Explanation and its Limits: Mystery and the Need for Explanation in Science and Religion

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Abstract

Both science and religion offer explanations for everyday events, but they differ with respect to their tolerance for mysteries. In the present research, we investigate laypeople's perceptions about the extent to which religious and scientific questions demand an explanation and the extent to which an appeal to mystery can satisfy that demand. In Study 1, we document a large domain difference between science and religion: scientific questions are judged to be more in need of explanation and less appropriately answered by appeal to mystery than religious questions. In Study 2, we demonstrate that these differences are not driven by differing levels of belief in the content of these domains. While the source of these domain differences remains unclear, we propose several hypotheses in the General Discussion.

Keywords: explanation; mystery; science; religion

In different ways, science and religion offer explanations for the world and for human experience. In science, explanations help us make sense of our observations and unify disparate phenomena (Woodward, 2017). In religion, explanations can provide meaningful narratives to explain otherwise mysterious events (Hood, Hill, & Spilka, 2009). On many accounts, achieving such explanations is a central aim of both science and religion. Harré (1985, p. 168) called scientific explanations "the crown of science." Similarly, some regard "the pursuit of explanation, prediction, and control [as] both necessary and sufficient for the flourishing of religious life" (Horton, 1997). Despite these commonalities, scientific and religious explanations are often perceived as conflicting (Preston & Epley, 2009; Scheitle, 2011). This raises the important question of whether and how explanation itself might vary across domains.

One possibility is that scientific and religious explanations are similar in their cognitive roles, but sometimes conflict because they focus on different content or are premised on different beliefs. Consistent with this idea, there is evidence that shared cognitive processes underlie both religious and non-religious explanations for everyday events (e.g., Barrett, 2000, 2004; Hood et al., 2009; Lupfer, Brock, & DePaola, 1992), that religious and scientific explanations can be integrated in individual minds (e.g., Legare, Evans, Rosengren, & Harris, 2012), and that religious and scientific beliefs can co-exist just as distinct sets of factual beliefs co-exist (Shtulman & Lombrozo, 2016). At the same time, there are some theoretical reasons to expect a sharper divide, with

science and religion operating with fundamentally different attitudes towards explanation and its limits.

One reason to expect explanation itself to differ across scientific and religious domains comes from each domain's tolerance for *mysteries*, which involve an abdication from explaining: either there is no need for explanation, or declaring something a mystery is considered an adequate response to this need. Within science, declaring something a mystery is a sign that a scientific theory is inadequate or incomplete. Yet some religious traditions seem to actively embrace (some) mysteries (Boudry & Coyne, 2016; Boudry & De Smedt, 2011; Boyer, 2001; Sperber, 1996). For instance, some theologians maintain that the trinity is a mystery (Tuggy, 2016), and some mystical traditions consider mystical experiences to be "ineffable" in that the experience or its object cannot be explained (Gellman, 2017).

A first aim of the current paper is to empirically test the hypothesis that science and religion indeed differ in the extent to which their respective questions demand an explanation, and in the extent to which "it's a mystery" is deemed an acceptable surrogate for explanation. For instance, does a question such as "why is rust red?" demand an explanation to a greater extent than "why is God good?" And is it more acceptable to declare the latter a mystery than the former? We refer to these judgments as "need for explanation" (NFE; Grimm, 2008; Wong & Yudell, 2015) and "mystery acceptability" (MA), respectively.

A second aim of the current paper is to begin to identify why science and religion might differ in these ways. One possibility is that NFE and MA differ only because religious questions and explanations involve greater uncertainty. That is, the question "Why is God good?" may elicit a lower NFE and higher MA than the question "Why is rust red?" because – on average – people may be more confident in the premise of the latter (that rust is red) than the former (that God exists and is good). If this is the case, we might expect that for a religious believer who is just as confident that God exists and is good as they are that rust is red, the differences in NFE and MA across domains will be smaller. But a more intriguing possibility is that NFE and MA differ even controlling for strength of belief, and that these judgments instead reflect differences in our epistemic attitudes and aims across domains. For instance, it could be that in religious contexts, accepting that something is a mystery is taken to reflect an appropriate form of humility towards God or God's creations.

In the general discussion, we consider additional possibilities.

