Regular Article

Science, Technology, & Human Values
2023, Vol. 48(4) 832-860

DOI: 10.1177/01622439211055144
journals.sagepub.com/home/sth
Sage

Learning Right from Wrong: A Cross-national Analysis of Education, National Scientific Investment, and the Morality of Science

Shiri Noy[1] and Timothy L. O'Brien[2]

Abstract

Opposition to and skepticism of science have important social consequences, as highlighted by contemporary debates about vaccines and climate change. Recent studies suggest that opposition to science is rooted in moral concerns and reflects a belief that science breaks down traditional conceptions of right and wrong. This article turns attention to the education system and to national contexts to examine how people see science as a moral threat. We analyze data from the World Values Survey using multilevel regression models and find that individuals with higher levels of education are less concerned about the effects of science on morality. Yet, education differences in moral concern about science are more than twice

[1]Department of Anthropology & Sociology, Denison University, Granville, OH, USA
[2]Department of Sociology, University of Wisconsin–Milwaukee, WI, USA

Corresponding Author:
Shiri Noy, Department of Anthropology & Sociology, Denison University, Knapp Hall–103D, 100 West College Street, Granville, OH 43023, USA.
Email: snoy@denison.edu

as large in countries with the highest levels of scientific investment compared to those with the lowest. We conclude that although the link between education and the moral consequences of science is not limited to specific countries, its intensity varies across national contexts. We discuss these findings in light of recent scholarship on political and religious opposition to science, noting the importance of understanding publics' views of the moral consequences of science.

Keywords
morality, values, science in society, education, cross-national

Introduction

Science is traditionally conceived as a source of knowledge and empirical information about the world (Kuhn 1962; Popper 2004; Latour and Woolgar 1979; Merton 1942). Yet, there is mounting sociological evidence that the public does not view science as a purely intellectual enterprise. Instead, recent research indicates that the public views science as a source of values in addition to knowledge. This has important implications for people's acceptance of scientific information, including in public health, environmental science, and other areas of global significance, which in turn helps shape social action and policy.

Broadly, science has become associated with a modern, rational lifestyle and progressive social and political beliefs. The cultural association between science and liberal values is evident in the growing importance of political dispositions for perceptions of science (Gauchat 2012; Sherkat 2017; Mann and Schleifer 2020). This normative meaning of science is also reflected in beliefs about moral conflict between science and religion (Evans 2014, 2018), and in wide-ranging differences in public opinion associated with perspectives on science (Noy and O'Brien 2016). While sociological analyses of science have long recognized its distinctive institutional values (Merton 1942), recent opposition to science suggests that it has acquired a new cultural meaning, one viewed by some as a threat to conservative religious and political values (Evans 2018).

Research on public perceptions of science often emphasizes the importance of personal experiences with science for shaping these views. The education system is one of the most common sites of exposure to science. In countries around the world, people with higher levels of education tend to

hold more favorable attitudes about science (Snow and Dibner 2016; Allum et al. 2008; O'Brien and Noy 2015). Although this association once was thought to reflect knowledge deficits and surpluses, researchers now argue that it signals the internalization of modern, rational values, which are imparted by formal education and closely associated with the institution of science (Bourdieu 1984; Noy and O'Brien 2019). This suggests the positive link between education and appreciation of science reflects exposure to scientific values more so than understanding of scientific principles (Kumarassamy and Koh 2019; Allchin 1999; Hoeg and Bencze 2017). Put differently, opposition to science among the less educated reflects their social distance from the cultural values rather—than lack of specialized knowledge—associated with science.

In addition to individual-level experiences with education, macro-level processes of rationalization and modernization may facilitate the transmission of scientific values. Specifically, in societies that prioritize scientific authority, alternative sources of cultural authority, such as tradition and religion, may be marginalized or even stigmatized. In these places, the threat to traditional values may seem most acute to the least educated, because of their social distance from one of society's primary sources of authority, that is, science. In contrast, where science is less prominent, moral outlooks on science may depend less on education, because scientific authority is relatively less threatening to other sources of knowledge and values.

In this article, we investigate beliefs about the effects of science on morality using survey data from forty-two countries. Our analysis centers on two questions: (1) Is education associated with the belief that science breaks down people's sense of right and wrong, that is, the perception of science as a moral threat? (2) How does the relationship between education and the perception of science as a moral threat correspond to macro-level measures of scientific activity? Multilevel regression models indicate that education is associated with less concern that science breaks down people's understanding of right and wrong. However, the magnitude of this association depends on national scientific contexts. Namely, educational differences in moral outlooks on science are two to three times larger in countries that invest the most in science compared to those that invest the least. This pattern is driven by especially negative views of science among people with little education in places that invest heavily in science. We argue that this is because the prominence of scientific knowledge, values, and institutions in these contexts marginalizes those with little experience with science, which amplifies the cultural conflict between modern and traditional values in these societies.

Literature Review

Science, Knowledge, and Values

The social studies of science have traditionally approached science as a method for acquiring facts about the world. This view of science as an intellectual, information-gathering activity is evident in philosophical research on the demarcation of science from nonscience (Popper 2004), in historical research on the development of scientific paradigms (Kuhn 1962), and in sociological research of the construction of scientific knowledge (Latour and Woolgar 1979). In addition to its intellectual content, science is associated with a set of institutional norms necessary for certifying knowledge (Merton 1942). Although the empirical evidence for these normative imperatives is mixed (Long 1978; Cole 1979), these studies illustrate the collective focus on understanding science as a fact-gathering activity.

To many, however, science is an ideological enterprise that teaches not only the difference between true and false but also the difference between right and wrong (Miller 2020). In this way, the boundaries of science are negotiated vis-à-vis other institutions (Gieryn 1983). For decades, research in science and technology studies has shown that scientific knowledge is never "value free" and that it is influenced by social forces including ideological commitments (Latour and Woolgar 1979). For example, Shapin and Collins (1994) argue that scientific authority stems from aristocratic values related to trust and civility. They suggest that scientific authority is most appealing to publics when it is seen as compatible with dominant culture forms, such as prevailing conceptions of morality (Shapin 1990).

Some argue that placing too high a priority on scientific values may lead to the application of scientific principles beyond the scope of scientific inquiry, e.g. scientism. Critics of scientism fear that its reductionist and mechanistic approach to knowledge and social life may lead to the exclusion of other worldviews (Waddell 1977). Others fear the expansionist agenda of science into domains that were previously beyond its purview. This type of boundary crossing may seem especially threatening to traditional worldviews because it calls into question long-held ideas of right and wrong rather than true or false. In this way, science may challenge understandings of issues beyond its magisterium or authority, and in doing so threaten alternative sources of values.

Recent sociological research further suggests that science in the United States is widely recognized as a normative enterprise. Since the 1970s,

conservatives in the United States have grown increasingly skeptical of science while liberals' attitudes about science have changed very little (Gauchat 2012; Evans 2013; Mann and Schleifer 2020; Sherkat 2017). These studies suggest that many people in the United States associate science with modern values and a progressive political agenda and view it as a threat to a traditional lifestyle.

