

Running Head: LEARNED FAITH

Learned Faith: The influences of evolved cultural learning mechanisms on belief in gods

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**** Unedited proofs: manuscript in press at *Psychology of Religion and Spirituality* ****

Abstract

Productive research programs have emerged, targeting the cultural, cognitive, and evolutionary origins of both religious belief and—more recently—religious disbelief. The current paper examines the role of specific theoretically supported cultural learning strategies in the development of belief and disbelief in gods. Using a sample from the World Values Survey, we investigate the role that kin-biased transmission, conformist transmission, and credibility enhancing displays have on individuals' beliefs in gods in 53 countries or regions worldwide. We test this relationship using a combination of signal detection analysis and multilevel modeling. The two separate analyses yield converging results, providing support for the necessary role of culture in the development of religious beliefs. This evidence supports models that place cultural learning (specifically context-biased transmission) central to the evolution of religious belief and disbelief, and suggest that revisions are necessary to popular cognitive byproduct frameworks that predict only a minimal role for culture.

Keywords: cultural learning; religious belief; evolution; atheism

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Give me the child for his first seven years, and I'll give you the man.
~Popularly attributed to the Society of Jesus, Catholic Church

*The only people I know who still believe in hell
are the ones who had the proper kind of upbringing*
~Mark Twain

Most people alive today believe in a god (or gods). Yet, there are also nearly a billion people who do not endorse the existence of gods (P. Zuckerman, 2007). There are presumably numerous factors that interact to produce different levels of supernatural belief among individuals (e.g., Norenzayan & Gervais, 2012) and societies (e.g., Inglehart & Norris, 2004). The present paper will empirically explore the role of specific cultural learning processes that have been hypothesized to be intimately connected to the development of religious (dis)belief (e.g., Banerjee & Bloom, 2013; Geertz & Markússon, 2010; Gervais & Henrich, 2010; Gervais, Willard, Norenzayan, & Henrich, 2011; Lanman, 2012).

Learning to believe? One question, two answers

Does religious belief require cultural learning and scaffolding? Different schools of social scientific thought tend to reach different answers when approaching this question. On the one hand, decades of research from social psychology demonstrate that attitudes and beliefs are powerfully shaped by social contexts (e.g., Cialdini & Goldstein, 2004; Cialdini & Trost, 1998; Zimbardo & Leippe, 1991), and religion should, in a sense, be no different. On the other hand, many researchers in the cognitive science of religion (e.g., Barrett, 2004a; Barrett, 2010) have argued instead that religion requires little cultural scaffolding to flourish. How to resolve this apparent discrepancy?

Potentially, researchers disagree on the role of learning in religion because they focus on different fundamental questions about religiosity. Researchers emphasizing the important role of

socialization tend to take the existence of religion as a given and explore how well-developed literatures on socialization and social influence might impact degrees and types of religious commitment. As a result, classic research on social influence, conformity, and the like (e.g., Cialdini & Trost, 1998; Zimbardo & Leippe, 1991) informs hypotheses regarding, for example, the role of parenting and childhood socialization or conformity to local norms in the development of different degrees of religiosity (e.g., Hardy, White, Zhang, & Ruchty, 2011; Hunsberger & Brown, 1984). Given the profound influence social context has on beliefs and attitudes in general, social psychologists would likely view it as obvious, if not self-evident, that religious socialization is important.

On the other hand, other researchers might suggest instead that religion—perhaps surprisingly—does not require cultural learning to flourish. For example, there are claims that when it comes to religion, “special cultural scaffolding is unnecessary” (Barrett, 2010, p. 169) and that religion might be a cognitive default with atheism only running “skin deep” (e.g., Bering, 2010). That is, a variety of researchers working in the early stages of the cognitive science of religion posited that religion’s near-universality may stem from a suite of evolved cognitive processes which make religious belief easy, natural, and possibly innate at some cognitive level (see, e.g., Barrett, 2004b). Religions may flourish because they are simply good fits for evolved human psychology. This approach has been influential and productive, stimulating research concerning the core cognitive faculties underlying religious belief (see, e.g., Atran & Norenzayan, 2004; Bloom, 2007; Gervais, 2013) and the role of certain memory biases in the transmission of some supernatural concepts at the expense of others (e.g., Barrett & Nyhof, 2001; Boyer & Ramble, 2001).

Resolving the disagreement?

How, then, to resolve an apparent paradox between two successful research perspectives? We propose that, in part, the two approaches reach different conclusions because they are asking different questions. Socialization accounts recognize the primacy of social context for influencing cognition, treat the existence of religion as a given, and ask how social pressures might influence degrees and types of religiosity. The cognitive science of religion asks, instead, how religion may have come to be in the first place, and why it takes predictable forms across cultures. One approach focuses primarily on individual variability in religiosity; the other focuses on the universality of religion, and the underlying cognitive mechanisms that might enable and constrain it.

