

The New Science of Religious Change

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Humans have believed in gods and spirits since the earliest days of the Holocene, and many people still believe in them today. Although the existence of religious belief has been a human constant, the nature and prevalence of religion has changed dramatically throughout human history. Here we describe the emerging science of religious change. We first outline a multilevel framework for studying religious change drawn from theories of socioecological psychology and cultural evolution. We illustrate this framework with four case studies featuring two ancient religious changes (the rise of punitive religions and doctrinal rituals) and two modern religious changes (the rise of atheism and nontraditional religions). We then review useful methods for examining religious change, including ethnographic coding, agent-based modeling, and time-series analysis. Next, we explore future directions, highlighting the need for predictive forecasts, nonlinear models, and non-Western samples. We also outline ten key questions that need to be answered for a fuller understanding of religious change.

Public Significance Statement

This review argues that religion has changed in systematic ways throughout human history and that cultural psychologists must study and understand this change. Here we summarize a theoretical framework and a set of methods for studying religious change and show how these approaches help explain four cases of ancient and modern religious change. A science of religious change may eventually help predict religious changes before they occur.

Keywords: cultural change, cultural evolution, religion, socioecological psychology, tightness-looseness

Religion is an ancient form of human culture. According to archeological evidence, humans have been ritualistically burying their dead, worshipping supernatural

figures, and making sacrifices to gods and spirits for tens of thousands of years (Peoples et al., 2016). But like many forms of human culture, religion has changed dramatically over time. In the last five millennia, hundreds of religions have gone extinct, Christianity and Islam have swept across the globe to claim more than half of the earth's population, and unprecedented religious identities such as "spiritual but not religious" have emerged (Johnson et al., 2018). As a result of these changes, the beliefs and practices of our ancestors would be unrecognizable today, just as today's religions may be unrecognizable in our distant future.

Psychological science has shown the power of religion to soothe death anxiety (Jong & Halberstadt, 2016), increase prosociality (Shariff et al., 2016), provide social support (Ellison & George, 1994), and improve self-regulation (McCullough & Willoughby, 2009), but it has been slow to appreciate that religion is dynamic. Just as the field has begun acknowledging the cultural specificity of past research (which often focuses on Western industrial nations; Henrich et al., 2010; Triandis & Brislin, 1984),

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we must acknowledge its *historical* specificity. Religion in an 18th century Puritan community is likely different from religion in 21st century Boston, even though both communities are predominantly White, Christian, and in Massachusetts.

Expanding the historical scope of religion research can seem like a challenge, at least without a time machine. Classic psychological methods and theories are designed to study people alive and accessible today. However, advances from anthropology, sociology, and linguistics have provided methods and theories for studying historical change. These tools have already helped psychologists understand how historical patterns of warfare, migration, economic development, and cultural complexification changed people's views of gods and ritual practices (see [Gray & Watts, 2017](#); [Johnson et al., 2011](#)), and they are ripe for widespread adoption in our field.

Here we bring together interdisciplinary insights and initial findings to sketch out an emerging science of religious change. This science uses a multilevel framework in which group-level cultural processes (e.g., industrialization, ecological threat) interact with individual-level psychological processes (e.g., meaning-making, social identification) to facilitate religious change. We apply this framework to four case studies of religious change—the ancient rise of punitive religious beliefs and doctrinal rituals, and the modern rise of atheism and nontraditional faiths—and then highlight future directions for this emerging field. The most intriguing of these future directions may be developing predictive models of religious change, which can forecast future religious change with historical and current-day data.

We hope this study will catalyze a new interdisciplinary science of religious change that examines both the history and future of faith.

A Multilevel Framework for Theories of Religious Change

Multilevel frameworks—which model the interplay between group-level and individual forces—are common in cultural psychology, especially among socioecological psychologists ([Gelfand, 2019](#); [Oishi, 2014](#); [Triandis, 1972](#)). A multilevel explanation of cross-cultural differences in divorce rate across China, for example, is that rice-farming provinces developed more group-level collectivism than wheat-farming provinces, and these collectivist values created more individual-level resistance to breaking apart families through divorce ([Talhelm et al., 2014](#)). A multilevel explanation of state-level differences in personality is that ecological threats make cultures more restrictive, and this cultural restrictiveness increases individual people's conscientiousness ([Harrington & Gelfand, 2014](#)).

Religion is also a multilevel system, which is clear simply by surveying various definitions of religion. William [James \(1902/1985\)](#) offered an individual-level definition of religion as “the feelings, acts, and experiences of individual men in their solitude . . . in relation to whatever they may consider the divine.” In contrast, Emile [Durkheim's \(1904/2008\)](#) definition focused on religion's group-level properties as “a unified set of beliefs and practices relative to sacred things . . . which unite into one single moral community called a Church.” A fully realized study of religion must acknowledge both definitions. Religion is a form of group-level culture that interacts with other group-level factors, but it is also a set of individual-level beliefs and practices which interface with individual-level psychology.