Education, Knowledge, and Values

In addition to political beliefs, educational attainment is one of the most consistent predictors of attitudes about science. Specifically, people with higher levels of education tend to express more favorable views of science. Education, particularly tertiary education, is generally viewed as a liberalizing project globally (Harland 2009). While evidence of the politicization of science comes mostly from the United States, several studies show that the link between education and science attitudes extends cross-nationally (Allum et al. 2008; Noy and O'Brien 2019; Chan 2018). This association is thought to reflect one of two mechanisms. On one hand is a deficit model, which suggests that the association between education and appreciation of science reflects the clearer understanding of the benefits of science (Irwin and Wynne 2003; Allum et al. 2008). In this account, familiarity with scientific knowledge and concepts is thought to reduce fear of science's negative consequences by increasing awareness of the utility of science and by reducing misinformation about the potential harms of science and technology. On the other hand is a cultural model, which suggests that the education system is a site of cultural reproduction and that the values of science are disseminated to the public through formal education (Bourdieu 1984; Drori et al. 2003). In this view, the positive relationship between education and science results from the internalization of cultural values associated with science.

These two explanations of the link between education and science attitudes have different implications for the cultural meaning of science and for efforts to reduce opposition to science. If education increases appreciation of science by increasing awareness of scientific knowledge, then it suggests that publics interpret science as a knowledge generating enterprise and reducing opposition requires increased educational outreach. However, if education increases appreciation of scientific values, it suggests that publics interpret science as a normative activity and that reducing opposition to science requires recasting science' cultural meaning. Unfortunately, surveys of science attitudes are not typically equipped to distinguish between

the moral and intellectual dimensions of science. Cross-national surveys in particular are needed to examine how national contexts shape these cultural meanings of science.

Modernization and Rationality

While there is an extensive literature on individual-level differences in perceptions of science, there is less attention given to the national contexts where these differences are situated. However, modernization theories illustrate the importance of macro-level factors for understanding individuals' worldviews. These theories suggest that economic development and political openness lead people to become more tolerant and to increasingly value individualism and rationality (Inglehart and Baker 2001). Weber's work provides an early argument about how rational, modern scientific values come to replace traditional ones (Weber [1904] 2013). Habermas (1981) proposes a related model of modernity in which instrumental rationality increasingly displaces other ways of knowing. Another set of theories identifies institutional differentiation and secularization as the primary drivers of this trend in cultural values (Bruce 2002; Gorski 2003; Drori et al. 2003; Inglehart and Baker 2001; Locke 2001; Ritzer 1998). Although these theories point to different underlying mechanisms, they all suggest that as societies modernize, scientific knowledge and institutions grow increasingly important, and the associated cultural values such as rationality and liberalism displace traditional values such as enchantment and conservatism.

These theories also imply that a society's orientation toward scientific values is evident in the worldviews of individuals within the society. These contextual effects are evident in cross-national research that shows that individuals' attitudes about science depend on macroeconomic, scientific, and religious factors (Chan 2018; O'Brien and Noy 2018; Noy and O'Brien 2019). Although these studies demonstrate the importance of national contexts for shaping science attitudes, they do not examine how these contextual factors relate to the perceived moral threat posed by science, which we seek to address in this article.

Empirical Expectations

The goal of this article is to investigate the individual and country level factors associated with the belief that science is morally harmful. Based on the preceding discussion, we expect that individuals with more exposure to

scientific values through education will view science as less morally injurious compared to those with less education. We also anticipate that the belief that science threatens morality is relatively low in societies where science is relatively prominent.

Yet, the more deeply scientific authority is rooted in society, the more threatening it may seem to those on its margins, that is, those with little formal education. In societies where science is most conspicuous, people with little experience with science are most socially distant from a primary source of status and influence. In these societies, outgroup threat may amplify educational differences in moral outlooks on science, because of unusually negative views of science among those with little education. Furthermore, in societies where there is high social value on science, education systems may transmit pluralistic and relativistic values (Terrén 2002). This may mean that formal education is most effective at improving moral outlooks on science in these societies. In other words, in societies that prioritize scientific authority, the most educated people may be even more optimistic—and the least educated, even more pessimistic—about science than similarly educated people in societies where science is less important.

Data

To examine the individual and contextual factors associated with moral opposition to science, we combine individual-level data from Wave 6 of the World Values Survey (WVS), which was fielded between 2010 and 2014, and country-level data from the World Development Indicators (WDI). In total, 89,565 individuals in sixty countries and regions completed surveys during this round of data collection. Country-level independent variables are not available for fifteen countries and regions.[1] Three additional countries did not include necessary individual-level measures on the WVS questionnaire.[2] Cases from these countries and regions are therefore excluded from the analysis. Additionally, 7.5 percent of cases are missing information on the dependent variable and 16.8 percent are missing information on one or more individual-level independent variables.[3] These cases are also excluded from the analysis. In total, the results below come from our analyses of data from 52,548 individuals nested in forty-two countries.

WVS data are well-suited for our analysis for several reasons. First, they contain a unique measure of beliefs about the effects of science on a core moral value, which provides an unparalleled chance to observe moral outlooks on science globally. Second, the data come a broad range of countries, which provide ample variation in macro-level variables that we suspect are

important to how people perceive the effects of science on morality, in particular levels of scientific investment. Third, the large, nationally representative samples included in the WVS allow us to control for numerous confounding factors and allow us to draw generalizable, statistical conclusions about global patterns in beliefs related to the morality of science.

Dependent Variable

Our dependent variable measures beliefs about the effects of science on morality. The survey question generating these data asks respondents to evaluate the statement "one of the bad effects of science is that it breaks down people's ideas of right and wrong." Responses are measured on a ten-point scale ranging from "completely disagree" (1) to "completely agree" (10).

Given the centrality of right and wrong to morality, we interpret higher scores on this item to indicate greater concern about and opposition to the negative effects of science on morality. We do not mean to suggest that this question measures active resistance to all aspects of science. Rather, we see it as an indicator of the moral consequences people associate with science. Our analysis differs from other studies of science attitudes, such as those interrogating whether science "causes more harm than good" or "makes our way of life change too fast," because we focus specifically on the moral values associated with science rather than more general measures of science valence or affect.

This item is only a partial measure of moral outlooks on science, and more fine-grained information on respondents' moral orientations would be ideal. Yet, this item is the best one available to examine science's normative meaning internationally. While our dependent variable focuses on a single dimension of morality, our analysis nonetheless advances research on this topic by testing recent theories of science attitudes using the best available data. If we find evidence that education and national scientific contexts relate to the belief that science breaks down people's understanding of right and wrong, then it would underscore the need for additional data and analyses on the moral meanings publics associate with science.

Independent Variables

Individual-level education. Education is one of the primary vehicles for transmitting the cultural values associated with science (Bourdieu 1984). We therefore expect that it is associated with individuals' internalization of scientific values and the level of moral threat they associate with science.