Both socialization and cognitive science of religion accounts have much to offer, and we suggest that more unified approaches to cultural learning—rigorously developed and modeled over the last 30+ years (e.g., Boyd & Richerson, 1985)—can incorporate insights from both perspectives, and provide a potentially more compelling account of both the stability of religion in *Homo sapiens sapiens*, and also individual and cross-cultural differences in religiosity. A unified approach wholeheartedly embraces insights that place socialization and social influence central to the formation of beliefs and attitudes, while also recognizing that certain cognitive biases can make some concepts more memorable and cognitively attractive than others. In the present paper, we use the concept of supernatural agent beliefs to empirically illustrate the utility of adopting a cultural evolutionary approach to understanding religious belief. We (among many others: e.g., Atran & Henrich, 2010; Geertz & Markusson, 2010) suggest that both socialization and cognitive canalization play important roles in religion. This is especially apparent when focusing specifically on religious beliefs, rather than mere representation of supernatural concepts.

Combined, many cognitive biases can tell us a great deal about why religions worldwide center on predictable themes, and why supernatural agents worldwide tend to share similar features. However, many research teams in recent years have challenged the notion that these biases actually explain *belief* in supernatural agents, rather than merely the features of supernatural agents that people find easy to *mentally represent* (e.g., Geertz & Markússon, 2010; Gervais & Henrich, 2010). After all, it is a far step from being able to easily mentally represent a given supernatural agent (such as Mickey Mouse, Zeus, or Yahweh) and actually believing that the agent is real. Even children quickly grasp the concept that some agents are fun to think about without believing that they in fact exist, after all (e.g., Sharon & Woolley, 2004).

In sum, socialization is important to beliefs and attitudes in general (Cialdini & Goldstein, 2004), and religious attitudes in particular (Hunsberger & Brown, 1984). These insights largely complement parallel theoretical innovations in cultural evolution. At the same time, many influential approaches (most notably early work on cognitive science of religion) viewed religious beliefs as reliably developing byproducts of ordinary human cognition. While there have been many important insights derived from this approach, we argue (in this paper and elsewhere: Gervais & Henrich, 2010; Gervais, Willard, et al., 2011) that it produces a rather incomplete view of how religion works; further, it does this by paying insufficient attention to recent advances in the evolutionary study of culture. Both socialization and cognitive science of religion have a lot to offer. However, we think that both views can be strengthened and integrated by a deeper consideration of the cognitive and evolutionary foundations of culture.

How cultures evolve

Rather than provide an in-depth review of existing scholarship on the cognitive and evolutionary underpinnings of culture, we instead will highlight a few excellent reviews of this

burgeoning line of inquiry. Next, we use models of cultural transmission to derive specific predictions about how cultural learning might explain variability in belief in gods worldwide.

Humans are a cultural species (Boyd, Richerson, & Henrich, 2011; Henrich & McElreath, 2003). However, humans are not blind cultural sponges who passively absorb whatever information is in the environment. Nor—contra some arguments for the acquisition of beliefs (e.g., Dawkins, 2006)—do children gullibly practice whatever their parents preach. Rather, human culture is the result of individuals employing specific learning strategies for extracting information from the environment (e.g., Rendell et al., 2011). These can include individual learning strategies as well as social learning strategies. Even among social learning strategies, there are two broad classes of learning biases, known as *content-biased learning* and *context-biased learning*. Content biases occur because some information is simply more emotionally evocative or memorable. The vast majority of early work in the cognitive science of religion focused on content biases (see, e.g., Gervais, Willard, et al., 2011), such as the presence of minimally counterintuitive supernatural agents (e.g., Barrett & Nyhof, 2001; Boyer & Ramble, 2001).

Context-biased learning, on the other hand, depends more on from whom a naïve learner learns, rather than on the specific information being learned. So, for instance, learners could preferentially adopt beliefs and practices that are demonstrated by their immediate families (kin-biased transmission), common in their immediate cultural milieus (Boyd & Richerson, 1985; Henrich & Boyd, 1998), or that seem to be held by especially successful or prestigious individuals (prestige-biased transmission: Henrich & Gil-White, 2001). Numerous other biases are possible (see, e.g., Rendell et al., 2011 for an accessible review). Further, people are more likely to adopt beliefs of individuals who actually practice what they preach: a learner would be

wise to be suspicious of someone who tells them a mushroom is delicious and nutritious, but will not eat said mushroom. Thus, the potentially costly¹ actions of others can serve as *credibility enhancing displays* of underlying beliefs (or CREDS: Henrich, 2009), ratcheting up levels of belief among learners. Combined, this suite of context-biased learning strategies has the potential to give researchers a lot more traction in understanding variability in religious beliefs (e.g., Gervais, Willard, et al., 2011; Lanman, 2012; Norenzayan & Gervais, 2013). Although this argument has been supported theoretically and empirically to various degrees (see, e.g., Lanman, 2012), we aim to extend it and directly test some of its additional implications.

