



**University of
Zurich**^{UZH}

**Zurich Open Repository and
Archive**

University of Zurich
University Library
Strickhofstrasse 39
CH-8057 Zurich
www.zora.uzh.ch

Year: 2023

Magic, Religion, and Science: Secularization Trends and Continued Coexistence

Matthews, Luke J ; Hertzog, Werner B ; Kyritsis, Thanos ; Kerber, Rose

Abstract: While multiple studies have applied cultural evolutionary perspectives to the study of religion, few studies have examined the cultural evolutionary dynamics of a more secretive but equally ubiquitous form of supernatural belief: magic. We conducted two studies, an American nationally representative survey and a comparative phylogenetic analysis of religious traditions, to test three hypothesized cultural evolutionary drivers for beliefs in magic. We find the greatest support for the hypothesis that magic is employed when it provides its users benefits that are distinct from those provided by either science or religion, some support for secularization (broadly conceived) trends applying to magic, and no evidence that innate and unavoidable features of human cognition are primary drivers of the cultural evolution of magical beliefs. We conclude by suggesting specific hypothesized benefits for magic that may account for the evolution of humanity's facultative (i.e., context-dependent) use of magical beliefs.

DOI: <https://doi.org/10.1111/jssr.12813>

Posted at the Zurich Open Repository and Archive, University of Zurich

ZORA URL: <https://doi.org/10.5167/uzh-251681>

Journal Article

Published Version



The following work is licensed under a Creative Commons: Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0) License.

Originally published at:

Matthews, Luke J; Hertzog, Werner B; Kyritsis, Thanos; Kerber, Rose (2023). Magic, Religion, and Science: Secularization Trends and Continued Coexistence. *Journal for the Scientific Study of Religion*, 62(1):5-27.

DOI: <https://doi.org/10.1111/jssr.12813>

Magic, Religion, and Science: Secularization Trends and Continued Coexistence

LUKE J. MATTHEWS

RAND Corporation, Boston, Massachusetts, USA

WERNER B. HERTZOG

Department of Social Anthropology and Cultural Studies University of Zurich, Switzerland

THANOS KYRITSIS

University of Auckland, New Zealand

ROSE KERBER

RAND Corporation, Boston, Massachusetts, USA

While multiple studies have applied cultural evolutionary perspectives to the study of religion, few studies have examined the cultural evolutionary dynamics of a more secretive but equally ubiquitous form of supernatural belief: magic. We conducted two studies, an American nationally representative survey and a comparative phylogenetic analysis of religious traditions, to test three hypothesized cultural evolutionary drivers for beliefs in magic. We find the greatest support for the hypothesis that magic is employed when it provides its users benefits that are distinct from those provided by either science or religion, some support for secularization (broadly conceived) trends applying to magic, and no evidence that innate and unavoidable features of human cognition are primary drivers of the cultural evolution of magical beliefs. We conclude by suggesting specific hypothesized benefits for magic that may account for the evolution of humanity's facultative (i.e., context-dependent) use of magical beliefs.

Keywords: *comparative, paranormal, phylogenetic, magic.*

INTRODUCTION

Multiple studies have applied a cultural evolutionary perspective to human religious behavior and belief (Bulbulia 2004, 2012; Irons 2001; Johnson 2005; Laurin et al. 2012; Matthews 2012; Matthews et al. 2013; Purzycki et al. 2016; Shaver et al. 2018; Sosis 2003, 2009; Sosis and Bressler 2003; Sosis and Ruffle 2004; Whitehouse et al. 2019, 2022). Few studies, however, have examined the cultural evolution of a less socially conspicuous form of supernatural beliefs and behavior: magic. We conducted two studies to test three hypothesized drivers for magical belief and behavior. Before describing these studies, however, it is necessary first to define magic, and especially important to delimit it from other forms of supernatural beliefs/behaviors that characterize religion.

Acknowledgments: Luke Matthews would like to thank RAND researchers Katherine Carman, Jennifer Kavanagh, and Andrew Parker for their input during the development of the magical thinking survey questions. This research was supported by RAND's internal investments in studies on Truth Decay and by Royal Society of New Zealand Marsden Fund grant (#3721245 20-UOA-123).

Correspondence should be addressed to Luke J. Matthews, RAND Corporation, Boston office, 20 Park Plaza, Suite 920, Boston, MA 02116. E-mail: lmatthew@rand.org

Journal for the Scientific Study of Religion (2023) 62(1):5–27

© 2022 The Authors. *Journal for the Scientific Study of Religion* published by Wiley Periodicals LLC on behalf of Society for the Scientific Study of Religion.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

Working definition for magic

Magic and religion both invoke the supernatural. They can be distinguished by several qualitatively distinct features, including (1) magic promises immediate rewards observable in this life, whereas religion generally promises unobservable rewards in a later life or nonempirical metaphysical realm; and (2) magic purports to work through the manipulation of impersonal forces (e.g., Mana) or the compulsion of personal forces whom the magician controls (e.g., imps, demons), whereas religion purports to work through supplication to gods who are more powerful than the supplicant and who can, and often do, refuse requests (Rosengren and French 2013; Stark 2008).

The above distinctions between magic and religion are conceptual. As Durkheim recognized, magic and religion can overlap empirically in complex ways, and many organized religions accept some degree of magical beliefs and practices within their canons (Durkheim, 1995:39–44). However, the occasional acceptance of magic does not obviate the conceptual difference between magical processes and the processes with *metaphysical* outcomes that constitute most religious beliefs. Although scholars may disagree on how precisely to delimit magic from religion, Durkheim's contemporaries, such as Mauss and Hubert, accepted Durkheim's fundamental distinction that magic functions as an instrumental manipulation of the sacred to obtain material ends, whereas religion focuses on noninstrumental interaction with the sacred through public rituals (Belier 1995). Anthropologists have often more attributed the conceptual distinction of magical and metaphysical foci in the supernatural to Frazer and have variously critiqued exactly how to express this dichotomy, but nevertheless basically accept the Frazer/Durkheim concept (Evans-Pritchard 1965; Malinowski 1931; Titiev 1960). The broad outlines of Durkheim's distinction between magic and [metaphysical] religion, which are still widely accepted, shall be sufficient for the working definition needed for the present study.

In this article, however, we will render the Durkheimian distinction more verbally clean by referring, whenever idiomatic, to magic and *metaphysical* religion. Durkheim would have used "religion" for the latter meaning, but this does create confusion since even Durkheim admitted that sometimes organized religions practice forms of magic. Since it seems obtuse to state that religion is not religion, we will adopt a more precise verbal formulation of Durkheim's meaning. Clarifying the distinction between magic and metaphysical religions, which might also be phrased appropriately as magical supernaturalism and metaphysical supernaturalism, also can help us study how these phenomena interact empirically even as they remain distinct conceptually. For example, Mestrović (1985) argued that magic was sinful specifically because it comingles the sacred transcendent reality with the profane observable world, and this comingling causes Durkheimian anomie. The pathological anomic effects of magic, according to Mestrović (1985), result from the conceptual distinction of magic and metaphysical religion, which he contended results in pathology when the two are blended as an empirical fact. Mestrović (1985) accepted evidence from O'Keefe (1982) that magic is actually relative common among modern people; hence the modern anomie.

Bloch (1998) again accepted Durkheim's conceptual distinction, but arrived at a novel conclusion in contrast to Durkheim's contention that magic never results in building up community. In his study, Bloch (1998), contended that "alternative spiritualists" use magic as one form of nonconformity to traditional Western religion (especially Christianity), and that socially shared nonconformity (including magic and other nonconformist features) then becomes a new way of creating community. Bloch (1998), however, still accepted that the magic of alternative spiritualists was also oriented toward achieving practical effects in the material world (as Durheim said), because without this feature it would fail to *nonconform* with the primarily metaphysical supernaturalism of the religion alternative spiritualists react against (Christianity). Thus, while Bloch identified a particular case of magic being used to create community, this case can occur only

in the context of Bloch accepting Durkheim's general point that most traditional religion was metaphysically rather than magically focused.

The key difference in metaphysical versus practical foci account for why religion, through its metaphysical supernaturalism, generally is inherently social, operates in the public eye, and importantly is *resistant to empirical refutation* (Durkheim 1995; Stark 2001). Religionists mostly take actions here and now (e.g., they follow moral rules, conduct rituals) to manipulate an unobserved reality at a future time (e.g., the afterlife) or contemporaneous but metaphysical plane of existence (e.g., a person's relatives in purgatory) (Durkheim 1995). Magic practitioners, in contrast, act here and now (e.g., rituals) to manipulate a metaphysical reality that feeds back to a timeframe that is meant to be observable and obtain something practical (e.g., love, fortune, vengeance). Importantly, magic practitioners do not claim to understand the causal mechanisms of their magic. In fact, across cultures magic is seen as a form of out-of-the-ordinary causation (Rosengren and French 2013). The magic practitioner aims to attain some material gain by employing causal pathways that are mysterious even to them (Rosengren and French 2013). Unlike a scientist, a magician does not seek to explain how or why magic works.

As a result of this combination of features, magic, as compared to metaphysical religion, tends to be transactional between the magician and the consumer and to be conducted in secret because it is subject to a greater potential for empirical refutation than is religion (Stark 2001). This pattern appears to be true even in magic sanctioned by various religions. For example, exorcisms, relics, and fortune-telling often are used in a highly personal and private manner. While some metaphysically focused religious acts are conducted similarly in private (e.g., Confession in the Catholic church), social scientists have noted for over a century that religious practices tend to be more public than magical ones (Durkheim 1995). We accept that this is not a hard and fast rule, but we think even the already noted exceptions to this tendency (Mestrovic 1985; Bloch 1998), support the consensus of scholarship that magic and metaphysical religion tend to differ in the manner Durkheim described.