Multilevel approaches to studying culture, such as cultural evolution and behavioral ecology, are well-suited for demonstrating how religious change originates from group-level pressures, individual-level psychology, or both ([Brewer et al., 2017](#); [Sng et al., 2018](#)). For example, a cultural evolution theory known as *cultural group selection* describes how a cultural feature can spread over time because it influences individual people's behavior in a way that is adaptive for human groups ([Boyd & Richerson, 1988](#)), whereas a complementary theory of niche construction describes how specific ecologies can make a cultural attribute more appealing to individuals (e.g., living in large cities can make franchises seem friendlier and more familiar; [Oishi et al., 2012](#)). Behavioral ecology models can show how environments can elicit behavioral changes that may not be conscious ([Sng et al., 2018](#)). These multilevel evolutionary theories are also valuable because they can distinguish between the “distal” causes of cultural change



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—how cultures change because these changes improve group survival—and “proximal” causes—how cultures change because change is appealing to individual people. For example, a distal cause of why people use spices in cooking is that it has antimicrobial functions, but a proximal cause is that spices taste good (Billing & Sherman, 1998). Together, these theories help us understand why socioecological factors may impact change in religious beliefs and practices.

Four Case Studies of Religious Change

Here we illustrate the usefulness of a multilevel framework for religious change with four case studies of religious change. We examine two ancient cases (the rise of punitive religious beliefs and doctrinal rituals) and two modern cases (the growth of atheism and the shift to nontraditional religions), which together capture the major strands of research on religious change.

Case Studies 1 and 2: Ancient Religious Changes

Gods Became More Punitive

Before the spread of modern world religions, humans likely believed in animistic religions that anthropomorphized the natural world with spirits, gods, and demons that inhabited animals and plants (Peoples et al., 2016; Tylor, 1871). However, over the last 12,000 years, people have increasingly believed in “Big Gods”: powerful deities who are believed to monitor human behavior (Norenzayan et al., 2016). These gods have moral codes such as the

Judeo-Christian “Ten Commandments” and the “Five Pillars of Islam,” and they are believed to punish humans who do not follow these codes (Johnson, 2016; Norenzayan et al., 2016). There is little evidence of Big God belief in most small-scale horticultural or hunter-gatherer groups, but they become increasingly more common in agricultural and urbanized societies (see Figure 1; Roes & Raymond, 2003). These gods may have appeared approximately around the time of some of the earliest large-scale human societies, such as Sumer and ancient Egypt, although there is debate around whether Big Gods preceded or followed these early empires (Beheim et al., 2021; Whitehouse et al., 2019).

Many societies who do not believe in Big Gods endorse another force of supernatural punishment—karma—which is believed to operate similarly to moralizing high gods by rewarding morally good humans with transcendence while punishing evildoers through pain, death, and mental illness (Bhangaokar & Kapadia, 2009; Shweder et al., 1997). The emergence of Big Gods and belief in karmic punishment constitute a historical rise of punitive religious beliefs (White et al., 2019).

Why do people believe in gods who punish them, and why did these beliefs spread so rapidly around the world throughout ancient history? A popular cultural group selection answer to this question is that punitive religious beliefs emerged and spread because they served a crucial function in large complex societies: promoting large-scale cooperation (Norenzayan et al., 2016). Supporting studies show that priming gods and karma increases parochial cooperation (White et al., 2019), and that cultural groups with punitive religious beliefs are more prosocial than groups without punitive religious beliefs (Purzycki et al., 2016; Shariff & Rhemtulla, 2012). These effects suggest that punitive religious beliefs might have thrived in complex societies because large-scale cooperation is necessary for taxation systems, military recruitment, market economies, and many other aspects of these groups (Murdock & Provost, 1973).

Group selection models provide distal explanations of why punitive religious beliefs persist once they are established, but they do not explain the proximal mechanisms that lead people to adopt these beliefs. Believing in wrathful gods and unforgiving supernatural forces may make people into better citizens, but it does not make them wealthier or safer as individuals. To address this gap, Jackson and colleagues (in press) recently introduced a niche construction model suggesting that people may find punitive gods most appealing in culturally tight societies—societies with strict norms and strong punishments for deviations from norms. In culturally tight societies, people are more sensitive to norm violations (Mu et al., 2015) and are more likely to support authoritarian leaders who



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promise to enforce law and order (Jackson, van Egmond, et al., 2019). People in tight societies may find punitive religious beliefs appealing for the same reason they find these authoritarian leaders appealing, because they are able to outsource their individual-level motivation to punish norm violators to supernatural norm enforcers (Purzycki et al., 2020). Supporting studies show that punitive religious beliefs are most common during culturally tight periods of history (as measured by the frequency of words reflecting restrictiveness in published books; Jackson, Gelfand, et al., 2019) and in culturally tight regions of the world. Priming cultural tightness also increases Christians' beliefs in punitive qualities of God partly because it makes people more motivated to punish rule-breakers (Jackson et al., in press).