Present Research

To test the role of context-biased transmission in religious belief worldwide, we employed data from the World Values Survey. This large dataset includes variables that can be used as proxies for specific learning strategies. Specifically, we considered the degree to which proxies for kin-biased learning, conformist learning, and credibility enhancing displays of faith predict rates of belief in gods across more than 13,000 respondents from more than 50 diverse countries and world regions. Further, we tried to assess the robustness of any effects by testing theoretically derived predictions at both the international and individual levels of analysis. International analyses treated cultural learning as a signal detection problem, while individual analyses used a multilevel modeling approach that allowed us to quantitatively assess the degree to which two straightforward cultural learning proxy variables predict belief in gods worldwide. In addition, these dual approaches enabled us to pit our predictions (that context-biased learning

¹ Credibility enhancing displays are costly only if an actor does not genuinely hold a cognitive representation he or she claims to hold. Eating the mushroom is only costly if it turns out to be toxic. This is one of the key distinctions between costly signaling approaches and CREDS.

matters in the development of religious beliefs) against approaches to religious cognition that are comparatively silent about the role of cultural learning.

Previous research has long highlighted the role of socialization in the development of religiosity (e.g., Hunsberger & Brown, 1984) and argues broadly that religious belief and disbelief depend on key cultural inputs (Geertz & Markusson, 2010). The present research extends this work in three specific ways. First, it grounds socialization approaches more firmly in the rich theoretical toolkit of cultural evolution. Second, it explores the simultaneous influence of specific cultural learning mechanisms (especially conformist transmission, kin biased transmission, and credibility enhancing displays) on the development of religious belief and disbelief. Finally, and perhaps most importantly, the present research explores the operation of the same cultural learning processes across diverse world cultures, enabling a greater degree of cross-cultural generalization that is often lacking in social scientific research (Henrich, Heine, & Norenzayan, 2010).

General Methods

For both international and individual level analyses, we first isolated a subsample of 13,449 WVS respondents (51% female) who were born from 1971 to 1981. We term this our focal group of participants. In addition, we isolated another group of 54,905 older participants from the same countries who were born prior to the year 1970. This latter group was used in calculations for one of our proxy cultural learning variable (more details below). Given these data, we were able to assess belief in gods, a proxy variable for kin-biased transmission, and a second proxy variable for a combination of conformist transmission and credibility enhancing displays. These variables, in turn, enabled both international and individual analyses of the impacts on belief in gods of three specific cultural learning strategies.

Measures

Belief in gods. We assessed belief in gods in our focal group with a single item that asked participants whether they believe in a god (or gods). We included only participants who left a definitive “yes” or “no” answer to this binary² question.

Kin-biased transmission. As a proxy for kin-biased transmission, we included one WVS item that asked participants whether they were raised to be religious. As with belief in gods, we only included participants who left a definitive “yes” or “no” answer to this binary question.

Conformist transmission and credibility enhancing displays. We created one proxy measure of both conformist transmission and credibility enhancing displays. To do so, we used the older group of participants (not our focal group). A single item asked them to rate how frequently they attend church or other religious services. We calculated the percentage of participants in each group who attended to services weekly or more than once per week. Thus, this proxy includes data from participants who are independent from our focal participants, older (e.g., age itself can be used as a prestige cue: Henrich & Gil-White, 2001), and focuses on visible behavior of people within a given cultural context—something essential for credibility enhancing displays.

Analytic strategies

In two sets of analyses, we tested the degree to which our proxy cultural learning variables predict rates of belief in gods worldwide. The first set of analyses was at the level of country or region. The second set was at the individual level, with individuals being nested inside countries. We expand on both approaches below.

² In other words, we omitted participants who responded “I don’t know” or who did not answer the question.

International-level analyses. To test the role of cultural learning in belief in gods across countries, we utilized a signal detection approach. In signal detection theory, people are typically given a task in which—across repeated trials—they are either exposed or not to a given signal (it could be a noise, a flashing light, etc.; the approach is domain-general). Their job is to respond on each trial whether the signal was present. By evaluating the rates with which participants accurately detect the signal (hits) to the rates with which they erroneously think the signal was present (false alarms), it is possible to calculate two parameters corresponding to both response *sensitivity* and response *bias*. An individual showing high sensitivity is able to accurately discern whether or not the signal was present. An individual showing high bias tends to report a signal frequently, whether or not it was present.

