same direction as atheists,' although the effect was not significant ( $p = .103$ ), and no significant differences emerged for religious participants ( $p = .382$ ).

We found no main effect of participant religious identification,  $F(2, 212) = .216, p = .806, \eta p^2 = .002$ . However, we did find a main effect of target religiosity,  $F(1, 212) = 5.13, p = .025, \eta p^2 = .024$ , with participants viewing the combination of atheist and evolutionary scientist identities as being more intuitive than religious and evolutionary scientist identities.

**\*\*Figure 4 about here\*\***

## Conclusion

These results support our findings from Studies 2 and 3. People do indeed view the combination of atheist and evolutionary scientist identities to be more intuitive; however, this is qualified by an interaction with the religious identity of the perceiver. We only found a significant simple effect for atheist participants, whereas NR-NA and religious participants did not differ significantly in their perceptions of the two targets. This suggests that for atheists, there is a strong intuitive link between evolutionary science and atheism. However, for religious and NR-NA individuals, this does not seem to be the case. This indicates that, at least for some groups of people, the combination of religious and evolutionary scientist identities might not necessarily be viewed as less intuitive. This furthermore shows that ego-centric bias alone cannot explain our participants' reactions to the evolutionary scientist targets.

Given the specificity of the evolutionary scientist target (and its closer ties with the conflict narrative), in Study 5, we returned to the more general targets of “religious scientist” and “atheist scientist.” Additionally, we wanted to again test whether participants show ego-centric bias with regards to perceptions of these targets. Further, we aimed to investigate the boundary conditions of these findings – would we only find the effects of target and participant religiosity for “scientist” targets, or would our findings generalize to other types of professions?

#### **Study 5a: The Intuitiveness of Combined Identities -- Scientists vs. Authors**

In this study we again used the adapted conjunctive fallacy method that we used in Study 4, but we added a condition in which participants were presented with the

control target “author”.<sup>3</sup> We preregistered hypotheses on OSF based on our previous findings (<https://osf.io/3fnvd>)<sup>4</sup>. Based on our findings from previous studies, we hypothesized that we would find evidence of ego-centric bias for the scientist target, such that atheist participants would be more likely to consider scientists as atheist versus religious, that religious participants would be more likely to see scientists as religious versus atheist, and that there would be no significant differences for non-religious participants. Additionally, regarding the control target (author), we predicted two potential outcomes: either a) atheist and religious participants would display the same egocentric bias when thinking about the author target as they would for the scientist target (indicating that this is not an effect unique to science-related professions), or b) there would be no differences in perceptions of the author target based on participants’ religious identity (that is, perceptions of religious/atheist authors would not interact with participants’ religious identity).

## Method

**Participants.** We recruited 624 participants residing in the UK via Qualtrics participant panels, as in previous studies (63% female;  $M_{age} = 37.74$ ; 90.9% White/European). We used a religious demographic question as a prescreen in order to recruit participants who identified as atheist ( $n = 208$ ), religious ( $n = 208$ ), and “other non-religious [e.g., agnostic, no religion]” ( $n = 208$ ). To determine the sample size, we conducted a power analysis in G\*Power software for a small to medium effect sizes

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<sup>3</sup> We ran a pilot test to determine the best control target for “scientist” in terms of the number of exemplars people could name who were also religious or atheist. This analysis is reported in Supplemental Material B.

<sup>4</sup> Unfortunately, due to human error, although we preregistered that “Those who guess the purpose of the study will be excluded”, we did not include this question at the end of either Study 5a or 5b.

derived from Study 4 and an additional study included in Supplemental Material C ( $\eta p^2 = .02 - .05$ ) to achieve .80 of power, at an  $\alpha = .05$ . The analysis estimated around 49 participants per cell.

**Materials, design, and procedure.** We presented participants with the same conjunction fallacy paradigm as in Study 4. We used a 3 *religious identity* (atheist vs. religious vs. NR-NA), by 2 *target religiosity* (religious vs. atheist), by 2 *target profession* (scientist vs. author) between-subjects design. Subsequently, participants completed a number of measures about belief in and engagement with science and religion, and demographic measures.

## Results

Using a 2x2x3 between-subjects ANOVA,<sup>5</sup> we found that the three-way interaction was not significant,  $F(2, 609) = 1.22, p = .297, \eta p^2 = .003, 95\% \text{ CI } [.01, .015]$ , and therefore we did not investigate simple effects for this interaction. However, we found that participants' religious identity significantly interacted with target religiosity in predicting conjunction fallacy difference scores,  $F(2, 609) = 4.35, p = .013, \eta p^2 = .014, 95\% \text{ CI } [.01, .03]$ . Atheist participants judged professional identities combined with atheist identities as being more intuitive ( $M = .81, SE = .26$ ) in contrast to professional identities combined with religious identities ( $M = 1.78, SE = .26$ ),  $F(1, 609) = 6.92, p = .009, \eta p^2 = .011, 95\% \text{ CI } [.001, .033]$ . The same pattern was true for NR-NA participants (combined professional and atheist identities:  $M = 1.32, SE = .26$ ; combined professional and religious identities:  $M = 2.11, SE = .26$ ),  $F(1, 609) = 4.66, p = .031, \eta p^2 = .008, 95\% \text{ CI } [.001, .03]$ . However, for religious participants there were no significant