We measure education using a six-category variable for highest level of schooling attained. Categories include (1) incomplete primary school, (2) complete primary school, (3) incomplete secondary school, (4) complete secondary school, (5) some tertiary education, and (6) tertiary degree.[4]

Despite cross-national variation in the quality and content of education, this variable provides a standardized measure of education capable of supporting comparisons between countries with diverse education systems. Ideally, we would have more detailed measures of science classes or a test of scientific knowledge. Unfortunately, such a measure is not available. Although this is an important limitation of the data, it must be weighed alongside the advantages of WVS data for our purposes, namely, the unique measure of the perceived moral effects of science and the wide variety of country contexts represented in the sample.

National scientific investment. One of this article's main goals is to examine how macro-level scientific contexts relate to individuals' moral opposition to science. To gauge the centrality of science within a society, we examine national scientific investment, measured as the percentage of national gross domestic product (GDP) devoted to spending on research and development (R&D). The variable we use is from the WDI and includes "both capital and current expenditures in the four main sectors: Business enterprise, Government, Higher education and Private non-profit. R&D covers basic research, applied research, and experimental development."[5]

R&D spending is a useful indicator of a nation's commitment to science much the way that defense or healthcare spending reflects a society's collective investment in those domains, though it does not account for differential distribution of these expenditures (e.g., across major cities versus rural areas). However, it provides an important first step to capture cross-national variation in investments in science. Presumably, the modern values associated with organized science such as rationality and liberalism are more prominent in countries with larger investments in science and technology.

Individual-level controls. Regression models include controls for several respondent characteristics related to perceptions of science. There is a substantial literature that suggests religious people are more skeptical than the nonreligious of science, and that this varies cross-nationally (Chan 2018; O'Brien and Noy 2015, 2018). We therefore control for respondents' religiosity in four ways. First, we control for religious traditions using binary variables indicating whether respondents are Catholic, Protestant,

Orthodox Christian, Jewish, Muslim, Buddhist, Hindu, another religion, or unaffiliated with organized religion. Second, we use a survey question that asked respondents how frequently they attend religious services from (1) never to (8) more than once a week. Our third measure asked respondents how frequently they pray ranging from (1) never or practically never to (8) several times a day. Fourth, we include a measure of religiosity that asked whether respondents consider themselves to be (1) an atheist, (2) not a religious person, or (3) a religious person. Additionally, we control for respondents' gender using a binary variable that equals one for female respondents. We measure age in years. We capture income using a measure that categorizes respondents' household income into deciles within each country, which facilitates cross-national comparisons.[6]

Country-level controls. We also control for cross-national differences in religiosity, political culture, and economic development. Because the moral threat posed by science is often constructed in opposition to traditional religious values, we control for national levels of religiosity and religious traditions. We control for national religious tradition with data from the World Christian Database (Johnson and Grim 2019). We use the mean level of religious service attendance in each country generated from the WVS to capture national religiosity. Including this control allows us to examine the relationship between moral opposition to science and rationalization net of secularization. In our sample, there is a moderate correlation between national scientific investment and national religious attendance ($r = -.42$).

We measure political culture using the 2008 Freedom House ratings of political rights, which ranges from one to six. The item is coded so that higher scores indicate more rights. We measure economic development with a natural log transformation of GDP per capita, which was obtained from the WDI. Finally, since data collection by the WVS occurred over five years in this wave (2010-14), we include a control variable for survey year. Descriptive statistics for the variables included in the analysis are presented in Table 1.

Analytic Strategy

Our data consist of individuals nested within countries. We therefore use hierarchical mixed-effects linear regressions to model moral concern about science cross-nationally (Rabe-Hesketh and Skrondal 2008; Raudenbush and Bryk 2002). In these models, intercept and slope coefficients are functions of country-level variables, which allow us to examine how

Table 1. Descriptive Statistics for Variables Included in the Analysis.

	Mean/Proportion	Std. Dev.	Min.	Max.
Individual-level variables ($n = 52{,}548$)				
Dependent variable				
Agreement that science breaks down people's ideas of right and wrong	5.34	2.71	1.00	10.00
Explanatory and control variables				
Education (highest degree earned)[a]	3.87	1.41	1.00	6.00
Religious service attendance (attendance at religious services)[b]	4.49	2.63	1.00	8.00
Prayer frequency[c]	5.13	2.71	1.00	8.00
Self-identified religiosity[d]	2.59	0.61	1.00	3.00
Female	0.51	0.50	0.00	1.00
Age (in decades)	4.22	1.65	1.6	9.9
Household income	4.92	2.09	1.00	10.00
Religious tradition				
Catholic	0.20	0.40	0.00	1.00
Protestant	0.11	0.32	0.00	1.00
Orthodox	0.11	0.31	0.00	1.00
Jewish	<0.01	0.05	0.00	1.00
Muslim	0.20	0.40	0.00	1.00
Buddhist	0.05	0.22	0.00	1.00
Hindu	0.05	0.22	0.00	1.00
Other	0.05	0.22	0.00	1.00
No religion (referent)	0.22	0.41	0.00	1.00
Country-level variables ($n = 42$)				
R&D expenditure (as a percent of gross domestic product [GDP])	1.04	0.95	0.04	3.47
Religiosity (average attendance at religious services)	4.36	1.35	1.84	7.23
Catholic nation (referent)	0.31	0.47	0.00	1.00
Protestant nation	0.17	0.38	0.00	1.00
Orthodox nation	0.14	0.35	0.00	1.00
Muslim nation	0.24	0.43	0.00	1.00
Buddhist nation	0.10	0.30	0.00	1.00
Other nation	0.05	0.22	0.00	1.00
Political rights	5.02	2.05	1.00	7.00

(continued)

Table 1. (continued)

	Mean/Proportion	Std. Dev.	Min.	Max.
GDP per capita (in thousands)	16.65	16.66	1.04	52.08
Year	2012.05	1.08	2010.00	2014.00

Source: Wave 6 of the World Values Survey.

[a] Categories are "incomplete primary school," "complete primary school," "incomplete secondary school: technical/vocational or university preparatory type," "complete secondary school: technical/vocational or university preparatory type," "some university-level education, without degree," and "university-level education, with degree."

[b] Categories are "never," "less than once a year," "once a year," "only on special holy days," "once a month," "once a week," and "more than once a week."

[c] Categories are "never or practically never," "less often than once a year," "once a year," "only on special holy days," "only when attending religious services," "several times each week," "once a day," and "several times a day."

[d] Categories are "an atheist," "not a religious person," or "a religious person."

respondents' attitudes are shaped by both individual and national characteristics. The regression model (prior to the addition of cross-level interactions) is:

$$y_{ij} = \beta_{00} + \beta_{10} educ_{ij} + \beta_2 X_{ij} + \beta_3 C_j + u_{1j} educ_{ij} + u_{0j} + \epsilon ij$$

where is the level of agreement that science breaks down people's ideas of right in wrong for individual i in country j. β_{00} is an overall mean intercept and u_{0j} country-specific random intercept. $\beta_{10} educ_{ij}$ is the overall mean slope for education and $u_{1j} educ_{ij}$ represents the country-specific random slope for education. Finally, X represents individual-level independent variables, C are country-level independent variables, and ϵij is an error term.[7] Analyses were conducted using Stata version 16 software. To interpret regression results, we calculate predicted values and average marginal effects using Stata's margins command.