This general procedure can also be used to model cultural learning in a given population by substituting many potential cultural learners for many trials in a standard detection task. Consider, for example, an evaluation of kin-biased transmission for acquiring the belief “spicy peppers are delicious.” As children, some learners’ families encourage them to eat spicy peppers. Other families do not expose their kids to spicy peppers. Thus, exposure to spicy peppers constitutes a signal. As adults, some of these learners will grow up to like spicy peppers while others likely will not. Liking peppers as an adult corresponds to the response. Upon calculating the signal detection theory parameters for sensitivity and bias, certain inferences can be made about the fidelity of transmission. A population showing high sensitivity would suggest that family upbringing to like spicy peppers or not (the signal) is highly diagnostic of adult preferences for spicy food. Low sensitivity would suggest that in this population, kin-biased transmission is not strongly diagnostic of adult preferences. High bias would suggest that, above

and beyond family influence, people tend to eventually like spicy peppers. Low bias would suggest that, despite family influence, people tend not to like spicy peppers.

From this basic logic, we treated countries or regions of origin of our focal group of participants as separate populations. The religious upbringing question was treated as a signal, and the belief in gods measure was treated as an outcome (see Table 1). From this, we followed standard procedures (e.g., Stanislaw & Todorov, 1999) for calculating sensitivity (d') and bias (C) for each country or region represented in our focal sample. Thus, high sensitivity would suggest that family upbringing plays a large role in determining adult beliefs within a given country. Bias then describes, above and beyond a religious upbringing, the degree to which people nonetheless tend to develop belief in gods.

Based on these values, we tested two primary hypotheses. First, we predicted that, across all of our countries, there would be significant and strong sensitivity—that is, that religious upbringing matters for future belief in gods. Second, we predicted that the degree of bias exhibited across countries would significantly covary with our proxy conformist transmission variable. That is, that a bias to believe in gods—above and beyond a religious upbringing—should itself be related to other cultural cues to believe in gods. Note that these two predictions strongly depart from approaches that do not view context-biased transmission as central to the development of religious beliefs. Such approaches would actually predict 1) low to nonexistent sensitivity (Upbringing matters little...), 2) high bias (...because religion fits so well with evolved psychology...), and 3) bias uncorrelated with other proxy measures of context-biased learning (...that additional cultural scaffolding is unnecessary).

Table 1: Schematic of signal detection approach to belief in gods, based on religious upbringing.

		Signal: Raised Religious	
		Yes	No
Response: Belief in gods	Yes	<i>Hit</i>	<i>False alarm</i>
	No	Miss	Correct rejection

Individual-level analyses. In addition to performing country-by-country level analyses, we also wanted to explore the degree to which cultural learning proxies account for individual variability in belief in gods. Because our proxy for conformist transmission and credibility enhancing displays (% of people among the older sample who attend church frequently) was only calculated at the country-level, and the other variables existed at the individual level, we used multilevel modeling to account for the nested nature of our data. In sum, we were predicting individual belief in gods from religious upbringing (at the individual level) and visibly religious contexts (at the country level). This approach lets us quantitatively estimate the amount of global variation in belief in gods that is explained by two straightforward proxy variables of context-biased learning. We predicted that both cultural learning proxy measures would be predictive of individual level belief in gods, and that combined they would explain substantial variability in belief in gods worldwide. As with our international analyses, these predictions starkly differ from the predictions derived from models of religious cognition that do not explicitly address modern (that is, within the last 30 years: Boyd & Richerson, 1985) scholarship on cultural transmission.

Results

International-level analyses

We sought to test two focal hypotheses. First, we predicted that overall countries would show significant sensitivity. In other words, we predicted that adult belief or disbelief in god would be substantially dependent on whether or not one has a religious upbringing. Second, we predicted that across countries, bias towards belief in god would be predicted by the percentage of adults in that country (in an older, independent sample) who attend religious services at least weekly. In other words, we predicted that a bias towards belief in gods would be predicted by cues that others in one's country are religious.

First, we calculated sensitivity (d') and bias (C) following standard formulae. We reverse scored bias so that more positive values reflect a stronger bias to believe in gods.

To test our first hypothesis, we used a one-sample t test to evaluate whether sensitivity differed from zero (zero reflecting a total absence of sensitivity for family cues to believe in gods). As expected, d' significantly differed from zero, $M = .95$, 95%CI = .82 to 1.08, $t(52) = 14.49$, $p < 2 \times 10^{-16}$. As hypothesized, family religious upbringing showed a strong effect on respondents' subsequent belief or disbelief in gods.

Second, we similarly tested for the existence of bias. A one-sample t test revealed that C significantly differed from zero, $M = .89$, 95%CI = .69 to 1.09, $t(52) = 8.96$, $p = 4 \times 10^{-12}$. But was this bias explained by visible religious context? Indeed, regression analyses revealed that the bias to believe in gods was strongly predicted by the percentage of adults in a country who attend religious services at least weekly, $\beta = .57$, $t(50) = 5.20$, $p = 4 \times 10^{-6}$, adjusted $R^2 = .34$. Next, we used nonparametric bootstrapping (10,000 samples, percentile) to calculate 95% confidence intervals for model parameters, $\beta = .38$ to $.78$, $R^2 = .13$ to $.58$. As hypothesized, a substantial amount of the bias that exists to believe in god—above religious upbringing—is predicted by other context-biased learning mechanisms.

