8-3-2018

Are Biological Science Knowledge, Interests, and Science Identity Framed by Religious and Political Perspectives in the United States?

Joseph C. Jochman
University of Nebraska-Lincoln, joseph.jochman@gmail.com

Alexis Swendener
University of Nebraska-Lincoln, aswendener@unl.edu

Julia McQuillan
University of Nebraska - Lincoln, jmcquillan2@Unl.edu

Luke Novack
University of Nebraska-Lincoln

Jochman, Joseph C.; Swendener, Alexis; McQuillan, Julia; and Novack, Luke, "Are Biological Science Knowledge, Interests, and Science Identity Framed by Religious and Political Perspectives in the United States?" (2018). *Sociology Department, Faculty Publications*. 591.
http://digitalcommons.unl.edu/sociologyfacpub/591

Published in *The Sociological Quarterly,* 59:4 (2018), pp 584-602.
doi 10.1080/00380253.2018.1481726

Published 3 Aug 2018.

Are Biological Science Knowledge, Interests, and Science Identity Framed by Religious and Political Perspectives in the United States?

Joseph C. Jochman, Alexis Swendener,
Julia McQuillan, and Luke Novack

Department of Sociology, University of Nebraska–Lincoln, Lincoln, Nebraska, USA

Corresponding author — Joseph C. Jochman joseph.jochman@gmail.com University of Nebraska-Lincoln, Department of Sociology, 711 Oldfather Hall, Lincoln, NE 68588-0334, USA

Abstract
Science trust and views of science differ by political and religious orientations. In this study we examine whether political and religious perspectives are also associated with biological science knowledge, science interest, and general science identity. Results show that conservative Protestants have lower biological science knowledge than other religious groups on several specific topics. Party affiliation is associated with vaccine knowledge but not science interest and identity. Adjusting for demographic characteristics explains some political and religious group differences, but not all. We discuss implications regarding attention to potential political and religious framings of science topics in public education efforts.

Keywords: Politics, religion, science framing, science identity, science interest, science knowledge

Introduction

The ability to navigate basic life demands such as health-care decisions, effective voting on science-related issues, and absorbing science-related news in the contemporary United States often demands accurate science knowledge. Therefore, conventional western science knowledge (Lam 2008) is helpful for contemporary life. Some Americans hold favorable views toward science and see investment in science as valuable (Pew Research Center 2015), yet many also give incorrect answers to science-knowledge questions, including basic biological facts (National Science Foundation 2012). There is evidence that contemporary Americans have higher trust and more favorable opinions of science than citizens of 40 years ago (Gauchat 2012; Sherkat 2017), yet these increases have not been uniform. For example, politically and religiously conservative Americans have had greater declines in opinions of and trust in science than members of other political or religious groups (Gauchat 2012, 2015; Miller 2004; Sherkat 2017).

Contemporary western science emphasizes minimizing bias and maximizing neutrality and objectivity in research. Studies of scientists describe efforts to separate scientific research from religious perspective even though many scientists are also religious (Ecklund 2010; Pew Research Center 2009). Most scientists seek to work in an "apolitical" space, not overtly trying to change political and religious structures (Gauchat 2012). Yet, political debates and religious controversies often focus on science because of the perceived implications of scientific findings for deeply held values (Noy and O'Brien 2016). As news and information become more immediately accessible, many members of the public rely on their values and beliefs (including religious and political beliefs) to help them select what issues to give attention to and what to accept as true information (Nisbet and Mooney 2007). Accordingly, prior evidence suggests that the public understanding of science is framed through certain value predispositions and schemas associated with both politics and religion (e.g., Goren 2005; Ho, Brossard, and Scheufele 2008). Indeed, political and religious groups sometimes oppose scientific statements and advancements that conflict with political or religious worldviews or that challenge authority over decision-making, morality, and the nature of the universe (Evans and Evans 2008; Johnson, Scheitle, and Ecklund 2015). Questions remain, however, about the implications of political partisanship, religious affiliation, and religiosity for the value predispositions and schemas that might shape understandings of conventional western biological science knowledge.

