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Religious People View Both Science and Religion as Less Epistemically Valuable Than Non-Religious People View Science

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Abstract

Religious people typically report low perceived conflict between science and religion, but also less trust in science than non-religious people. We address these puzzling findings using insights from goal systems theory. Goal systems theory suggests that, when people have more means of achieving a goal, they perceive each individual means as less instrumental. We translate this "instrumentality hypothesis" to differences in how religious and non-religious people perceive science and religion. Religious people—who use both science and religion as means to gain knowledge—may perceive both as moderately instrumental, and as less instrumental than non-religious people, who do not use religion as a source of knowledge. We support the instrumentality hypothesis in studies where participants evaluate the capacity of science and religion to explain extraordinary phenomena (Study 1), fill gaps in knowledge (Study 2), answer life's big questions (Study 3), and to help avoid COVID-19 infection (Study 4). We also find that non-religious people overperceive religious people's trust in religion and underperceive religious people's trust in science as sources of knowledge (Study 5). Our studies suggest that non-religious people think that religion specifically deters trust in science, but instead, religious people typically avoid extreme epistemic reliance on any single source of knowledge.

Humans are motivated to understand the world. For thousands of years, we have grappled with questions that are both abstract (life after death, our role in the universe) and concrete (the next day's weather, the best way to respond to a pandemic). Humans have historically used their religious beliefs as a means of answering these questions (Atran, 1998; Jackson et al., 2023). Throughout Medieval history, most Europeans relied on the Catholic Church for their knowledge about the earth's origins, the nature of the afterlife, the meaning of virtue, the causes of climate variation, and the best way to exorcise demons (Thomas, 2004). But the scientific revolution has provided people with new secular sources of knowledge. To explain life's big questions, the current-day person can now access scripture and prayer, but also articles and books from chemistry, biology, physics, and neuroscience. How do humans adjudicate between these sources of knowledge?

Here we consider two narratives around this question. The conflict narrative claims that science and religion are inherently inhibitory, and that religiosity—the strength of someone's religious conviction—will inhibit trust and confidence in science (Dawkins & Ward, 2006; Dennett, 2006; S. Harris, 2006). In contrast, the compatibility narrative holds that religion and science are easily compatible, and that people simultaneously hold religious beliefs while also reporting confidence in scientific information (Ecklund, 2010; Legare & Gelman, 2008; McPhetres et al., 2021; Watts et al., 2020). These two perspectives stand in sharp relief to one another, and they have sparked high-profile debates about the relationship between science and religion (Lipka, 2014).

It can be puzzling to adjudicate between these narratives because they both cite evidence supporting their claims. Proponents of the conflict narrative point to robust evidence that religious people report lower trust in science than non-religious people (Chan, 2018; DeFranza et al., 2021; Preston & Epley, 2009). Proponents of the compatibility narrative point to the fact that religious people frequently mix religion and science to understand the

world (Legare & Gelman, 2008; Watts et al., 2020), and report lower subjective conflict between science and religion than do non-religious people (Leicht et al., 2022). This combination of findings is simultaneously replicable and seemingly paradoxical: Why do religious people report lower trust in science than non-religious people, even though they frequently use science and perceive it to complement their religious beliefs?

Here we suggest that this puzzle can be solved using goal systems theory, which is a general theory of how people accomplish goals using means (Kruglanski et al., 2002). The "instrumentality hypothesis" in goal systems theory suggests that people who have multiple means to the same goal should rely on each mean less than if they only had one mean to pursuing a goal (Bélanger et al., 2015). This hypothesis has previously been applied to highly concrete goals, but we suggest that it should also apply to the goal of understanding the world. We suggest that people view religion and science as two major sources of knowledge, which they employ along with other sources. Whereas religious people can employ both of these sources interchangeably or in tandem, non-religious people must rely more exclusively on science. We suggest that religious people should therefore view science and religion as both less instrumental as a source of knowledge than non-religious people view science.

In this view, religious people's lower trust in science is not a product of any great incompatibility between science-based and faith-based mindsets. Rather, it is an inevitable product of having multiple tools at one's disposal, like dieting and exercising as two tools to lose weight. Our view aligns with growing evidence that many people use religion as a highly instrumental resource (Hong & Henrich, 2021). It also proposes a novel and falsifiable hypothesis: religious people should also view religion—not only science—as less instrumental than non-religious people view science.

We develop our argument throughout this paper and ground it more thoroughly in previous scholarship on science and religion from across the social sciences. Across five

empirical studies, we also validate our key claims across different domains of explanation. We consistently find support for our predictions, regardless of whether people are explaining extraordinary phenomena, answering life's big questions, and trying to avoid COVID-19 exposure.

Two Different Narratives About Science and Religion

The scientific study of religion has long been focused on how children (Richert & Corriveau, 2022) and adults (Park, 2005) make meaning of the world using religious beliefs and practices. However, the beginning of the 21st century saw a surge of debate which specifically focused on how people view the relationship between religion (faith-based beliefs and practices associated with traditions such as Christianity or Hinduism) and science (evidence-based information associated with disciplines such as biology, physics, and of course social psychology) as sources of knowledge and meaning.

One narrative, driven by the "New Atheist" movement, proposes that religious people use their religious beliefs as their primary means of explaining the world, whereas non-religious people rely on science. New Atheists have claimed that science and religion are inherently at odds, and that religious belief fundamentally undermines trust in science (Dawkins & Ward, 2006; Hitchens, 2008). In the essay "Science Must Destroy Religion," Sam Harris wrote that "the success of science often comes at the expense of religious dogma; the maintenance of religious dogma always comes at the expense of science" (S. Harris, 2006). Other scholars have suggested that religious systems are "memeplexes" that narrow people's worldviews so that they can replicate at the expense of other memes (Dawkins & Ward, 2006; Dennett, 2006).

Two lines of evidence support this conflict narrative. First, a pair of experimental studies published in 2009 found that experimentally increasing belief in God decreased implicit evaluations of science and vice versa (Preston & Epley, 2009). Second, several

surveys have found that religiosity is correlated with lower trust in science, a link that is particularly strong in the United States (McPhetres et al., 2021; Payir et al., 2021) but also generalizes to countries around the globe (Chan, 2018). A study during the COVID-19 pandemic found that highly religious regions of the United States were more likely than non-religious regions to violate science-based social distancing and shelter-in-place directives (DeFranza et al., 2021), and another study conducted during COVID-19 found that science mindsets towards the pandemic were correlated negatively with faith mindsets (K. A. Johnson et al., 2021).

A competing narrative is that religious people are surprisingly favorable towards scientific knowledge (Legare et al., 2012). Cross-cultural field studies have found that religious people from non-Western societies often endorse scientific as well as religious explanations of illness and death (Gelman & Legare, 2009; Legare & Gelman, 2008). Recent studies have found that religious individuals appeared to complement (rather than replace) supernatural explanations with science-based explanations in their explanations for life after death, the weather, and a variety of other phenomena (Watts et al., 2020), and that many religious people view scientific authorities as credible sources of information (Hoogeveen et al., 2022). Developmental research has shown that children are willing to rely on science and religion as co-existing sources of knowledge (P. L. Harris & Koenig, 2006; Shtulman, 2013). Survey studies have found that religious people subjectively perceive science and religion as more compatible than non-religious people (Leicht et al., 2022).

These two narratives seem directly contradictory. According to one narrative, religion inhibits confidence in science; according to the other, highly religious individuals often use science as a source of knowledge which complements religion. But paradoxically, both narratives have empirical support from multiple studies. How can this be?

Science and Religion as Instrumental Means in a Goal System

Whereas empirical support for both of those narratives could indicate the presence of moderating variables, in this paper we suggest that goal systems theory, a general theory of goal pursuit (Kruglanski et al., 2002), can help adjudicate between the contrasting evidence of past research. Goal systems theory is a general theory of motivation which describes and predicts how people strive for their *goals* using different *means* of achieving these goals. Goal systems theory is "general" in the sense that it is not specific to particular kind of goal: it applies to goal pursuits ranging from gaining knowledge, to losing weight, to making friends. Goal systems theory claims that goals and means form certain constellations that have specific psychological consequences. For example, "equifinality" describes whether multiple means serve the same goal (Kruglanski et al., 2011), and "multifinality" describes how one means serves multiple goals (Kruglanski et al., 2015).

According to goal systems theory, different configurations between goals and means have important consequences for how people evaluate the utility of and relationship between means. For example, the instrumentality hypothesis, also called the "dilution effect" describes how adding equifinal means to a goal network (e.g., dieting and exercising to lose weight) will weaken people's perceived instrumentality of means (Anderson & Bower, 1973). In other words, someone who uses dieting and exercising as multiple means to lose weight will perceive both dieting and exercising as moderately instrumental whereas someone who uses only dieting will perceive it as extremely instrumental. This "more is less" dynamic means that people with multiple means can feel less dependent on any single strategy.

We apply goal systems theory to the relationship between science and religion as means to achieve the goal of knowledge. The word "knowledge" has a complicated past, and epistemologists since Plato have sought to separate the concept of "knowledge" from "belief" by implying that knowledge refers only to things that people can know with certainty to be

true (Aristotle, 350 BCE; Plato, 380 BCE). Here we use the word "knowledge" slightly differently, to refer to participants' subjective experience of knowing something, which is more similar to how epistemologists have defined "belief" (a term that we do not use in this paper because it has an inherently supernatural connotation in the scientific study of religion, and we seek to avoid confusion that might arise because of this meaning). We claim that religious people have both science and religion at their disposal as means for gaining knowledge. In contrast, people who were raised Atheist or deconverted from their religion will not have religion at their disposal as a means for gaining knowledge. This schematic is illustrated in Figure 1, with annotations marking different links in the means-goal system.

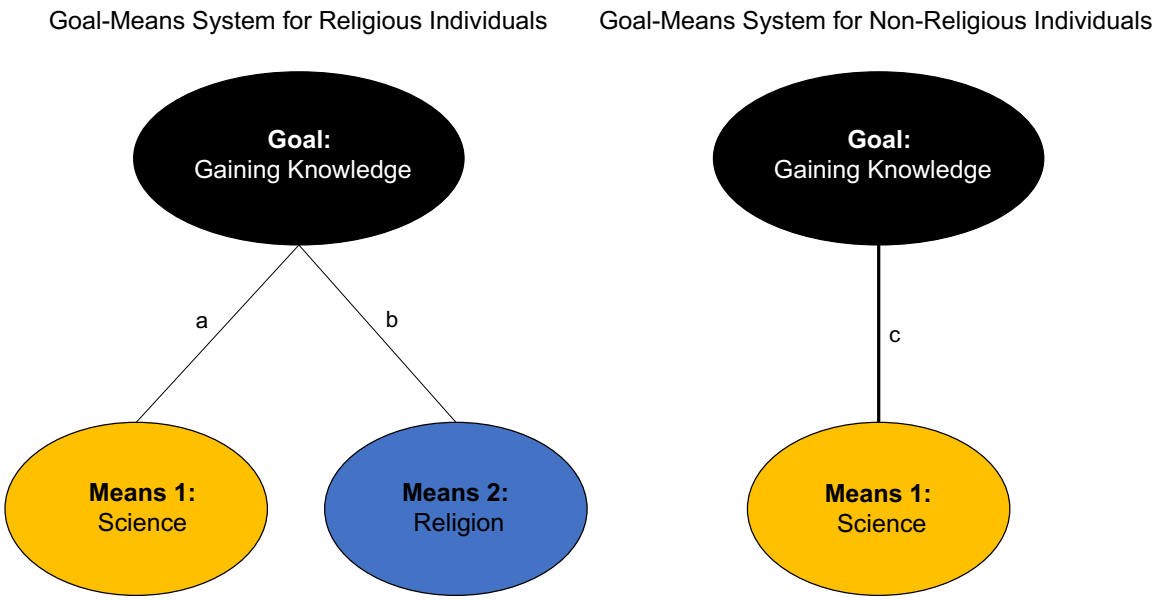

Figure 1. Networks displaying goal-means systems for religious individuals (left) and non-religious individuals (right). Individuals may also rely on other means for gaining knowledge that we have not displayed in this diagram, but which we consider in Study 2a.