Below we present two studies designed to evaluate three hypotheses regarding MA and NFE across domains. The first hypothesis is that NFE and MA do not differ across scientific and religious domains. This is what we might expect if science and religion involve equivalent attitudes towards explanation and its limits, as well as equivalent levels of uncertainty. Second, it could be that NFE and MA differ across domains, but only because these domains differ in average levels of uncertainty. On this view, we would expect (a.) that religious belief would moderate the difference between religion and science (tested in Study 1), and (b.) that differences between science and religion would disappear once we appropriately control for degrees of belief in the premise of each question (tested in Study 2). Third, we might expect that epistemic commitments or practices specific to each domain lead to genuine differences in the role of explanation and its limits across domains. Under this hypothesis, we would expect domain differences in NFE and MA to persist, even controlling for degrees of belief in the corresponding religious and scientific content.

Study 1

In Study 1, we examine potential domain differences in need for explanation (NFE) and mystery acceptability (MA). To do so, we ask participants to rate either NFE or MA in response to questions from various domains, including religion and science. We also begin to investigate the root of possible differences, focusing on general belief within the domain of religion.

Method

Participants Participants in Study 1 were 208 adults recruited from Amazon Mechanical Turk (124 males, 84 females, mean age 36, range 20-69). Participation was restricted to MTurk workers in the United States who had completed at least 50 HITs with a minimum approval rating of 95%. Eight additional participants were excluded for failing an attention check (described below), and one was excluded for failing to provide responses to more than half of all items.

Materials Seventy questions were selected from Answers.com (http://www.answers.com), ten from each of seven domains based on the website's classification: "science," "math," "health," "religion and spirituality," "supernatural and the occult," "psychology," and "philosophy and philosophers." From each category, questions that contained the word "why" were extracted from the first 50 pages of questions. From each of these lists, 10 questions were selected and edited lightly for grammar and readability. See Table 1 for sample questions.

To measure religious belief and religious engagement, we used the religiosity inventory from Pennycook, Cheyne, Seli, Koehler, and Fugelsang (2012). This scale included three items measuring religious engagement (α = 0.89) and six

measuring religious belief (α = 0.94). We also measured supernatural beliefs using a subset of the paranormal belief scale from Tobacyk (2004), as well as domain-general epistemic preferences using the criteria for belief scale from Experiment 4 of Metz, Weisberg, and Weisberg (2018). In the interest of space, analyses of these measures are not reported here.

Table 1: Sample questions from Study 1. Domain classifications determined by *Answers.com* users.

Domain	Sample Question
Science	Why do balloons lose helium?
Religion	Why did God give us two ears?
Health	Why is calcium helpful in treating osteoporosis?
Math	Why will a set of data not always have a mode?
Philosophy	Why should we tell the truth?
Psychology	Why do people get addicted to computer games?
Supernatural	Why are demons so powerful?

Procedure Participants were randomly assigned to rate NFE (N = 106) or MA (N = 102) for each question. Those who rated NFE responded on a 7-point scale to the prompt "To what extent does this question demand explanation?" for each question. Those who rated mystery acceptability were shown each question and the answer, "It's a mystery," and responded on a 7-point scale to the prompt "How good is this explanation?" The order of questions was randomized, as was the position of an attention check, which instructed participants to select the sixth scale point. After rating NFE or MA for all 70 questions, participants completed the religiosity inventory, the modified paranormal belief scale, and the criteria for belief scale. These three measures were presented in a random order. Finally, participants reported their age and gender.

Results

First, we investigated domain differences in NFE and MA. For each measure, we fit a multilevel model predicting participant responses to each item. Domain was included in the model as a fixed effect (dummy coded, with science as the reference group). Random intercepts were included for participant and item, with items nested within domains. For NFE, there was a significant difference between science ratings and religion ratings, $t(63) = -7.81, p < .001$. Similarly, there was a difference between science ratings and supernatural ratings, $t(63) = -8.83, p < .001$, psychology ratings, $t(63) = -3.99, p < .001$, and philosophy ratings, $t(63) = -4.22, p < .001$. The difference between ratings in the health and math domains were not significantly different from those in science (see Figure 1).