In this study we use survey data of random samples of Nebraskans to examine if politics and religion are associated with biological science knowledge, interest in biological science, and general science identity. Research suggests that public opinion and trust in science are associated with value predispositions and schemas connected with politics and religion that can shape the personal or social relevance of science-related topics (Goren 2005; Nisbet and Mooney 2007). We extend prior work to assess whether political party affiliation, political ideology, religious affiliation, and religious service attendance are associated with multiple measures of biological science knowledge, biological science interest, and general science identity. The science topics include 17 measures of human biological knowledge including vaccines, diseases, evolution, and microbes. Multivariate models show which political and religious associations persist with science outcomes after controlling for relevant sociodemographics.

Value predispositions, schemas, and the framing of science

Science opinions are shaped by political partisanship and religion. Political and religious identities can operate as "perceptual filters" to determine what people consider relevant and true. Furthermore, politics and religion act as sources of knowledge for topics that science also covers, therefore potentially conflicting with science (Brossard and Nisbet 2005). "Value predispositions" refer to the belief systems and values connected to politics and religion that are involved with the selection of or alignment with information that is in agreement with one's beliefs and values (Goren 2005; Ho et al. 2008). Value predispositions serve as "information shortcuts" (Ho et al. 2008:176) that "powerfully influence information processing and judgment" (Goren 2005:881). Importantly, value predispositions associated with politics and religion work in complex ways to generate broad societal differences in opinions of science among members of political and religious groups (Brossard and Nisbet 2006; Ho et al. 2008). Such differences likely reflect differential selection of media and information congruent with the value predispositions connected to political and religious groups (e.g., Nisbet and Mooney 2007).

Political and religious value predispositions are also associated with the schemas that individuals use to determine the importance of information, including scientific information. Nisbet (2005) defines schemas as the cognitive processes through which information becomes organized into a coherent worldview. Schemas are thought to act as "mediators" between value predispositions and opinions of science because schemas link broader value predispositions to the cognitive processes used to shape science (or antiscience) worldviews and the acceptance (or rejection) of scientific statements and knowledge (Nisbet 2005). Thus, value predispositions and schemas are considered part of the process of political and religious framing of science.

Politics, trust, and opinions of science

There is a rich literature on the association among political partisanship, ideology, and opinions of science. Gauchat (2012) and Sherkat (2017) summarize general trends linking party affiliation and religion, levels of science trust, and favorable public opinion of science from the 1970s–2010s. Both studies note a general decrease in trust and opinions of science among Republicans and more conservative religious and political groups over time. Hartman (2015) summarizes the "culture wars" of the 1980s and 1990s in the United States in which the Republican Party became more religious and the Democratic Party more secular. Gauchat (2015) describes the contemporary "politicization of science" as the alignment of political partisanship with scientific statements and advancements. The politicization of science often involves factors such as science-related funding decisions (e.g., stem-cell research), individual mandates (e.g., mandatory vaccinations), and government policies (e.g. environmental standards, climate change). For example, technologies and public-health mandates are sometimes at odds with political, ideological views such as freedom from the state (Johnson et al. 2015). Antiscience attitudes and objections to the political limits of science may also lead to lower overall science opinion and interest (Gauchat 2008; Miller 2004; Sherkat 2017).

Political alignments and the politicization of science shape attitudes toward science. For example, McCright and Dunlap (2011) found that Democrats and liberals are generally more favorable toward contemporary scientific information and express greater concern for topics such as climate change than Republicans or conservatives. Libertarians may oppose vaccination mandates because of perceptions of government overreach in healthcare, while liberals may oppose mandates because of pharmaceutical marketing strategies (Lewandowsky, Gignac, and Oberauer 2013). Antivaccination views may also be related to fears of overimmunization and the chemical composition of vaccines (Song 2014). Conservatives may base resistance to technological advancements (e.g., stem-cell research, computer technologies) on fears of rapid modernization—a sense that the "world is changing too fast" (Johnson et al. 2015; Miller 2004). Opposition to science topics likely also lowers engagement with scientific information, with implications for science knowledge, interest, and identity across political alignments (Brossard and Nisbet 2006; Ho et al. 2008; Sturgis and Allum 2004).