Here we consider the instrumentality that religious people should view science *and* religion as less instrumental than non-religious people view science, just as someone who uses both dieting and exercise to lose weight may view each activity as less effective than if

they only relied on dieting (Bélanger et al., 2015). This hypothesis is illustrated in Figure 1, in which religious people view both science (path a) and religion (path b) as moderately instrumental for gaining knowledge whereas non-religious people view science as extremely instrumental for gaining knowledge (the thicker path c). This does not necessarily mean that religious people will always view science and religion as exact equals, only that religious people should perceive both religious belief and science as less instrumental than non-religious people perceive science. The instrumentality hypothesis explains why religious people report lower trust in science than non-religious people (Chan, 2018; McPhetres et al., 2021; Payir et al., 2021) while perceiving no conflict between science and religion. We do not imply that science and religion are the exclusive means through which people acquire knowledge. In this paper, we focus on science and religion due to the historical and current significance of the relationship between them. Nevertheless, we acknowledge that people employ various other ways to attain knowledge (e.g., observation, reliance on peers).

This motivationally enriched account of religion and science may explain why both conflict- and compatibility-based narratives about science and religion have found empirical support. For example, proponents of the conflict narrative point to evidence that religiosity is correlated with lower trust in science (Chan, 2018; Payir et al., 2021), but this observation is perfectly consistent with a goal systems perspective because religious people should view science as moderately instrumental whereas non-religious people should view science as extremely instrumental. Opponents of the conflict narrative point out that religious people report perceiving epistemic value in both science and religion (Davoodi & Lombrozo, 2020) and frequently combine their religious and scientific beliefs (Watts et al., 2020). This is also consistent with the goal systems viewpoint: if people are using multiple means to pursuing the same goal, there is no reason to view these means as conflicting.

Inaccurate Outgroup Perceptions

An interesting extension of our model concerns how religious and non-religious people perceive each other. Research on naive realism finds that humans often overestimate the prevalence of their own views in the wider world. This research implies that religious people may project their views of instrumentality onto perceptions of non-religious people, whereas non-religious people may project their assumption of conflict onto religious people (Ross & Ward, 1996). For example, non-religious people may assume that religious people also see science and religion as incompatible. We therefore predict that religious people should overestimate non-religious people's confidence in religion as a means of gaining knowledge, whereas non-religious people should underestimate religious people's confidence in science as a means of gaining knowledge.

Our hypothesis would ironically imply that–contrary to New Atheist claims that religion is a homogenizing memeplex (Dawkins & Ward, 2006)—it is actually non-religious people who are more dogmatic and close-minded because non-religious people wrongly assume that science and religion are incompatible while underestimating religious people's confidence in science. This extension of our model is important because mis-calibrated intergroup perceptions are a common ingredient of intergroup prejudice (Ross & Ward, 1996). Past research has shown that religious people perceive high levels of stigma and discrimination in academic and scientific institutions (Cheng et al., 2018; Rios et al., 2015). Understanding that at least some religious people view both religion and science as useful could reduce some of this anti-religion stigma in scientific institutions (Mackey et al., 2021, 2022).

Research Program

Here we test the instrumentality hypothesis across five original studies ($\sum N = 2{,}124$) which explore how individuals apply religion and science as explanatory tools in different

domains of life. We test our hypothesis in the context of explaining extraordinary phenomena (Study 1), searching for everyday knowledge (Studies 2a and 2b), answering life's "big questions" (Study 3), and managing the COVID-19 pandemic (Study 4). Our final study (Study 5) asks participants about their general reliance on science and religion—without specifying a domain—and then contrasts religious people's self-reports with non-religious people's lay characterization of religious people's responses and vice versa. In this final study, we can replicate the instrumentality hypothesis while also testing whether religious and non-religious people misperceive one another.

Our key prediction in all of these studies is that religious people will perceive both science and religion as less instrumental than non-religious people view science. We test this hypothesis using regression, and we also compute BIC-derived Bayes Factors with uninformed priors so that we can demonstrate when religious people view science and religion as equally instrumental and when they may view one source of knowledge as more instrumental than the other. We use this strategy because non-significant findings are not sufficient evidence to accept a null hypothesis, so Bayes Factors allowed us to evaluate the probability that religious people perceived science and religion as equally instrumental. We interpret these Bayes Factors according to Lee and Wagenmakers (2014).

We make no claims in these studies that science and religion are actually helping people gain true knowledge. The objective epistemic value of science and religion is beyond the scope of this paper, and it would be difficult for any self-report study to answer this question since people are notoriously bad at estimating their explanatory knowledge (Rozenblit & Keil, 2002). We are simply interested in how people perceive religion and science as sources of knowledge. None of our studies investigate whether people actually understand phenomena better because of scientific or religious material, or even whether

people feel like they understand these phenomena better. The objective epistemological value of science and religion is a distinct topic that we leave for future research to study.

Measuring Religiosity

In this paper we commonly describe differences between "religious" and "non-religious" people using categorical language. Categorizing people as religious or non-religious is intuitive because many people view their religious identity categorically—either identifying with a religious tradition such as Christianity or identifying as non-religious (Pew Research Center, 2012). They may also have a categorical religious belief, such as belief in the existence of God(s). Nevertheless, religion can also be measured continuously through frequency of service attendance (Ecklund & Scheitle, 2007), perceived importance of religion in life (Gorsuch, 1988), or strength of supernatural beliefs (Jong et al., 2013).

Throughout this paper, we employ several measures of religion. In most cases, we use categorical measures of religion. The advantage of categorical measures is that they are face valid and they are parsimonious (i.e., allow us to compare the mean perceived instrumentality of science and religion for religious vs. non-religious participants). One disadvantage is that we could mistakenly classify people as religious when they identify with a group like "Judaism" or "Sikh" more as a cultural or ethnic identity than as a religious identity. For this reason, we employ different categorical measures of religion (e.g., religious identification in Study 1 vs. belief in God in Studies 2a-b), and use continuous measures of religion as robustness checks (e.g., service attendance in Study 2b). In our general discussion, we provide further commentary on extreme religious groups, and discuss why some religious fundamentalists could be unique cases of extreme reliance on religion with little reliance on science. Table S1 in our supplementary materials provides a summary of the religion measures that we used in our research organized by study, including minor differences in our religious identification measure across studies.

Open Science Statement

We provide data and code for all studies on our OSF repository at https://osf.io/7v4hd/?view_only=f77a9286894e4eec979c8a037e5932a3. We pre-registered Studies 4-5, but not Studies 1-3. Study 1 was an aggregation of data across different waves of survey data collection for projects that were originally meant to test different hypotheses. Studies 2a-b were completed before pre-registration was widespread, and Study 3 was a non-pre-registered honor's thesis. This lack of pre-registrations is a limitation of our studies, but this limitation is partially offset by our pre-registered replications in Studies 4-5, and by the fact that we repeatedly show support for the same hypothesis using the same analytic procedures. Our research received IRB approval from the University of Otago (#DP8/19), the University of Maryland (#315495) and the University of North Carolina at Chapel Hill (#15-3184).

Study 1

Our first study measured religious and non-religious people's perceptions of science and religion as epistemic sources using a measure of how people explain extraordinary events. We hypothesized that religious people would view science and religion as similarly and moderately instrumental for explaining these phenomena, whereas non-religious people would see science as extremely instrumental and religion as not at all instrumental.

Method

Participants

We analyzed data from 1,173 American participants (508 men, 638 women; M_{age} = 36.40, SD_{age} = 12.85) across two different waves of data collection on Amazon Mechanical Turk. Four hundred and three participants from our first wave answered the full set of stimuli. Seven hundred and seventy participants from our second wave answered an abbreviated set

of stimuli (see below in Table 1). These data were originally gathered from surveys meant to test different hypotheses. We hosted the surveys on Qualtrics for all studies.

Measures

Religiosity. We measured religiosity categorically in this study by asking participants to choose from one of 10 religious identities at the end of the survey: Christian, Sikh, Buddhist, Hindu, Muslim, Jewish, Atheist, Agnostic, None, and "Other." Participants who chose "Atheist," "Agnostic," or "None" were classified as non-religious in this study and all other studies, and all other participants were classified as religious (see Jong et al., 2012). In total, 811 participants identified as religious, 335 participants identified as non-religious, and 27 participants did not respond to the question and were excluded from our analysis.

Ratings of Instrumentality. Participants were presented with a set of vignettes depicting "extraordinary" phenomena. For example, one vignette described a fortune teller who predicted an unexpected job offer, and another depicted a ghost sighting. We developed the scale via a pilot study in which people were asked to free-generate extraordinary events, which were used to create nine prototype scenarios for the most common categories. Table 1 lists the five scenarios that were used in both studies, and the supplemental materials lists the full set of stimuli and notes some small differences across the two waves of data collection. Participants were asked to rate each item in terms of whether (a) science and (b) religion could explain it from 1 ("Definitely Cannot Explain") to 7 ("Definitely Can Explain").

Table 1.

Examples of Extraordinary Phenomena in Study 1

Category	Description

Clairvoyance	A man visits an elderly woman who works as a fortune-teller. After consulting some cards, she tells him that he will receive an unexpected job offer in the next month. It happens exactly as she predicted.
Witchcraft	A stranger has raped a woman from an African village. Unbeknownst to him, the village priest performs a ritual of cursing against him. A short time later the stranger falls terribly ill.
The Afterlife	A man has an argument with a close friend, who dies before they can be reconciled. A few weeks later, waking during the night, the man believes he can see his friend standing at the end of his bed. His friend reassures him that all is well before disappearing
Unexplained Recovery	A man is diagnosed as having incurable cancer. Friends and family gather every day for a week to pray for his recovery. Shortly after this his doctor informs him that his cancer seems to have disappeared.
Ghost Sightings	A man inherits an old farmhouse. The first time he sleeps in the house, he awakes terrified in the night to see a ghostly female figure standing above him, knife in hand. He later discovers that one of his ancestors had murdered a servant-girl in a room near where he slept.

Note. These items were included in both waves of data collection. Table S2 includes supplemental items that were only included in one data collection wave.

A factor analysis found a clear two-solution solution where ratings of science's instrumentality across the scenarios loaded onto one factor and ratings of religion's instrumentality across the scenarios loaded onto a second factor. We fully summarize this factor analysis in the supplemental materials.

Analytic Approach

Studies 1-5 each used the same analytic framework which we describe here. For these studies, we constructed a dataset in which ratings (e.g., each rating of an extraordinary event) were nested in participants. We then fit a multi-level model with intercepts and slopes varying randomly across participants. We employed Gaussian estimation when ratings were made using Likert-type scales and logistical regressions when the dependent variable was binary (see Study 4). We employed the lme4 package in R to fit these models (Bates et al., 2014).

Results

We fit a multi-level model with ratings nested in participants to test the instrumentality hypothesis. This model revealed a significant religious identification × source of knowledge (i.e., religion vs. science) interaction, $b = 4.20$, $SE = 0.23$, $t = 18.06$, $p < .001$, 95% *CI*s [3.75, 4.66]. Non-religious people viewed science as better able to explain extraordinary phenomena than religious people, $b = 1.77$, $SE = 0.15$, $t = 11.92$, $p < .001$, 95% *CI*s [1.48, 2.06], whereas religious people viewed religion as better able to explain extraordinary events than non-religious people, $b = 2.44$, $SE = 0.14$, $t = 16.96$, $p < .001$, 95% *CI*s [2.15, 2.72].