The link between cultural tightness and punitive religious beliefs does not only explain *why* people might adopt punitive religious beliefs but also *where* these beliefs might evolve. In particular, research shows that cultural tightness often rises during times of social or ecological threat, such as warfare, pandemics, or natural hazards, and so it is possible that punitive beliefs are also most common in highly threatened areas of the world. Several studies now show that regions with high levels of natural disasters have the most punitive religious beliefs (Botero et al., 2014; Caluori et al., 2020; Zuckerman et al., 2018), and priming ecological threat increases people's punitive religious beliefs via their support for greater cultural tightness (Jackson et al., in press). Together with group selection models, these studies

suggest that people may first adopt punitive religious beliefs because they are appealing during times of environmental threat and cultural tightness, and punitive religious beliefs might persist and spread because they make societies more cooperative.

Religious Rituals Grew More Doctrinal

Cross-cultural and historical evidence also suggests that the characteristics of religious rituals have changed over time. Anthropologists have pointed to a distinction between “imagistic” rituals, which are rare events involving high levels of physiological arousal, and “doctrinal” rituals that involve less arousal but high levels of repetition and frequent participation (Durkheim, 1904/2008; Whitehouse, 2004). Both forms of ritual are practiced today. A contemporary imagistic ritual is the Mawé initiation rite where young men put their hands into gloves filled with bullet ants, whereas doctrinal rituals include the Jewish Shabbat prayers and the Muslim daily call to prayer.

However, anthropological evidence suggests that doctrinal rituals have grown more common and spread around the world over the past several thousand years, whereas imagistic rituals have declined (Whitehouse et al., 2019; Whitehouse et al., 2014). Like moralizing gods, doctrinal rituals may have risen alongside the rise of large-scale and socially complex societies. An analysis of 645 rituals across 74 cultures found that larger historical communities practicing agriculture and living in fixed settlements were more likely to practice high-frequency and low-arousal rituals, whereas smaller-scale hunter-gatherer, pastoral, fishing, and horticultural groups in more mobile settlements were especially likely to practice imagistic rituals such as the Mawé bullet ant ceremony (Atkinson & Whitehouse, 2011).

Several cultural evolutionary theories have sought to explain why doctrinal rituals might be more prevalent in large complex societies whereas imagistic rituals are more common in small-scale nonagricultural groups. Most of these theories focus on the challenges associated with cohesion in large groups, where we must often place our trust in anonymous strangers (Dunbar, 1992). Social identity theory suggests that group identification could be an important mechanism for preserving cohesion in these groups by bonding people over their shared attributes, ranging from shared political and ideological affiliation to having the same eye color (Tajfel & Turner, 1985). Building on these theories, Whitehouse and Lanman (2014) introduced a cultural evolutionary model arguing that rituals become more routinized and frequent in larger and more complex societies to accommodate the growing need for group identification. For example, many Christians are likely to view the Lord's Prayer as an important signal of group identity, just



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as many Hindus will identify with wearing a bindi. Doctrinal rituals may have therefore become more prevalent over time as growing societies needed frequent routinized rituals to remain cohesive, just as Big Gods may have been important to keep these large societies cooperative.

A different set of psychological theories claims that doctrinal rituals might have become more prevalent because they reduce individual-level anxiety and improve goal pursuit. Brooks and colleagues (2016) supported this explanation by showing that repetitive rituals increased people's performance when they needed to sing in public or perform complex math equations. Other studies show that repetitive rituals improve self-control (Tian et al., 2018) and decrease arousal in stressful situations (Hotton et al., 2019), especially when people are anxious (Lang et al., 2020). Reviews suggest that doctrinal rituals may play a key function by increasing performance and affiliation in societies of any size and scale (Hobson et al., 2018; Stein et al., 2021). These individual-level theories focus on the universal benefits of doctrinal rituals rather than their unique cultural evolutionary function in large groups.

The differences between group-level cultural evolutionary and individual-level psychological models have not yet been resolved, but these streams of research may be complementary. It might be that a wide range of rituals can decrease anxiety and increase performance by acting as "placebos" that relieve stress and anxiety, but doctrinal rituals also have a secondary function by increasing social identification, which explains why they have grown more

prevalent over history. Testing this account may be a fruitful area of future research.