Individual-level analyses

Modeling approach. In order to test the effects of both individual variables as well as country or region variables on belief in gods, hierarchical (multilevel) modeling was used. We produced the final model via a planned step-wise process³. The first model included only the intercept with no predictor variables. The second model included a variable for whether the individuals were raised as religious or not (1 raised religion, 0 not raised religious) with a random coefficient. The third model added the Weekly variable both at the intercept and on the Raised variable as an interaction term.

Results. Model 1 revealed a significant amount of variation in belief in gods between countries ($\tau = 2.260, p < .001$). Model 2 revealed significant effects of religious upbringing, where those who reported being raised religious having a higher likelihood of believing in gods than those who were not (OR = 6.123, CI: 5.176-7.244). The test for random-effects was significant ($\chi^2 = 519.896, p < .001$), indicating that there were differences country-to-country in the effect of religious upbringing on belief in gods. Model 3 tested to see if these country-to-country differences in slope were themselves related to weekly church attendance among the older cohort within a given country. It also tested to see if the intercepts (average belief in gods) of each country varied as a function of Weekly. Weekly did not contribute to differences in slope for the first-level variable Raised (OR = 1.001, CI: .993-1.009). As a result, this coefficient was dropped from the final model for the sake of parsimony.

³ Though our predictions did not include anything specific about gender, we ran a model including gender to rule out possible confounds. The standard gender effect (women tending to be more religious) was found, but our variable of interest was still significant in this model and had a larger coefficient. Because we were not theoretically interested in the effects or interaction of gender, this variable was not included in our final full model nor discussed in further analyses.

Though Weekly did not interact with the first-level term (Raised), it was significant when considering the second-level intercept (OR = 1.037, CI: 1.030-1.045). Specifically, this means that comparing two countries one unit apart in average weekly church attendance, the country with higher attendance will have a greater proportion of individuals in the focal analysis group that believe in gods. That this variable did not contribute to differences in slope for the first-level variable indicates that this significant second-level effect did not vary by country. In other words, the trend that higher attendance in a country will lead to higher levels of belief in gods for the younger focus group holds similarly across countries, as opposed to, for example, causing a small increase in one country, an extreme increase in another, a decrease in a third, etc.

The final model predicts belief in gods from Raised on the first level and Weekly in the second-level intercept model. An overview of the results for this model are given in Table 2. Overall, being raised religious does in fact strongly affect whether an individual grows up to believe in gods (OR = 4.811, CI: 4.160-5.563). Binary logistic regressions were run for each individual country, predicting individual belief in gods from whether individuals were raised

Table 2. *Model 3 – individual and country levels*

	Odds ratio	95% confidence interval (odds ratio)	
		Lower Bound	Upper Bound
Level 1			
Raised	4.811***	4.160	5.563
Level 2			
Intercept	1.863***	1.476	2.352
Weekly	1.037***	1.030	1.045
Random Effects			
	Variance	Standard error	
Intercept	1.152***	0.158	
Raised	0.308***	0.042	

P* < .05, *P* < .01; ****P* < .001

religious. The odds ratios associated with each country are given in Figure 1, organized from left to right by OR magnitude. Average weekly church attendance is given for each country by the color gradient. Had there been a significant interaction between Raised and Weekly in the multilevel model, the gradients in this figure would have exhibited some pattern associated with OR on belief in gods predicted by Raised. As this interaction was not significant, there is no recognizable trend in this variable.