Examining the intercepts showed that non-religious people rated science's explanatory power as extremely high ($M = 6.40$, $SE = 0.12$) and religion's explanatory power as very low ($M = 2.08$, $SE = 0.12$), whereas religious people rated science ($M = 4.63$, $SE = 0.08$) and religion ($M = 4.51$, $SE = 0.08$) as both moderately and equally instrumental for explaining extraordinary phenomena, $b = 0.12$, $SE = 0.13$, $t = 0.94$, $p = .35$, 95% *CI*s [-0.37, 0.13], $BF_{10} = 0.016$. In sum, non-religious people viewed science as more instrumental than religious people viewed science or religion (see Figure 2).

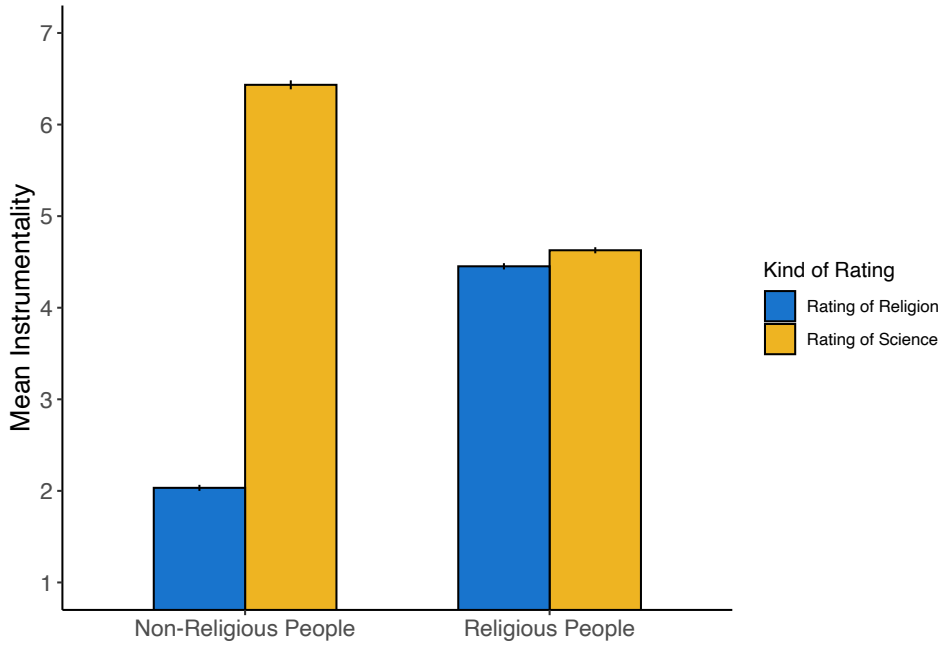

Figure 2. Religious and non-religious people's ratings of how effectively science and religion could explain extraordinary phenomena. Error bars represent standard error.

Discussion

Study 1 showed that religious people perceived science and religion as similarly and moderately instrumental sources of knowledge, whereas non-religious people perceived science to be extremely instrumental and religion to be not instrumental at all. This study offered support for our instrumentality hypothesis.

One limitation of this study was that our "extraordinary phenomena" were a unique set of stimuli which involved apparent magical causality. Religious people may have therefore rated religion as more instrumental for explaining these phenomena than if they had evaluated religion's general epistemic utility, or its utility for explaining more traditional phenomena. Therefore, Studies 2a-b and Study 3 conceptually replicated Study 1's result with more direct questions about the instrumentality of science and religion.

Studies 2a-2b

Studies 2a-b were two replications of Study 1, with two key differences. First, participants evaluated whether science and religion were instrumental sources of knowledge directly, rather than evaluating whether science and religion could explain extraordinary phenomena. Second, we measured religion using a broader set of measures than religious identification alone. In Study 2a, we measured religiosity in terms of both religious identification and belief in God. In Study 2b, we measured religious identification, belief in God, and also service attendance as a more continuous measure of religious identification.

A power analysis using Study 1's estimates suggested that, given the mean difference between non-religious people's ratings of science vs. religious people's ratings of science and religion (respective effect sizes of $r = 0.27$ and $r = -0.23$), a sample of 145 would provide 80% to detect a significant effect. Oversampling this estimate in Studies 2a-b ensured higher power, even after excluding participants who did not provide their religion.

Study 2a

Method

Participants

We recruited 182 American participants (90 men and 92 women, $M_{age} = 37.62$, $SD = 12.46$) to participate in this study via Amazon Mechanical Turk. In total, 68 participants were non-religious, 108 participants were religious, and 6 participants either did not answer the question or answered "other" and were not included in analyses.

Measures

Religiosity. We measured religiosity using the same approach as Study 1. However, we also added a dichotomous measure of whether participants believed in God (coded as "1") or did not believe in God (coded as 0). We used the same two measures in Study 2b.

Ratings of Instrumentality. Participants answered the question: "To what extent do you rely on the following people or institutions when you do not know what to think about something?" Participants answered this question for 10 epistemic sources which were presented in a randomized order: Your parents, the Internet, the government, celebrities, God, your friends, science, intuition, your co-workers, and schoolteachers. Participants answered using the scale from 1 (Not at All) to 7 (A Great Deal). Our central analyses focused on participants' ratings of "God" and "Science." In the supplemental materials, we summarize a factor analysis in which we analyzed how ratings of each source covaried.

Extraordinary Events. In addition to including our new measures, we also included the extraordinary events scale in order to replicate our Study 1 findings. We present results using this scale in the supplemental materials because they closely mirrored our Study 1 results. We present results using the main dependent variable here.

Results

Results Using Religious Identification

Our initial analyses used the religious identification measure from Study 1. Like in Study 1, we fit a multi-level model with ratings nested in participants to test our prediction. This model revealed a significant religious identification × source of knowledge (i.e., religion vs. science) interaction, $b = 4.30$, $SE = 0.37$, $t = 11.63$, $p < .001$, 95% *CI*s [3.58, 5.03]. Non-religious people viewed science as more instrumental than did religious people, $b = .74$, $SE = 0.26$, $t = 2.83$, $p = .005$, 95% *CI*s [0.23, 1.25], whereas religious people viewed religion as more instrumental than did non-religious people, $b = 3.56$, $SE = 0.26$, $t = 13.62$, $p < .001$, 95% *CI*s [3.05, 4.08].

Examining the intercepts of these models showed that non-religious people rated science's instrumentality as extremely high ($M = 5.47$, $SE = 0.20$) and religion's instrumentality as very low ($M = 1.35$, $SE = 0.20$), whereas religious people rated science (*M*

= 4.73, *SE* = 0.16) and religion (*M* = 4.92, *SE* = 0.16) strategies as both moderately and equally instrumental, *b* = 0.18, *SE* = 0.23, *t* = 0.81, *p* = .42, 95% *CI*s [-0.26, 0.64], BF_{10} = 0.09. Again, non-religious people viewed science as more instrumental than religious people viewed religion or science. These results are illustrated in Figure 3.

Results Using Belief in God

We next replicated these results using belief in God as a convergent measure of religiosity. Using belief in God, we found the same significant religious belief × source of knowledge (i.e., religion vs. science) interaction, *b* = 4.33, *SE* = 0.38, *t* = 11.39, *p* < .001, 95% *CI*s [3.59, 5.08]. Participants who did not believe in God viewed science as more instrumental than did participants who believed in God, *b* = 0.86, *SE* = 0.27, *t* = 3.19, *p* = .005, 95% *CI*s [0.33, 1.38], whereas participants who believed in God viewed religion as more instrumental than participants who did not believe in God, *b* = 3.47, *SE* = 0.27, *t* = 12.93, *p* < .001, 95% *CI*s [2.95, 4.00].

Examining the intercepts of these models again showed that participants who did not believe in God rated science's explanatory power as very high (*M* = 5.56, *SE* = 0.22) and religion's explanatory power as very low (*M* = 1.33, *SE* = 0.22), whereas participants who believed in God rated science (*M* = 4.71, *SE* = 0.16) and religion (*M* = 4.80, *SE* = 0.16) strategies as both moderately and equally instrumental, *b* = 0.10, *SE* = 0.23, *t* = 0.43, *p* = .67, 95% *CI*s [-0.35, 0.55], BF_{10} = 0.07. These results are illustrated in Figure 3.

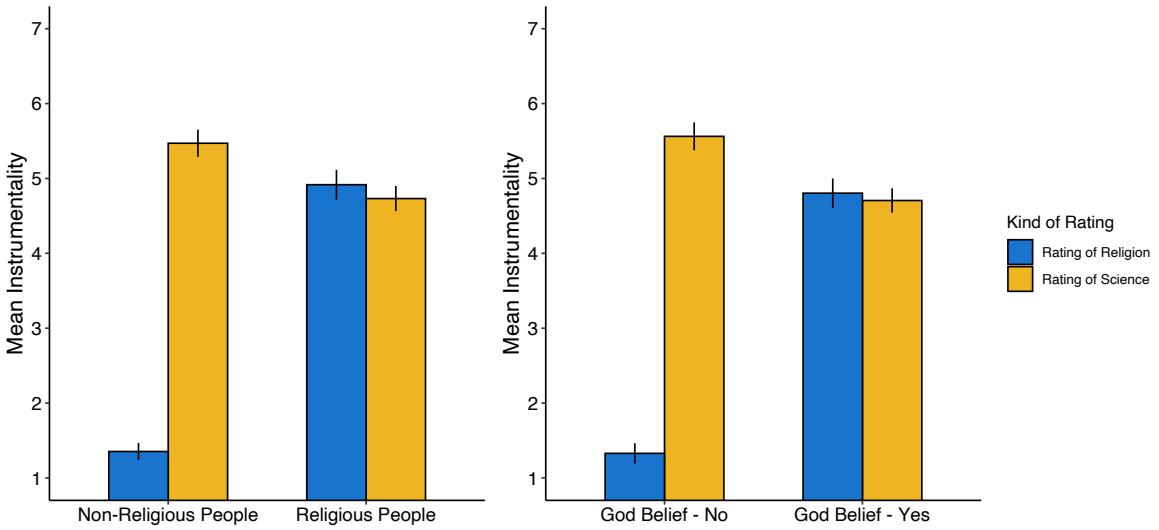

Figure 3. Religious and non-religious people's instrumentality ratings of science and religion in Study 2a. The left panel shows results when religiosity is measured through religious identification. The right panel shows results when religiosity is measured through God belief. Error bars represent standard errors.

Study 2b

Method

Participants

We recruited 260 American participants (104 men and 156 women, M_{age} = 33.26, *SD* = 10.86) to participate in this study via Amazon Mechanical Turk. In total, 100 participants were non-religious and 160 participants were religious. Ten participants did not respond to the question or answered "other" and were excluded from analyses.

Measures

Religiosity. In addition to the two measures of religiosity from Study 2a, we also measured religious service attendance as a more continuous measure of religious conviction which has been used in previous research on perceptions of religion and science (Ecklund &

Scheitle, 2007). We measured frequency of service attendance using a 1 ("Less than Once per Year") – 5 ("More than Once per Week") scale.

Ratings of Instrumentality. Participants read the following instruction "In this study, we are interested in how you perceive SCIENCE [RELIGION] as a source of knowledge through which you can understand the world. Please rate the extent to which SCIENCE [RELIGION] is an effective source of knowledge." Participants answered on a scale from 1 (Very ineffective) to 9 (Very effective). They completed the measure separately for science and religion, and we counterbalanced the order in which participants evaluated science and religion. We also randomly assigned half of participants to evaluate science and religion on the same screen, and half of participants to evaluate science and religion on separate pages. However, this condition had no effect on ratings and so we combined these two conditions for our central analyses.