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<sup>5</sup> All the dependent variables in this manuscript were normally distributed allowing us to conduct parametric tests.

differences in the intuitiveness of combined professional and atheist identities ( $M = 1.93$ ,  $SE = .26$ ) and combined professional and religious identities ( $M = 1.49$ ,  $SE = .26$ ),  $F(1, 609) = 1.50$ ,  $p = .222$ . Finally, there was a significant difference between religious and atheist participants in judging targets with combined professional and atheist identities – atheist participants perceived combined professional and atheist identities as more intuitive than religious participants,  $F(2, 609) = 4.67$ ,  $p = .010$ ,  $\eta^2 = .015$ , 95% CI [.001, .04]. Other comparisons were not significant,  $ps > .201$  (See Figure 5).<sup>6</sup>

The main effect of target profession was marginally significant,  $F(1, 609) = 3.27$ ,  $p = .071$ ,  $\eta^2 = .005$ , 95% CI [.001, .031]. Overall, participants judged all identities combined with scientist as being marginally more intuitive ( $M = 1.38$ ,  $SE = .15$ ) than all identities combined with author ( $M = 1.77$ ,  $SE = .15$ ). Further, the main effect of target religiosity was significant,  $F(1, 609) = 4.31$ ,  $p = .038$ ,  $\eta^2 = .007$ , 95% CI [.001, .022], such that participants viewed all identities combined with atheist as more intuitive ( $M = 1.36$ ,  $SE = .15$ ) than all identities combined with religious ( $M = 1.79$ ,  $SE = .15$ ). Finally, there was no main effect of participant religious identity,  $F(2, 609) = 1.74$ ,  $p = .177$ ,  $\eta^2 = .006$ .

**\*\*Figure 5 about here\*\***

## Conclusion

For this study, we hypothesized that we would find evidence of ego-centric bias for the scientist target, such that atheist participants would be more likely to consider scientists as atheist than religious and that religious participants would be more likely to see scientists as religious versus atheist, and that there would be no significant differences for non-religious participants. Instead, we found the same general trend as in Study 4,

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<sup>6</sup> In Studies 5a and 5b we used Holm-Bonferroni corrections for multiple comparisons.

with atheists seeing the combination of “religious” and other identities related to profession as less intuitive than the combination of “atheist” and other professional identities, while religious participants did not perceive a difference between these combinations of identities. Similar to the counter-stereotype findings in Study 3, the non-religious participants showed the same pattern as atheists.

Interestingly, and in partial support of hypothesis b, there was a marginally significant difference between perceptions of the scientist and author targets, and no significant interactions between participant religious identity and target profession. This suggests that our effects may not only be specific to targets with science-related professional identities.

However, there were some potential limitations with regards to the vignettes used. Although the “author” vignette made reference to the target teaching creative writing, the label of “author” is a very broad category. Participants could potentially bring to mind exemplars of non-fiction writers who might be seen to be more similar to scientists (or indeed may also scientists – for example, someone might think of Richard Dawkins when they think of “author”). Additionally, because he was described as working “at a top university,” the author target used in this study may be associated with non-religion based on stereotypes about academia being predominantly secular. Thus, the target of “author” may not have as much conceptual distance from “scientist” as initially thought.

#### **Study 5b: The Intuitiveness of Combined Identities – Scientists vs. Novelists**

Given the potential confounds with the target “author” and wording of the vignette in Study 5a, in Study 5b we made two crucial changes to the materials. We changed the target from “author” to “novelist”, and we removed the sentence in which we



made reference to the target working in academia. We preregistered our hypotheses on OSF (<https://osf.io/cfu4s>). In light of the combined findings from Studies 3-5a, we did not hypothesize that there would be evidence of ego-centric bias. Rather, we predicted a significant interaction among target religiosity, target profession, and participants' religious identity. Additionally, we hypothesized that atheist participants would find atheist targets more stereotypical than religious targets, but only for scientist (and not novelist) targets. We predicted the same pattern of results for non-religious participants as for atheist participants, but with smaller effect sizes. Finally, we expected that religious participants would not show any differences in their perceptions of the different targets.

## Method

**Participants.** We recruited 615 participants residing in the UK via Prolific Academic online platform (44% female;  $M_{age}$  = 28.26; 86.1% White/European). We used the platform's prescreening in order to recruit participants who identified as belonging to any religious tradition or as being "atheist," "agnostic," "irreligious" or "naturalist." Participants were grouped into religious, atheist, and NR-NA based on their responses to a demographic question at the end of the survey. Our sample included 186 atheist, 173 religious, and 224 non-religious individuals. Using the same power analysis as in Study 5a, we aimed to recruit approximately 50 participants per cell. Thirty-two participants failed the attention check and were removed from the analysis.

**Materials and design, and procedure.** The materials, design, and procedure were the same as Study 5a, with the exception of the revised vignettes.