Results

Figure 1 contains the mean level of concern about science's effects on morality in each country. The figure suggests that a substantial number of people in each country believe that science threatens understandings of right and wrong. However, there is also much cross-national variation in moral opposition to science, with mean scores ranging from 3.69 (of 10) in

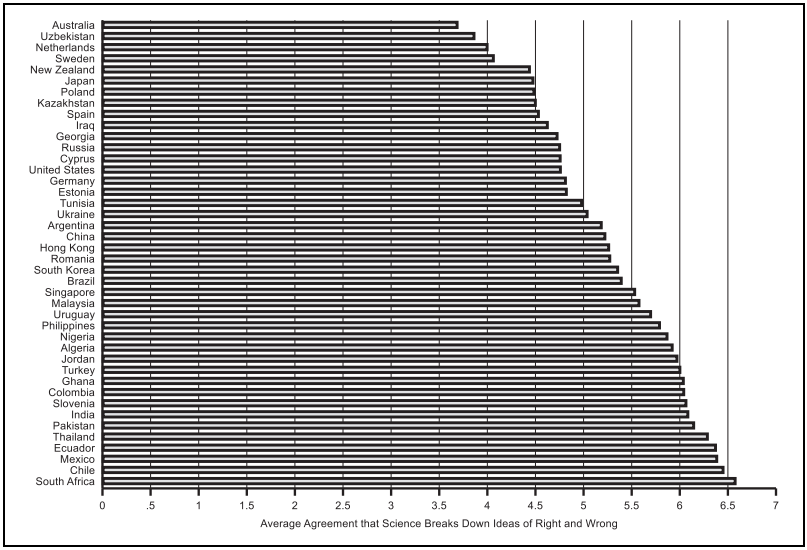

Figure 1. Level of agreement (1 = completely disagree, 10 = completely agree) that science breaks down people's ideas of right and wrong. *Source:* World Values Survey; $n = 52{,}548$ in forty-two countries.

Australia to 6.58 in South Africa. These differences provide initial evidence of the importance of country-level forces in shaping moral opposition to science. The intraclass correlation coefficient indicates that approximately 8.45 percent of the variance in beliefs about the moral consequences of science reflects differences between countries. Thus, although individual-level differences account for much of the variation in these beliefs, country context also appears to play an important role.

To examine the individual- and country-level conditions associated with the belief that science threatens morality, we estimate multilevel regression models. Our analysis proceeds in three stages. First, we introduce the individual-level covariates detailed above (model 1). Then, we add variables that measure national characteristics, including R&D spending and religiosity (model 2). Third, we add cross-level interactions between national R&D spending and individual-level education (model 3). Results are presented in Table 2.

Model 1 suggests that, as expected, higher levels of education are associated with less concern that science threatens morality. Several control variables are also associated with beliefs about science's moral

Table 2. Mixed Effects Regressions of Attitudes about the Morality of Science on Covariates.

	Model 1 Individual-level Covariates	Model 2 + Country-level Covariates	Model 3 + Cross-level Interactions: Education × R&D Expenditures
Individual-level variables			
Education	−0.16***	−0.16***	−0.09**
	(0.03)	(0.03)	(0.03)
Religious service attendance	0.04***	0.04***	0.04***
	(0.01)	(0.01)	(0.01)
Prayer frequency	0.06***	0.06***	0.06***
	(0.01)	(0.01)	(0.01)
Self-identified religiosity	0.16***	0.16***	0.16***
	(0.03)	(0.03)	(0.03)
Female	0.07**	0.07**	0.07**
	(0.02)	(0.02)	(0.02)
Age	−0.12***	−0.12***	−0.12***
	(0.04)	(0.04)	(0.04)
Age-squared	0.01*	0.01*	0.01*
	(0.00)	(0.00)	(0.00)
Income	0.03***	0.03***	0.03***
	(0.01)	(0.01)	(0.01)
Catholic[a]	0.20***	0.20***	0.20***
	(0.05)	(0.05)	(0.05)
Protestant[a]	0.20***	0.20***	0.20***
	(0.05)	(0.05)	(0.05)
Orthodox[a]	0.38***	0.39***	0.39***
	(0.07)	(0.07)	(0.07)
Jewish[a]	−0.45*	−0.45†	−0.45†
	(0.23)	(0.23)	(0.23)
Muslim[a]	0.32***	0.35***	0.35***
	(0.06)	(0.06)	(0.06)
Buddhist[a]	0	−0.01	−0.01
	(0.08)	(0.08)	(0.08)
Hindu[a]	0.45***	0.45***	0.45***
	(0.10)	(0.10)	(0.10)
Other religious tradition[a]	0.33***	0.33***	0.33***
	(0.06)	(0.06)	(0.06)
Country-level variables			
R&D expenditures		0.16	0.39*
		(0.15)	(0.17)

(continued)

Table 2. (continued)

	Model 1 Individual-level Covariates	Model 2 + Country-level Covariates	Model 3 + Cross-level Interactions: Education × R&D Expenditures
Protestant nation[a]		−0.01	<0.01
		(0.26)	(0.26)
Muslim nation[a]		−0.57†	−0.57†
		(0.30)	(0.30)
Orthodox nation[a]		−0.58*	−0.58*
		(0.26)	(0.26)
Buddhist nation[a]		0.65†	0.65†
		(0.36)	(0.36)
Other religion nation[a]		−0.07	−0.08
		(0.43)	(0.43)
National mean religious service attendance		0.04	0.04
		(0.08)	(0.08)
Political rights		0.06	0.06
		(0.07)	(0.07)
Gross domestic product per capita		−0.03**	−0.03**
		(0.01)	(0.01)
Cross-level interaction			
Education (L1) × Country-level scientific activity (L2)			−0.06**
			(0.02)
Year	0.07	0.06	0.06
	(0.09)	(0.09)	(0.09)
Constant	−128.66	−108.99	−106.64
Country variance	0.55*	0.52*	0.47*
	(0.07)	(0.08)	(0.07)
Education variance	0.02***	0.02***	0.02***
	(<0.01)	(<0.01)	(<0.01)
Log likelihood	−124,041	−124,031	−124,028
Bayesian information criterion	248,321.9	248,398.4	248,403.1

Source: Wave 6 of the World Values Survey (WVS).

Note: $n = 52{,}548$. Standard errors in parentheses.

[a]No religious denomination is referent for individual-level denomination, and Catholic religious tradition the referent for country religious tradition.

†$p < .10$.

*$p < .05$.