Another cross-cultural observation about magic is helpful in defining the phenomenon. Across cultures, magic typically invokes two putative supernatural processes, contagion and similarity. Contagion means that what is physically or morally unclean/holy will spread its uncleanness/holiness to other things/people in contact (both Nemeroff and Rozin (1994) and Rosengren and French (2013) offer as an example that imagining wearing Adolf Hitler's sweater is physically repulsive). Similarity means items that are aligned in form are supernaturally connected such that changes in one item change the other item (e.g., voodoo doll) (Rosengren and French 2013).

Theories explaining the cultural evolution of magic

Having reviewed at least a portion of the literature that seeks to delimit what magic is conceptually and how it articulates with metaphysical religion, we turn now to theories for why people engage in magic, and what that engagement has to do (or not) with religion. Prominent theories are three:

Unilineal Evolution/Secularization (Tylor 1871): Magic is an evolutionary precursor to organized religion, which intellectualized human supernatural speculations and replaced magic. The continuance of magic after religion is a survival of the past, like the rare continuance of an extant species that has a highly ancient physical form (e.g., horseshoe crabs). Science then replaces metaphysical religion by joining intellectualism with empirical observations (Gellner 1989). Some theorists have proposed another phase between metaphysical religion and science that focuses on abstract metaphysical principles (e.g., utilitarianism, Kantianism) that were secular (i.e., nonsupernatural) but nonempirical (Dennett 1995). Secularization theory from the sociology of religion can be viewed as the most recent (usually post-19th century) transition from a religious to a scientific worldview within this broader and more ancient unilineal evolutionism

context. While portions of this sequential theory of magic were developed by Frazer (1894), it was Tylor who first articulated the detailed sequence. Modern studies of secularization, particularly common in sociology, can be viewed as investigations of the most recent episode of the overarching cultural evolutionary process that Tylor described (Brauer 2018; Kosmin and Keysar 2009; Pew Research Center 2015; Ruck, Bentley, and Lawson 2018)

As described below, we conducted the present study within the modern American secularization context and through a comparative cross-cultural analysis whose time depth goes to the origins of institutional religions. Our current research tests hypotheses derived from Tylor's theory and competing ideas (described below) in this postinstitutional religion context. We note that the exact point at which institutional religions became the most typical context for human religious behavior is debated, with the original Axial Age hypothesis of Jaspers placing its evolution as recently as 3000 years before the present (Jaspers 1953), and some recent scholars pushing institutional religions back to as far as 12,000 years before present (Norenzayan et al. 2016). Regardless of precisely when it happened, institutionalized religions have been the context for most of humanity's religious experiences for the past several thousands of years, but it is solely in this context that we tested the competing hypotheses. Our hypothesis tests might not generalize to noninstitutional religious contexts that would have characterized most of human evolutionary history before the rise of institutional religions but that today are observed only among a relatively small set of human cultures.

It is important to note that, although Tylor did not properly frame his ideas about evolutionary trends within Darwinian mechanisms, unilineal trends can arise from Darwinian processes in evolutionary biology. Pagel, O'Donovan and Meade (2022) documented unilineal trends, for example, steadily increasing body size, in hundreds of measured traits on a genetic tree of living mammals. A different research group demonstrated unilineal trends in some of the same features among living cephalopods (Ibañez et al. 2021). Darwinian mechanisms can produce these types of trends because the day-to-day ratchet of natural selection can still stack up to net unilineal effects. For example, if larger bodied individuals of a species are better able to range over territory, defend against predators, obtain mates, or gestate offspring to term/lay more eggs, then over time selection will gradually ratchet up body size. Dynamics of precisely this sort were documented by Currie and Mace (2011) regarding the evolution of political complexity, which exhibits strong unilineal trends over long periods that emerge from day-to-day interactions within polities.

A separate matter is that Tylor, and his contemporaries like Frazer, often read moral meaning into these trends, such that they interpreted cultures further down a trend line as normatively "better" or more morally evolved in some sense. We have no opinion about these normative matters in this study, as we regard them as irrelevant to the scientific and empirical issue of whether magic exhibits unilineal trends in its evolution over time.

Distinct Markets (Stark 2001): This theory takes an economic markets perspective to propose that there is no necessary unilineal evolution among magic, metaphysical religion, and science, because each provides distinct goods to consumers. The goods provided by magic, metaphysical religion, and science, are theorized to be distinct such that none of these three can fully satisfy the needs of human consumers, who have separate needs for, and uses of, magic, religion, and science. Magic provides the promise of control and rewards in this life that cannot be attained through science. Metaphysical religion provides rewards in a non-empirical realm that cannot be accessed through science. The distinct markets theory suggests all these systems will continue to exist without any necessary relationship to each other in terms of correlations in their use by consumers. Consumers will use whichever provider is most appropriate to their needs at a time. This theory also predicts that over time religions will eliminate magical features (but not metaphysical ones) because the magical features needlessly expose the religion to potential empirical refutation in a way that metaphysical claims do not because the latter are inaccessible to scientific observation. Both magical and metaphysical claims can invoke the supernatural, but magic is potentially refutable, whereas metaphysics is not.

Evolved Tendencies (Barrett 1999; Boyer 2003): This theory proposes that magical thinking is a by-product of evolved cognitive predispositions. The theorized mechanism is that human cognition is constrained by innate evolved tendencies that act as attractors for the cultural evolution of supernatural beliefs: to include both magic and metaphysical religion. Because belief in magic or the gods were in the evolutionary past, most people irrevocably inherit tendencies to think in these ways. Thus, magical thinking has been explained as a by-product of hard-wired cognitive systems for managing contagion, pollution, and risk (Boyer 2003). In general, the Evolved Tendencies theory predicts that magic and metaphysical religion will continually reassert themselves within human culture even if they logically conflict with organized atheism or newer epistemologies like science (Boyer 2008).

It is worth noting that the Evolved Tendencies theory purports to explain how and why cultures have certain recurring features. It is trivial to assert that humans, as individuals and as a species, have evolved cognitive tendencies. It is not controversial at this point to assert that human cognition is not a complete *tabula rasa*. What is in question, however, is the extent to which innate cognitive tendencies stabilize cultural norms over multigenerational cultural-evolutionary time. It is this latter hypothesis we sought to test among our research hypotheses (i.e., we did not investigate whether humans have innate cognitive tendencies—we assume they do).

Conspiracy Theories as Secular Magic: In addition to using magical thinking items derived from prior studies of traditional supernatural magic, we also considered the possibility that magical thinking might show up in apparently secular ways by substituting conspiracy beliefs as an outcome in the place of magic in our regression models. Our logic was that many conspiracy beliefs shared aspects of cognition in common with magic and religion. Conspiracy theories have religious aspects in that they postulate that events arise from agents (conspirators) whose actions are hidden to prevent empirical verification of their activities or even their existence (e.g., the “deep state”). Conspiracy theorizing also involve seeing causal connections between events separated in space and time but that are similar in quality (magical similarity) or connected by shared corrupt interests (magical contagion). Prior empirical research also has supported that magical thinking and conspiracy beliefs appear to be correlated forms of cognition (Brotherton and French 2014; Bryden et al. 2018; Eckblad and Chapman 1983). Conspiracy theories therefore seemed a complementary lense to magical thinking because they might show more robust patterns that would sidestep any generic effects of secularization whereby people rule out supernatural causation, but then engage in the same types of causal reasoning in a secular manner (i.e., conspiracy theorizing).

Tests of Theory

We conducted two studies to operationalize and test hypotheses derived from the three theories of magic from Tylor, Stark, and Barret/Boyer.

- Study 1 examined correlations among survey items related to magic, religion, and science within a nationally representative sample of American adults. We also examined beliefs in conspiracy theories as another magic-like outcome that is more secular in content. Prior research has supported that conspiracy theories appear to utilize magical forms of cognition that “see” connections between otherwise disconnected events (Brotherton and French 2014; Bryden et al. 2018; Eckblad and Chapman 1983). By replacing magic with conspiracy theories as the outcome in our models, we sought to assess whether the predicted patterns from the three theories might be more robust for a magic-like outcome that is not overtly supernatural. This seemed relevant to test given the context that contemporary America exists postscientific revolution and is known to be experiencing secularization generally speaking (Brauer 2018).
- Study 2 coded magical traits for major world religions to assess how magic and institutional religion most likely changed with respect to each other since the rise of the current World

religions. We did this by mapping traits onto a global religion tree that was based on known historical events.

METHODS

Study 1

Sample

In study 1, we invited 1626 individuals from the RAND American Life Panel (ALP) to take our survey, of which 1333 completed the survey (81.9 percent completion rate). The ALP is a nationally representative survey panel of American adults who are retained in the panel over multiple years. Because basic demographic data can be collected only once and then shared across multiple surveys for the same individual, more detailed question sets can be fielded to the panel than often allowable in research designs that impanel new subjects for each survey. The original purpose of the survey study was to examine how variation across individuals in susceptibility to cognitive biases was associated with their susceptibility to common forms of misinformation (Matthews et al. 2022). As part of that study, we developed and fielded a seven-item magical reasoning instrument.

Survey Item Development

We based the seven magical reasoning survey items in our survey on previous similar scales developed by psychologists and modified some items based on the ethnographic evidence for contagion and similarity as being common assumptions of magical reasoning across many cultures (Eckblad and Chapman 1983; Kingdon, Egan, and Rees 2012; Rosengren and French 2013). Prior psychometric research supported that magical reasoning is distinct from, and largely uncorrelated with, traditional Western religious beliefs such as belief in God, angels, or intercessory prayer (Kingdon, Egan, and Rees 2012). Thus, our magical reasoning items did not include these concepts. We did ask separately about religious denominational affiliation and frequency of worship service attendance, which are the traditional way to ask these questions in sociological survey research (General Social Survey 2018). We also accepted prior critiques by Kingdon, Egan, and Rees (2012) that magical reasoning scales should not include items that are directly indicative of psychopathic breaks with an individual's perception of reality (e.g., schizophrenia), which excluded some prior items from Eckblad and Chapman (1983) magical reasoning scale.