## Results

As in Study 5a, we conducted a 2 (target religiosity: atheist vs. religious) x 2 (target profession: scientist vs. novelist) x 3 (participants' religious identity: atheist, NR-NA, religious) between-subject ANOVA. The predicted three-way interaction among target profession, target religiosity, and religious identity was marginally significant,  $F(2, 571) = 2.58, p = .077, \eta p^2 = .008, 95\% \text{ CI } [.001, .028]$ . Nevertheless, we conducted further investigations based on our preregistered hypotheses. These analyses indicated that, for atheists, the combination of atheist and scientist identities was more intuitive than the combination of atheist and novelist identities,  $t(571) = 2.36, p = .018, d = .57, 95\% \text{ CI } [.16, .98]$ . Similar post-hoc comparisons for religious and non-religious participants were not significant,  $ps > .174$  (see Figure 6).

For atheist participants, we found the combined identities of atheist and scientist to be more intuitive than the combined identities of religious and scientist,  $t(571) = 6.42, p < .001, d = 1.36, 95\% \text{ CI } [.89, 1.81]$ . Also (albeit to a lesser extent), for atheist participants, the combination of atheist and novelist identities was more intuitive than the combination of religious and novelist identities,  $t(571) = 3.06, p = .002, d = .63, 95\% \text{ CI } [.21, 1.03]$ . For NR-NA participants, we found the same pattern – they found the combination of atheist and scientist identities to be more intuitive than the combination of religious and scientist identities,  $t(571) = 4.70, p < .001, d = .83, 95\% \text{ CI } [.47, 1.19]$ . NR-NA participants also found the combination of atheist and novelist identities to be more intuitive than the combination of religious and novelist identities, but this effect was only marginal,  $t(571) = 1.80, p = .072, d = .37, 95\% \text{ CI } [-.04, .77]$ . For religious participants there were no significant differences between those judgments,  $ps > .382$ .

**\*\*Figure 6 about here\*\***

The overall effect of target religiosity was significant,  $F(1, 571) = 2.45, p < .001, \eta p^2 = .075$ , 95% CI [.042, .124], with participants viewing identities combined with atheist ( $M = 1.96, SE = .14$ ) to be more intuitive than identities combined with religious ( $M = 3.42, SE = .15$ ). The two-way interaction between target profession and participant religious identity was not significant,  $F(2, 571) = .38, p = .68, \eta p^2 = .001$ , 95% CI [.001, .010]; however the two-way interaction between participant religious identity and target religiosity was significant,  $F(2, 571) = 9.53, p < .001, \eta p^2 = .030$ , 95% CI [.009, .064]. Atheists,  $t(571) = 6.74, p < .001, d = .99$ , 95% CI [.68, 1.29], and non-religious participants,  $t(571) = 4.44, p < .001, d = .59$ , 95% CI [.32, .86], viewed identities combined with atheist to be more intuitive than identities combined with religious. For religious participants there were no differences in perceptions of the targets,  $t(571) = .64, p = .52$ .

The target profession by target religiosity interaction was marginally significant,  $F(2, 571) = 3.47, p = .063, \eta p^2 = .005$ , 95% CI [.001, .025]. We found that participants found the combined identities of atheist and scientist to be more intuitive than atheist and novelist,  $t(571) = 2.36, p = .018, d = .28$ , 95% CI [.05, .51], but there were no significant differences in conjunction fallacy difference scores between the combination of religious and scientist identities and religious and novelist identities,  $t(571) = .41, p = .680$ .

Finally, we found that that the main effect of target profession was not significant,  $F(1, 571) = 1.77, p = .184, \eta p^2 = .003$ , 95% CI [.001, .019]. The main effect of religious identity was marginally significant,  $F(1, 571) = 2.45, p = .087, \eta p^2 = .008$ , 95% CI [.001, .027]; however, follow-up tests showed no significant comparisons.

## Conclusion

The predicted 3-way interaction between target profession, target religiosity, and participant religiosity was marginally significant for this study and should be interpreted with caution. However, the results are indicative of interesting differences in how participants of different (non)religious identities perceive targets based on their profession and religiosity.

Looking by participant group, similarly to Study 5a (and in support of our hypotheses), religious participants did not show any differences in their perceptions of religious or non-religious targets, for either of the target professions. Also supporting our hypotheses, atheist and NR-NA participants found the combined identities of atheist and scientist to be more intuitive than religious and scientist. Contrary to our hypotheses, they also found the combined identities of atheist and novelist more intuitive than religious and novelist. However, this was to a much lesser extent. Atheist participants also perceived the combination of atheist and scientist to be more intuitive than atheist and novelist. This clearly shows that at least for atheists, there is a stronger intuitive association between atheism and scientists than atheism and novelists.

This is an interesting contrast to the previous study, Study 5a. As with the findings in this study, in Study 5a we found that atheist and non-religious participants intuitively linked atheist identities with professional identities (scientist and authors) more than they linked religious identities with those professional identities, but that religious participants did not. However, in that study (unlike in the current study), we found only a marginally significant difference between perceptions of the scientist and author targets.

These results, across both Study 5a and 5b, suggest that “scientist” (potentially as well as other academic professions, as found in Study 5a) may be a profession that is particularly subject to being stereotyped as atheist. This may suggest evidence of a larger societal problem than just science-related professions. It may be that, for atheist and NR-NA individuals, any high-status professions (or indeed any professions) are stereotyped as being more easily combined with “atheist” identities, at least in the UK.