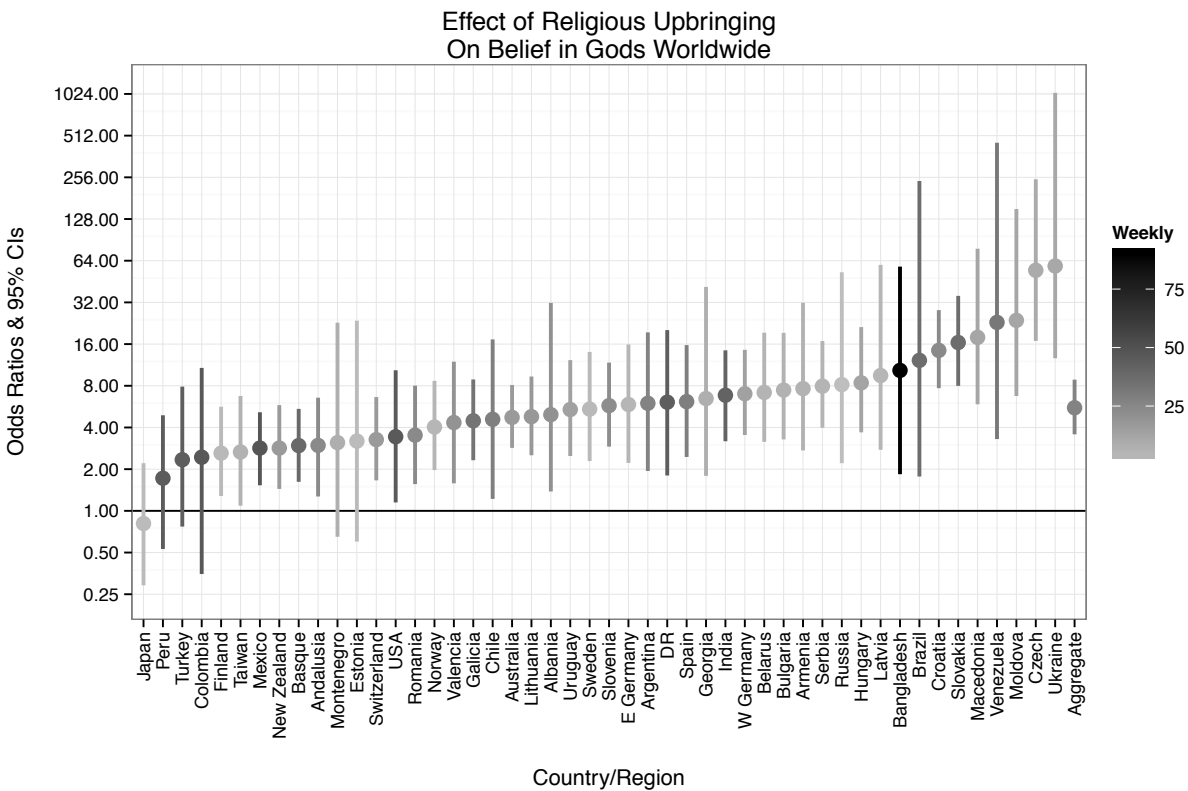


Figure 1. The effect of religious upbringing on belief in gods (Odds ratios and 95% CIs) across 49 world countries and regions, as well as an aggregate effect size estimate. Note: y-axis is log 2 scaled. Shading of bars reflects the percentage of adults in each country who attend religious services at least weekly among an independent, older sample. Five regions (Azerbaijan, Nigeria, Phillipines, South Africa, and Tambov) were omitted from the graph because their distributions violated the assumptions of the logistic regressions used to create this figure.

Results summary

In sum, these analyses found converging evidence supporting the role of context-based learning strategies on belief in gods worldwide across two analytic strategies. First, a signal detection framework demonstrated the influence of two proxy measures for specific learning strategies on belief in gods across more than 50 world countries and regions. Second, a multilevel model showed that a substantial amount of variability in individual-level belief in gods worldwide is explained by the same two proxy measures. Finally, to further illustrate the role of cultural learning in belief in gods, consider two additional findings. Among individuals in our focal group who were raised religious and who grew up in countries in which at least 50% of their elders attend church at least weekly, 98.9% go on to believe in gods (95% CI: 98.2-99.4). However, among individuals who neither were raised religious nor grew up in countries in which at least 50% of their elders attend church at least weekly, fewer than 3 in 5 believe in gods (58.5%, 95% CI: 57.1-59.9).

General Discussion

We used World Values Survey data to empirically examine the effects of specific theoretically specified cultural learning strategies on belief in gods worldwide. Using both international- and individual- level analyses, we found converging support for the substantial and independent impacts of kin-biased transmission, conformist transmission, and credibility enhancing displays on belief in gods. This work complements and extends previous work on both cultural learning and religious cognition; highlights the utility of applying cultural evolutionary models to large archival datasets; and demonstrates that kin-biased transmission, conformist learning, and credibility enhancing displays act in concert to powerfully influence the development of religious belief and disbelief around the globe.

Further, we specifically defined our tests to pit a cultural learning approach—focused heavily on context-biased learning—against approaches to the cognitive science of religion arguing that little cultural scaffolding is required to develop belief in gods (e.g., Barrett, 2010). Specifically, in our first set of analyses, we used a signal detection approach to explore belief in gods internationally. Within this approach, our model predicts high sensitivity to religious upbringing, and that additional bias to believe in gods would itself be predicted by other cultural cues. In contrast, approaches that minimize or underplay the contributions of context-based cultural learning would make neither prediction. Results were consistent with our predictions. In our second set of analyses, we used multilevel modeling to explore individual variation in belief in gods, nested within countries. Our model predicts that both religious upbringing (at the individual level) and broader visible religious context cues (at the country level) should predict individual differences in belief in gods. Approaches that do not incorporate context-biased cultural learning to religion do not cleanly make such predictions. As with the international analyses, results were consistent with our predictions. In sum, our results were highly consistent with an account of religious belief that makes cultural learning central; on the other hand, they are much more difficult to reconcile with approaches that do not incorporate context-biased cultural learning.