Case Studies 3 and 4: Modern Religious Changes

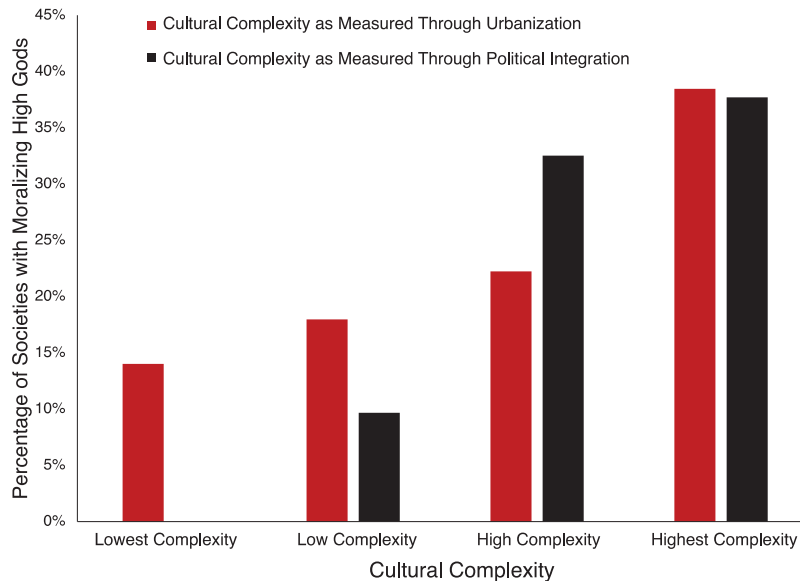
Nonreligious People Are Growing More Prevalent

Perhaps the most notable form of modern religious change is the rise in the proportion of people who identify as nonreligious. The category of "nonreligious" can be broadly defined, but here we use this term to refer to people who identify as atheist, or do not believe in a god or gods. The first wave of the World Values Survey (1981–1984) found that a mere 2.29% of American respondents fell into this category, whereas the figure jumped to 22.23% in the survey's most recent (2017–2020) wave. Atheism is also common in Europe: As of 2017, 25% of Czechian adults did not believe in God, along with 19% of Belgians, 16% of Danes, and 15% of French and Slovakian people (see Figure 2 for a change in nonreligion around the world). These numbers may even underestimate the true number of atheists, as people are hesitant to identify as atheists because of the term's stigma (Abbott & Mollen, 2018). Indirect questioning techniques that can circumvent this socially desirable responding find that the percentage of Americans who do not believe in God could be as high as 26% (Gervais & Najle, 2018).

The rise of the nonreligious has many potential explanations. One of the most popular of these explanations was articulated by Norris and Inglehart (2004), who proposed that rising nonreligion might be tied to group-level industrialization and development, which make life less uncertain and more secure by increasing the quality of education, social support systems, and health care. This view claims that religion is primarily a means of coping with anxiety and uncertainty, and so the rise of secular support systems that alleviate health care concerns and increase security should make religion less valuable. Supporting studies show that religion is often highest in areas of the world that have poor health care, inequality, and acute ecological threat (Gelfand et al., 2011; Gray & Wegner, 2010; Zuckerman et al., 2018), and that people believe most in powerful gods when they perceive the government as weak (Kay et al., 2010).

Another theory of nonreligion, the "rationalist" view popularized by scholars such as Weber (1905/1930) and Berger (2011), suggests that nonreligion should increase as society increasingly relies on science. This theory rests on the assumption that belief in religion and in science are mutually exclusive, offering different meaning-making frameworks. Some research has supported this assumption, finding that manipulating Christians' trust in science can decrease their belief in God (Preston & Epley, 2009). But other studies have found very different effects, showing that religion and science can often coexist as meaning-making

Figure 1
Belief in Moralizing High Gods and Cultural Complexity



Note. Sample is drawn from the standard cross-cultural sample. Moralizing high god data are from the Ethnographic Atlas. Urbanization and political integration data come from Murdock and Provost's (1973) cultural complexity codes. Urbanization levels correspond to (a) fewer than 100 people per community, (b) 100–199, (c) 200–399, and (d) above 400. Political Integration corresponds to (a) authority at the household level, (b) the local level, (c) the chiefdom level, (d) the state level. Small and large states have been combined for this visualization. See the online article for the color version of this figure.

systems, especially in non-Western societies (Legare et al., 2012; Watts et al., 2020).

Many other lines of research have tried to explain the difference between groups that secularize and groups that remain religious. For instance, Abrams and colleagues (2020) used longitudinal studies to show that people and nations are least likely to become nonreligious when they view religion as essential to morality. Other studies have focused on religious signaling by suggesting that a lack of credible religious cues (like publicly praying, attending services, etc.) can lead to less religious conviction (Willard & Cingl, 2017). Some studies have simply documented the reasons that people list for leaving religion, such as negative experiences with religion, distrust of religious groups, and intuitive doubt (Bradley et al., 2018). These studies help explain why some individuals and groups may be especially likely to deconvert.