Results

Results Using Religious Identification

A multi-level model with ratings nested in participants revealed a significant religious identification × source of knowledge (i.e., religion vs. science) interaction, $b = 4.23$, $SE = 0.33$, $t = 12.92$, $p < .001$, 95% *CI*s [3.59, 4.87]. Non-religious people viewed science as more instrumental than did religious people, $b = .55$, $SE = 0.22$, $t = 2.58$, $p = .01$, 95% *CI*s [.13, .98], whereas religious people viewed religion as more instrumental than did non-religious people, $b = 3.68$, $SE = 0.25$, $t = 14.90$, $p < .001$, 95% *CI*s [3.19, 4.16].

Like in Study 2a, the intercepts of these models showed that non-religious people rated science's instrumentality as extremely high ($M = 8.28$, $SE = 0.17$) and religion's instrumentality as very low ($M = 2.26$, $SE = 0.19$), religious people rated science ($M = 7.73$, $SE = 0.16$) and religion ($M = 5.94$, $SE = 0.16$) strategies as both moderately instrumental. Unlike Study 1 or Study 2a, religious participants in Study 3b perceived science to be

significantly more instrumental than religion, $b = 1.79$, $SE = 0.21$, $t = 8.62$, $p < .001$, 95% *CI*s [1.38, 2.19]. Nevertheless, non-religious people rated science as more instrumental than religious people rated either religion or science, supporting the instrumentality hypothesis (see Figure 4).

Results Using Belief in God

We observed the same pattern of results while operationalizing religiosity through belief in God. There was a significant religious belief × source of knowledge (i.e., religion vs. science) interaction, $b = 4.39$, $SE = 0.33$, $t = 13.15$, $p < .001$, 95% *CI*s [3.73, 5.04]. Participants who did not believe in God viewed science as more instrumental than did participants who believed in God, $b = .86$, $SE = 0.27$, $t = 3.19$, $p = .005$, 95% *CI*s [.33, 1.38], whereas participants who believed in God viewed religion as more instrumental than participants who did not believe in God, $b = 3.47$, $SE = 0.27$, $t = 12.93$, $p < .001$, 95% *CI*s [2.95, 4.00].

The intercepts of this model showed the same pattern that we found when analyzing religious identification. Participants who did not believe in God rated science's explanatory power as very high ($M = 8.39$, $SE = 0.17$) and religion's explanatory power as very low ($M = 2.14$, $SE = 0.20$). In contrast, participants who believed in God rated science ($M = 7.69$, $SE = 0.13$) and religion ($M = 5.83$, $SE = 0.15$) strategies as moderately instrumental and also rated science as significantly more instrumental than religion, $b = 1.86$, $SE = 0.23$, $t = 9.20$, $p < .001$, 95% *CI*s [1.47, 2.26]. Like with religious identification, non-religious people rated science as more instrumental than religious people rated both religion and science, supporting the instrumentality hypothesis. These results are illustrated in Figure 4.

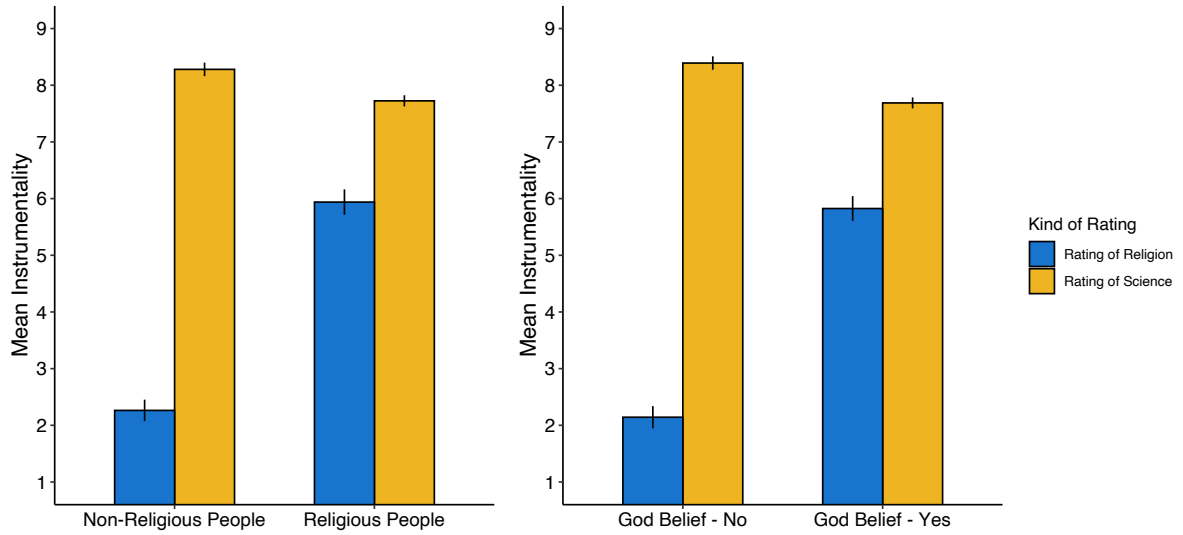

Figure 4. Religious and non-religious people's instrumentality ratings of science and religion in Study 2b. The left panel shows results when religiosity is measured through religious identification. The right panel shows results when religiosity is measured through God belief. Error bars represent standard error.

High- vs. Low-Service Attendance Participants

Our final analysis examined how ratings of instrumentality varied across religiously identified individuals with high vs. low frequency of service attendance. We conducted this analysis because our findings supported the instrumentality hypothesis—and even found greater support for science than religion—when we averaged results across all religious individuals. However, one possibility is that this analysis hid meaningful variation among religious individuals such that strongly committed religious participants would mirror the non-religious participants—viewing religion as highly instrumental and science as not at all instrumental.

A three-way interaction between religious identification, source of knowledge, and service attendance was small but significant, $b = 0.84$, $SE = 0.41$, $t = -2.04$, $p = .04$, 95% *CI*s [0.04, 1.64]. Participants who identified as religious but showed low service attendance rated

science (M = 8.17, SE = 0.21) as more instrumental than religion (M = 4.27, SE = 0.24) by a wider margin than participants who identified as religious but showed high service attendance (Science: M = 7.55, SE = 0.14 vs. Religion: M = 6.52, SE = 0.16). However, the difference between science and religion was significant for participants across the range of service attendance, and participants both high and low in their level of service attendance rated science as less instrumental than did non-religious people, although those who were low in their level of service attendance overlapped with the 95% confidence intervals of non-religious participants' ratings, 8.28, 95% *CIs* [7.95, 8.61]. Participants who identify as religious but do not attend services may therefore have attitudes towards science and religion that resemble non-religious individuals.

Discussion

Studies 2a-b again supported the instrumentality hypothesis using a different paradigm that involved participants directly rating the instrumentality of religion and science. As with Study 1, we found that religious people rated science and religion as moderately instrumental whereas non-religious people rated science as highly instrumental and religion as not at all instrumental. We observed the same pattern of results regardless of whether we measured religion through identification with a religious tradition or belief in God. We even found evidence for the instrumentality hypothesis when we focused on participants who attend services frequently and were the most likely to view religion as highly instrumental.

One limitation of these studies is that they asked participants to evaluate the instrumentality of science and religion in a very general sense. Participants rated whether science and religion were effective sources of knowledge, but we did not specify what kind of knowledge they were effective for understanding. For example, a participant reviewing Study 1's extraordinary events scale could perceive science as able to explain *how* cancer is eradicated by the body while viewing their religious beliefs as well-suited to explain *why*

some people will recover after prayer while others do not. Study 3 addressed this limitation by allowing participants to rate religion and science's efficacy for different kinds of questions.

Study 3

Our next study conceptually replicated Studies 1-2 with an important modification: participants separately rated the explanatory power of religion and science to answer proximal ("how?") and ultimate ("why?") questions. This how-why distinction is highly relevant to Stephen Jay Gould's notion of non-overlapping magisteria, which claims that religion is best suited to answer ultimate "why" questions whereas science is best suited to answer mechanistic "how" questions (Gould, 2014). By asking participants to separately rate the explanatory power of science and religion for "why" and "how" questions, we could test whether the instrumentality hypothesis generalized across both kinds of question, or whether the instrumentality hypothesis only applied to one of these questions—or neither question.

We conducted Study 3 in New Zealand rather than the United States, which was another notable feature of the study because New Zealand is a relatively more secular and less evangelical country than the United States. This allowed us to test whether the instrumentality hypothesis would replicate in a country where supernatural explanations are less popular in social and political spheres.

Method

Participants

We recruited a total of 209 participants (69 men, 138 women, 2 other; M_{age} = 21.52, SD_{age} = 4.64) from the University of Otago in New Zealand for a laboratory study. This study was run as a student's senior thesis, and our sample size goal was to recruit as many participants as possible throughout the course of a semester. In total, we ended up with slightly more participants than Studies 2a-b, which ensured higher power. While Study 3 did

have an additional manipulation ("why" vs. "how" question framing), this manipulation was within subjects so it did not pose a threat to our Study 3 power.

Study 3 used the same measure of religion as Study 1, but included slightly different categories (see Table S1), including an additional option of "undecided." We excluded 17 participants who indicated they were undecided, leaving a total of 138 non-religious participants and 54 religious participants who identified as Buddhist (n = 4), Christian (n = 44), Hindu (n = 4), Jewish (n = 1), and Muslim (n = 1). This study had a larger percent of non-religious participants than Studies 1-2 because it was conducted in a less religious country (New Zealand vs. the USA).

Procedure

After providing informed consent, participants entered a testing room where they completed all experimental materials online. Participants viewed a series of questions about six meaningful topics: the universe, human existence, consciousness, religion, death, and suicide. Participants in the "how" condition were asked how each of the six phenomena work or came into existence (e.g., "How did the universe come to exist? What was the cause?"), while participants in the "why" condition were asked why each phenomenon exists (e.g., "Why did the universe come to exist? What was the purpose?"). The full list of questions is given in Table S3 in our supplemental materials.

For each question, participants had the option to consult up to four sources before providing their own written responses, but were required to consult at least one. Specifically, they could choose to consult real answers—which were compiled prior to the study—provided by a religious expert (the University of Otago Chaplain), and/or a scientist (a colleague who holds PhDs in both Physics and Psychology). After viewing the first selected source's answer, the participant had the option to answer the question without further consultation, or to consult another source from among the remaining three. The process was

repeated until the participant chose to answer the question, or until they viewed all sources and were then prompted to do so.

Measures

Sources Consulted. We measured the sources that participants consulted so that we could estimate the likelihood that religious and non-religious participants consulted religious authorities and science authorities.

Ratings of Instrumentality. We measured perceived instrumentality by asking participants how much they relied on each of the sources of information. For each question, participants indicated the influence of each source they consulted using a scale from 0 ("I did not rely on this source at all") to 4 ("I relied on this source completely").

One potential limitation of this measure is that participants made ratings of instrumentality after they provided their own response. Participants' personal confidence in their knowledge could have therefore biased their reporting of instrumentality (e.g., if participants believed that they personally knew how to explain phenomena, they could have reported less reliance on religion and science). For this reason, the instrumentality measure should be interpreted with caution. Fortunately, the "sources consulted" measure is less vulnerable to this limitation since this was a behavioral (rather than self-report) measure and participants consulted sources before gauging their own knowledge.

Results

We began by analyzing the sources that participants consulted and the ratings of instrumentality across "how" and "why" questions. Next, we entered question-type "how" vs. "why" as a three-way interaction term to analyze how ratings varied across "how" and "why" questions.

Sources Consulted

What kinds of sources did religious and non-religious people consult? Our model found a religious identification × source of knowledge (religion vs. science) significant interaction, $b = 2.50$, $SE = 0.44$, $t = 5.70$, $p < .001$, 95% *CI*s [1.63, 3.34], which resembled the interactions from Studies 2-3. Compared to non-religious people—religious participants were significantly more likely to consult the religious source, $b = 1.75$, $SE = 0.39$, $t = 4.52$, $p < .001$, 95% *CI*s [0.99, 2.50]. We did not find a significant difference between religious and non-religious people's likelihood of consulting the science source, $b = -0.74$, $SE = 0.40$, $t = -1.87$, $p = .06$, 95% *CI*s [-3.05, 0.03].