Like previous work arguing that socialization is important in religion (Hunsberger & Brown, 1984), the present results show that cultural learning is an important—and perhaps necessary—factor in the development of religious belief and disbelief. Those raised religious, and those raised in highly religious contexts, were much more likely to subsequently believe in gods across a large international sample. We urge future work that brings together both socialization and cognitive science of religion under a broader cultural evolutionary framework.

Limitations and future refinements

Naturally, the present results should be interpreted as preliminary. Our primary predictors relied on proxy variables derived from an archival dataset. People answering “yes” to a question about religious upbringing could be driven by a whole host of possibilities, beyond the specific mechanisms underlying kin-biased transmission. Indeed, such retrospective reports of one’s upbringing are probably quite noisy, and potentially biased by current beliefs. Similarly, using national church attendance rates as an index for local exposure to credibility enhancing displays of faith is an admittedly imperfect measure. Nonetheless, it is worth noting that even proxies as crude as the ones we could derive from the World Values Survey still had great predictive power in explaining patterns of belief and disbelief in gods. Future research could easily explore other archival datasets to find other potential proxies for cultural exposure to a wide variety of beliefs. We merely intended to use the present analyses to empirically highlight the applicability of modern approaches to cultural evolution to the study of religious belief. In addition, a whole host of additional cultural learning strategies (e.g., prestige-biased learning) are likely also interacting to influence people’s degrees of belief in gods. Plausibly, these additional cultural variables may explain why people who were not raised religious, and who do not live in strongly religious countries, nonetheless are slightly more likely than not to believe in gods. Our proxies imperfectly captured only a few learning strategies, and surely others are also involved.

Our analyses focused specifically on belief in gods. Yet, there are numerous other supernatural beliefs that may be more or less affected by cultural learning. For example, among adults dualistic tendencies are incredibly strong (Forstmann & Burgmer, 2014). Preliminary evidence suggests that mind-body dualism is both reliably developing (Chudek, McNamara, Birch, & Bloom, Under Review; Hood, Gjersoe, & Bloom, 2012) and cross-culturally persistent

(e.g., Slingerland & Chudek, 2011). Universal dualistic tendencies might lead belief in immaterial souls to require less cultural scaffolding than belief in gods, and it would be well-worth exploring the impact of cultural learning on different sorts of supernatural beliefs. This is especially important, as some researchers have used terms such as “intuitive theism” to apply to belief in *both* gods and souls (e.g., Uhlmann, Poehlman, & Bargh, 2008), or to teleological beliefs in children (e.g., Kelemen, 2004). Yet souls, gods, and teleological reasoning are conceptually and empirically dissociable, and cultural learning may differentially support each. Indeed, preliminary analyses mirroring our international analyses reveal that the present cultural learning proxy variables have substantially less explanatory power for individual differences in soul beliefs.

Skin-deep atheism and universal implicit theism?

Across cultures, religion is a universal (e.g., Brown, 1991). Yet, there is also considerable international (Inglehart & Norris, 2004) and individual (P. Zuckerman, 2007) variability in self-reported belief in gods. How to reconcile the cross-cultural universality of religion with its apparent variability across societies and people within societies?

One possibility is that some degree of belief in supernatural agency emerges as an evolved trait (whether a byproduct or an adaptation), yet expressions of religious belief and disbelief only poorly approximate underlying cognition (see, e.g., Bering, 2010). In this view, whatever its evolutionary trajectory, belief in supernatural agents might be implicitly universal while self-reported beliefs vary across cultures. That is, atheism may only be skin deep, and even open atheists might harbor some degree of implicit belief in gods.

Although this account is superficially plausible according to some evolutionary accounts, we view it as problematic on both theoretical and empirical grounds. Theoretically, evolutionary

psychologists have long recognized that many traits can emerge as evolutionary adaptations and byproducts, while still exhibiting meaningful individual variability (e.g., Buss, 2009). This is especially true in light of recent work on cultural evolution and gene-culture coevolutionary theory (e.g. Boyd, Richerson, & Henrich, 2011; Henrich & McElreath, 2003). A given attribute may exist both as a cross-cultural human universal and as a trait with marked individual differences. In our view, the capacity for the mental representation of supernatural agents likely emerges as a reliably developing human universal, but *belief* in any specific supernatural agents requires additional cultural support. Without such support, disbelief may be the natural result.