Nontraditional Religions Are Gaining Popularity

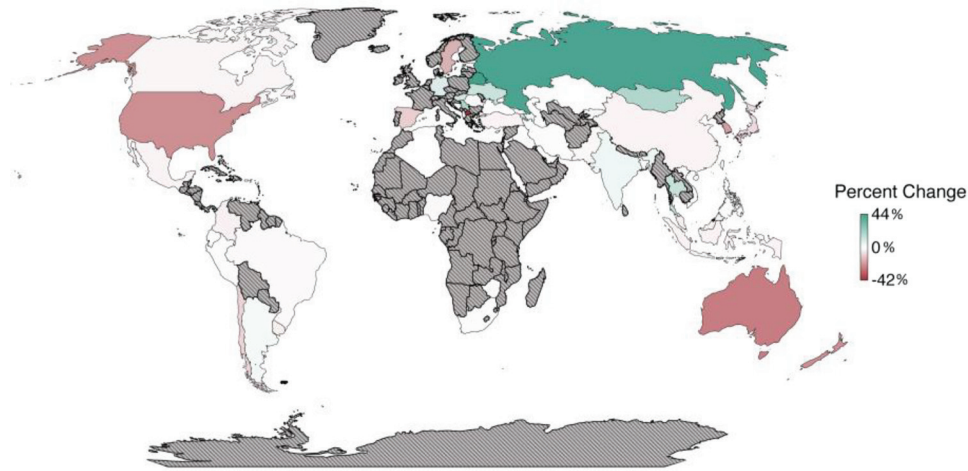
Another modern trend involves people turning away from organized religion in favor of more personal, decentralized religious practices. People identifying as “spiritual but not religious” (SBNR) rose from 19% of Americans in 2012 to 27% just five years later in 2017 (Lipka & Gecewicz, 2017), and the number is also rising in Europe (Lindeman et al.,

2019). Only 5% of SBNRs do not believe in God (Pew Research Center, 2017), but people in this group have a unique profile that sets them apart from typical members of organized religions (Saucier & Skrzypińska, 2006). SBNRs are more likely than religious people to see God as an impersonal force rather than a personal being (Johnson et al., 2018) and to view science and religion as compatible (Lindeman et al., 2019). They also claim to not fit in with religious groups (Johnson et al., 2018). There is even variation within the SBNR identity, with some members of this group practicing more than one religion and others who are indifferent to most religious activities (Tong & Yang, 2018).

A variety of noncentralized religions have also gained popularity over the last several decades. New religious movements, especially Paganism, have drawn more followers in North America, the United Kingdom, and Europe. The broadly defined “New Age” religious movement grew between 1981 and 2000, with the largest increases occurring in the United States, France, Great Britain, The Netherlands, and Sweden (Houtman & Aupers, 2007; Kosmin & Keysar, 2008). Together with SBNRs, these groups constitute a recent rise of nontraditional religious identities.

Surprisingly little research has analyzed the rise of non-traditional religious identities, especially given the large

Figure 2
Global Change in Nonreligion



Note. Shading reflects change in percentage of people who responded “Yes” when asked whether or not they believe in God (red = loss of belief, green = gain in belief, gray = no data). Change is between first and latest waves of the World Value Survey, in which a particular country was surveyed (for exact years and full data, see <https://osf.io/tfhe6/>). See the online article for the color version of this figure.

body of work on the rise of nonreligion. But one possibility is that the rise of nontraditional religions is tied to cultural individualism. Two streams of research support this possibility. One line of research has found that religions vary widely in their individualism (Cohen & Hill, 2007) and that people belonging to nontraditional religions are often highly individualistic (Farias & Lalljee, 2008). A second line of research shows that individualism is rising in the United States (Grossmann & Varnum, 2015) and around the world (Santos et al., 2017), owing to rising economic security and fewer natural disasters. The historical correlation between individualism and nontraditional religions does not mean that these variables are causally connected. However, individual-level evidence suggests that cultural individualism may have psychological properties that lead people to migrate from organized religions to nontraditional religious groups. For example, as people come to see the individual as capable of moral and ethical decisions, religious communities and organizations may become less necessary for this guidance (Kurtz, 2015). Other research shows that SBNRs typically cite questioning religious traditions and a dislike of religious institutions as their two major reasons for leaving organized religion (Pew Research Center, 2018). This evidence is still cursory, but it does raise the intriguing possibility that individualism creates a cultural niche in which nontraditional religions thrive.

Methods of Studying Religious Change

Findings about religious change rely on a variety of relatively new methods, many of which were developed in

other fields. It is impossible to travel back in time and survey people from earlier in history, but these methods allow us to gain insights into the ancient and modern history of religion. We summarize these methods here and provide more resources in Table 1.