Statistical Analysis and Operationalization of Theory

We applied unrotated principal components analysis (PCA) to the magical reasoning items (with `prcomp` function in base R). During PCA, we scaled the original Likert variables to all have a unit variance, which means that the variables were all equally weighted in the PCA. Without scaling, Likert responses with a larger empirical variance would have effectively had more weight to determine the first principal component (PC1). The PC1 from this analysis expresses the maximum variance across all the original items. We modeled scores on this item as an outcome variable in a regression model with predictors we selected to test the three theories outlined in the Introduction. We fitted all regressions for Study 1 using the `lm` function in base R.

PCA is a statistical technique invented by Karl Pearson at roughly the same time as when Charles Spearman invented factor analysis. Although these techniques result in similar outputs, their intent and underlying mathematical mechanisms differ in important ways (Jolliffe 2002). PCA always maximizes as much of the original variation on the PC1, which makes it particularly useful as a data reduction technique. We sought to represent the variation in our original survey questions as much as possible with a single outcome variable so that we could use straightforward

regressions in our hypothesis tests. The PCA is simply a way to do that. Compared to just summing or averaging the original magic or conspiracy items, using PC1 from the PCA means we would remove variation from individual questions that loaded much less strongly than others on PC1. This makes sense because it guards against the possibility that we might have erroneously included a question that does not relate to the others; PCA eliminates the variation in such questions from the outcome we modeled in a regression.

In contrast, most implementations of factor analysis seek not just to reduce the data to one or a few descriptor variables but to test a hypothesis about how many “latent” variables underly the observed variables. Thus, factor analysis specifies one or more sets of N latent factors and then tests the fit of different numbers of latent factors against one another. Factors typically are “rotated” in order to maximally load variables on a single factor and not on others. This rotation reduces the amount of the original variation described by the first factor and increases the observed loadings of variables on factors. Practitioners of factor analysis then commonly discard variables from factors if their loading is below some conventional threshold. Unrotated PCA, in contrast, always produces as many principal components as original variables, with each component maximally expressing the joint variations in the original variables that are not expressed by the prior components. Because this is the only optimality criterion in PCA, the loadings of variables on PCs frequently are lower than the loadings of the same variables on the factors of a factor analysis. Although it would be possible to conduct an exploratory factor analysis without rotation and with the number of factors set equal to the number of variables minus one, doing this would simply converge on the PCA solution (Jolliffe 2002). We did not have hypotheses about any multiple-factor latent structures underlying magic or conspiracy thinking; we sought just to maximally express the variation among our items in single outcome variables if possible. It is, for this reason, that we opted for unrotated PCA rather than factor analysis.

Unilineal Evolution / Secularization: This hypothesis predicts that individuals in a cross-sectional sample will believe in magic less if they have greater formal education and greater scientific reasoning ability. This is because the hypothesized mechanism, at the individual level, of the unilineal secularization trend was proposed by Edward Tylor to be greater rational reflectivity in cognition by individuals brought about by education and science. We measured education with a standard question about level of degree attainment and measured scientific reasoning with a published scale based on puzzle questions that had been validated previously to reflect an acceptance of scientific consensus (Drummond and Fischhoff 2017). These questions were not about acceptance of scientific consensus but rather about scientific reasoning (e.g., if a radio works in a cold room with a light but not in a warm room without a light, can you determine whether light or heat affects the radio’s functioning?).

The unilineal evolution/secularization theory also proposes a three-stage evolutionary sequence whereby magic is followed by metaphysical religion which is followed by science. This emergent pattern across societies also predicts that within religiously variable societies, like 21st-century America, individuals who are less religious and those without religious affiliation would exhibit less magical reasoning. We measured religiousness as worship service attendance and measured denominational affiliation using survey questions that were simplified versions of the General Social Survey questions for these items (General Social Survey 2018). We provide the full survey in the data supplement.

Distinct Markets: This hypothesis predicts that magical reasoning will have no particular association with formal education, scientific reasoning, or religiosity and religious affiliation. Science, metaphysical religion, and magic all provide different kinds of benefits to the consumer; goods that need not have any particular relation among them. According to this theory, the benefits of magic are the putative attainment of worldly goods (e.g., money, love, and social status) for those who cannot attain them through direct material causation (i.e., through science or otherwise “rational” economic interactions). Thus, the distinct markets hypothesis predicts that individuals with lower income will exhibit greater magical thinking. It likewise predicts that minorities will

exhibit more magical thinking to the extent that being non-White in America presents barriers to attaining material goods in a way not reflected by income. Relatedly, the structurally-similar prediction could be made for women in America as they remain a disadvantaged group when compared to men.

Evolved Tendencies: If one assumes that cognitive tendencies to magical thinking are invariant across the human species, this hypothesis predicts that less religious individuals will have greater magical reasoning, which directly contrasts with the prediction of unilineal evolution. The Evolved Tendencies hypothesis agrees with unilineal evolution that magic and religion are inter-related. However, it proposes that when individuals or societies attempt to purify themselves of overt supernatural thinking (e.g., metaphysical religion), magic creeps back as human cognitive biases tend to select supernatural beliefs and practices over secular ones. If all humans share the same innate tendencies to supernatural thinking, but some human cultures disallow expression of this tendency through metaphysical religion, then these are the humans we would expect to find another outlet (like magic) for their innate supernatural thinking tendencies. This predicts that individuals with less worship service attendance and without religious affiliation would engage in more magical thinking.

Alternatively, one could assume cognitive tendencies to magic and religion vary significantly across individuals, in which case the Evolved Tendencies hypothesis would predict that more religious individuals would express more magical thinking, assuming these are somehow driven by linked cognitive mechanisms. This prediction is identical to that of the unilineal evolution hypothesis.

Conspiracy Theories

We think the conspiracy theory outcome fits the same predictions for each hypothesis described above for magical thinking because the hypothesis is that modern-day conspiracy theories are a secular manner by which magical cognitions are triggered. If this hypothesis is true, then conspiracy theories should share similar relationships to the predictors as do magical thinking items. We operationalized conspiracy thinking through a five-item set of survey questions used in prior conspiracy belief research (Gidengil et al. 2019; Lewandowsky, Gignac, and Oberauer 2013; Matthews et al. 2022; Nowak et al. 2020), which we processed through an unrotated principal component analysis in the same manner as we did independently for the magical thinking items.

Study 2

Construction of an Evolutionary Tree for Religions

In Study 2, we tested predictions from the three theories over long periods of cultural evolutionary time by mapping magical traits onto a global tree of religious groups. The tree reflects the splitting of groups from each other based on historical dates. Full references for the dates are provided in the Supplement. The global religion tree is characterized mainly by splitting of groups. Still, in a few notable cases there are clear hybridization events in which a denomination arises from the joining of two others. The evolution of Sikhism from a combination of Islam and Hinduism is one of the clearest examples of such hybridization. We accommodated these hybridization events by creating tree structures for every combination of relevant branches and then averaging results from analyses across all the trees.

We shall note that the phylogenetic approach we adopted is fairly standard within biological and cultural evolutionary studies. Although culture does not always follow a bifurcating pattern in which two descendent “species” arise from a single ancestor, neither does biology. Many biological systems are studied routinely with phylogenetic methods even when they exhibit significant hybridization dynamics or asexual reproduction (Felsenstein 1985). Culture is not different. Although some anthropologists in the past contended that horizontal cultural admixture would

obliterate cultural inheritance dynamics, many empirical and simulation studies have shown this to be untrue, at least for many real-world cultural systems (Collard, Shennan, and Tehrani 2006; Greenhill, Currie, and Gray 2009; Matthews et al. 2011; Nunn et al. 2010). More simply, the obvious continuance over hundreds and thousands of years of religious traditions suggests that at least sometimes phylogenetic models could be appropriate. We describe below how we explicitly incorporated hybridization events into our religion trees, and the statistical techniques we used all zero out the tree parameters in the models if the trees prove to not predict the variation in the outcome variable.

Another standard methodological choice in our study was to use only extant (currently existing) religions as our data because these can all be observed equally well. Phylogenetic reconstruction biology (inference of tree structures and patterns of variables on those structures) does not rely on the fossil record (Felsenstein 1985; Grafen 1989; Nunn 2011). Modern biological trees are based primarily on DNA evidence from extant species only. The fossil record serves to inform the timing of branching events. Analogously, our trees used historical documentation in the place of fossils to inform the timing of branching events. Comparative methods that model how traits evolve over trees can use only extant data, only fossil data, or a combination of both, because once the tree structures are made, they provide a nesting pattern that can be used to test statistical patterns expected at many levels within the overall tree (Felsenstein 1985; Nunn 2011).