For mystery acceptability, the same pattern of results arose. There was a significant difference between science ratings and religion ratings, $t(63) = 11.16, p < .001$. Similarly, there

was a difference between science ratings and supernatural ratings, $t(63) = 11.57$, $p < .001$, psychology ratings, $t(63) = 5.81$, $p < .001$, and philosophy ratings, $t(63) = 7.02$, $p < .001$. There was no difference between ratings in the health and math domains and ratings in the science domain.

These results provide support for a domain difference in need for explanation and mystery acceptability, allowing us to reject the first hypothesis outlined above. Further, they suggest that domains outside of science and religion also reflect variability in NFE and MA: the domains of science, math, and health received similar ratings (high ratings for NFE, low ratings for MA), the domains of religion and the supernatural received similar ratings (lower ratings for NFE, higher ratings for MA), and the domains of philosophy and psychology received similar ratings (in each case falling between the other two sets).

Next, we tested whether strength of religious belief could account for the difference in NFE and MA ratings across the domains of science and religion (corresponding to Hypothesis 2, above). For each participant, NFE and MA ratings were averaged within the science and religion domains. We then created two difference scores for each participant, describing the extent to which they thought the science questions were more in need of explanation than the religion questions and the extent to which they thought that it was more acceptable to answer the religion questions than the science questions by appeal to mystery.

We then fit a regression model predicting each difference score from the religious belief subscale of the religiosity inventory. For NFE scores, religious belief was a significant negative predictor of domain difference, $\beta = -0.27$, $t(104) = -2.90$, $p = .005$, and for MA scores, religious belief was a marginally significant negative predictor, $\beta = -0.17$, $t(100) = 1.70$, $p = .09$. In other words, for both NFE and MA, increasing religious belief predicted a smaller domain difference between science and religion. However, these effects are modest: religious belief explained 7% of the
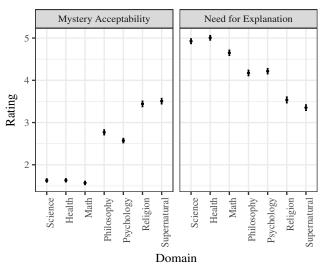
variance in NFE difference scores and 2% of the variance in MA difference scores. Therefore, a substantial portion of variance remains unexplained.

Discussion

Study 1 offers good evidence for the hypothesis that NFE and MA differ across domains and modest evidence against the hypothesis that differences are driven entirely by strength of belief. In Study 2, we use a more nuanced measure of belief, investigating agreement with the premise of *each question*. While general religious belief may be a rough proxy for item-level belief in the domain of religion, it cannot fully capture item-level differences. For example, if a person does not believe that Jesus healed the sick on the Sabbath, this person is unlikely to judge this event to be in need of explanation. However, this does not preclude their belief in *other* religious claims, and, perhaps, their judgment that questions about these claims demand explanation. Furthermore, an item-level measure of belief allows us to account for differences in agreement with scientific claims as well as religious claims.

Study 2

In Study 2, we test whether domain differences are driven by differences in item-level belief. We use new stimuli, restricted to the science domain and the religion domain, for which belief in the general US population is roughly matched. We also ask participants to rate their agreement with the premise of each individual question, and we control for this item-level measure of belief in our analyses.

We also control for a related confound, which might explain domain differences in NFE or MA: the extent to which people believe they already know the answer to the question.

Method

Participants Participants in Study 2 were 112 adults recruited from Amazon Mechanical Turk (70 males, 42 females, mean age 33, range 18 to 71). Participation was restricted to MTurk workers recruited as in Study 1. Seven additional participants who failed to pass two attention checks (described below) were excluded.

Materials Five claims or questions about science and five claims or questions about religion were selected from several large-scale surveys (Funk & Goo, 2015; Funk & Kennedy, 2016; National Science Board, 2014; Pew Research Center, 2015). These claims were selected so as to match general acceptance across domains, based on acceptance rates in these representative national polls. Averaged over the five claims, general acceptance was 77% in the religion domain ($SD = 0.14$) and 77% in the science domain ($SD = .07$). Each claim was rewritten as a "why" question. For example, the claim "The center of the Earth is very hot" was rewritten as "Why is the center of the earth so hot?" and the question "Do you believe in hell, where people who have lived bad lives and die without being sorry are eternally punished?" was rewritten as "Why is there a Hell?"