Studying Ancient Religious Change

Most studies of ancient religious change must rely on differences between large-scale societies and smaller-scale hunter-gatherer and horticultural groups to infer how religion may have shifted over the past several millennia. Studying these societies can be insightful because they have been less affected by globalization and the spread of world religions than industrialized countries. Religious beliefs and practices in modern small-scale societies may therefore resemble the beliefs and practices from thousands of years ago, at least more so than major world religions such as Christianity (Peoples et al., 2016). Researchers will typically study these societies by reading through ethnographies and transforming anthropologists’ qualitative descriptions into quantitative data about features of religion (Slingerland et al., 2020), and several recent databases now make these ethnographic descriptions accessible and organized (Kirby et al., 2016; Watts et al., 2015). Other studies have established field sites in small-scale societies where anthropologists can conduct in-depth interviews and behavioral observations to understand prevailing religious beliefs and rituals in these groups (Purzycki et al., 2018).

Agent-based models can also be useful for studying ancient religious change. Like experiments, these models represent simplified and controlled settings where researchers

Table 1
Methods of Studying Religious Change

| Method | Resources | Applications to religious change |
|-----------------------|---|--|
| Ethnographic analysis | Slingerland et al. (2020) : Provides best practice guidelines for how to organize coding data and increase the transparency of coding studies. | Watts et al. (2015) : Analyzed ethnographic data from Pacific religions to test the relationship between moralizing gods and social complexity. |
| Agent-based modeling | Jackson et al. (2017) : Gives an accessible overview of how social psychologists can build theories of cultural change using agent-based models. | Lane (2019) : Used agent-based modeling to explore the evolution of doctrinal rituals in large religious groups. |
| ARCL and LCM models | Usami et al. (2016) : Outlines best practices in fitting ARCL models. Curran et al., 2014 : Describes LCM models, and shows how to separate trends from lagged effects in these models. | Stronge et al. (2020) : Used LCM to analyze the relationship between personality traits and deconversion. Balkaya et al. (2020) : Used ARCL to study religious identity and civic engagement in Muslim children. |
| Time series analysis | Grossmann & Varnum (2015) : Shows how time series models, cross-correlation, and Granger causality can shed light on dynamics of cultural change. | Caluori et al. (2020) : Used time series methods to show that historical conflicts encouraged more punitive views of God. |

Note. ARCL = autoregressive cross-lagged; LCM = latent growth curve model.

can study behavior ([Henrich & Boyd, 2002](#)). But unlike most experiments, agent-based models are dynamic, and a researcher can use these models to test how culture and religion may have changed over thousands of years ([Jackson et al., 2017](#)). Agent-based models using game theory paradigms also allow researchers to simulate evolutionary dynamics to test functional theories about religion and evolution ([Henrich & Boyd, 2002](#)). The insights from these models are strongest when complemented with empirical data that can support their assumptions. But even without data, models can be theory-building tools about religious change in ancient societies.

Studying Modern Religious Change

Some methods are well suited to study more modern religious change. Many studies of modern change use longitudinal data from worldwide and nationwide surveys such as the World Values Survey, the General Social Survey, and the European Values Survey, which have been running waves of data collection since the late 20th century. Researchers can analyze these multipanel surveys using autoregressive cross-lagged (ARCL) models and latent growth curve models (LCMs), which can test whether multiple factors are changing together across several time-points (commonly between three and 15), and whether one factor may have a lagged effect on another. For example, [Stronge and colleagues \(2020\)](#) used LCM models to find that decreases to agreeableness typically preceded deconversion, and that deconversion typically preceded increases in conscientiousness. Researchers can also introduce exogenous factors as control variables to make sure that change over time isn't confounded with third variables.

Another longitudinal method of studying modern data involves time series analysis in which a researcher will study a single culture or individual across many time points. Time series analyses are not difficult to understand. Often a first step in time series analysis will involve detecting trends

and patterns of autocorrelation in time series. For example, [Jackson, Gelfand, et al. \(2019\)](#) found that cultural tightness decreased over the last 200 years of American history, and also found autocorrelations such that each year's level of cultural tightness was correlated with cultural tightness the previous year. A second step may then detect for bivariate or multivariate associations between time-series. For example, cross-correlation fits a variety of correlations at different lags to identify whether variables have some lagged relationship or whether they are changing at the same time. Granger causality and vectoral autoregression (VAR) models are more complex because they can model a bivariate relationship while controlling for a variable's effect on itself ([Ding et al., 2006](#)). [Jackson and colleagues \(in press\)](#) used these methods to show that historical increases in cultural tightness preceded and predicted historical increases in punitive religious beliefs.

Future Directions in the Study of Religious Change

A new scientific field of religion opens up new questions, and these questions can serve as an agenda for the study of religious change. To outline this agenda, we present [Table 2](#), which represents ongoing (questions 1–4) and new (questions 5–10) questions about how religion changes over time, and how it might change in the future. Answering these questions requires new theories and methodological innovations. For example, most studies of culture and religion use linear explanatory models, but future research must take advantage of forecasting algorithms that allow us to predict religious change, new approaches to model nonlinear religious change, and more globally representative samples to understand how ongoing religious changes are unfolding outside the United States and around the world.