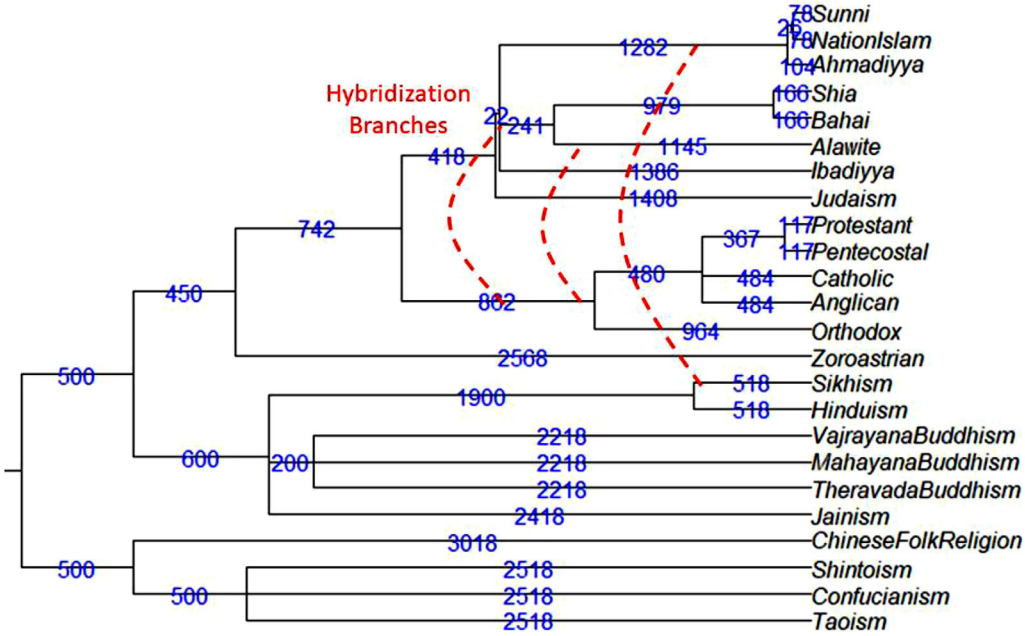
In constructing a tree, one must decide how much to split up religious groups or lump them together. We opted to use groups that are sometimes called “denominational families” for the tips of our tree (The ARDA: Family Trees for American Religions 2020). These families are groups like “Baptist,” “Hindu,” and are how most religious adherents typically self-identify when asked the open-ended question “what is your religion?” (Kosmin and Keysar, 2006, 2009). Other researchers have split religious groups to a much greater degree and arrived at classification schemes that involve thousands of groups. This approach is crucial for research on religious demographics and especially in terms of which particular congregations are gaining or losing members and influence across countries. However, for our purposes of characterizing religious practices and their evolution, such fine divisions of religious groups are counterproductive. Shared practices are central to the way religions unify otherwise unconnected and anonymous people into a community (Matthews 2012; Whitehouse et al. 2019, 2022), and people generally conceive of themselves as experiencing shared identity with others in the same denominational family rather than only feeling religious identity at the level of congregations (Kosmin and Keysar 2006).

Our only divergence from the approach just described was to lump together groups that see each other as distinct when some of the required predictor variables were available only for a higher-level grouping. This occurred only for the Mainline Protestant denominations (Lutheran, Methodist, Baptist, and Presbyterian), which we grouped together as a taxon *Protestant* because their percentage frequency across countries was available only in aggregate. The tree that resulted from this process is shown in Figure 1, and detailed notes and references that support each branching date are in the Supplement.

Coding Magical Features of Religion

By analyzing the distribution of magical practices on the global religion tree we were able to test predictions derived from each of the three hypotheses (see below). We developed a set of magical features of religion by reviewing the same literature already discussed on magical thinking, but within the context of features that are overt characteristics of religious groups. In Study 2, we were interested in how magical features evolve as sanctioned practices within religious cultural traditions. We note that many people within these traditions might engage in other magical practices that are not sanctioned, but in this study we were trying specifically to test hypotheses about how sanctioned forms of magic evolved over religious phylogenies. With this goal in mind, we defined six magical features that we were able to code reliably for presence or absence across all the religious groups we studied (Table 1). The references from which we coded the six magical features of religion are provided in the Supplement.

Figure 1
Global phylogenetic tree of contemporary religious groups
[Color figure can be viewed at wileyonlinelibrary.com]



Note: Branch lengths show years.

Statistical Analyses and Operationalization of Theory

Unilineal Evolution / Secularization: This hypothesis predicts that religions will become less magical over cultural-evolutionary time because religious adherents and ecclesia will reflect on the tradition and remove magical elements as they become more secular. It further predicts that less magical religions will be more widespread across countries because over time cultures evolve to be more secular and so will disbelieve magical practices. We operationalized these hypotheses with a phylogenetic regression model that regressed the summed number of magical features as the outcome of the number of branching events that lead to each religious group and the number of countries in which it was a majority religion (i.e., >50 percent of the country’s population are adherents). We obtained religious group frequencies from the compiled data across multiple sources that is supplied by the Association of Religion Data Archives (n.d.). We used branching events as our measure of cultural evolutionary time because prior research on similar features of religion showed that these features tend to evolve in a punctuated manner at schism events (Matthews 2012). As a robustness check, we repeated the regressions with prevalence of the religions being measured as the number of countries in which they were >5 percent of adherents, as this would indicate they are at least a substantial minority group in those countries.

Regressions that use data from phylogenetic trees exhibit a statistical violation termed phylogenetic autocorrelation. This is a form of data point nonindependence such that the values of the data cannot be regarded as having been drawn independently from each other from a statistical distribution. Consider for example the critical value in our regressions of the number of religious schisms leading to a contemporaneous religious group. The count of schisms for Catholic and Protestant Christians is highly statistically nonindependent, because that count reflects almost all the same schism events. The count of schism for Catholics is much more statistically independent, however, as compared to the count of schisms for Jainism, as these two groups share very little institutional religious history in common.

Table 1: Religious features coded across a global phylogeny of religious groups

Theme	Definition
Divination	Practices that find or predict unseen or future events through supernatural means. Such practices can include use of dice or casting stones, reading natural signs in the stars (astrology), or birds (ornithomancy), or use of spirits as mediums.
Prayer of petition	Asking the gods to effect a healing or effect some other positive outcome.
Relics	Artifacts that are purported to heal or grant other effects through supernatural means. Such artifacts could be any tool, a cup, a sword, or body parts of an animal or person (e.g., bones of a saint), or a talisman.
Exorcism	Ritual that removes a malevolent or unwanted case of spirit possession from a person, place, animal, and so forth.
Positive possession	A desired and positive possessing of a person by a spirit, usually temporary. Examples include being “slain in the [Holy] Spirit,” speaking in tongues, possession by ancestor spirits.
Siddhi	Supernatural powers attained through intense practice of asceticism, meditation/yoga, and/or religious devotion. These powers are feats, they do not heal or achieve practical ends but instead are impressive displays. Examples include supernatural levitation, extending one’s conscious awareness away from the physical body (astral projection), handling of snakes or drinking their venom without harm.

Fortunately, there exists an extensive literature on how to statistically correct for the nonindependence that is introduced into regression by tree structures (Felsenstein 1985; Grafen 1989; Pagel 1999). While these statistical techniques were developed from within evolutionary biology, they have been widely adapted to cultural data in contexts when a tree structure makes sense theoretically (for a review, see Matthews 2012). We utilized an up-to-date implementation of phylogenetic regression procedures that employed Pagel’s scaling parameter *lambda*. The *lambda* parameter allows the regression to reduce to an ordinary regression in the case that there is no observed phylogenetic autocorrelation in the fitted model’s residuals, which could occur even if individual variables like number of schisms are autocorrelated. Ultimately it is only the residuals that need correcting to deal with data nonindependence (Rohlf 2006). We employed an up-to-date implementation of this model available in the *phylolm* package for R (Tung Ho & Ané, 2014).

Distinct Markets: Like Unilineal Evolution/Secularization, this hypothesis predicts that religions will become less magical, but it makes this prediction for different reasons. Stark (2001) articulated that religions might be expected to become less magical over time because magic, being at least somewhat verifiable, exposes a religion to the potential of empirical refutation. Since he contended religion and magic provided distinct and separable goods to consumers, Stark proposed that this risk of empirical refutation posed by magic was without any intrinsic benefit to the organized religions, which could rely on metaphysical claims about the supernatural to provide their primary benefits to consumers. He did not specify the social mechanism by which this cost/benefit trade-off would be optimized. We propose such an optimization could arise from (1) religious leaders realizing the risks posed by magic and acting to suppress it, or (2) more magical

religions being refuted, losing believers, and resulting via cultural group selection in a tendency for less magical religions to become more common over cultural-evolutionary timescales.

Because the distinct markets theory does not make different phylogenetic predictions from unilineal evolution/secularization, Study 2 does not test these theories against each other. They are strongly contrasted, however, in Study 1. We designed Study 2 primary to test hypotheses from the Evolved Tendencies theory.

Evolved Tendencies: Testing contrastive predictions of the Evolved Tendencies hypothesis was a prime motivator for us to conduct Study 2, as Study 1 did not distinguish this hypothesis well from the unilineal evolution hypothesis. In Study 2, the distinction is clear: if evolved magical/supernatural thinking tendencies drive the evolution of cultural forms, then religions should not become less magical over time. Even if religious leaders attempt to purge a religion of its magic, the hypothesis proposes that cognitive tendencies will drive the cultural evolutionary train. As such, the Evolved Tendencies hypothesis predicts that religions either become more magical over time or evolve around an optimal level of magical thinking that is far from zero. Evolved tendencies also predicts that more magical religions will be more widespread across countries because they more effectively engage with the evolved cognitive biases that induce people to participate in religion (i.e., it is the cognitive tendencies that drive human cultural expression, and people have the evolved tendency to like magic).

We tested the Evolved Tendencies hypothesis through the same phylogenetic regression as described for the unilineal evolution hypothesis. We also fitted an Ornstein-Uhlenbeck (OU) model for evolution on the religion tree that would be centered on an optimal level of magicalness and compared the Akaike Information Criterion (AIC) value for this model to that of a white noise model for no phylogenetic signal and to a Brownian motion model of straightforward inheritance of the trait on the branches of the phylogenetic tree. A lower AIC value for the OU model as compared to both the white noise and Brownian models would have supported the Evolved Tendencies hypothesis. We implemented these tests with the *phylolm* R package (Tung Ho and Ané 2014).