This represented the first pattern of results which did not support the instrumentality hypothesis because religious and non-religious participants consulted scientific sources at the same frequency. This effect was interesting partly because we replicated other key findings from our past studies: religious participants were equally likely to consult the religious and scientific source, $b = 0.02$, $SE = 0.40$, 95% *CI*s [-0.76, 0.79], $t = 0.04$, $p = .97$, $BF_{10} = 0.045$, and non-religious participants were much less likely to consult the religious source than the scientific source, $b = -2.47$, $SE = 0.47$, 95% *CI*s [-3.05, -1.89], $t = -8.40$, $p < .001$. One possibility is that the non-significant difference between religious and non-religious people's rates of consulting the science source may have arisen from a ceiling effect, since both religious and non-religious participants consulted the science sources more than 75% of the time (see Figure 5). Another possibility is that consulting a source does not necessarily have to be solely motivated by its epistemic usefulness. Curiosity about what a specific source has to say could also play a role. This could indeed explain the unusually high level of interest in religious sources among non-believers in this study. For this reason, it was important to analyze participants' self-reports of instrumentality.

Ratings of Instrumentality

We also found a significant interaction between religious identification and source of knowledge on ratings of instrumentality, $b = 1.34$, $SE = 0.20$, $t = 6.75$, $p < .001$, 95% *CI*s [.95, 1.73], operationalized as self-reported reliance on the source when making a judgment. Religious participants reported greater reliance on religious sources, $b = 0.90$, $SE = 0.16$, $t = 5.56$, $p < .001$, 95% *CI*s [0.58, 1.21], and less reliance on scientific sources, $b = -0.44$, $SE = 0.16$, 95% *CI*s [-0.76, -0.13], $t = -2.75$, $p = .007$, than non-religious participants.

Participants' ratings of instrumentality were consistent with the instrumentality hypothesis. As with Studies 1-2, non-religious participants reported high reliance on scientific sources ($M = 2.67$, $SE = .09$) and very low reliance on religious sources ($M = 1.15$, $SE = 0.09$), whereas religious participants reported moderate and similar reliance on both the religious ($M = 2.05$, $SE = 0.13$) and scientific ($M = 2.23$, $SE = 0.14$) sources, $b = -0.18$, $SE = 0.17$, 95% *CI*s [-0.50, 0.15], $t = -1.09$, $p = .28$, $BF_{10} = 0.032$. These results, illustrated in Figure 5, supported the instrumentality hypothesis.

"Why" vs. "How" Questions

We next examined how effects varied depending on whether participants answered proximal ("how?") or ultimate ("why?") questions. We began by fitting three-way interactions involving religious identification, source of knowledge, and question type. This model did not converge for sources consulted, but it did converge for ratings of instrumentality, and the three-way interaction was significant, $b = -1.07$, $SE = 0.36$, $t = -2.98$, $p = .001$, 95% *CI*s [-1.76, 0.37]. The results showed an interesting limitation to the instrumentality hypothesis.

For "how" ratings, we found results which closely resembled what we had found in Studies 1-2. Religious identification and source of knowledge interacted, $b = 1.89$, $SE = 0.13$, $t = 14.62$, $p < .001$, 95% *CI*s [1.63, 2.14]. As with our overall model, religious participants reported greater reliance on religious sources, $b = 1.17$, $SE = 0.17$, $t = 6.78$, $p < .001$, 95%

*CI*s [0.83, 1.23], and less reliance on scientific sources, b = -0.71, SE = 0.17, t = -4.27, p < .001, 95% *CI*s [-1.04, -0.39], than non-religious participants. We found again that non-religious people relied more on scientific sources (M = 3.20, SE = 0.09) than religious people relied on either scientific (M = 2.48, SE = 0.14) or religious sources (M = 2.20, SE = 0.14).

For "why" ratings, however, we found a unique pattern of results. As with "how" ratings, religious identification and source of knowledge interacted, b = 0.89, SE = 0.14, t = 6.30, p < .001, 95% *CI*s [.61, 1.16], and religious participants reported greater reliance on religious sources than non-religious participants, b = 0.68, SE = 0.20, t = 3.27, p = .001, 95% *CI*s [0.76, 1.06]. However, unlike "how" ratings, there was no significant difference between religious and non-religious participants' self-reported reliance on scientific sources, b = -0.20, SE = 0.21, t = -.97, p = .33, 95% *CI*s [-.61, 0.20].

Why did religious and non-religious participants report similar confidence in science for "why" ratings? One possibility is that religious participants view religion as better suited than science for "how" questions. But this was not the case: religious participants reported equivalent reliance on scientific (M = 2.00, SE = 0.18) and religious (M = 1.98, SE = 0.18), sources, b = -0.02, SE = 0.12, t = -0.16, p = .87, 95% *CI*s [-0.25, 0.21], BF_{10} = .05. Instead, we found that non-religious participants reported lower reliance on science for "why" ratings (M = 2.20, SE = .10) than they did for "how" ratings (M = 3.20, SE = .09) while continuing to report low reliance on religion (M = 1.29, SE = 0.11). In other words, non-religious people did not rely on either science or religion for "why" ratings. This culminated in a pattern of findings in which the instrumentality hypothesis was clearly supported for "how" questions but not "why" questions. We show results broken down by "why" and "how" in Figure 5.

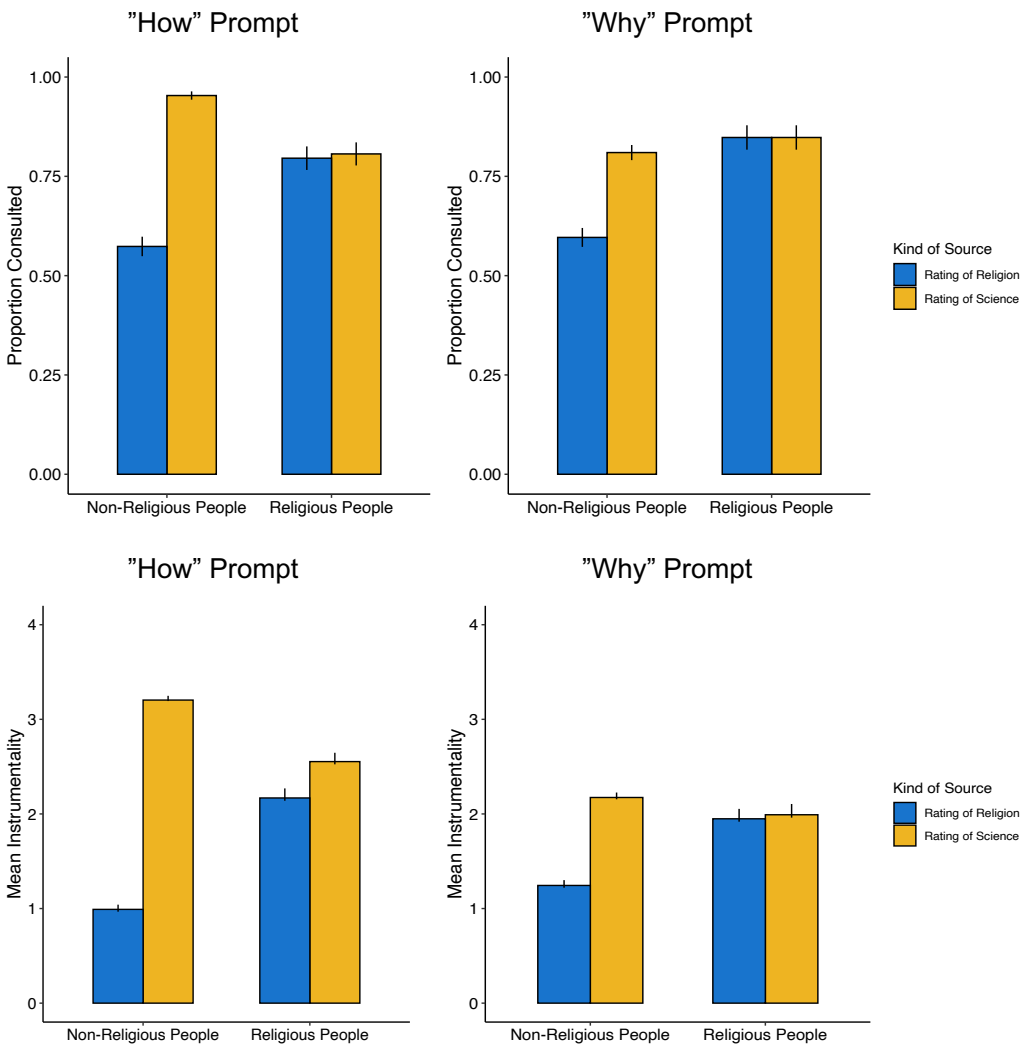

Figure 5. Religious and non-religious people's likelihood of consulting science sources and religious sources (left), and their self-reported reliance on these sources (right) in Study 3. Error bars represent standard error.

Discussion

Study 3 found further support for the instrumentality hypothesis, but also offered a boundary condition to the hypothesis. When people evaluated answers to "big questions," non-religious people perceived scientific sources as more instrumental than religious people perceived either scientific sources or religious sources.

However, this pattern of results was different when participants were explicitly focused on explaining the ultimate reasons for a phenomenon's existence. For these ultimate questions, religious participants viewed science and religion as equally as instrumental as non-religious people viewed science. This suggests that the instrumentality hypothesis enjoys its most robust support for proximal explanations, and that non-religious people may feel unequipped to answer questions of ultimate causation since they only have scientifically derived information at their disposal, which is more proximal in nature. One possibility is that, for these questions, non-religious people may rely on spiritual explanations that they do not identify with organized religion. Unfortunately, we could not test this possibility because our religious source in Study 3 was associated with organized religion.

Our findings are partially consistent with Gould's theory of non-overlapping magisteria, which claims that religion is better suited for explaining ultimate causation than proximal causation. However, unlike Gould's hypothesis, religious people perceived scientific and religious sources as equally suited for explaining ultimate causation.

Another interesting pattern of results in Study 3 was that non-religious participants showed a modest likelihood of consulting and endorsing religious sources of information, whereas their perceived instrumentality of religion was at floor in Studies 1-2. One reason for this unique pattern of results was the religious sources were people in Study 3 rather than "religion" in the abstract. Non-religious people may find pastors, priests, and other religious professionals somewhat insightful, even if they dismiss religion as a whole as uninformative.

Study 4

Study 4 applied our instrumentality hypothesis to the COVID-19 pandemic. We conducted this study in early April of 2020, when the pandemic was still in its early stages. We predicted that religious people would see science-based and faith-based means of avoiding COVID-19 as both less effective than non-religious people would view science-

based means of avoiding COVID-19. We viewed this test as important because some papers have used regional data to suggest that highly religious regions of the United States were more resistant to scientific mandates compared to less religious regions (DeFranza et al., 2020). Our study could examine the individual-level basis of these findings.

Method

Participants

In Studies 2-3, we observed smaller effect sizes than in Study 1. Given these smaller effect sizes, and the unique nature of the pandemic, Study 4 doubled the sample size of Studies 2-3. We advertised on Amazon Mechanical Turk for 400 participants. In total, 441 participants signed up for the study, and 401 participants (263 men, 137 women, 1 "other"; M_{age} = 36.96, SD_{age} = 11.54) completed it. In total, 129 participants identified as non-religious, whereas 271 participants identified as religious, with 165 Catholics, 73 Protestants, 5 Jews, 2 Buddhists, 4 Hindus, 2 Muslims, 2 Sikhs, and 18 participants who identified with other religions.