### **General discussion**

In this article, we aimed to explore the ways in which the conflict narrative between science and religion is represented in the types of identities that people see as being stereotypical or counter-stereotypical. The results across our five studies, with two approaches (looking at either counter-stereotypicality or intuitiveness), and using three different methodologies (emergent attributes, a novel vignette-based measure of counter-stereotypicality, and an adaptation of the conjunction fallacy method), support both of our overarching hypotheses.

First, we hypothesized that there would be *target differences* in perceptions of the stereotypicality/counter-stereotypicality of religious and atheist scientists, with participants viewing religious scientists as more counter-stereotypical than atheist scientists. We found support for this across all studies with the exception of Study 2.

Second, we hypothesized that we would find *group differences* in that atheists (who share an ingroup identity with the atheist scientist targets) would likely see religious scientists as being the most counter-stereotypical, and this effect would be attenuated for religious participants (and to a lesser extent, non-religious participants who do not identify specifically as atheist [e.g., “agnostic,” “no religion”]). Across Studies 2-5b,

atheist participants saw the combination of “religious” and “scientist” identities as being more counter-stereotypical and less intuitive (and the combination of “atheist” and “scientist” identities as being less counter-stereotypical and more intuitive). However, we found different results for our NR-NA and religious participant groups. NR-NA participants (who did not share an identity with either target) in some cases found the combined identities of religious and scientist to be more counter-stereotypical and less intuitive, but not consistently across all studies. Religious participants, however, showed the opposite pattern. They never perceived the combination of religious and scientist to be more counter-stereotypical or less intuitive than the combination of atheist and scientist. Study 2 was the only study in which religious participants perceived a difference between targets, and in that case, they actually saw the combination of atheist and scientist as being more counter-stereotypical. Thus, it seems that the impression that someone forms of a religious scientist or an atheist scientist will depend both on the identity of the *perceiver* and the identity of the *target*.

Moreover, our results from Studies 5a and 5b shed light on the boundary conditions of these results. Study 5a showed that religious participants were not biased against religious people working in academia, in that they did not perceive either identity (religious or atheist) to be more intuitive when combined with a professional identity described as working in academia. This was not the case for atheists and other non-religious participants, who perceived the combination of atheist and a professional identity working in academia to be more intuitive. Study 5b further explained these findings by suggesting that it was not *only* ego-centric bias that explained these findings. Rather, we also found evidence of a stronger intuitive linking between science and

atheism, particularly for atheist participants (who found the combination of atheist and scientist identities to be more intuitive than the combination of atheist and novelist).

These studies had several limitations. The results of Study 2 suggested that our findings could be at least partially explained by ego-centric bias, in that both the atheist and religious participant groups found the combined identity including their ingroup to be less counter-stereotypical than the combined identity including their outgroup. However, for Studies 3-5b we found limited evidence for this. We only found a difference in perceptions of the targets for nonreligious participants (for atheists in all studies, and for NR-NA participants in Studies 3, 5a, and 5b). Thus, it may be that ego-centric bias contributes to people's perceptions, but this does not negate the fact that stereotyping plays a major role in perceptions of religious and atheist scientists.

Furthermore, we conducted these studies in the U.K., a largely non-religious society. We might find different patterns of results in a society with different demographic features and different narratives around the relationship between science and religion. Indeed, the fact that in Study 5a we found only a marginally significant difference in people's perceptions of scientist and author target professions indicates that stereotypes and prejudices (particularly those held by atheists) may be a wider societal issue, particularly regarding perceptions of the "secular academy". Moreover, participants were only given a very small amount of information about the targets – in a real-world setting, people would likely have more information with which to make their judgments about an individual. Despite these limitations, we believe that our findings regarding people's perceptions of religious scientists and atheist scientists can contribute to our understanding of larger social narratives and instigate future research.

First, our findings suggest that the “conflict narrative” may be driven in part by intergroup dynamics. People’s social identities affect the ways in which they think about religious scientist and atheist scientist targets. Moreover, it seems to primarily be people with atheist and non-religious social identities whose responses correspond to the conflict narrative, as they see the combination of “religious” and “scientist” as less intuitive and more counter-stereotypical. This raises questions for future research regarding how the conflict narrative is perpetuated in society and academia.

Second, this research has implications for diversity in science. It is clear that religious identity does play a role in who is perceived to be a stereotypical scientist. Study 3 also indicated that across all participant groups, religious scientists were perceived as being less respected. Future research should examine the extent to which these findings have implications for attainment and progression in STEM careers for those who identify as religious. The UK’s Campaign for Science and Engineering’s policy review on diversity (2018) states that certain populations, particularly women and ethnic minorities, are underrepresented in STEM (Science, Technology, Engineering, and Mathematics); however, increased diversity demonstrably benefits both individuals and organizations. Research investigating the underrepresentation of women in STEM has found numerous challenges that women face when entering STEM fields. Prominently, research has shown that people perceive there to be a mismatch between stereotypes associated with women and stereotypes associated with people who work in STEM fields. This contributes to an effect often described as the “leaky pipeline,” in which women drop out of STEM fields at every stage on the way to leadership positions (Alper, 1993). Research indicates that the stereotypic associations between being a man and



working in STEM fields contribute to a culture where women feel that they do not belong (Cheryan, Plaut, Davies, & Steele, 2009; Good, Rattan, & Dweck, 2012). Our findings showing that there is a tendency to associate atheism with science at least for some participant groups indicate that there could be a similar process at play for religious people in science. In support of this, across both our general population and student samples in these studies, we found that religious people never saw the combination of religious and scientist identities as being more counter-stereotypical or less intuitive than atheist and scientist identities, and yet religious individuals are underrepresented in the sciences.