RESULTS

Study 1, Analyses

The magic and conspiracy beliefs PCAs both exhibited all the survey items loading in the same direction on the PC1, which substantially exceeded the other components in terms of percentage of variance for both sets of items (Magic: PC1 = 34 percent, PC2 = 15 percent, PC3 = 12 percent, PC4 = 12 percent, PC5 = 10 percent, PC6 = 9 percent, PC7 = 8 percent, eigenvalues = 2.5, 1.1, 0.83, 0.78, 0.68, 0.57, 0.56; Conspiracies: PC1 = 48 percent, PC2 = 23 percent, PC3 = 15 percent, PC4 = 9 percent, PC5 = 6 percent, eigenvalues = 5.7, 2.7, 1.8, 1.0, 0.76; Table 2). This led us to analyze the scores of individuals on only the PC1 derived from each of the PCA for magic and for conspiracies.

Using the PC1 scores from these PCAs as our operationalizations of the outcome variables, we found support for both Unilineal Evolution and Distinct Markets in multiple linear regression models (Table 3). We converted the original Magic and Conspiracies PC1 scores into z-scores (i.e., rescaled to have a mean of zero and standard deviation of 1) so that the coefficients are interpretable as each variables association with a one standard deviation change in either outcome. Consistent with the predictions of Unilineal Evolution, we find that individuals with no religion, agnostics, and atheists all exhibit less magical reasoning than do individuals affiliated with a religion. Among the religious affiliates there are no differences across denominations in magical reasoning. Also as predicted by this theory, greater scientific reasoning is associated with less magical reasoning (by about 1/10th of a standard deviation in the outcome). We do not find the

Table 2: Loadings for survey items on separate magical thinking and conspiracy beliefs principal component analyses

Survey question	Mean on 0–6 disagree to agree scale	Loading on magical thinking PC1	Survey question	Mean on 0–6 disagree to agree scale	Loading on conspiracy beliefs PC1
I have a little ritual or superstition I do for my favorite sports team, like wearing a certain shirt or sitting in a particular chair.	1.3	0.28	The U.S. government caused or let the 9/11 attack happen on purpose.	1.14	0.46
Sometimes there can be connections between everyday events that we don't fully understand.	3.7	0.38	Barack Obama was not born in the United States.	1.43	0.51
I would feel uncomfortable buying a house where a murder had occurred.	3.1	0.34	At least some moon landings didn't actually happen and were instead faked productions in Hollywood.	0.74	0.35
I avoid thinking or saying things that I think might jinx an outcome I want.	2.2	0.42	The assassination of John F. Kennedy was part of a larger conspiracy.	2.53	0.59
Some ancient peoples may have known secrets about the universe that we don't know today.	3.1	0.39	[Tupac/Elvis] is not actually dead, and is still seen periodically in the United States.	0.57	0.25
I think sometimes things really happen for a reason.	3.9	0.43			
I have sometimes sensed an evil presence in a specific place where I was, like a particular room in a house.	1.7	0.37			

Table 3: Results from multiple linear regression of magical and conspiracy beliefs on predictor variables

	Magic PC1, z-score	Conspiracies PC1, z-score
Age	-0.01***	-0.01*
Woman	0.15**	-0.11*
Less than high school	-0.37	0.34
Some college	0.003	-0.11
College	-0.12	-0.10
Income midpoint/10,000	-0.01	-0.01*
Race- Black, non-Hispanic ($N = 81$)	0.41***	0.31**
Race-Hispanic ($N = 148$)	0.17	0.34***
Race-Asian ($N = 33$)	0.12	0.07
Race-Other ($N = 26$)	0.14	0.28
Mainline Protestant	0.05	-0.05
Evangelical or Pentecostal	0.09	-0.02
Nondenominational Christian	-0.04	0.06
Other Christian groups	-0.20	-0.24
Jewish	-0.27	-0.004
Other religions	-0.02	0.37*
No religious affiliation	-0.43***	-0.09
Atheist or Agnostic	-0.83***	-0.23*
Religious service attendance	-0.02	0.04
Scientific reasoning	-0.12***	-0.02
Constant	1.09***	0.47*
N individuals	1319	1315
R^2	.19	.06
Adjusted R^2	.17	.05
F -statistic ($df = 20; 1298$)	14.84***	4.29*** ($df = 20; 1294$)

Note: Data available to researchers via request to the American Life Panel (<https://www.rand.org/research/data/alp.html>). Base levels: Male, High School, Race-White, non-Hispanic, Catholic. Responses of "unsure" have been recoded as the mean of an individual's responses to related questions for Magic and Conspiracies.

* $p < .05$, ** $p < .01$, *** $p < .001$

predicted association, however, for religiosity and magical reasoning; that is, worship service attendance appears to have no relationship whatsoever with magical reasoning (Table 3).

The lack of a relationship with service attendance is consistent with the Distinct Markets view that magic and religion are providing different types of goods. We find other support for this hypothesis because women and Black Americans exhibit greater magical reasoning after controlling for income, education, and scientific reasoning ability. These results are likely the outcome of differential opportunity structures available to women and Black Americans. It has been shown that participation in religious groups can covary with opportunity structures. For instance, Ebaugh (1993) found that woman religious orders in Catholicism declined in countries where women's secular opportunity increased. The decline in woman religious orders, thus, shows that religious organizations can play a role in enhancing women's social mobility in places where opportunities for women are restricted. Once structural restrictions are removed, such religious organizations may cease to be relevant and decline. Our results indicate that a similar dynamics

plays a role in determining magical beliefs: people with less opportunity are more likely to resort to magic to overcome those structural limitations.

It is important to notice that our results are not saying women or Black Americans think less well than do White men. In fact, the regressions control for both educational level and a performance assessment of scientific reasoning ability; thus, they indicate that after controlling for education and scientific reasoning, women and Black Americans engage in more magical reasoning. This is consistent with the Distinct Markets view that peoples' use of magical reasoning is in response to their relative social opportunities rather than anything about cognitive functioning *per se*. In other words, because structural opportunity for women and Black Americans remains restricted relative to White males in American society, the distinct markets hypothesis predicts they would turn to magic at a higher rate than do White males as a means of attaining material goods. The negative relationship with age also fits the distinct markets hypothesis, in that on average individuals become more powerful in their careers as they get older, and hence might have less need for magic than younger individuals. We note that all individuals in the survey were over 18 years of age, so we can rule out an age effect arising from maturation process that involves a child coming to understand what types of causes are considered by their culture to be normal rather than magical.

The conspiracy beliefs outcome (Conspiracies PC1) shows many similar patterns as does the magical thinking outcome (Magic PC1). These two outcome variables themselves have a low correlation (Pearson $r = .082$, Spearman $\rho = .089$), so they do not appear to be merely redundant measures of the same thing. As with the magic outcome, Conspiracies PC1 shows a negative association with age, a positive association with a panelist being Black, and a negative association with Atheist or Agnostic religious preference. However, the association with both Age and Atheist/Agnostic is reduced. Because the outcomes are standardized as z-scores (mean of 0 and standard deviation of 1), the coefficients for each predictor variable can be compared across the outcomes. In the case of Atheist/Agnostic, the association with Conspiracy PC1 is roughly 1/4 its relationship with Magic PC1, and the statistical significance is greatly reduced. Furthermore, while individuals with No Religion tended to disbelieve in magic, they were not significantly different from individuals with a religious affiliation for Conspiracy PC1. "No Religion" is a category of religious belief well-characterized in religious studies that comprises individuals who do not consider themselves to be Atheist or Agnostic, but assert they have no overt religious affiliation or preference. Most of these individuals believe in God and pray despite having no religious affiliation (Hout and Fischer 2002; Lim, MacGregor, and Putnam 2010; Smith and Cragun 2019; Stark 2008).

Other differences as compared to the Magic PC1 include that Conspiracies PC1 exhibits a negative association with gender of woman, indicating that men tend to engage in more conspiracy beliefs (men are ~ 10 percent of a standard deviation more conspiratorial), and that Hispanic Americans have about the same greater rate of conspiracy beliefs as compared to non-Hispanic White Americans that is observed for Black Americans. Hispanic and non-Hispanic White Americans did not differ for Magic PC1.

Study 2, Analyses

We coded religious practices as magical if they conformed conceptually to one of the two laws of magic (similarity or contagion), or if they were intended to otherwise affect a material outcome in some repeatable fashion. These criteria resulted in the practices that we could code across a global religion tree by using reference sources on religions and official documents of the religions themselves. The final data set has 192 coded values (six features across 32 religious groups). Two coders (WBH and LJM) independently coded 48 percent of the characteristics from across 16 of the religious groups. Their percentage agreement across the features was 75 percent or higher (Prayer of Petition = 100 percent, Relics = 87 percent, Siddhi = 80 percent, Exorcism = 81 percent, Positive Possession = 81 percent, Divination = 75 percent). These agreement levels

Table 4: Results from a phylogenetically corrected linear regression of summed magical features

Predictor	Coefficient	<i>p</i> -Value
Intercept	6.8	<.001
Schism Count	-0.52	.002
Number of countries where group >50% population	0.02	.25

Note: $N = 24$ religious groups shown in Figure 1, $R^2 = .38$, $\lambda < .001$.

do not correct for agreement that might arise by chance. We calculated a chance-corrected inter-rater agreement via the Spearman correlation, which is suitable for binary data coded as only 0s or 1s. Chance levels of agreement are 0 for the Spearman, while perfect agreement is 1 and perfect disagreement is -1 . Across all traits the average Spearman correlation was .65 (Prayer of Petition = NA because of invariance in the 48 percent double-coded sample, Relics = .74, Siddhi = .72, Exorcism = .65, Positive Possession = .60, Divination = .54). Data for this analysis are provided in the Supplement.