**$p < .01$

***$p < .001$ (two-tailed tests).

consequences. For example, individuals who attend religious services more frequently report that science is more morally harmful. Furthermore, compared to those who are unaffiliated with organized religion, Catholics, Protestants, Orthodox Christians, Muslims, Hindus, and those belonging to other religious traditions each report that science is more morally damaging. In contrast, Jews report less moral opposition to science compared to those who do no affiliate with organized religion. Additionally, women believe that science is more morally injurious than men do, which is consistent other research on gender differences in perceptions of science. Surprisingly, higher levels of income are associated with worse views of science although this relationship is only statistically significant after controlling for education. Finally, the coefficients for age and age squared suggest that age has a curvilinear relationship with the belief that science has negative effects on morality, which is lowest among the middle-aged.

Model 2 adds country-level variables. Notably, individual-level education remains associated with less concern about the moral effects of science, net of differences among countries. To illustrate the negative relationship between education and moral opposition to science, Figure 2 presents predicted values of attitudes about science's moral effects at each educational level when other covariates are at their mean values. For respondents with the least education, the predicted level of moral opposition to science is 5.82 (on a ten-point scale). For respondents with the most education, predicted moral opposition to science declines 14 percent, to 5.02. This difference is striking given the controls for several country- and individual-level predictors, including religiosity, gender, income, national religious tradition, and national economic development. Further, while the scale ranges, in theory, from 1 to 10, the highest national average is below 7, suggesting that this is a considerable change in these data.

Model 2 also suggests that several national-level variables have significant effects on the model. For example, there is less concern about the effects of science on morality in Orthodox Christian nations and more in Buddhist nations compared to Catholic ones. And, the perception that science threatens morality is less severe in more economically developed countries compared to less economically developed ones, all else equal. Notably, the effect of R&D spending is not statistically significant in Model 2. In other words, macro-level scientific context is not related to the belief that science threatens traditional values, net of other individual and country factors. However, although scientific investment does not have a significant average effect across countries, there is reason to believe that it may

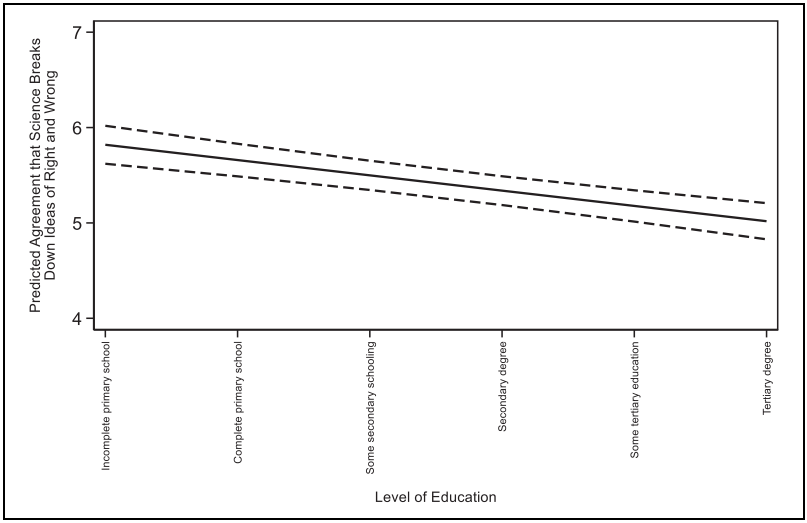

Figure 2. The effect of individual-level education on predicted agreement that science breaks down people's ideas of right and wrong. Graph contains the predicted values with 95 percent confidence intervals of agreement that science breaks down peoples' ideas of right and wrong, adjusted for respondent and country-level characteristics. Predictions are based on model 2 in Table 2. Data are from wave 6 of the WVS ($n = 52{,}548$ in forty-two countries).

moderate the effect of education on moral opposition to science. We test this contention in Model 3.

Model 3 includes a cross-level interaction between individual-level education and country-level scientific investment. The significant negative interaction coefficient suggests that the negative link between education and concern about the effects of science on morality is amplified in countries that invest the most in science and attenuated in countries that invest the least. To illustrate this pattern, Figure 3 graphs the differences in predicted moral opposition to science between the most and least educated groups in three different country contexts. While the education difference is statistically significant in each context ($p < .01$), it is more than twice as large in societies with the most scientific investment compared to those with the least (i.e., countries at the 90th and 10th percentiles of R&D spending). A difference-in-difference test (not shown) indicates that educational differences are significantly larger in high R&D countries than in low ones ($p < .01$). Moreover, predicted values (not shown) reveal that the large

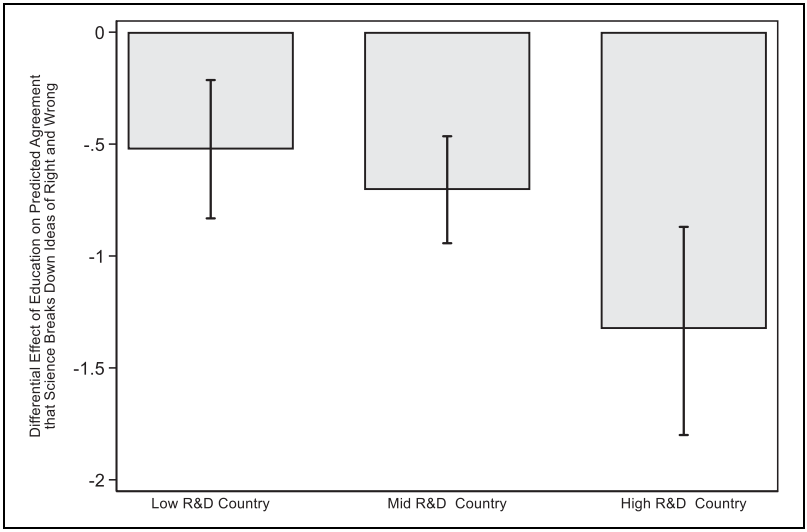

Figure 3. Marginal differences in predicted agreement that science breaks down people's ideas of right and wrong adjusted for individual- and country-level characteristics. Graph contains marginal differences in predicted values with 95 percent confidence intervals of agreeing that science breaks down people's ideas of right and wrong for high versus low education where high and low levels of education refer to individuals with a tertiary degree and those that have not completed primary school. Results presented for countries at the 90th, 50th, and 10th percentiles of the average country expenditures on research and development (R&D) as a percent of gross domestic product (GDP). Education differences within each type of country are statistically significant at the .05 level. Predictions based on model 3 in Table 2. Data are from wave 6 of the World Values Survey ($n = 52{,}548$ in forty-two countries).

education effect in high R&D countries is driven by unusually negative views of science among people with little education, not by unusually positive views of science among highly educated people. In other words, people with little education in high R&D countries report worse views of science compared to their educational peers in mid- and low-R&D countries. Instead, there is little difference in the moral outlooks on science between highly educated people in high R&D countries compared to mid- and low-R&D countries. Altogether, these findings indicate that while national scientific context does not have an average effect on moral opposition to science, it moderates the effects of individuals' education on these attitudes.