Research in the sociology of religion might additionally help us to understand this finding. In Ecklund and Park's (2009) research on elite scientists, the majority of scientists surveyed did not see science and religion as being in necessary conflict. However, nearly half of scientists (45%) surveyed thought that their colleagues were not positive towards religion. This indicates that the *culture* of science and more broadly a 'secular academy' may be hostile towards religious individuals, even when individual scientists on average are not. This is supported by our findings in Study 3, in which all participants, independent of (non)religious identity, viewed religious scientists as being less respected than atheist scientists.

Recent research on scientific workplaces further supports this. In scientific workplaces, "being non-religious was the assumed norm and (any) religiosity regarded as somewhat suspicious and odd, to be carefully managed in order not to interfere with scientific credibility" (Catto, 2020). This suggests that there is a culture within science departments and workplaces in which the disclosure of religious belief may be a social

and professional risk, in which disparaging religious belief is normalized. This suspicion even reaches into the wider perceptions of research disciplines, at least within the social sciences. Recent research on social and personality psychologists' perceptions of various subdisciplines shows that the psychology of religion/spirituality is perceived as being less rigorous and less "mainstream" than other psychology subdisciplines. Additionally, psychologists who study religion were least often associated with intelligence (Rios & Roth, 2019).

Altogether, this negative perception and bias against religion (and indeed even the study of religion) within the sciences is something that should be taken seriously if we do want to encourage diversity of all kinds in science and science (higher) education. As research regarding women in STEM fields has demonstrated, when people feel that they do not belong, they are likely to be deterred from developing an interest in that subject (Cheryan, Plaut, Davies, & Steele, 2009). Prominent scientists are often seen as role models and can be viewed as important representatives and leaders of their institutions. In that sense they model what a "good scientist" should be like and what they should believe or not believe. This may impact on whether individuals feel that their other social identities (female, religious, ethnic minority) are compatible with the identity of "scientist." Thus, religious individuals may enter the sciences in lower numbers not because of any negative associations that they personally hold between religion and science, but because of perceptions and experiences confirming that they do not belong.

By limiting perceptions of who can be a scientist to a particular set of identities, we limit the diversity of perspectives that can contribute to the kinds of knowledge production arising from scientific research. Moreover, this may contribute to a climate

where people who do not fit those identities may feel that they do not have a stake in science, which could in turn impact their support for it. We argue that it would be beneficial to learn from research on the underrepresentation of other social identities (e.g., gender) in STEM and work towards creating an environment that is welcoming of all identities in science. This is important to address if we want to ensure that STEM fields are inclusive and that anyone could become a scientist regardless of their other social identities.

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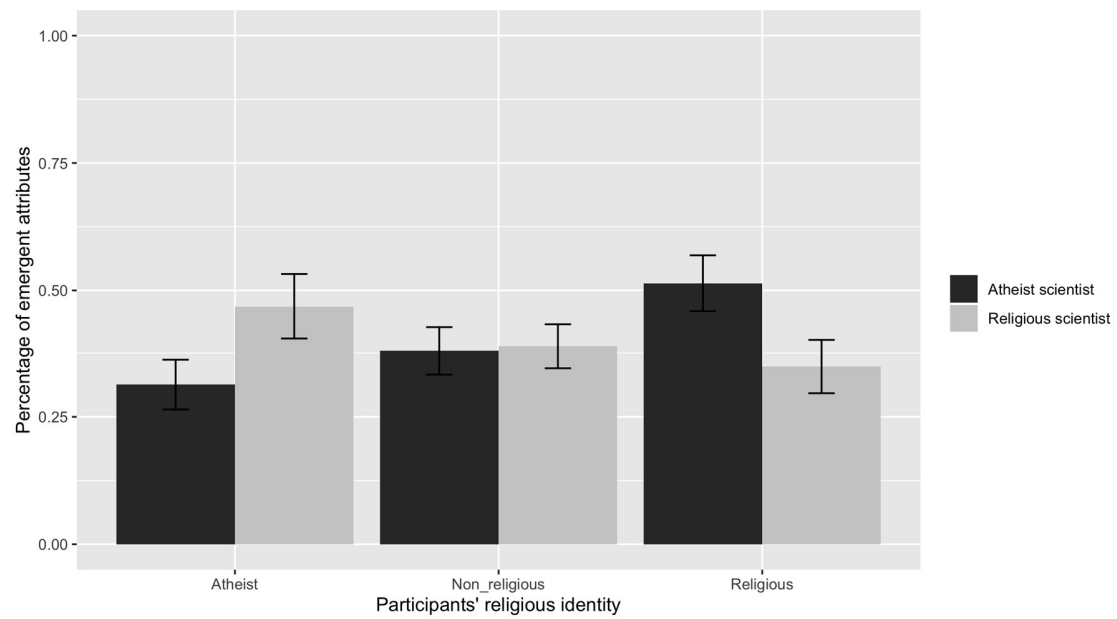
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Table 1