Having achieved a reliable coding of magical features of religions, we then performed a phylogenetically corrected regression with the summed number of magical features as the outcome, and predictors being the number of branching events (religious schisms) through which each religion passed as well as the number of countries for which it was the majority religion (i.e., >50 percent of a country's populations are adherents. A robustness check used number of countries where a religion was a substantial minority, >5 percent are adherents, and produced the same null results as for >50 percent). The Unilineal Evolution hypothesis predicted that both these features would be negatively associated with summed magical features, but the Evolved Tendencies hypothesis predicted both would be positively associated with magical features. The results show that the number of branching events is strongly and negatively associated with the summed magical features, thus supporting the Unilineal Evolution and Distinct Markets hypotheses and providing evidence against the Evolved Tendencies hypothesis (Table 4).

We also applied an OU model to the evolution of summed magical feature count on the phylogenetic tree. We compared the AIC values of this model to a simple cultural inheritance model (Brownian motion on the tree) and a white noise model (no phylogenetic signal) in order to test the prediction that the number of magical features of religions would evolve around an optimal value that is somewhere along its continuous distribution. While the OU model (AIC = 98.5) was preferred to the Brownian motion model (AIC = 119.9), it was not better than a null white noise model (AIC = 96.7). The last model indicates a trait that exhibits very little or no phylogenetic autocorrelation. This result is consistent with the multiple regression that estimated Pagel's lambda to be zero.

DISCUSSION

We found support for both the Unilineal Evolution and the Distinct Markets hypotheses to explain the cultural evolution of magic. Consistent with Tylor's idea that magic is rationalized away over time by scientific thinking, we found that modern education and scientific reasoning ability was correlated with less magical thinking in a nationally representative sample of Americans. However, these patterns were greatly reduced for a related cognitive process, conspiracy beliefs, that prior research has supported shared similar low-verifiability thought structures as magic. This suggests that the mechanism linking greater scientific thinking with reduced magical thinking might arise from a simple form of cultural rule that individuals learn through scientific

training (i.e., that science and supernatural beliefs must be antithetical) equally or more so than from internalizing more rational thought processes. We say this because if learning of more rational thought processes wholly accounted for the negative relationship of science with magic, then it ought to apply equally to secular thought processes like conspiracy beliefs that mimic magical thinking but in a wholly secular context. Thus, the unilineal evolution hypothesis is supported by Study 1, but perhaps equally or more so due to simple cultural-rule mechanisms like those proposed in Durham (1991) (“secondary value selection”) rather than deep philosophical reflection as proposed by Tylor.

Study 1 also supported the Distinct Markets hypothesis, in that women, Black Americans, and younger Americans all engaged in more magical thinking than did men, White Americans, and relatively older Americans. Although these patterns are not predicted by the Unilineal Evolution hypothesis, they are clearly predicted by the Distinct Markets hypothesis which stipulates that individuals with less opportunity are more likely to seek out magic than individuals with greater opportunity.

Due to the two-tailed predictions of the Evolved Tendencies hypothesis, Study 1 did not provide predictions for it that were distinct from the Unilineal Evolution hypothesis. Study 2, however, makes clear and distinct predictions from these hypotheses. The results support firmly that religions that passed through more branching events tend to be less magical. Each additional two branching events (schisms) is associated with the loss of one magical feature. This finding directly contradicts the Evolved Tendencies hypothesis, and it supports both/either the Unilineal Evolution and Distinct Markets hypotheses as these both predict a reduction in magic within religions over cultural evolutionary time. Furthermore, we found no support for the evolution of magic on the religion tree around a cognitively optimal level of magicalness, which the Evolved Tendencies hypothesis would predict.

Conclusions from Studies 1 and 2

We conducted two studies that support Tylor’s Unilineal Evolution theory and Stark’s Distinct Markets theory. We find evidence against the notion that evolved cognitive tendencies shape the cultural evolution of magic. Further distinguishing the relative contribution of the supported hypotheses will require more study, but we might suggest that the balance of evidence supports that Distinct Markets may be a prime driver. We say this because the main support for the Unilineal Evolution theory that magic is “rationalized” away derives from having a religious affiliation at all versus not. Religiosity (level of religious involvement) had no association, but it should have under this hypothesis. Also, much of the association with scientific reasoning and religious affiliation disappeared when we examined what has been argued to be a secular form of magical ideation: conspiracy beliefs.

In contrast, several otherwise unexpected associations support the Distinct Markets hypothesis: younger age, gender of woman, and race of Black American all are associated with increased magical thinking. Although the pattern for gender flipped for conspiracy beliefs outcome as compared to magic, the association with identifying as Black was robust. We also observed a similar positive association between endorsing conspiracy theories and Hispanic ethnicity compared to non-Hispanic Whites. Overall, the conspiracy beliefs model shows greater support for the Distinct Markets hypothesis than the Unilineal Evolution hypothesis, but further research is needed on this.

Limitations

This research has several limitations that we wish to note. First, we had set out to keep the various Mainline Protestant denominations separate in the analysis, but we ended up having to combine them for analytic purposes. We coded their magical features separately, and these data

are provided in the Supplement. However, as noted in the methods, we could not find consistently reported data on their frequencies across countries (Association of Religion Data Archives n.d.), which required us to combine the Mainline Protestant groups during analysis. Future studies might be able to improve on this.

An additional limitation is that Study 1 does not include traditional control variables to mitigate against finding support for any of the research hypotheses. This limitation is because the demographic variables (e.g., race, gender, and income) that constitute control variables in many studies are a way we operationalized the Distinct Markets theory in Study 1. Additional research might be able to use more nuanced operationalizations of the Distinct Markets theory, perhaps with more detailed data on adverse life events for individuals, and thereby avoid using demographic measures as the operationalization.

A related limitation about operationalization of measurements is that we used PCA as a means to summarize as much variation as possible regarding magic questions in our survey. Further refinement of the measurement of magic through factor analysis might lead to additional insights in future research. To date, only a few studies have engaged in full psychometric factor analytics specifically to develop magical thinking scales (Eckblad and Chapman 1983; Kingdon, Egan, and Rees 2012).

Directions for Further Research

We feel it is important to note that even if further research were to continue to support the Distinct Markets theory for magic, this leaves us with a hypothesized mechanism for the cultural evolution of magic that is plausible in terms of human psychology but that would appear not to be an evolutionary stable solution. It is psychologically intuitive that otherwise frustrated humans might turn to radical alternatives like magic to achieve their ends, but this is not an evolutionary argument. Assuming magic does not actually work, then effort to obtain material goods through magic, rather than continued secular effort, is wasted. Over evolutionary time, individuals who were cognitively inclined to *disbelieve* magic would then have had a Darwinian advantage, as at least they would not have wasted time and effort on something futile. We wish to note that we are not asserting that magic never works. This would be a metaphysical assertion that we cannot test scientifically. In fact, the lead author is a devoutly religious person who would agree with some of the magical thinking items used in our survey. That being said, it seems a certainty that magic does not work reliably enough to obtain routine fitness benefits by employing it.

One possibility would be to argue that the benefits of magic, contra Stark, in fact have nothing to do with what magic claims to achieve, and rather that the benefits are simply that engaging in magic is a way to create social bonds with other individuals. These social bonds then enable beneficial cooperative interactions among the bonded individuals. Some version of this argument is generally what is put forward and supported by evolutionary theories as applied to nonmagical (metaphysical) religious behavior (e.g., Bulbulia 2012; Irons 2001; Matthews 2012; Norenzayan 2013; Norenzayan et al. 2016; Purzycki et al. 2016, Sosis 2003). Relying on prosocial cooperation to explain magic, however, seems insufficient, because beginning with Durkheim/Frazer, many scholars for a century have noted that magic tends to be more secretive than is religion. The priest/rabbi/iman/brahman/and so forth practices in the public square; whereas, the sorcerer/fortune teller/rammal/guru practices more privately for specific clients. Even when religious officials engage in magic, the magic specifically often is rather private (e.g., exorcisms, group prayers of petition held in “silence of heart”). Stark proposed this public/private difference between metaphysical supernaturalism and magical supernaturalism is because the latter is empirically refutable, whereas the former is not. Assuming this broadly and long-accepted comparison applies to magic, then it seems poorly suited as a prosocial cooperation-building mechanism. Why not just engage in more metaphysical supernaturalism? Indeed, our empirical findings suggest that over time religions have reduced the amount of formally sanctioned magical practice.

This is consistent the notion that, over time, institutional religions come to “realize,” either explicitly or indirectly via group selection, that magic is on balance a hindrance rather than a help to community building (Mestrovic 1985).