Overall, our results indicate that there is a negative relationship between education and the belief that science breaks down people's understanding of right and wrong. However, there is considerable variation between countries in the strength of this relationship. Specifically, the extent to which education reduces moral concern about science is significantly and substantially greater in countries that invest the most in science compared to those that invest the least. Importantly, these patterns are robust to controls for numerous individual- and country-level differences. Altogether, these results are consistent with the theoretical account developed in this article, which suggests that the education system transmits the cultural values of science and thereby reduces the belief that science undermines morality. However, the more deeply engrained science is in society, the more deeply it disaffects those with the least access to its status and influence. Consequently, in societies with the largest investments in science, people with the least education are most concerned about its moral consequences.

Conclusion

Reducing opposition to science has taken on new importance in light of ongoing public health and environmental crises. Recent studies suggest that much of the contemporary skepticism of science is rooted in the belief that it undermines traditional values. In this article, we have developed a framework for understanding moral opposition to science as an outcome of individual and societal-level processes. Our analysis suggests that education is a key medium for disseminating and reproducing values that are amenable to science at the individual level. However, this relationship is conditioned by macro-level forces related to rationalization.

One of this article's most important contributions is the finding that education is associated with less concern about the moral repercussions of science across countries. That is, more educated people are less likely to believe that science breaks down people's understanding of right and wrong. Notably, the education differences we find exist independently of differences in household income, which suggests that experience with the education system net of economic standing drives these differences. However, the relationship is significantly and substantially stronger in countries that invest the most in science compared to those that invest the least. The patterns cannot be attributed to other macro-level political, economic, and religious forces associated cross-national differences in

public opinion about science. We see this as evidence of the unique importance of scientific contexts in shaping the reach of scientific authority in society.

While the correlation between education and science attitudes is well known, past studies often attributed the relationship to the understanding of science gained through education. Only recently have social scientists begun to conceptualize science's moral dimensions, and our study examines these issues on a global scale. This article provides evidence that people in countries around the world believe that science undermines people's conceptions of right and wrong. Our results also suggest that education tempers this belief about science regardless of country context.

Sociologists have long known that education systems transmit social and cultural in addition to human capital. One of the cultural preferences reproduced in this process is an affinity toward modern, rational values. Education is therefore a critical marker of cultural distinction, because it shapes tastes for scientific authority. Put simply, the norms and values of science are internalized through formal education, making it likely that individuals will increasingly prefer scientific authority to other forms of cultural authority as they advance through their educational career. The moral consequences of science may therefore seem most benign to those with the most experience in the education system. In contrast, those with less education have greater social distance from science, making scientific institutions and actors a seemingly greater cultural threat. Moreover, our findings suggest that prior evidence of a positive correlation between education and science attitudes may reflect the enculturation of scientific values in addition to the accumulation of scientific knowledge.

Equally important, we found that national scientific contexts affect the link between education and moral outlooks on science. Specifically, the difference in attitudes between the most and least educated groups is, on average, two to three times larger in the nations that invest the most in science compared to those that invest the least. We suspect that this is because education is a more important site of cultural conflict in highly scientific countries. In these contexts, the salience of scientific values may strengthen outgroup opposition to science, because its threat to alternative value systems may seem most acute. Moral concern about science among the least educated is therefore greatest in these places. In societies where

science is more marginal, it is less threatening to other values systems. While education may demarcate preferences for scientific authority in these contexts as well, science's diminished cultural status may render it less hostile to alternative normative frameworks. Existing quantitative studies provide valuable insight about the foundations of scientific authority within-countries and qualitative case studies have examined particular technologies and scientific domains (Zarhin et al. 2019). Our results illustrate the importance of national scientific investment for contextualizing these relationships.

Our findings also extend research and theory on public perceptions of science. Traditionally, many studies of views of science in society assumed that publics interpret science as a source of knowledge about the natural world. This assumption reflected the literature's scrutiny of science literacy. The outcome variable we examine instead measures how people think about science vis-à-vis morality. This conceptualization of science is consistent with recent advances in social scientific work on the intersections of science, religion, and politics (Evans 2018). There is mounting evidence that opposition to science among religious and political conservatives reflects normative conflict with scientists (Evans 2014, 2018). The results of this paper further suggest that publics attribute a normative outlook to science, which filters the public's acceptance of scientific authority.

These patterns suggest at least two ways that public opposition to science can be reduced. One option is to widen the transmission of scientific values by increasing the share of the public with high levels of education. However, social and geographic inequalities in access to education, especially higher education, may intensify the cultural divide associated with educational attainment. Indeed, some have criticized formal education as currently practiced as culturally insensitive and neocolonial (Ryan 2008). A second option is to change the cultural meaning attached to science. The current association between science and liberal values is a recent historical development (Shermer 2013) and not an essential quality of science. However, political and religious conflict with science during the past several decades have likely fueled the perception that the modern cultural values of science and scientists threaten traditional lifestyles (Evans 2018). Decoupling science from this liberal sociopolitical worldview would be a slow and difficult process, but it is likely the more

effective strategy to reducing public opposition to science and making science education more inclusive.

To sum up, we argue that the association of education with reduced concern about science's effects of morality indicates that perceptions of science are grounded in cultural values rather than accumulations of knowledge, and that educational differences are most pronounced in societies where science is most prominent because its cultural eminence threatens other sources of cultural authority. This supposition, pointing to the capital and values rather than only information associated with science as significant, is bolstered by studies that do not show an effect of natural science major in college, as compared with other majors on reduced religiosity—a key source of traditional values often framed as competing with scientific approaches (Uecker and Longest 2017; Scheitle 2011). That is, if it was content alone, we might expect that exposure to natural science curricula would be more closely associated with a disavowal of traditional (in this case religious) values as compared with other majors.

Cross-national variation in the association between education and moral opposition to science suggests that in more rationalized societies, education distinguishes perceptions of science more strongly than in societies with less scientific activity. However, our conclusions are limited by the available measures and data. One important task for future researchers will be to examine other aspects of morality associated with science. While the distinction between right and wrong is a fundamental dimension of morality, further investigation is needed into other values that publics attribute to science and scientists. Additionally, while the international survey we analyzed is well-suited to support general conclusions about statistical associations, within-country or small-*N* studies are needed to clarify the processes of how contextual- and individual-level factors interactively steer beliefs about science in society. Such work can help clarify the mechanisms behind the statistical patterns we observed in this article.

Our analysis provides a valuable step forward in understanding moral outlooks related to science and shows that education is an important as a predictor of these beliefs in societies where science is most salient. Although further research is needed for a more complete understanding of the mechanisms behind these associations, this article lays an important foundation by demonstrating the empirical linkages between education, national contexts, and beliefs about the effects of science on morality.

Appendix

Table A1. Mixed Effects Regressions of Attitudes about the Morality of Science on Covariates, Controlling for Political Views.