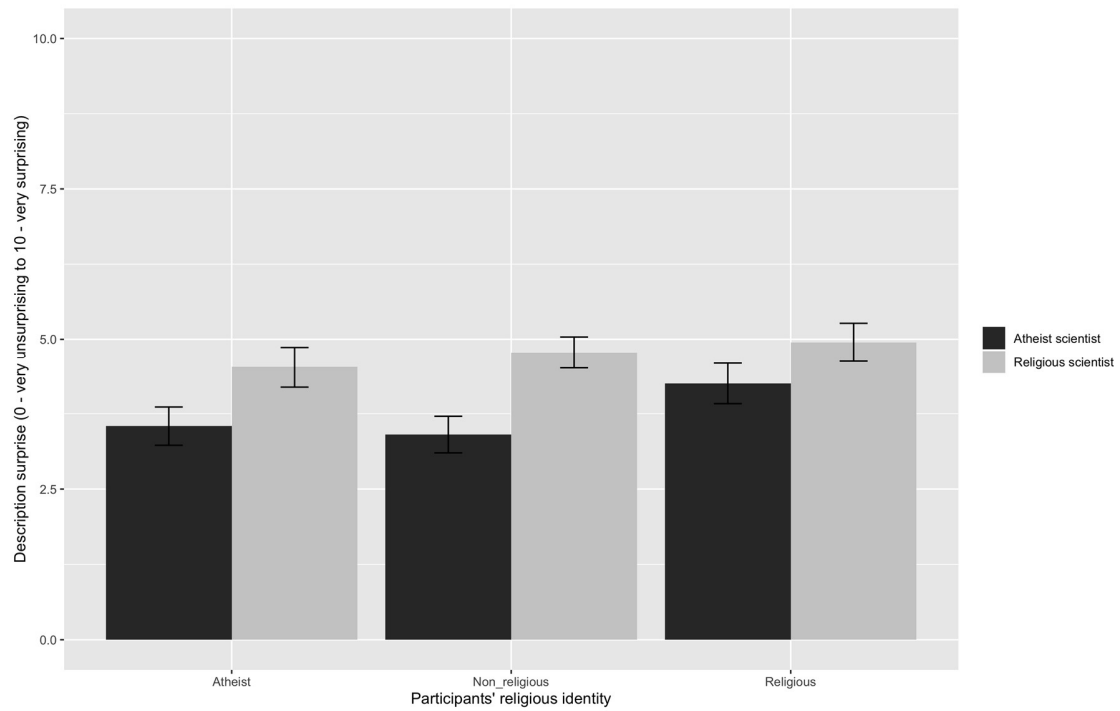
*Attributes generated for R-EB and A-EB Targets in Study 1 (Frequency).*

	Emergent	Overlapping	Constituent (EB)	Constituent (R)	Constituent (A)
Religious EB	Open-minded (14)	Kind (15)	Intelligent (26)	Faithful (12)	
	Conflicted (10)	Devoted (13)	Educated (10)	Polite (6)	
	Sensible (7)	Confident (9)	Thoughtful (8)	Calm (5)	
	Well-spoken (6)	Friendly (8)	Inquisitive (7)	Cheerful (4)	
	Wise (6)	Introverted (6)	Interesting (7)	Determined (4)	
	Confused (5)	Stubborn (6)	Hard-working (5)	Giving (4)	
	Trusting (4)	Arrogant (5)	Nature-related (5)	Honest (4)	
		Happy (4)	Studious (4)	Understanding (4)	
Atheist EB	Passionate (5)	Intelligent (36)	Hard-working (8)		Realist (11)
	Well-read (5)	Studious (15)	Methodical (7)		Argumentative (7)
	Analytical (4)	Logical (14)	Serious (7)		Honest (7)
	Cold (4)	Opinionated (11)	Boring (5)		Knowledgeable (7)
	Factual (4)	Scientific (11)	Ambitious (4)		Skeptical (7)
	Focused (4)	Arrogant (10)	Dedicated (4)		Calm (6)
	Heavy handed (4)	Interesting (7)	Enthusiastic (4)		Imaginative (5)
	Well-spoken (4)	Friendly (6)	Humorous (4)		Questioning (5)
		Non-religious (6)	Old (4)		
		Confident (5)	Quiet (4)		
		Curious (5)	Thoughtful (4)		
		Educated (4)			
		Happy (4)			
		Kind (4)			