Figure 1: Study 1 domain differences in NFE and MA. Error bars = 1 SEM.

We again used the religiosity inventory from Pennycook et al. (2012), providing measures of religious engagement (α = 0.89) and religious belief (α = 0.95). We also included the criteria for belief scale from Metz et al. (2018), but results from this measure are again not reported in the interest of space.

Procedure All participants rated NFE, MA, belief, and knowledge for each question. For the belief measure, participants indicated on a seven-point scale how much they agreed with the truth of the question's premise (e.g., "Please rate your agreement with the following: that there is a Hell"). For the knowledge measure, participants rated on a seven-point scale their confidence that they knew the answer to the question. The belief and knowledge measures were completed together in a single block. NFE and MA were completed separately in two additional blocks. The order of these blocks was randomized.

Next, participants completed the religiosity inventory and the criteria for belief scale. These measures were presented in a random order. Within each scale, an attention check instructed participants to select a given option ("I disagree" for the religiosity inventory and "bad reason" for the criteria for belief scale). Finally, participants reported their age, gender, and highest level of education.

Results

First, we investigated domain differences in NFE and MA, controlling for belief at an item-level. For each measure, we fit a multilevel model predicting participant responses to each item. Domain (religion vs. science) and belief (continuous rating from 1 to 7) were included in the model as fixed effects. Random intercepts were included for participant and item, with items nested within domains. For NFE, type III Wald tests revealed a significant main effect of domain, $\chi^2(1)$ = 6.42, p = .01, and a significant main effect of belief, $\chi^2(1)$ = 18.10, $p < .001$. The interaction between belief and domain was not significant. For MA, type III Wald tests revealed a marginally significant main effect of domain, $\chi^2(1)$ = 3.82, p = .0507, a significant main effect of belief, $\chi^2(1)$ = 5.16, p = .02, and a significant interaction between belief and domain, $\chi^2(1)$ = 3.85, p = .0496.

These results suggest that domain differences in NFE and mystery acceptability are not driven only by differences in belief. However, it remains possible that effects of belief are non-linear, with claims that are explicitly endorsed (as reflected in ratings above the mid-point) exhibiting a different profile. As an additional analysis, we therefore tested the domain difference only in the subset of ratings above the midpoint of the item-level belief scale (indicating agreement with the question's premise; see Figure 2). The main effect of domain remained significant for both NFE, $\chi^2(1)$ = 13.76, $p < .001$ and for MA, $\chi^2(1)$ = 117.23, $p < .001$. Domain differences trended in the same direction even in the subset of ratings below the midpoint of item-level belief (indicating disagreement with the question's premise), though this difference was not significant for NFE ratings.

Similarly, we investigated domain differences controlling for *knowledge* at an item-level. In the interest of space, the details of these analyses are not reported here. However, they demonstrate that the domain difference also cannot be accounted for by differences in perceived knowledge.
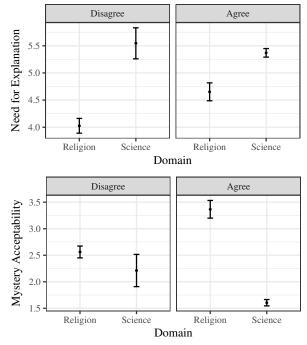

Figure 2: Study 2 NFE and MA judgments in each domain, as a function of item-level belief ("Disagree" = below scale midpoint; "Agree" = above scale midpoint); data from scale mid-point not included. Error bars = 1 SEM.

Discussion

Study 2 challenges the hypothesis that NFE and MA differ across the domains of science and religion merely because of differing levels of agreement with claims from these domains. Even holding belief fixed at an item level, and using items for which belief is roughly matched in the United States population, we found marked domain differences in both NFE and MA. Furthermore, these domain differences cannot be accounted for by perceived knowledge of the correct explanation for each item.