One possibility that we will put forward for consideration and future study is that although magic is, most of the time, a waste, and selected against in a Darwinian sense, the pursuit of magic as a Distinct Market on rare occasions leads to novel discoveries of previously unknown forms of causation that, postdiscovery, might then be understood as ordinary causation. These discoveries then pay out punctuated bursts of benefits to the discoverers, their biological descendants, and their cultural associates, and it is these punctuated bursts of selective advantage from magic that support its continued evolution and use specifically by disenfranchised people. That is, when a person’s opportunities are limited by structural factors, there could be a net advantage over many generations to roll the dice on magic to discover something radically new, even though most individuals who do this will discover nothing and waste time and effort. This would be a highly rare payout strategy, which is why the enfranchised would be selected to not pursue it because they have more reliable payout alternatives. Ethnographic and historical examples of this seem apparent in that aspects of modern science in some cases emerged from the pursuit of magic. Most especially, modern chemistry has been argued to have emerged quite directly from alchemy (Conniff 2014; Kean 2011; Newton 2006). Looking earlier in history, practices from antiquity centered on astrology are thought to have led to the serendipitous discovery of astronomical insights (Kasak 2000; Lerner 2001). We note we are not arguing that this strategy necessarily pays off in the present, but in the evolutionary past it might have paid off sufficiently such that it has left humans with the tendency to engage in magic specifically when they are disenfranchised. For example, over the course of most of human evolution, there was no writing, and so new technical discoveries had more limited capabilities to spread by social learning across the whole population. Having one Isaac Newton may have been insufficient to spread new insights because there was much more limited transmission of technical information across the global human social network. Instead, comparatively, many Isaac Newtons would have been needed. Again, this is a possibility for further study, but the limited nature of information diffusion in our evolutionary past may have created sufficient benefits for magical thinking if it occasionally resulted in highly novel technical discoveries.

While the incremental approach of modern science to gradually build from what is already known has proven itself time and again, prescientific generations may have relied on more fortuitous leaps among islands of causal understanding separated by empty spaces in their mental map of causation. A willingness to delve into magic may have facilitated these leaps of imagination across the empty spaces on the map, because to practice magic is to partake in causal relations which the practitioner her/himself does not understand and regards as fully outside their own culture’s causal understanding. Indeed, if there were wholly undiscovered causal pathways in the natural world, the modern incremental scientific method that works outward only from the edges of the known might be particularly unlikely to discover them, whereas perhaps the disenfranchised who voyage into magic would be more likely to make such discoveries, even though the great majority of the time they find nothing.¹ To quote Captain Barbosa from his magical journal to the land of the dead, “For certain you have to be lost to find a place as can’t be found. Elseways, everyone would know where it was.”²

¹This point is consistent with some interpretations of ontological theory in anthropology. At least occasionally, non-Western cultures and/or nonscientific traditions develop ideas that, if real, would transcend what science can study. The scientific researcher might then need to adopt metaphysical openness as the only stance that does not prejudice the evidence (Merz and Merz 2017).

²*Pirates of the Caribbean, At World’s End.*

STATEMENT ON REPLICATION

All data needed to replicate the results are provided in the Supplement or through the American Life Panel (<https://www.rand.org/research/data/alp.html>).

REFERENCES

- Association of Religion Data Archives. (n.d.). Data Sources. Available at <https://www.thearda.com/internationaldata/datasource.asp>.
- Barrett, Justin L. 1999. Theological correctness: Cognitive constraint and the study of religion. *Method & Theory in the Study of Religion* 11(4):325–39. <http://www.jstor.org/stable/2355537>.
- Belier, Wouter. W. 1995. Religion and magic: Durkheim and the Année Sociologique group. *Method & Theory in the Study of Religion* 7(2):163–84. <http://www.jstor.org/stable/23549592>.
- Bloch, Jon. P. 1998. Individualism and community in alternative spiritual “magic”. *Journal for the Scientific Study of Religion* 37(2):286–302.
- Boyer, Pascal. 2003. Religious thought and behaviour as by-products of brain function. *Trends in Cognitive Sciences* 7(3):119–24. [https://doi.org/10.1016/S1364-6613\(03\)00031-7](https://doi.org/10.1016/S1364-6613(03)00031-7).
- Boyer, Pascal. 2008. Religion: Bound to believe? *Nature* 455(7216): 1038–39. <https://doi.org/10.1038/4551038a>.
- Brauer, Simon. 2018. The surprising predictable decline of religion in the United States. *Journal for the Scientific Study of Religion* 57(4): 654–75. <https://doi.org/10.1111/jssr.12551>.
- Brotherton, Robert, and C. C. French. 2014. Belief in conspiracy theories and susceptibility to the conjunction fallacy. *Applied Cognitive Psychology* 28(2):238–48. <https://doi.org/10.1002/acp.2995>.
- Bulbulia, Joseph. 2004. The cognitive and evolutionary psychology of religion. *Biology and Philosophy* 19(5):655–86. <https://doi.org/10.1007/s10539-005-5568-6>.
- Bulbulia, Joseph. 2012. Spreading order: Religion, cooperative niche construction, and risky coordination problems. *Biology & Philosophy* 27(1):1–27. <https://doi.org/10.1007/s10539-011-9295-x>.
- Bryden, Gabrielle M., Matthew Browne, M. Rockloff, and Carolyn Unsworth. 2018. Anti-vaccination and pro-CAM attitudes both reflect magical beliefs about health. *Vaccine* 36:1227–34.
- Collard, Mark, Stephen J. Shennan, and Jamshid J. Tehrani. 2006. Branching, blending, and the evolution of cultural similarities and differences among human populations. *Evolution and Human Behavior* 27:169–84.
- Conniff, Richard. 2014. Alchemy may not have been the pseudoscience we all thought it was. *Smithsonian*. Available at <https://www.smithsonianmag.com/history/alchemy-may-not-been-pseudoscience-we-thought-it-was-180949430/>.
- Currie, Thomas E., and Ruth Mace. 2011. Mode and tempo in the evolution of socio-political organization: Reconciling “Darwinian” and “Spencerian” evolutionary approaches in anthropology. *Philosophical Transactions of the Royal Society B: Biological Sciences* 366(1567):1108–17.
- Dennett, Daniel. 1995. *Darwin’s dangerous idea: Evolution and the meaning of life*. New York: Touchstone.
- Drummond, Catilin, and Baruch Fischhoff. 2017. Development and validation of the scientific reasoning scale. *Journal of Behavioral Decision Making* 30(1):26–38. <https://doi.org/10.1002/bdm.1906>.
- Durham, William H. 1991. *Coevolution: Genes, culture, and human diversity*. Stanford, CA: Stanford University Press.
- Durkheim, Émile. 1995. *The elementary forms of religious life* (K. E. Fields, Trans.). New York: Simon and Schuster
- Ebaugh, Helen R. 1993. The growth and decline of Catholic religious orders of women worldwide: The impact of women’s opportunity structures. *Journal for the scientific study of religion* 32(1):68–75.
- Eckblad, Mark, and Loren J. Chapman. 1983. Magical ideation as an indicator of schizotypy. *Journal of Consulting and Clinical Psychology* 51(2):215–25. <https://doi.org/10.1037//0022-006x.51.2.215>.
- Evans-Pritchard, Edward E. 1965. *Theories of primitive religion*. Oxford: Oxford University Press.
- Felsenstein, Joseph. 1985. Phylogenies and the comparative method. *American Naturalist* 125(1):1–15. <https://www.jstor.org/stable/2461605>.
- Frazer, James G. 1894. *The golden bough: A study in comparative religion*. London: Macmillan and Co.
- Gellner, Ernest. 1989. *Plough, sword, and book: The structure of human history*. Chicago, IL: University of Chicago Press.
- General Social Survey. 2018. *About the GSS*. Available at <https://gss.norc.umd.edu/>. Accessed September 4, 2022.
- Gidengil, Courtney, Christine Chen, Andrew M. Parker, S. Nowak, and Luke Matthews. 2019. Beliefs around childhood vaccines in the United States: A systematic review. *Vaccine* 37(45):6793–802. <https://doi.org/10.1016/j.vaccine.2019.08.068>.
- Grafen, Alan. 1989. The phylogenetic regression. *Philosophical Transactions of the Royal Society of London. B, Biological Sciences* 326(1233):119–57. <https://doi.org/10.1098/rstb.1989.0106>.
- Greenhill, Simon J., Thomas E. Currie, and Russell D. Gray. 2009. Does horizontal transmission invalidate cultural phylogenies? *Proceedings of the Royal Society B-Biological Sciences* 276(1665):2299–306.