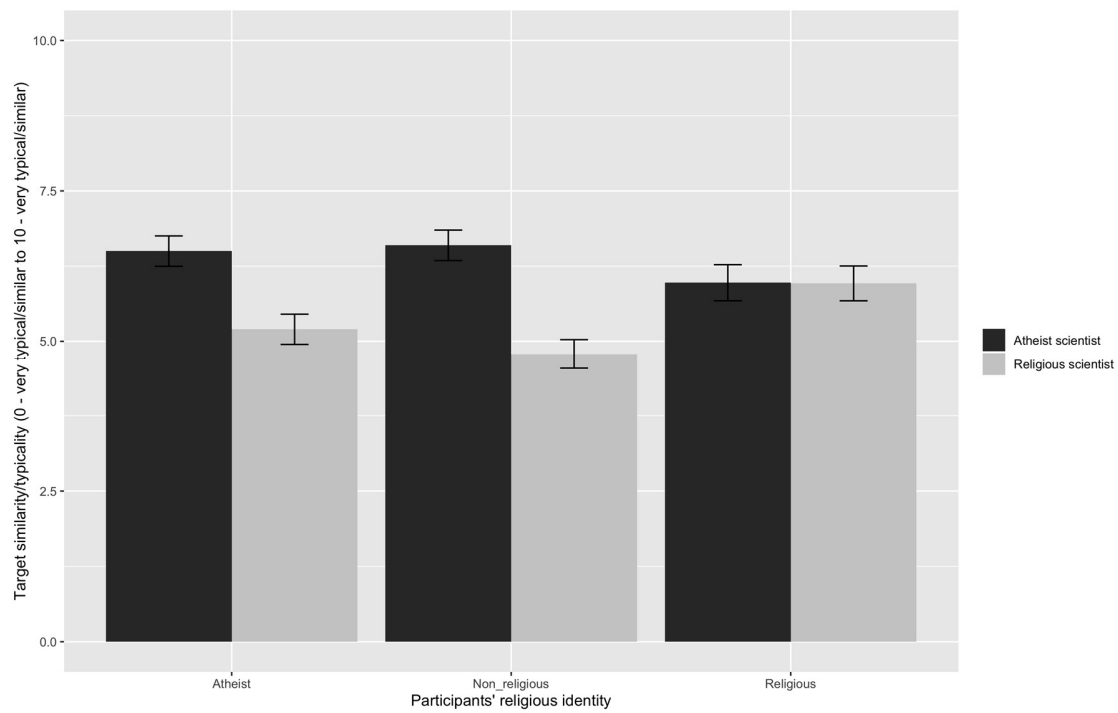
Note. Frequencies reported in parentheses. Categories reported if accounted for at least 1% of total adjectives ( $n = 4$ ).



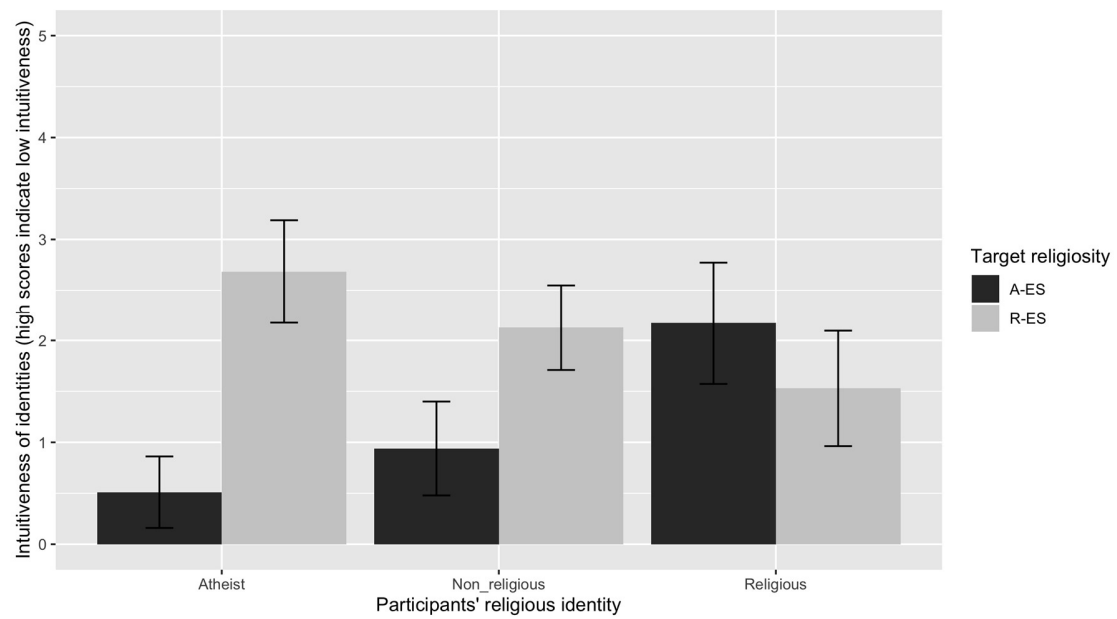
*Figure 1.* Percentage of emergent attributes used to describe religious and atheist scientist as a function of participants' religious identity in Study 2. Error bars indicate  $\pm 1$  standard error.