	Model 1 Individual-level Covariates	Model 2 + Country-level Covariates	Model 3 + Cross-Level Interactions: Education × R&D Expenditures
Individual-level variables			
Education	−0.17***	−0.16***	−0.09*
	(0.03)	(0.03)	(0.04)
Religious service attendance	0.04***	0.04***	0.04***
	(0.01)	(0.01)	(0.01)
Prayer frequency	0.06***	0.06***	0.06***
	(0.01)	(0.01)	(0.01)
Self-identified religiosity	0.16***	0.16***	0.16***
	(0.03)	(0.03)	(0.03)
Female	0.06*	0.06*	0.06*
	(0.03)	(0.03)	(0.03)
Age	−0.13**	−0.13**	−0.13**
	(0.04)	(0.04)	(0.04)
Age-squared	0.01*	0.01*	0.01*
	(<0.00)	(<0.00)	(<0.00)
Income	0.02***	0.02***	0.02***
	(0.01)	(0.01)	(0.01)
Catholic[a]	0.16**	0.15**	0.15**
	(0.05)	(0.05)	(0.05)
Protestant[a]	0.21***	0.22***	0.22***
	(0.05)	(0.05)	(0.05)
Orthodox[a]	0.45***	0.47***	0.47***
	(0.07)	(0.07)	(0.07)
Jewish[a]	−0.42†	−0.41†	−0.41†
	(0.24)	(0.24)	(0.24)
Muslim[a]	0.31***	0.35***	0.35***
	(0.07)	(0.07)	(0.07)
Buddhist[a]	−0.06	−0.07	−0.08
	(0.09)	(0.09)	(0.09)
Hindu[a]	0.56***	0.57***	0.57***
	(0.12)	(0.12)	(0.12)
Other religious tradition[a]	0.33***	0.33***	0.33***
	(0.07)	(0.07)	(0.07)
Political views	0.05***	0.05***	0.05***
	(0.01)	(0.01)	(0.01)

(continued)

Table A1. (continued)

	Model 1 Individual-level Covariates	Model 2 + Country-level Covariates	Model 3 + Cross-Level Interactions: Education × R&D Expenditures
Country-level variables			
R&D expenditures		0.13	0.37*
		(0.15)	(0.17)
Protestant nation[a]		−0.02	−0.02
		(0.25)	(0.26)
Muslim nation[a]		−0.63*	−0.63*
		(0.32)	(0.32)
Orthodox nation[a]		−0.54*	−0.55*
		(0.26)	(0.26)
Buddhist nation[a]		0.63†	0.64†
		(0.36)	(0.36)
Other religion nation[a]		−0.55	−0.55
		(0.51)	(0.52)
National mean religious service attendance		0.05	0.05
		(0.09)	(0.09)
Political rights		0.1	0.1
		(0.08)	(0.08)
Gross domestic product per capita		−0.03**	−0.03**
		(0.01)	(0.01)
Cross-level interaction			
Education (L1) × Country-level scientific activity (L2)			−0.07**
			(0.03)
Year	0.07	0.04	0.04
	(0.10)	(0.09)	(0.09)
Constant	−135.29	−84.59	−80.64
Country variance	0.58*	0.46*	0.41**
	(0.08)	(0.08)	(0.07)
Education variance	0.02***	0.02***	0.02***
	(<0.01)	(<0.01)	(<0.01)
Log likelihood	−101,435	−101,423	−101,420
Bayesian information criterion	203,114.9	203,187.4	203,191.3

Source: Wave 6 of the World Values Survey (WVS).

Note: $n = 43{,}037$. Standard errors in parentheses.

[a]No religious denomination is referent for individual-level denomination, and Catholic religious tradition the referent for country religious tradition.

†$p < .10$.

*$p < .05$.

**$p < .01$.

***$p < .001$ (two-tailed tests).

Acknowledgments

The authors thank Patricia McManus and audiences at the 2019 Science and Belief in Society Conference in Birmingham, UK, and 2021 American Sociological Association Annual Meeting for helpful conversations about this research.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Shiri Noy https://orcid.org/0000-0002-0755-1652

Notes

1. The countries and regions that do not include the variables for our analysis are Azerbaijan, Armenia, Belarus, Haiti, Kuwait, Kyrgyzstan, Lebanon, Libya, the Palestinian territories, Peru, Rwanda, Taiwan, Trinidad and Tobago, Yemen, and Zimbabwe.
2. Questions on religiosity were not asked in Egypt, Morocco, and Qatar.
3. Compared to those with complete information, individuals with missing information on one or more of the explanatory variables have slightly lower household income, are slightly older, more likely to be female, Muslim, Hindu and less likely to be Catholic, Protestant, Jewish, or belong to an "Other" denomination.
4. This measure is a transformation of an eight-category variable that distinguishes between "technical/vocational" and "universitypreparatory" tracks in secondary education. Since these different educational tracks cannot be ranked, we combine them. Results from analyses of the untransformed eight-category education variable are consistent with those presented here.
5. Available at https://data.worldbank.org/indicator/gb.xpd.rsdv.gd.zs. There were some countries for which this variable was unavailable in 2010. Therefore, we used data from earlier years, and in two cases from 2011, with the understanding that levels of research and development remain comparatively stable within countries over time.
6. Table A1 in Appendix contains supplementary analyses that controlled for respondents' self-reported political views, which found that right-leaning political ideology is associated with more agreement that science breaks down people's ideas of right and wrong. However, the conclusions about national context

and education discussed in this article are unaffected by the inclusion of this control for political views. We opt not to include this variable in the main analysis because there is no data for China, Jordan, and Singapore once this variable is included.

7. Supplementary analyses with original country weights provided by the World Values Survey yield the same conclusions as those presented in this paper.

References

Allchin, Douglas. 1999. "Values in Science: An Educational Perspective." *Science & Education* 8 (1): 1-12.

Allum, Nick, Patrick Sturgis, Dimitra Tabourazi, and Ian Brunton-Smith. 2008. "Science Knowledge and Attitudes across Cultures: A Meta-analysis." *Public Understanding of Science* 17 (1): 35-54.

Bourdieu, Pierre. 1984. *Distinction.* Translated by *R. Nice*. Cambridge, MA: Harvard University Press.

Bruce, Steve. 2002. *God Is Dead: Secularization in the West*, Vol. 3. Oxford, UK: Blackwell.

Chan, Esther. 2018. "Are the Religious Suspicious of Science? Investigating Religiosity, Religious Context, and Orientations towards Science." *Public Understanding of Science* 27 (8): 967-84.

Cole, Jonathan R. 1979. *Fair Science: Women in the Scientific Community*. New York: Free Press.

Drori, Gili S., John W. Meyer, Francisco O. Ramirez, and Evan Schofer. 2003. *Science in the Modern World Polity: Institutionalization and Globalization*. Stanford, CA: Stanford University Press.

Evans, John H. 2013. "The growing social and moral conflict between conservative Protestantism and science." *Journal for the Scientific Study of Religion* 52(2): 368-385.

Evans, John H. 2014. "Faith in Science in Global Perspective: Implications for Transhumanism." *Public Understanding of Science* 23 (7): 814-32.

Evans, John H. 2018. *Morals Not Knowledge: Recasting the Contemporary US Conflict between Religion and Science*. San Diego: University of California Press.