General Discussion

Despite a growing body of research on explanation (e.g., Lombrozo, 2016), very little empirical research has explored the differences and similarities between attempts to explain in the domains of science and religion. In the present research, we demonstrated large domain differences in the extent to which religious and scientific questions were judged to be in need of explanation, as well as the extent to which non-explanations appealing to "mystery" could fulfill this need. In the science domain, "why" questions were generally judged to be strongly in need of explanation, and appeal to mystery was not judged to fulfill this need. However, in the domain of religion, "why" questions were judged to be less

in need of explanation, and explanations that appeal to mystery were judged to be more acceptable (though still not highly satisfying). Furthermore, these domain differences were *not* a result of differences in belief or knowledge across domains: although both belief and knowledge affected need for explanation and mystery acceptability, these variables did not fully account for differences across domains.

These studies have several limitations. First, the questions in the domain of religion focused very narrowly on Judeo-Christian traditions. We initially chose this subset of religious questions because the Pennycook et al. (2012) measure of religious belief and religious engagement focused on corresponding beliefs. Furthermore, while MTurk samples tend to be less religious than other samples, most religious MTurk workers are Protestant or Catholic (Berinsky, Huber, & Lenz, 2012). Nonetheless, we cannot make strong generalizations about general domain differences until NFE and MA are investigated across a more representative set of religious traditions and across a more representative set of participants.

Furthermore, the studies presented here do not reveal how our participants interpreted the terms "explanation" or "mystery." It is possible that the very interpretation of these terms varies across domains, or across religious and non-religious participants.

These studies leave many additional questions open for future research. For instance, what is the relationship between a mystery – the idea that something is unexplainable – and ignorance – the idea that the explanation is simply unknown? By age 9, children recognize that some facts, such as the number of leaves in the world, are "unknowable," and they favor experts who acknowledge their ignorance about them (Kominsky, Langthorne, & Keil, 2016). There is also evidence that both children and adults care that informants be "well-calibrated" in the sense that they can accurately report their uncertainty (Bridgers, Buchsbaum, Seiver, Griffiths, & Gopnik, 2016; Tenney, MacCoun, Spellman, & Hastie, 2007). So while declaring a question a mystery may be unacceptable in science, recognizing one's own ignorance could be a virtue.

Another open question concerns the source of domain differences in MA and NFE. In the following section, we propose several hypotheses for future study.

Possible Sources of Domain Differences

A first hypothesis concerns the potential epistemic limits of our understanding. People might suppose that the topics of religion are ones that generally reflect the limits of human understanding. If this is the case, religious questions may be genuine mysteries that cannot be explained, or at least believed to be such. While prior work has investigated the perceived limits of *scientific* explanation (Gottlieb & Lombrozo, 2018), little is known about the perceived limits of explanations of other kinds.

Another hypothesis is that explanation (and its abdication) play different epistemic roles within science and religion. In the case of religion, accepting a mystery could be taken to reflect not only a religious virtue but an epistemic virtue, such as humility in the face of the divine. Accepting something without further explanation or evidence could also be seen as a form of faith that characterizes some people's religious beliefs (Buchak, 2012).

A third hypothesis is that domain differences could be produced by differing metaphysical beliefs about whether there is a "fact of the matter" in each domain (for related work, see Goodwin & Darley, 2008; Heiphetz & Young, 2017). Van Leeuwen (2014) argues that religious "credences" are distinct from factual beliefs in that they are context dependent, do not govern genuine factual beliefs, and are non-responsive to evidence (see also Van Leeuwen, 2017). It is clear that these differences may impact need for explanation and mystery acceptability: why demand an explanation when there is no "true" explanation?

Finally, epistemic practices across domains could differ with respect to these domains' *social* roles. Van Leeuwen (2017) suggests that the "evidential invulnerability" that characterizes religious credence could reflect a non-epistemic function, such as social signaling (see also Kahan, 2013; Norenzayan, 2013; Sosis & Alcorta, 2003). Corresponding empirical work suggests that religious beliefs are treated as important guides to others' behavior and social identity (for a review, see Heiphetz, 2018). We are exploring these hypotheses in ongoing work.

Conclusion

While science and religion both seek to provide explanations for everyday events and phenomena, people's judgments of need for explanation within these domains seem to be meaningfully different. In science, unanswered questions are thought to stand in need of explanation, while in religion, unanswered questions are sometimes accepted as mysteries. These differences are not a simple function of differences in content-specific belief. What is the basis of these differences? While future research will certainly find an explanation, at present it remains a mystery.

Acknowledgements

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