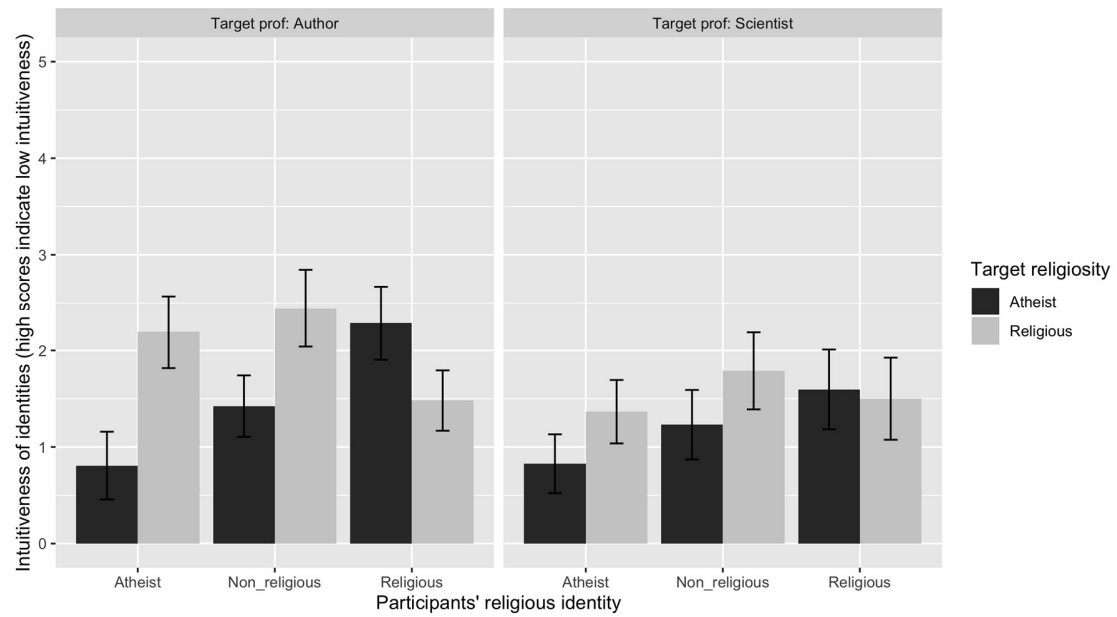
*Figure 2.* Mean surprise ratings as a function of participants' religious identity and target religiosity (atheist or religious scientist) in Study 3. Error bars indicate  $\pm 1$  standard error.



*Figure 3.* Mean typicality/similarity to other scientists ratings as a function of participants' religious identity and target religiosity (atheist or religious scientist) in Study 3. Error bars indicate  $\pm 1$  standard error.

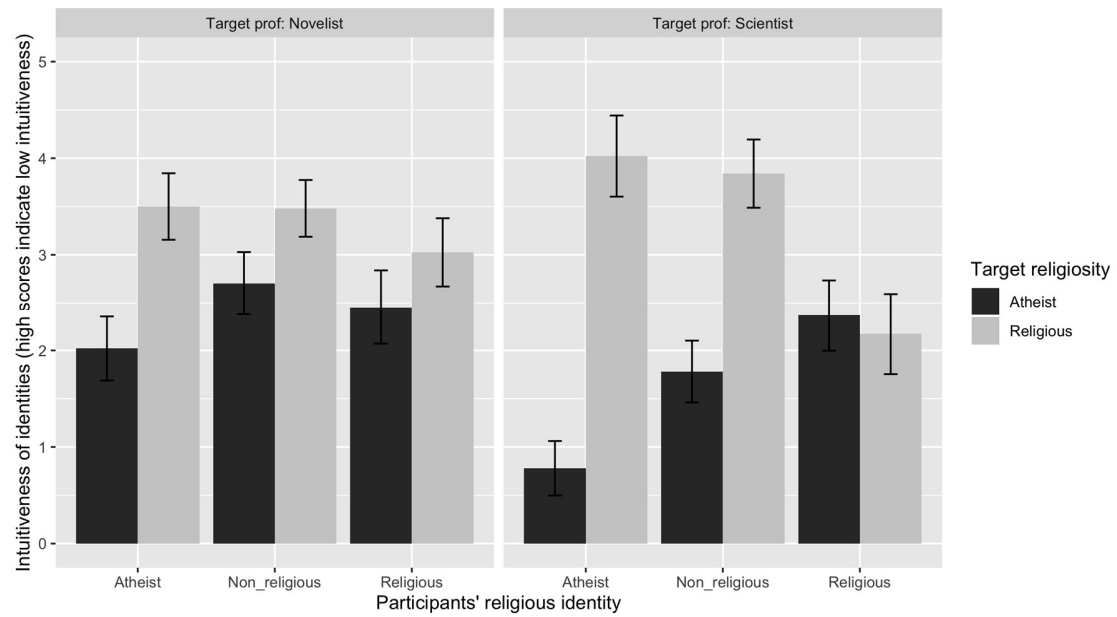


*Figure 4.* Intuitiveness of identity combinations (mean conjunction fallacy difference scores) as a function of target's religiosity (atheist or religious evolutionary scientist) and participants' religious identity in Study 4. Error bars indicate  $\pm 1$  standard error.



*Figure 5.* Intuitiveness of identity combinations (mean conjunction fallacy difference scores) as a function of target religiosity (atheist or religious), target profession (author or scientist), and participants' religious identity in Study 5a. Error bars indicate  $\pm 1$  standard error.





*Figure 6.* Intuitiveness of identity combinations (mean conjunction fallacy difference scores) as a function of target religiosity (atheist or religious), target profession (novelist or scientist), and participants' religious identity in Study 5a. Error bars indicate  $\pm 1$  standard error.