A Predictive Science of Religious Change

Typical models of religious change are *explanatory* and focus on explaining why historical trends have occurred, yet new

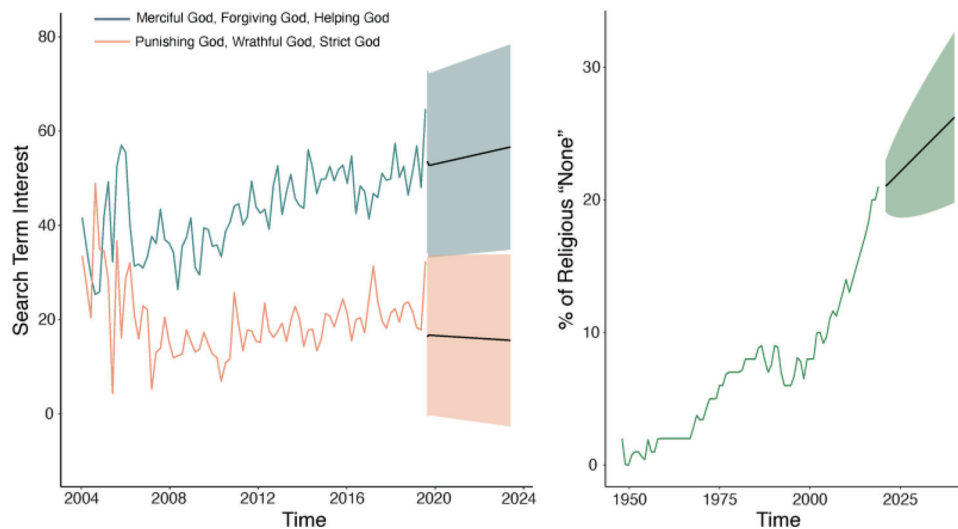
Table 2*Key Questions About Religious Change*

1. Why did beliefs in punitive and moralizing gods and spiritual forces spread around the world in ancient history?
2. Why have rituals historically become less physiologically intense and become more frequent and repetitive?
3. Why is the number of nonreligious people growing, and why is secularization so much more pronounced in some countries than in others?
4. Why are people leaving larger organized religions in favor of smaller nontraditional religious groups, or identifying as “spiritual but not religious?”
5. Does religious belief follow cyclical trends, such that people’s conviction in their belief follows consistent cycles over time?
6. Can forecasts of religious change predict universal and cross-cultural trends in future religious conviction and views of gods?
7. Do the same factors that explain the rise of Christianity also explain why people are beginning to deconvert from Christianity in many countries?
8. Will rising globalization lead to a homogenization of religious belief, such that religions will be less distinct in the future than they are today?
9. Could rising life expectancy and existential security lead to religious traditions that place less emphasis on the afterlife?
10. Do the same factors influence religious conviction universally, or do separate cognitions and motivations encourage conviction based on a person’s culture and religion?

methods allow us to build *predictive* models of religious change that anticipate future trends. Some time series analyses make it possible to use properties of cultural time series to forecast future change (Grossmann & Varnum, 2015). In particular, autoregressive integrated moving average (ARIMA) models can decompose a time series into gradual trends, intertemporal dependencies, known as autoregressive components, and error in these dependencies, known as moving average components (Khandakar & Hyndman, 2008). ARIMA-based studies of weather may find that cloud cover has gradually decreased over time, but they may also show autocorrelations. For example, the extent of cloud cover on one day may correlate highly with cloud cover on the next day. These models can generate more accurate forecasts than models which just focus on underlying trends.

ARIMA models are common in econometrics (e.g., to estimate the future of stock prices) and climate sciences (e.g., to estimate weather patterns), but they have only just begun appearing in cross-cultural research. Grossmann and Varnum (2015), for example, forecasted future increases in individualism using data on multiple indicators of individualism across the 20th century. With these methods, we can use previous trends of religious change to forecast future changes. For example, Figure 3 shows that the rise of religious “nones” is likely to continue in the United States and that people are increasingly viewing God as a loving (rather than a punitive) figure. Forecasting models will vary in important ways. For example, some models will incorporate *drift* in a time series, where some variable is linearly increasing or decreasing over time, and some models will incorporate higher-level autocorrelation structures.

Figure 3
Forecasts of Views of God and Religious Affiliation Based on Historical Time Series



Note. (Left) Time series trends and forecasts of adjectives that people have ascribed to God over the last 15 years from Google Trends (using the adjectives in Caluori et al., 2020, Study 2). (Right) Data on the number of people who do not identify as religious from Gallup over the 20th century. Shaded regions represent 48-month (left) and 20-year (right) forecasts derived from an autoregressive integrated moving average (ARIMA) model incorporating drift. See the online article for the color version of this figure.