- Hout, Michael, and Claude S. Fischer. 2002. Why more Americans have no religious preference: Politics and generations. *American Sociological Review* 67(2):165–90. <https://doi.org/10.2307/3088891>.
- Ibañez, Christian M., Mariana Díaz-Santana-Iturríos, Sergio A. Carrasco, Fernando A. Fernández-Álvarez, David A. López-Córdova, Claudio F. Cornejo, Nicolás Ortiz, Francisco Rocha, Erica A. G. Vidal, and María Cecilia Pardo-Gandarillas. 2021. Macroevolutionary trade-offs and trends in life history traits of cephalopods through a comparative phylogenetic approach. *Frontiers in Marine Science* 8: 707825.
- Irons, William. 2001. Religion as a hard-to-fake sign of commitment. In *Evolution and the capacity for commitment*, edited by R. M. Nesse, pp. 290–309. Russell Sage Foundation. Available at <https://psycnet.apa.org/record/2001-05917-013>.
- Jaspers, Karl. 1953. *The origin and goal of history*. New Haven and London: Yale University Press.
- Johnson, Dominic. D. P. 2005. God's punishment and public goods. *Human Nature* 16(4):410–46.
- Jolliffe, Ian T. 2002. *Principal component analysis*, 2nd ed. New York: Springer.
- Kasak, Enn. 2000. Ancient astrology as a common root for science and pseudo-science. *Electronic Journal of Folklore* 15, 84–104. Available at:
- Kean, Sam. 2011. Newton, the last magician. *Humanities* 32(1).
- Kingdon, Bianca L., Sarah J. Egan, and Clare S. Rees. 2012. The illusory beliefs inventory: A new measure of magical thinking and its relationship with obsessive compulsive disorder. *Behavioural and Cognitive Psychotherapy* 40(1):39–53.
- Kosmin, Barry A., and Ariela Keysar. 2006. *Religion in a free market: Religious and non-religious americans, who, what, why, where*. Ithaca, NY: Paramount Market Publishing, Inc.
- Kosmin, Barry A., and Ariela Keysar. 2009. *American religious identification survey (ARIS 2008)*. Available at https://commons.trincoll.edu/aris/files/2011/08/ARIS_Report_2008.pdf.
- Laurin, Kristin, Azim F. Shariff, Joseph Henrich, and Aaron C. Kay. 2012. Outsourcing punishment to God: Beliefs in divine control reduce earthly punishment. *Proceedings of the Royal Society B: Biological Sciences* 279(1741):3272–81. <https://doi.org/10.1098/rspb.2012.0615>.
- Lerner, K. Lee. 2001. *Astrology and astronomy in the ancient world. Science and its times: Understanding the social significance of scientific discovery*. Thomson Gale. Available at <https://scholar.harvard.edu/kleelerner/publications/astrology-and-astronomy-ancient-world>.
- Lewandowsky, Stephan, Gilles E. Gignac, and K. Oberauer. 2013. The role of conspiracist ideation and worldviews in predicting rejection of science. *PLOS One* 8(10): e75637. <https://doi.org/10.1371/journal.pone.0075637>.
- Lim, Chaeyoon, Carol Ann MacGregor, and Robert D. Putnam. 2010. Secular and liminal: Discovering heterogeneity among religious nones. *Journal for the Scientific Study of Religion* 49(4):596–618. <https://doi.org/10.1111/j.1468-5906.2010.01533.x>.
- Malinowski, Bronislaw. 1931. Culture. In *Encyclopedia of the Social Sciences* Vol. 4, edited by Edwin R. A. Seligman and Alvin Johnson, 634–42. New York: The Macmillan Company.
- Matthews, Luke J. 2012. The recognition signal hypothesis for the adaptive evolution of religion. *Human Nature* 23(2):218–49. <https://link.springer.com/article/10.1007/s12110-012-9138-8>.
- Matthews, Luke J., Jeffrey Edmonds, Wesley J. Wildman, and Charles L. Nunn. 2013. Cultural inheritance or cultural diffusion of religious violence? A quantitative case study of the Radical Reformation. *Religion, Brain & Behavior* 3(1):3–15. <https://doi.org/10.1080/2153599X.2012.707388>.
- Matthews, Luke J., Sarah A. Nowak, Courtney C. Gidengil, Christine Chen, Joseph M. Stubbersfield, Jamshid J. Tehrani, and Andrew M. Parker. 2022. Belief correlations with parental vaccine hesitancy: Results from a National Survey. *American Anthropologist* 124(2):291–306.
- Matthews, Luke J., Andrew M. Parker, Katherine Grace Carman, R. Kerber, and Jennifer Kavanagh. 2022. *Individual differences in resistance to truth decay: Exploring the role of reasoning and cognitive biases*. RR-A112-17.
- Matthews, Luke J., Jamie J. Tehrani, Fiona M. Jordan, Mark Collard, and Charles L. Nunn. 2011. Testing for divergent transmission histories among cultural characters: A study using Bayesian phylogenetic methods and Iranian tribal textile data. *PLOS One* 6(4):e14810.
- Merz, Johannes, and Sharon Merz. 2017. Occupying the ontological penumbra: Towards a postsecular and theologically minded anthropology. *Religions* 8(5): 80.
- Mestrovic, Stjepan G. 1985. Anomia and sin in Durkheim's thought. *Journal for the Scientific Study of Religion* 24(2):119–36.
- Nemeroff, Carol, and Paul Rozin. 1994. The contagion concept in adult thinking in the United States: Transmission of germs and of interpersonal influence. *Ethos* 22(2):158–86.
- Newton, Isaac. 2006. *Dibner MS. 1031B SCDIRB (The Chymistry of Isaac Newton)*. Available at <https://webapp1.dlib.indiana.edu/newton/>.
- Norenzayan, Ara. 2013. *Big Gods: How religion transformed cooperation and conflict*. Princeton, NJ: Princeton University Press.
- Norenzayan, Ara, Azim F. Shariff, Will M. Gervais, Aiyana K. Willard, Rita A. McNamara, E. Slingerland, and J. Henrich. 2016. The cultural evolution of prosocial religions. *Behavioral and Brain Science* 39. <https://doi.org/10.1017/s0140525.14001356>.

- Nowak, Sarah A., Christine Chen, Andrew M. Parker, Courtney A. Gidengil, and Luke J. Matthews. 2020. Comparing covariation among vaccine hesitancy and broader beliefs within Twitter and survey data. *PLOS One* 15(10):e0239826. <https://doi.org/10.1371/journal.pone.0239826>.
- Nunn, Charles L. 2011. *The comparative approach in evolutionary anthropology and biology*. Chicago, IL: University of Chicago Press.
- Nunn, Charles L., Christian Arnold, Luke Matthews, and Monique Borgerhoff Mulder. 2010. Simulating trait evolution for crosscultural comparison. *Philosophical Transactions of the Royal Society B-Biological Sciences* 365(1559):3807–19.
- O’Keefe, Daniel. 1982. *Stolen lightning: The social theory of magic*. New York: Random House.
- Pagel, Mark. 1999. Inferring the historical patterns of biological evolution. *Nature* 401(6756):877–84. <https://doi.org/10.1038/44766>.
- Pagel, Mark, Ciara O’Donovan, and Andrew Meade. 2022. General statistical model shows that macroevolutionary patterns and processes are consistent with Darwinian gradualism. *Nature Communications* 12:1113.
- Pew Research Center. 2015. *America’s changing religious landscape*. Available at <https://www.pewforum.org/2015/05/12/americas-changing-religious-landscape/>
- Purzycki, Benjamin Grant, Coren Apicella, Quentin D. Atkinson, Emma Cohen, Rita Anne McNamara, Aiyana K. Willard, D. Xygalatas, Ara Norenzayan, and J. Henrich. 2016. Moralistic gods, supernatural punishment and the expansion of human sociality. *Nature* 530(7590):327–30. <https://doi.org/10.1038/nature16980>.
- Rohlf, F. James. 2006. A comment on phylogenetic correction. *Evolution; International Journal of Organic Evolution* 60(7):1509–15. <http://www.jstor.org/stable/4095344>.
- Rosengren, Karl S., and Jason A. French. 2013. Magical thinking. In *The Oxford handbook of the development of imagination*, edited by M. Taylor, pp. 42–60. Oxford: Oxford University Press.
- Ruck, Damian J., Alexander R. Bentley, and Daniel J. Lawson. 2018. Religious change preceded economic change in the 20th century. *Science Advances* 4(7). <https://doi.org/10.1126/sciadv.aar8680>.
- Shaver, John H., Susan DiVietro, Martin Lang, and Richard Sosis. 2018. Costs do not explain trust among secular groups. *Journal of Cognition and Culture* 18(1–2):180–204. <https://doi.org/10.1163/15685373-12340025>.
- Smith, Jesse M., and Ryan. T. Cragun. 2019. Mapping religion’s other: A review of the study of nonreligion and secularity. *Journal for the Scientific Study of Religion* 58(2):319–35. <https://doi.org/10.1111/jssr.12597>.
- Sosis, Richard. 2003. Why aren’t we all hutterites? *Human Nature* 14(2):91–127. <https://doi.org/10.1007/s12110-003-1000-6>.
- Sosis, Richard. 2009. The adaptationist-byproduct debate on the evolution of religion: Five misunderstandings of the adaptationist program. *Journal of Cognition and Culture* 9(3):315–32. <https://doi.org/10.1163/156770909.12518536414411>.
- Sosis, Richard., and Eric. R. Bressler. 2003. Cooperation and commune longevity: A test of the costly signaling theory of religion. *Cross-Cultural Research* 37(2):211–39. <https://doi.org/10.1177/1069397103037002003>.
- Sosis, Richard, and Bradley J. Ruffle. 2004. Ideology, religion, and the evolution of cooperation: Field experiments on Israeli Kibbutzim. In *Socioeconomic aspects of human behavioral ecology*, edited by Michael Alvard, pp. 89–117. Bingley: Emerald Group Publishing.
- Stark, Rodney. 2001. Reconceptualizing religion, magic, and science. *Review of Religious Research* 43(2):101–20. <https://doi.org/10.2307/3512057>.
- Stark, Rodney. 2008. *What Americans really believe: New findings from the Baylor surveys on religion*. Baylor University Press.
- Titiev, Mischa. 1960. A fresh approach to the problem of magic and religion. *Southwestern Journal of Anthropology* 16(3):292–98.
- Tung Ho, Lam si, and Cécile Ané. 2014. A linear-time algorithm for Gaussian and non-Gaussian trait evolution models. *Systematic Biology* 63(3):397–408. <https://doi.org/10.1093/sysbio/syu005>.
- Tylor, Edward B. 1871. *Primitive culture: Researches into the development of mythology, philosophy, religion, art, and custom*. London: Murray.
- Whitehouse, Harvey, Pieter François, Patrick E. Savage, Thomas E. Currie, Kevin C. Feeney, Enirco Cioni, Rosalind Purcell, Robert M. Ross, Jennifer Larson, John Baines Barend Ter Haar, Alan Covey, and Peter Turchin. 2019. Complex societies precede moralizing gods throughout world history. *Nature* 568: 226–9. <https://www.nature.com/articles/s41586-019-1043-4>
- Whitehouse, Harvey, Pieter François, Patrick E. Savage, Daniel Hoyer, Kevin C. Feeney, Enrico Cioni, ... and Peter Turchin. 2022. Testing the Big Gods hypothesis with global historical data: A review and “retake”. *Religion, Brain & Behavior* 1–43.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Supplementary Appendices

Supplementary Codes