Empirically, little extant empirical evidence speaks directly to the existence—or nonexistence—of implicit theism among atheists. Research on the psychology of atheism is a recent trend, however, and we view this area as one ripe for future investigation. At the same time, two independent lines of research suggest that in many cases self-reported atheism should (albeit tentatively) be treated as genuine nonbelief, rather than as merely superficial self-reports. In social psychology, implicit and explicit measures of attitudes often diverge in predictable ways when social desirability pressures are high (e.g., Greenwald, McGhee, & Schwartz, 1998). People may be reluctant to explicitly endorse socially undesirable attitudes, while still implicitly holding such associations. However, in all but a few extant cultural contexts (e.g., countries with historically state-mandated atheism) it is difficult to see why believers would explicitly claim to be atheists. After all, atheists are among the most stigmatized groups in the USA (Edgell, Gerteis, & Hartmann, 2006) and other religious-majority cultures. Atheists are viewed as untrustworthy and morally questionable (Gervais, 2014; Gervais, Shariff, & Norenzayan, 2011), even in largely secular countries such as the Netherlands, the UK, the Czech Republic, and China (Gervais et al., in prep). There appears to be little social pressure for people to endorse atheism,

and there may in fact be considerable social pressures leading people to instead overinflate their self-reported religiosity (e.g., Cox, Jones, & Navarro-Rivera, 2014; Hadaway, Marler, & Chaves, 1993; Presser & Stinson, 1998; Sedikides & Gebauer, 2009). Additional evidence for the potential psychological depth of religious nonbelief comes from investigations of religious priming. In much recent work, researchers have used subtle experimental primes to activate religious cognition in participants (see Shariff, Willard, Andersen, & Norenzayan, 2015 for a recent meta-analysis). If atheism is only skin deep, then one would predict that even self-described atheists would nonetheless be affected by subtle experimental manipulations that make religion salient. That is, an individual who is an explicit atheist who nonetheless harbors implicit religious beliefs would be expected to react similarly to avowed believers when given subtle religious primes. However, meta-analytically, this is not the case (Shariff et al., 2015). Across 17 studies, there is no reliable evidence that subtle religious primes affect the nonreligious. Even subtle religious prods fail to reliably affect individuals who claim to not hold religious beliefs, a fact not easily accommodated by a hypothetical universal implicit theism.

Combined, these insights suggest that in some cases, explicit atheism likely does not mask a universal underlying theistic belief. At the same time, we view the potential divergence between implicit and explicit religious cognition as an exciting domain for future research. With continuing refinements to implicit measurement techniques, as well as a continuing confluence of cultural and evolutionary approaches to understanding human behavior, more and more intriguing predictions regarding religious cognition will become empirically testable.

The many origins of religious disbelief

The present research focused on the role of specific cultural learning strategies on belief in gods. However, religious beliefs are complex and multiply determined. Previous work

suggests the operation of at least four factors that influence individual variability in belief in gods (Norenzayan & Gervais, 2013). First, individual differences in the cognitive substrates (mentalizing) that intuitively support mental representation of supernatural agents predict rates of belief in gods (e.g., Norenzayan, Gervais, & Trzesniewski, 2012). Second, various motivational factors combine to support or undermine religious belief (e.g., Inglehart & Norris, 2004; Inzlicht, Tullett, & Good, 2011). Third, as highlighted in the present work, religious beliefs depend on cultural learning. Finally, individual differences in cognitive style are also important, as analytic thinking tends to reduce religious belief (e.g., Gervais & Norenzayan, 2012; Pennycook, Cheyne, Seli, Koehler, & Fugelsang, 2012; Shenhav, Rand, & Greene, 2012). Viewed in this broader context, it becomes clear that culture is important, but by no means exclusively important, for predicting individual or societal differences in religious belief. Thus, for example, intelligence may influence religiosity (e.g., M. Zuckerman, Silberman, & Hall, 2013) primarily through its effects on cognitive style, and be wholly independent of—or perhaps enhance—the influence of cultural learning. Similarly, some facets of religiosity appear modestly heritable (e.g., Waller, Kojetin, Bouchard, Lykken, & Tellegen, 1990; Winter, Kaprio, Viken, Karvonen, & Rose, 1999). The heritability of religiosity may depend on heritable differences in core intuitions (Hughes & Cutting, 1999), intelligence (though see Chabris et al., 2012), or other factors. The relative contribution of different factors to individual differences in religious beliefs still largely awaits rigorous investigation.

Coda

Religion is both cross-culturally universal and individually variable, making religion an intriguing test case for consilient models of culture, evolution, and human nature (Wilson, 1999). While the capacity to mentally represent gods appears to be a reliably developing human

universal, belief and disbelief in gods also requires cultural learning (see also Banerjee & Bloom, 2013; Geertz & Markússon, 2010; Gervais & Henrich, 2010; Gervais, et al., 2011; Lanman, 2012). In this paper, we applied models of cultural learning to existing debates in the literature regarding the role of culture in religious beliefs. We found consistent support for the hypothesis that culture matters a lot in determining belief and disbelief in gods worldwide. Further, we tried to adapt existing archival measures to the empirical study of cultural learning, using belief in gods as a test case. Humans are a cultural species, and religious beliefs are no exception. The evolution of religious belief and disbelief, we argue, can only be understood through the dual inheritance of both reliably developing cognitive biases and cognitive adaptations for cultural learning.

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