In climate science models, for example, it can be important to integrate autocorrelation because patterns of weather are highly correlated from day to day. Researchers will typically examine the fit of different model specifications to determine which type of forecasting is best suited for their data.

An important future direction in forecasting involves incorporating exogenous variables into ARIMA forecasts. Typically, these forecasts use previous changes in a time-series to forecast future changes, but hypothetically they could also incorporate projections of other trends such as globalization, inequality, and political polarization to adjust projections of future religious changes. One possibility, for example, is that globalization will lead to a homogenizing of religious belief in the future as religious ideas and values are exchanged across different belief systems (Bhawuk, 2008). Another possibility is that rising life expectancy and existential security may lead to religious systems that place less emphasis on the afterlife and more emphasis on religious experiences during one's own lifetime.

Exploring Nonlinear Patterns of Change

Most studies of religious change have identified linear patterns, such as the rise of punitive religious beliefs and doctrinal rituals. Yet linear trends may not capture the complexity of religious change or the possibility of nonlinear patterns. One interesting form of nonlinear religious change could involve *seasonality*: when trends rise and fall at consistent intervals. Religious conviction could rise and fall along with major rituals such as Christmas or more frequent rituals such as the Sabbath. Yearly pilgrimages such as the Islamic Hajj could also lead to patterns of seasonality for religious conviction. These seasonality trends could have a range of implications. For example, surveys could find different patterns of religious conviction depending on the day or month that they collect data. Seasonal changes in religiosity could also lead to seasonal changes in factors related to religion such as prosociality.

Another form of nonlinear religious change could involve exponential growth or logarithmic trends which plateau over time. This logarithmic dynamic may characterize the rise of nonreligion. Nonreligion has risen steadily in many countries for the past several decades, but demographic factors may counteract this trend. For example, religious families have more children than nonreligious families, and this could slow or even reverse the prevalence of nonreligion (a possibility which has been raised by the Pew Religious Future project).

Nonlinear methods could also help predict future religious trends. Current forecasting methods in cultural change have mostly produced linear forecasts, like the projections in Figure 3. However, new forecasting methods that combine ARIMA models with artificial neural networks are well-suited for modeling nonlinear change. These hybrid models go by a number of names, such as the feedforward neural network (FNN; Zhang, 2003) and the Elman's recurrent neural network

(ERNN; Aladag et al., 2009), which each combine seasonal ARIMA models with neural networks which differ slightly in their setups. These nonlinear forecasts have been applied to research on seasonal variation in stock price analysis (Pai & Lin, 2005) and nuclear power plant functionality (Şeker et al., 2003), but they are also well-suited for forecasting patterns of future religious change.

Studying Non-Western Religions

The vast majority of research on religious change has sampled Christians and most of the remaining studies have focused on Jews and Muslims. This is a major limitation of research on religious change, as changes to Abrahamic religions do not necessarily reflect changes to other religions (Norenzayan et al., 2016). It may be, for example, that individualism is only related to interest in nontraditional religions within the United States and Europe, or that science only decreases religious conviction in industrialized societies where religion and science are more often viewed as competing explanatory frameworks (Legare et al., 2012). Polytheist religions are especially underrepresented by past research, and it is still not clear whether dynamics involving Christians and Muslims can be generalized to Buddhists, Hindus, or smaller traditional faiths.

One of the best ways of increasing religious diversity is to increase the availability of data from non-Western cultures. To this end, several databases of religious history, such as Pulu (Watts et al., 2015), D-Place (Kirby et al., 2016), and the Database of Religious History (Slingerland & Sullivan, 2017), now offer access to data on hundreds of different religious traditions. The long-running "Human Relations Area Files" (HRAF) is another useful resource, which compiles ethnographic information about small-scale societies from around the world and tags each paragraph by subject so that scholars can easily filter information (Ember, 1997). One limitation of these databases is that they rely on Western ethnographers' descriptions of non-Western societies, which can be biased. To address this limitation, Abrams and colleagues (2020) are currently creating a database of religious art, which will host thousands of pieces of religious art as well as numeric codes for qualities of these art pieces. This free and publicly accessible database will allow researchers to analyze religious art in nonliterate societies to gauge how people in these societies viewed gods free of potential ethnographer bias.

Conclusion

Religion has been changing for thousands of years, but psychological scientists have only recently begun to study this change. This is an unprecedented time to study religious change, both because we are building multilevel theories of how culture shapes religion and because we are developing the methods to test these theories with an unprecedented level of statistical rigor and causal inference. Here we hope to spark a formal science of religious change by

documenting widespread trends in religious change, emergent theories that explain these trends using cultural and psychological factors, and future directions that may improve the scope and impact of studies on religious change. The quantitative study of religious change is still in its infancy, but this new field could demystify current trends in religiosity and help us chart the path of one of the most important facets of human culture.

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