Gauchat, Gordon. 2012. "Politicization of Science in the Public Sphere: A Study of Public Trust in the United States, 1974 to 2010." *American Sociological Review* 77 (2): 167-87.

Gieryn, Thomas F. 1983. "Boundary-work and the Demarcation of Science from Non-science: Strains and Interests in Professional Ideologies of Scientists." *American Sociological Review* 48 (6): 781-95.

Gorski, Philip S. 2003. "Historicizing the Secularization Debate." In *Handbook of the Sociology of Religion*, edited by M. Dillon, 110-22. Cambridge, MA: Cambridge University Press.

Habermas, Jürgen. 1981. *Reason and the Rationalization of Society*. Boston, MA: Beacon Press.

Harland, Tony. 2009. "The University, Neoliberal Reform and the Liberal Educational Ideal." In *The Routledge International Handbook of Higher Education*, edited by M. Tight, K. H. Mok, J. Huisman, and C. Morphew, 511-21. New York: Routledge.

Hoeg, Darren G., and John Lawrence Bencze. 2017. "Values Underpinning STEM Education in the USA: An Analysis of the Next Generation Science Standards." *Science Education* 101 (2): 278-301.

Inglehart, Ronald, and Wayne E. Baker. 2001. "Modernization's Challenge to Traditional Values: Who's Afraid of Ronald McDonald?" *The Futurist* 35 (2): 16.

Irwin, Alan, and Brian Wynne. 2003. *Misunderstanding Science?: The Public Reconstruction of Science and Technology*. Cambridge, UK: Cambridge University Press.

Johnson, Todd M., and Brian J. Grim. 2019. *"World Religion Database." Leiden/Boston*. 2019. Accessed September 26, 2019. https://worldreligiondatabase.org/.

Kuhn, Thomas S. 1962. *The Structure of Scientific Revolutions*. Chicago, IL: University of Chicago Press.

Kumarassamy, Jayanthy, and Caroline Koh. 2019. "Teachers' Perceptions of Infusion of Values in Science Lessons: A Qualitative Study." *Research in Science Education* 49 (1): 109-36. doi: 10.1007/s11165-017-9612-8.

Latour, Bruno, and Steven Woolgar. 1979. *Laboratory Life: The Social Construction of Social Facts*. Princeton, NJ: Princeton University Press.

Locke, Simon. 2001. "Sociology and the Public Understanding of Science: From Rationalization to Rhetoric1." *The British Journal of Sociology* 52 (1): 1-18.

Long, J. Scott. 1978. "Productivity and Academic Position in the Scientific Career." *American Sociological Review* 43 (6): 889-908.

Mann, Marcus, and Cyrus Schleifer. 2020. "Love the Science, Hate the Scientists: Conservative Identity Protects Belief in Science and Undermines Trust in Scientists." *Social Forces* 99 (1): 305-32.

Merton, Robert K. 1942. "A Note on Science and Democracy." *Journal of Legal and Political Sociology* 1 (1/2): 115.

Miller, Boaz. 2020. "Is Technology Value-neutral?" *Science, Technology, & Human Values* 46 (1): 53-80. doi: 10.1177/0162243919900965.

Noy, Shiri, and Timothy L. O'Brien. 2016. "A Nation Divided: Science, Religion, and Public Opinion in the United States." *Socius* 2 (2016): 1-15.

Noy, Shiri, and Timothy L. O'Brien. 2019. "Science for Good? The Effects of Education and National Context on Perceptions of Science." *Public Understanding of Science* 28 (8): 897-916. doi: 10.1177/0963662519863575.

O'Brien, Timothy L., and Shiri Noy. 2015. "Traditional, Modern, and Post-secular Perspectives on Science and Religion in the United States." *American Sociological Review* 80 (1): 92-115. doi: 10.1177/0003122414558919.

O'Brien, Timothy L., and Shiri Noy. 2018. "Cultural Authority in Comparative Context: A Multilevel Analysis of Trust in Science and Religion." *Journal for the Scientific Study of Religion* 57 (3): 495-513. doi: 10.1111/jssr.12537.

Popper, Karl. 2004. *Conjectures and Refutations: The Growth of Scientific Knowledge*. London, UK: Routledge.

Rabe-Hesketh, Sophia, and Anders Skrondal. 2008. *Multilevel and Longitudinal Modeling Using Stata*. College Station, TX: STATA press.

Raudenbush, Stephen W., and Anthony S. Bryk. 2002. *Hierarchical Linear Models: Applications and Data Analysis Methods*, Vol. 1. Thousand Oaks, CA: Sage.

Ritzer, George. 1998. "The Weberian Theory of Rationalization and the McDonaldization of Contemporary Society." *Illuminating Social Life: Classical and Contemporary Theory Revisited* 37-61.

Ryan, Ann. 2008. "Indigenous Knowledge in the Science Curriculum: Avoiding Neo-colonialism." *Cultural Studies of Science Education* 3 (3): 663-702. doi: 10.1007/s11422-007-9087-4.

Scheitle, Christopher P. 2011. "Religious and Spiritual Change in College: Assessing the Effect of a Science Education." *Sociology of Education* 84 (2): 122-36. doi: 10.1177/0038040711401811.

Shapin, Steven. 1990. *Science and the Public*. New York: Routledge.

Shapin, Steven, and Harry Collins. 1994. "A Social History of Truth: Civility and Science in Seventeenth-century England." *Nature* 370 (6491): 605.

Sherkat, Darren E. 2017. "Religion, Politics, and Americans' Confidence in Science." *Politics & Religion* 10 (1): 137-60.

Shermer, Elizabeth Tandy, ed. 2013. *Barry Goldwater and the Remaking of the American Political Landscape*. Tucson: University of Arizona Press.

Snow, Catherine E. and Kenne A. Dibner, eds. 2016. *Science Literacy: Concepts, Contexts, and Consequences*. Washington, DC: National Academies Press.

Terrén, Eduardo. 2002. "Post-modern Attitudes: A Challenge to Democratic Education." *European Journal of Education* 37 (2): 161-77.

Uecker, Jeremy E., and Kyle C. Longest. 2017. "Exposure to Science, Perspectives on Science and Religion, and Religious Commitment in Young Adulthood." *Social Science Research* 65 (2017): 145-62.

Waddell, Eric. 1977. "The Hazards of Scientism: A Review Article." *Human Ecology* 5 (1): 69-76.

Weber, Max. (1904) 2013. *The Protestant Ethic and the Spirit of Capitalism*. New York: Routledge.

Zarhin, Dana, Maya Negev, Simon Vulfsons, and Sharon R. Sznitman. 2019. "'Medical Cannabis' as a Contested Medicine: Fighting Over Epistemology and Morality." *Science, Technology, & Human Values* 45 (3): 488-514. doi: 10.1177/0162243919862866.

Author Biographies

Shiri Noy is an assistant professor of sociology at Denison University. In addition to her research on public perspectives of science, she conducts research on global health and development.

Timothy L. O'Brien is an associate professor of sociology at the University of Wisconsin–Milwaukee. In addition to public perceptions of science, he studies the use of scientific knowledge in courts.