Measures

Ratings of Instrumentality. Participants evaluated three science-based strategies for avoiding COVID-19 including (a) Frequently washing hands for 20+ seconds, (b) social distancing (standing 6 feet away in social interactions), and (c) avoiding large groups of people (10+). These strategies became less popular at later stages of the pandemic, but in April of 2020 there was no available vaccine, and most scientists recommended isolation and hand washing as the most effective means of protection. The three faith-based strategies included (a) Prayer, (b) Reading scripture, and (c) Attending virtual religious gatherings and services (we specified that services were virtual so that this option did not directly conflict with the science-based strategies. We also find that our results are virtually identical when we exclude this item from the faith-based measures). For each measure, participants reported

their perceived instrumentality of science-based and faith-based strategies for avoiding COVID-19 ("I believe this strategy is effective to avoid COVID-19") using a 1 ("Strongly Disagree") to 7 ("Strongly Agree") scale.

Reported Self-Engagement. In addition to instrumentality, participants self-reported their level of engagement in science-based and religion-based strategies. For each strategy, participants responded to the statement "I am using this strategy to avoid COVID-19" using the same 1 ("Strongly Disagree") to 7 ("Strongly Agree") scale as they used for ratings of instrumentality. Perceived instrumentality and self-reported engagement were highly correlated ($r = 0.84$).

Conservatism. Since the COVID-19 pandemic was heavily politicized at the time of our study, we measured participants' self-reported political conservatism using a 1 ("Very Liberal") to 9 ("Very Conservative") scale.

Results

We fit the same models as in Studies 1-3, controlling for age, gender, and political conservatism. Our results were essentially identical with or without controlling these controls, so we present results including the controls here.

Instrumentality

How did religious people and non-religious people view religion-based and science-based strategies of avoiding infection? Our model revealed the same religious identification × strategy source (religion vs. science) interaction we observed in Studies 2-4, $b = 2.91$, $SE = 0.21$, $t(398) = 13.74$, $p < .001$, 95% *CI*s [2.49, 3.32], such that non-religious people viewed science-based measures as more effective than religious people viewed them, $b = 0.35$, $SE = 0.12$, $t(404) = 3.01$, $p = .003$, 95% *CI*s [0.12, 0.57], whereas religious people viewed religion-based measures as more effective than non-religious people viewed them, $b = 2.56$, $SE = 0.18$, $t(405) = -14.52$, $p < .001$, 95% *CI*s [2.22, 2.91].

The intercepts of the model showed a similar pattern of results to Studies 2b. Non-religious participants viewed science-based measures as extremely effective (M = 6.45, SE = 0.09) and faith-based measures as not at all effective (M = 2.03, SE = 0.14), whereas religious people rated science-based measures as highly effective (M = 6.11, SE = 0.06) and faith-based (M = 4.59, SE = 0.10) measures as moderately effective: less effective than science-based measures, b = -1.52, SE = 0.12, 95% CIs [-1.75, -1.28], t(398) = -12.66, p < .001, but still well above the scale's midpoint.

Engagement

We found a highly similar pattern of results for self-reported engagement. Religious identification and source of knowledge interacted significantly, b = 3.31, SE = 0.21, t(398) = 15.50, p < .001, 95% CIs [2.89, 3.72], such that non-religious people engaged in science-based measures more than religious people, b = 0.26, SE = 0.11, t(399) = 2.30, p = .02, 95% CIs [0.04, 0.49], whereas religious people engaged in religion-based measures more than non-religious people, b = 3.04, SE = 0.18, t(400) = 17.08, p < .001, 95% CIs [2.70, 3.40].

The intercepts again showed that non-religious people reported high levels of engagement in science-based measures (M = 6.49, SE = 0.09), and little engagement in faith-based measures (M = 1.45, SE = 0.15), whereas religious participants reported moderate levels of engagement in faith-based measures (M = 4.49, SE = 0.10) and high engagement in science-based measures (M = 6.23, SE = 0.06). Figure 6 illustrates these findings.

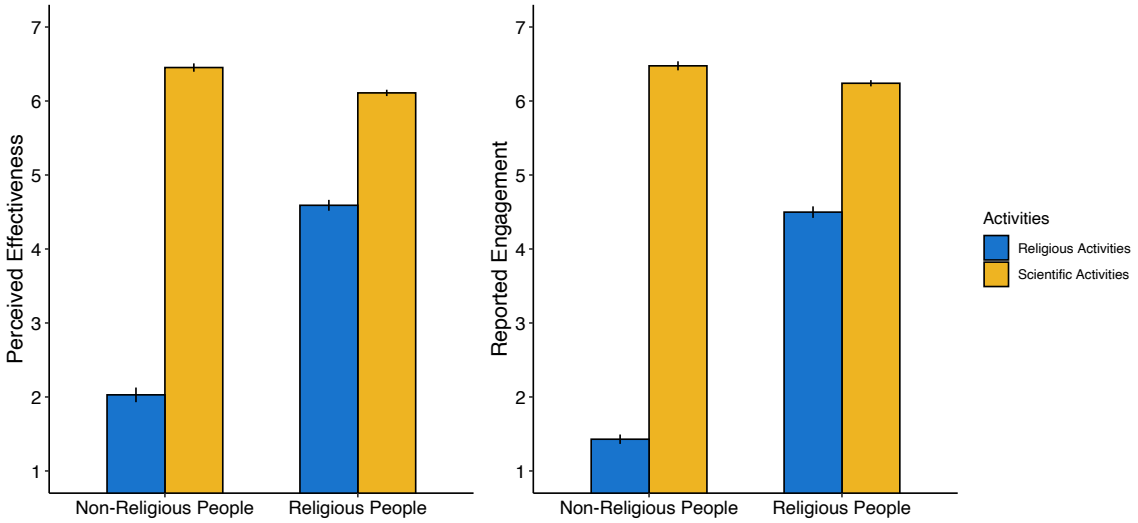

Figure 6. Participants' ratings of instrumentality (left) and self-reported engagement (right) in religion-based and science-based strategies for avoiding COVID-19 in Study 4. Error bars represent standard error.

Discussion

Study 4 supported the instrumentality hypothesis in the context of COVID-19. In the early stages of the pandemic, religious people perceived science- and religion-based measures of avoiding infection from COVID-19 as less instrumental than non-religious people perceived science-based measures. As with Study 2b, we found that religious people perceived science as significantly more instrumental than religion. Overall, religious people did trust science-based measures of avoiding COVID-19, but not to the same degree as non-religious people.

In sum, Studies 1-4 show general support and also boundary conditions for the instrumentality hypothesis. We supported the instrumentality hypothesis in contexts where participants evaluated the instrumentality of religion and science when explaining extraordinary phenomena (Study 1), filling gaps in knowledge (Studies 2a-2b), answering mechanistic questions about natural and social phenomena (Study 3), and avoiding COVID-

19 infection (Study 4). However, we found that asking participants to focus on ultimate "why" explanations behind phenomena was a boundary condition to the instrumentality hypothesis because non-religious people perceived neither science nor religion as well-equipped to answer these questions.

Study 5

Our final study tested whether religious and non-religious people misperceive how the other group views the instrumentality of science and religion as sources of knowledge. In Studies 1-4, we found that religious individuals view science and religion as moderately and similarly instrumental whereas non-religious individuals perceive science as extremely instrumental and religion as minimally instrumental. We hypothesized that naïve realism would lead religious participants to erroneously view non-religious ratings of instrumentality as more moderate (rating science as less instrumental and religion as more instrumental) and non-religious participants to erroneously view religious ratings of instrumentality as more extreme (rating religion as more instrumental and science as less instrumental) than the self-reports which we observed in Studies 1-4. Study 5 was pre-registered.

Method

Participants

We advertised the study for 300 Amazon Mechanical Turk participants in the U.S., which an f^2 power analysis suggested would provide 94% of power to detect a small effect size of .05. In total, 310 participants (193 men, 104 women, 4 "other"; M_{age} = 37.67, SD_{age} = 10.71) signed up for the study. Of these, 9 participants did not finish the study and a further 15 participants did not indicate their religion or indicated "other," leaving 286 participants in our analysis. We measured religious identification using the same approach as Studies 1-5. In total, 66 participants identified as non-religious and 220 participants identified as religious, including 110 Catholics, 56 Protestants, 6 Buddhists, 6 Jews, and 3 Hindus.

Procedure

After consenting to the study, participants read an opening prompt which defined science and religion. This prompt read "There are many sources of knowledge, but two popular sources of knowledge are **religion (e.g., insights from scripture, advice from religious authorities)** and **science (e.g., insights from scientific studies, advice from scientific experts).** We would like you to answer some questions about science and religion." Participants then completed two key measures—one measure required participants to estimate their own and an out-group's reliance on science and religion as sources of knowledge. The other measure required participants to estimate how their confidence in science and religion would change if an important prediction from science or scripture were confirmed. The measures were counterbalanced. We present results here collapsed across order of presentation, because findings were identical regardless of the presentation order.

Measures

Self-Report and Out-Group Instrumentality. Participants used a sliding 1 ("Not at All") - 100 ("Very Much") scale to indicate how much religious and non-religious people relied on religion and science as sources of knowledge. Participants then estimated their own reliance on science and religion as sources of knowledge using the same scale. We used a 1-100 scale in this study because (a) these scales have better psychometric properties due to a more continuous (and less ordinal) distribution (Lozano et al., 2008), and (b) it allowed us to confirm that our moderation analysis was robust to measurement style. We also measured participants' perceptions of their own group (e.g., religious participants rated how much religious people rely on religion and science). These ratings mirrored participants' self-reports, and so we summarize them in the supplemental materials.

Analysis Plan

To test for misperceptions, we compared religious people's self-reported reliance on science and religion with non-religious people's perceptions of religious people, and vice versa. This involved creating four key variables (variables a-d) in our dataset. The first two variables measuring religious people's reliance on (a) science and (b) religion contained self-reports from religious participants and out-group reports from non-religious participants. The third and fourth variables measuring non-religious people's reliance on (c) science and (d) religion contained out-group reports from religious participants and self-reports from non-religious participants. These variables allowed us to fit regression models which could easily contrast non-religious people's ratings of religious people against religious people's self-report ratings, and vice versa.

We also note that our pre-registration contained an additional hypothesis: That non-religious (but not religious) participants would assume that gaining trust in religion would imply losing trust in science and vice versa. We found support for this hypothesis, but since these findings were not relevant for our instrumentality hypothesis, we summarize these effects in the supplemental materials

Results

Neither religious nor non-religious participants could accurately estimate the other group's self-reported reliance on science and religion as sources of knowledge. Non-religious people overestimated how much religious people relied on religion as a source of knowledge, $b = 30.44$, $SE = 4.29$, $t = 7.09$, $p < .001$, 95% *CI*s [21.99, 38.89], and underestimated how much religious people relied on science as a source of knowledge, $b = -38.71$, $SE = 3.32$, $t = -11.66$, $p < .001$, 95% *CI*s [-45.24, -32.17]. Religious participants also made erroneous estimates, underestimating the extent that non-religious people relied on science as a source of knowledge, $b = -12.63$, $SE = 2.76$, $t = -4.57$, $p < .001$, 95% *CI*s [-18.07, -7.19], and

overestimated the extent that non-religious people relied on religion, $b = 30.90$, $SE = 4.30$, $t = 7.18$, $p < .001$, 95% *CI*s [22.43, 39.37].

Examining the intercepts of these models showed that the instrumentality hypothesis was not intuitive for religious or non-religious participants. In Studies 1-4, we found that religious people viewed both science and religion as less instrumental than non-religious people viewed science. However, non-religious people did not perceive a significant difference between religious people's reliance on religion as a source of knowledge, 84.89, *95% CIs* [77.50, 92.29], and their own reliance on science, 92.00, *95% CIs* [87.23, 96.77]. Religious people made a different judgment error—falsely estimating that non-religious people's reliance on science as a source of knowledge, 79.37, *95% CIs* [76.76, 81.98], as similar to their own self-reported reliance on science, 75.11, *95% CIs* [71.99, 78.23]. Figure 7 displays these differences.

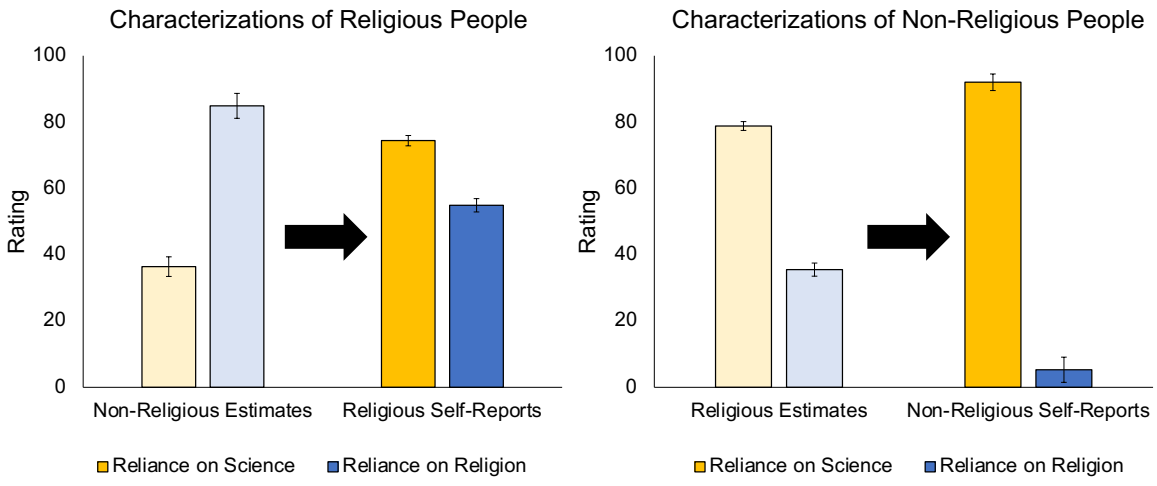

Figure 7. Out-group estimates of how much religious and non-religious people rely on religion and science, compared to their self-reported reliance on religion and science. Pale bars indicate out-group perceptions, whereas darker bars indicate self-reports. Error bars represent standard error.

Discussion

We found that religious and non-religious participants both misperceive each other's views of religion and science. Consistent with naïve realism, religious participants estimated that non-religious people viewed science and religion as more moderate than non-religious people's actual views, whereas non-religious participants estimated that religious participants viewed religion as more extremely instrumental than religious people's actual self-reports. These results showed that our instrumentality hypothesis—that religious people view religion and science as less instrumental than non-religious people view science—was not intuitive to ordinary people.

In contrast to our previous studies, religious people rated science as more important than religion. Given that this pattern emerged in the only study that made the outgroup (i.e., non-religious people) salient, it is possible that when religious people are asked about themselves and non-religious individuals, self- and group-presentation concerns affect their responses. For instance, religious individuals might inflate their ratings of reliance on science to avoid appearing less science-oriented compared to the non-religious outgroup. This is a reasonable concern since religious people are often stigmatized in scientific settings (Rios et al., 2015). Further research is needed to investigate our interpretation.

General Discussion

When explaining the world, do people turn to science, religion, or both? There are currently two dominant answers to this question. Proponents of the conflict narrative argue that religion and science are, on average, incompatible, and that religious belief is more often than not an obstacle to confidence in science. Opponents of this narrative have suggested that religious individuals are just as open to science as non-religious individuals, and that religiosity is more likely to complement—rather than displace—scientific convictions.

Here we introduce a different perspective on religion and science that forges a middle ground between these two perspectives. Drawing on general goal systems models of human

motivation (Kruglanski et al., 2002), we propose that religious and non-religious people have different views of religion and science because of how these two means are connected to the goal of having knowledge. Religious people—who have both religion and science available as sources of pursuing knowledge—are motivated to view the two institutions as moderately instrumental. Non-religious people—who rely on science but do not rely on religion as a means of pursuing knowledge—should be more likely to view science as a more valuable source of knowledge. Importantly, both groups can also use other epistemic means in addition to science and religion (including non-religious spiritual means). We support this goal systems perspective using five studies. Studies 1-4 show that religious people view science and religion as both less instrumental than non-religious people view religion. In our final study, we find that religious people erroneously believe that non-religious people rely moderately on religion and science, while non-religious people erroneously believe that religious people rely extremely on religion.

Limitations and Future Directions

One significant limitation of this research program is that we relied mostly on online representative community samples and student samples. Studies 1-2 and Studies 4-5 were online studies using Mechanical Turk and hosted on Qualtrics, whereas Study 3 was a laboratory experiment with New Zealand students. One limitation of this approach was that we did not have sufficient statistical power to compare how Christian vs. non-Christian religious individuals perceived religion and science. Some evidence suggests that people from non-Christian religions also tend to perceive science and religion as moderately instrumental (McPhetres et al., 2021; Payir et al., 2021), but no study has directly tested our hypotheses among non-Christian believers. Our sampling strategy was also limited because we did not survey extreme religious groups which may have unique attitudes towards science, such as religious fundamentalists (M. K. Johnson et al., 2011).

One possibility is that fundamentalist groups resemble ordinary religious people. However, another possibility is that fundamentalists resemble a mirror image of non-religious individuals—perceiving religion as extremely instrumental and science as not at all instrumental as a source of knowledge. Kruglanski and colleagues (2021) have written about extreme commitment to a means can lead to "motivational imbalance" wherein other means are perceived as un-substitutable (e.g., science can never substitute religion as a source of knowledge). We encourage future research to explore our hypotheses among religious fundamentalists across cultures.

A related limitation is that we did not explicitly analyze the views of people who consider themselves "spiritual but not religious." This group is growing in the United States and around the world, and includes an amorphous set of belief systems ranging from agnosticism to new-age religions like Paganism and Wicca (Jackson et al., 2021). Because the "spiritual but not religious group" is so diverse, it is unlikely that they show a homogenous set of attitudes about science and religion. However, we consider it more likely that they resemble religious individuals than non-religious individuals, since they may view spirituality as an additional source of knowledge which is compatible with science.

We also encourage future research to explore the boundary conditions of the instrumentality hypothesis. In general, our studies supported the hypothesis—religious people generally perceived science and religion as less instrumental than non-religious people perceived science. However, we touched on a boundary condition of the hypothesis in Study 3, where we found that religious and non-religious people perceived science as equally instrumental for answering ultimate "why" questions about natural and social phenomena. Our finding suggested that an important boundary condition to the hypothesis may be participants' general level of belief that knowledge can be achieved. For example, in Study 3, non-religious people perceived both sources of knowledge as less equipped to answer

ultimate questions. Further research could explore other domains where religious individuals view knowledge as easier (or harder) to access than non-religious individuals, and whether these domains pose boundary conditions for the instrumentality hypothesis.

Finally, future research should explore how religious individuals use religion as a means to pursue other goals. We focused on the goal of knowledge pursuit in this paper because religion and science are both meaning-making systems (Sacks, 2012), making them candidates for knowledge pursuit. However, in other domains such as morality, religious people may not perceive other available means, leading them to view religion as extremely instrumental and science as not instrumental at all. We encourage research on whether non-religious people view science as less instrumental to address moral questions than epistemic questions, or whether they are committed to using science to resolve moral dilemmas as well as to gain knowledge. Exploring other goals (e.g., political goals, social belonging) could be a valuable way of further validating goal systems theory as a framework for understanding how both religious and non-religious people use science and religion during goal pursuit.

Conclusion

Here we show that the general goal systems theory of human motivation can explain differences in how religious and non-religious people use religion and science as means for pursuing the goal of knowledge (Kruglanski et al., 2015). Simultaneously using science and religion as means for pursuing knowledge also leads religious people to perceive both of these means as less instrumental than non-religious people view science. These findings are consistent with how people use other means in goal pursuit (e.g., dieting and exercising to as means of staying healthy), but they are not intuitive to ordinary religious and non-religious individuals, who mischaracterize each other's beliefs.

Trust in science is important, especially during times of threat such as the COVID-19 pandemic where scientific innovations can be vital. Our findings may therefore encourage

scientists to develop interventions that seek to increase trust in science among believers. However, a certain level of scientific skepticism is not unhealthy, especially since science should be self-correcting. The ongoing replication reform in psychology and other disciplines is a testament to the importance of scientific self-scrutiny. For this reason, we encourage more research on the "optimal" level of scientific trust, if such an optimum exists.

In the meantime, our research helps dispel concern that religion is a strong barrier to adoption of science. While we do find religious people express lower confidence in science than the non-religious, this gap in confidence is small and it is not driven by explicit beliefs in science-religion conflict but rather greater caution about the explanatory power of any single worldview. While more research is needed, our studies suggest that religion is not necessarily a barrier to science.

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Supplementary Materials

Measures of Religion Across Studies

Table S1.
Measures of Religion Across Studies

	Religious identity	Belief in God	Religious service attendance
Study 1	Christian, Buddhist, Hindu, Jewish, Muslim, Sikh, Atheist, Agnostic, None, Other		
Study 2a	Christian, Buddhist, Hindu, Jewish, Muslim, Sikh, Atheist, Agnostic, None, Other	Believe (1) or did not believe in God (0)	
Study 2b	Christian, Buddhist, Hindu, Jewish, Muslim, Sikh, Atheist, Agnostic, None, Other	Believe (1) or did not believe in God (0)	"Less than Once per Year" (1) – "More than Once per Week" (5)
Study 3	Christian, Buddhist, Hindu, Jewish, Muslim, Non-Religious, Undecided		
Study 4	Catholic, Protestant, Sikh, Buddhist, Hindu, Muslim, Jewish, Atheist, Agnostic, None, Other		
Study 5	Catholic, Protestant, Sikh, Buddhist, Hindu, Muslim, Jewish, Atheist, Agnostic, None, Other		

Supplemental Information for Study 1

Full Extraordinary Events Scale

Table S2 contains all the scenarios in our extraordinary events scale.

Table S2.

Study 1 Stimuli

Category	Description
Clairvoyance*	A man visits an elderly woman who works as a fortune-teller. After consulting some cards, she tells him that he will receive an unexpected job offer in the next month. It happens exactly as she predicted.

Witchcraft*	A stranger has raped a woman from an African village. Unbeknownst to him, the village priest performs a ritual of cursing against him. A short time later the stranger falls terribly ill.
The Afterlife*	A man has an argument with a close friend, who dies before they can be reconciled. A few weeks later, waking during the night, the man believes he can see his friend standing at the end of his bed. His friend reassures him that all is well before disappearing
Unexplained Recovery*	A man is diagnosed as having incurable cancer. Friends and family gather every day for a week to pray for his recovery. Shortly after this his doctor informs him that his cancer seems to have disappeared.
Ghost Sightings*	A man inherits an old farmhouse. The first time he sleeps in the house, he awakes terrified in the night to see a ghostly female figure standing above him, knife in hand. He later discovers that one of his ancestors had murdered a servant-girl in a room near where he slept.
Prayer	A man goes through an acrimonious marriage breakup. In a fit of anger his ex-wife prays that he will be punished. In the following weeks he falls ill, suffering from a life-threatening illness.
Religious Trance	At religious meetings people sometimes fall into a trance-like state and 'speak in tongues' (they pray aloud in what seems to be a language that no one present can understand).
Psychokinesis	There exists an individual who seems able to move objects simply by thinking about them. No-one has been able to discover how he does this.

Out of Body Experiences	A man suffers a heart attack and is taken to the hospital. He later discovers that at one point his heart stopped beating for several minutes. He has a vivid memory of floating above the bed, and believes he can describe what the medical staff were doing.

There were two key differences across Study 1's two waves of data collection. First, participants in the first wave of data collection evaluated science's explanatory power and religion's explanatory power simultaneously for each event—that is, the science item and the religion item were displayed on the same page. Participants in the second wave, however, viewed them on different pages (counterbalanced). We made this change because having both items on the same page could imply that the options were mutually exclusive, and we wanted to make sure our results replicated without this artifact.

Second, participants in the second wave of data collection only responded to 5 of the 9 stimuli in our scale so that we could test whether a short-form version of the measure had the same psychometric properties as our full measure. This shorter 5-item scale also dropped any items that featured themes from Western religion (e.g., prayer, speaking in tongues). The 5 items included in both studies are included in Table 1, and we conducted separate psychometric analyses of each wave of analysis given the changes in our measurement technique. We include psychometric analysis of the scale's properties in the supplemental materials, which support the construction of two separate indices, tapping the perceived explanatory power of (a) religion and (b) science.

Psychometrics for Extraordinary Events Scale

We evaluated the psychometric properties of the extraordinary events scale through two exploratory factor analysis (EFAs). It is common to evaluate scales using a combination of EFA and confirmatory factor analysis (CFA). However, we chose to conduct two EFAs

because we used a shorter version of the scale in our second sample. All of our EFAs revealed two-factor solutions. For the 9-item measure, the first factor had an eigenvalue of 9.14 and contained participants' ratings of science's explanatory power. The second factor had an eigenvalue of 3.77 and contained participants' ratings of religion's explanatory power. The 5-item measure had a very similar structure. The first factor had an eigenvalue of 4.79 and contained participants' ratings of religion's explanatory power, whereas the second factor had an eigenvalue of 2.09 and contained participants' ratings of science's explanatory power. All items loaded on their factors above .50 and no items cross-loaded above .40. No other factors exceeded eigenvalues of 1.00, suggesting that the extraordinary events scale was a stable two-factor measure with one factor tapping beliefs in science's explanatory power and another factor tapping beliefs in religion's explanatory power.

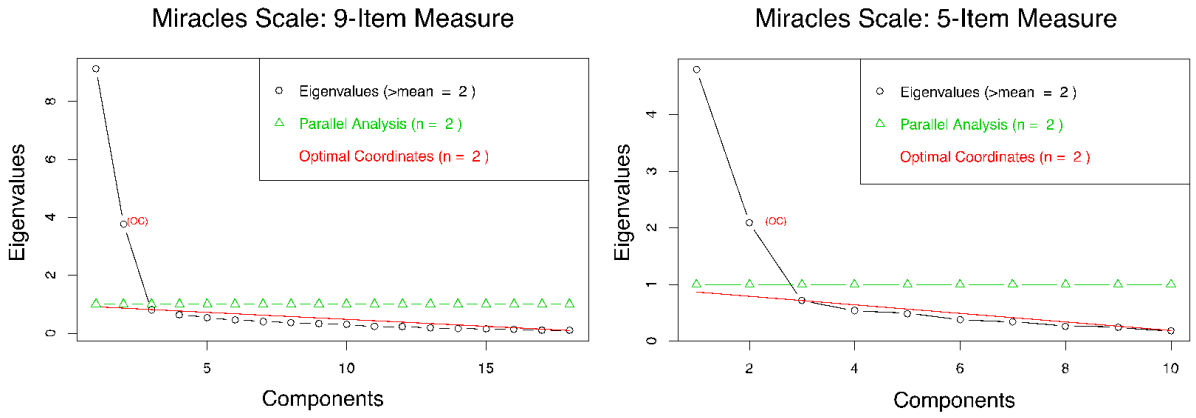

Figure S1. Illustrations of exploratory factor analyses of the extraordinary events scale's 9-item form (left) and 5-item form (right). Factor recommendations from eigenvalue analysis, parallel analysis, and optimal coordinates analysis are displayed in the top right.

Supplemental Information for Study 2a

Our central analyses in Study 2a focused on how participants evaluated science and religion as sources of knowledge. However, in a secondary analysis, we also conducted an

EFA which considered how ratings of instrumentality covaried across the full range of sources. We conducted the analyses using the same parameters of the EFA on the extraordinary events scale, summarized above.

This EFA supported 3 factors with eigenvalues above 1.00, and a parallel analysis also supported a 3-factor solution. The first factor (eigenvalue = 3.06) contained informal/proximal social sources of information, with loadings from “parents” (0.62), “friends” (0.66), and “coworkers” (0.64). The second factor contained more formal/distant social sources of information, with loadings from “the government” (0.85) and “celebrities” (0.54). The third factor contained science and technology sources, with loadings from “science” (0.65) and “the internet” (0.46). “Intuition” did not load with any factor, and two items cross-loaded, with loadings above 0.40 on multiple factors. “Teachers” cross-loaded with factor 1 (0.49) and factor 2 (0.42), reflecting the fact that teachers can represent formal sources of information, but are also more proximal than celebrities and the government.

“God” cross-loaded with factors 1 (0.46) and 3 (-0.41), representing the fact that God may be viewed by some as a proximal and social source of knowledge, but as others as a non-scientific form of knowledge. This cross-loading resembles our findings across other studies, in which non-religious people seem to view religion as conflicting with science, whereas religious people view religion as complementing science by providing an alternative form of knowledge. In support of this possibility, a factor analysis conducted with just non-religious participants showed a strong factor one which loaded positively with “science” (0.72) and “the internet” (0.50) and negatively with “god” (-0.42), whereas science and religion did not load in opposite directions on the same factor when we fit the factor analysis with just religious participants. Instead, it loaded positively with “parent” (0.30), “intuition” (0.48), and “teacher” (0.45).

Supplemental Information for Study 3

Table S3 provides the full list of questions that participants saw in Study 3.

Table S3.

List of Questions in Study 3

Question Topic	"How" Format	"Why" Format
Universe	How did the universe come to exist? What was the cause?	How did the universe come to exist? What was the purpose?
People	How did people come to exist? What was the cause?	How did people come to exist? What was the purpose?
Consciousness	What causes consciousness?	What is the purpose of consciousness?
Religion	How do people come to have religious belief? What is the cause?	How do people come to have religious belief? What is the purpose?
Death	How do people die? What causes death?	Why do people die? What is the purpose of death?
Suicide	What causes suicide?	Why does suicide exist? What purpose does it serve?

Supplemental Information from Study 4

Here we report a small deviation from pre-registration. We pre-registered including an innocuous behavior—drinking wine with dinner" as an attention check, such that we would exclude anyone who rated this behavior as a somewhat effective strategy for mitigating COVID-19. However, we realized shortly after launching the study that people might view drinking wine with dinner as psychologically palliative, and descriptive statistics showed that over a quarter (n = 143/401) of our sample rated this behavior as at least somewhat effective (a 4 or above out of 7) for mitigating the impact of COVID-19. For this reason, we did not use the item as an attention check. Our results were substantively identical with or without this exclusion criterion.

Supplemental Information from Study 5

In Study 5, we also analyzed whether non-religious people—but not religious people—intuitively see gains in religion's instrumentality as entailing losses in non-religion's instrumentality and vice versa.

Participants read the prompt "we would like you to consider how your own beliefs might change in light of different information." Participants were then asked (emphasis in original), "Imagine that an important prediction from **scripture** were confirmed. How would this impact your beliefs in religion and science?", and separately, "Imagine that an important prediction from **science** were confirmed. How would this impact your beliefs in religion and science?" For both prompts, participants estimated the change in their religious and scientific beliefs using a -50 to 50 scale, where 0 represented no change in belief, -50 represented a complete loss of belief, and 50 represented much stronger belief. We tested our hypothesis by correlating changes in participants' confidence in science and confidence in religion by religious identity. We estimated Bayes factors to accompany frequentist estimates for models with null results.

Analyses models offered support for our prediction. Non-religious people estimated a negative relationship between confidence in science and confidence in religion, both in light of a confirmed prediction from scripture, b = -44.00, SE = 0.13, t = -3.41, p = .001, 95% CIs [-0.70, -0.18], and a confirmed prediction from science, b = -64.70, SE = 0.11, t = -5.81, p < .001, 95% CIs [-0.86, -0.42]. However, religious people viewed confidence in science and confidence in religion as orthogonal, both following a confirmed prediction from scripture, b = -44.00, SE = 0.13, t = -3.41, p = .001, 95% CIs [-0.70, -0.18], BF_{10} = 0.13, and a confirmed prediction from science, b = -64.70, SE = .11, t = -5.81, p < .001, 95% CIs [-0.86, -0.42], BF_{10} = 0.07. These results, displayed in Figure 10, show that non-religious people have an inherent perception of religion and science as conflicting, whereas religious people are more likely to view religion and science as compatible sources of knowledge.

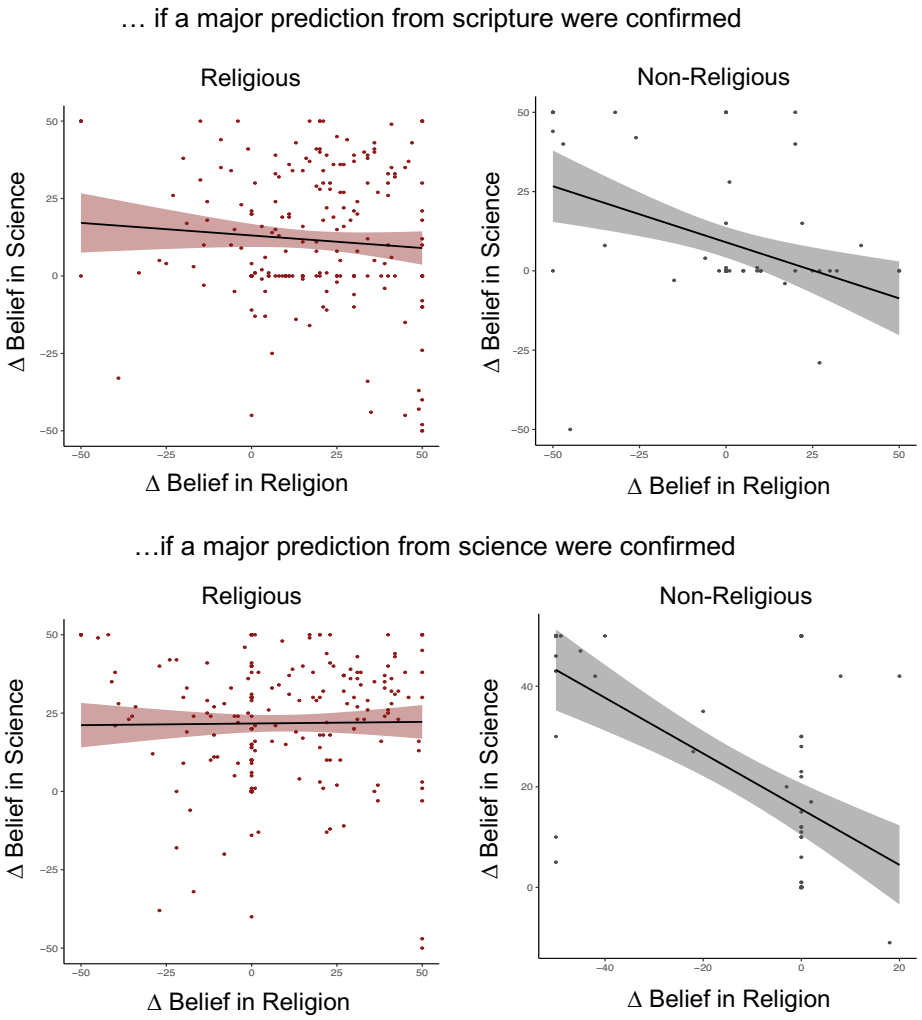

Figure S2. The relationship between change in science belief and change in religious belief for religious (in red) and non-religious (in gray) participants. The triangle symbol indicates change in beliefs.