Religious affiliation, religiosity, and science

Religious affiliation and religiosity are also associated with trust and opinions of science in the United States. Science and religious leaders often frame science and religion in opposition (Evans and Evans 2008; Evans and Feng 2013). For example, Evans and Evans (2008:89) argue that social scientists often view religion as an "object of study" rather than a "source of knowledge." Religion and science sometimes conflict over issues of knowledge authority and worldviews regarding the meaning and structure of the universe and life (Gauchat 2008, 2012). At other times there are simply separations between religion and science, even though those who are highly religious may frame scientific findings within preexisting religious worldviews (Ecklund 2010; Evans and Evans 2008; Johnson et al. 2015).

Religious affiliation and belief can influence trust, understanding, and knowledge of science through the value predispositions and schemas linked to religious identities and beliefs. For example, individuals with fundamentalist religious worldviews may see environmental science and technology as a form of "earth worship" and therefore reject them (Sherkat 2017:141). Individuals who view the Bible as the literal word of God may have less support for science-funding policies and be less accepting of the influence of science in public policy debates (e.g., stem-cell research, fertility and reproductive science) (Evans and Feng 2013; Gauchat 2015). In addition, more frequent religious service attendance—a focal predictor of religiosity broadly defined among US

Christians (Presser and Chaves 2007)—is often associated with lower trust and opinion of science (Gauchat 2012; Sherkat 2017). Gauchat (2008) suggests that service attendance may influence science views through social network homophily, shared values, and value dispositions of like-minded individuals. Compared to those who are religious, however, those who are not religious have shown higher interest, positive opinion, and trust in science in other studies (Noy and O'Brien 2016; Sherkat 2017).

Politics, religion, education, and science

The links between politics and religion are multidimensional, and it is therefore important to account for both political partisanship and religion in shaping science knowledge, interest, and identity. Politics and religion, however, are also associated with education (Schwadel 2011), and education is associated with science trust and views of science (Gauchat 2015; Sherkat 2017). Political or religious associations with science outcomes, therefore, may disappear when accounting for education. Yet, there are inconsistent findings about the association of education and religious affiliation. For example, Sherkat (2017) found that conservative Protestants are less likely to seek higher education and study science topics, but Johnson et al. (2015) found that conservative Protestants are more likely to enroll in science classes during college. Perhaps more important than the association between religious affiliation and seeking science education is the finding that differences in science outcomes by political and religious groups persist after adjusting for level of education (Miller 2010; Sherkat 2011; Sturgis and Allum 2004). In addition to education, other studies find that the association between religious affiliation and science knowledge does not persist after controlling for demographic characteristics (Zigerell 2012). Miller (2010) and Sherkat (2017), however, both find that more religiously conservative individuals have lower science opinions and trust after adjusting for age, gender, and socioeconomic status.

Current study

Guided by prior research and frameworks, we evaluate the extent to which politics and religion are associated with biological science knowledge, biological science interest, and general science identity. In addition, we build on prior research that has focused on trust in science to assess vaccination knowledge, curiosity, and explicit science identities (Hill et al. 2017). Including a variety of measures of science topics, plus science orientation, provides a way to assess if the specific word "science," specific science topics, or general science interest are more or less shaped by the value predispositions and schemas connected to politics and religion. Based upon frameworks of value predispositions and schemas as well as prior research we predict that individuals with more conservative political or religious alignments will have less accurate biological science knowledge (based upon contemporary western understandings of science and scientific consensus), lower biological science interest, and lower science identities than individuals with less conservative political or religious alignments. This study advances our understanding of how political and religious perspectives shape consumption of science, which is relevant for navigating aspects of contemporary life.

Data and method

This study uses the 2011, 2014, and 2015 Nebraska Annual Social Indicators Surveys (NASIS) (Nebraska Annual Social Indicators Survey 2011; 2014; 2015). Administered by the University of Nebraska Bureau of Sociological Research, NASIS is an annual repeated cross-sectional survey of Nebraskans ages 19 or older. Conducted by mail, the 2011 (N = 906, response rate = 39.3 percent), 2014 (N = 1,018, response rate = 29.1 percent), and 2015 (N = 1,143, response rate = 32.7 percent) surveys had noncompletion primarily due to undeliverable addresses, ineligible households, and refusal. Following the guidelines for the data sets, we used sampling weights calculated based on geographic region, age, gender, number of adults in the household, and survey nonresponse.

Dependent variables

We measured biological science knowledge, biological science interest, and general science identity using 19 variables. We measured *biological science knowledge* with the following questions: 1) "Humans share a common ancestor with apes (true)," 2) "We owe our lives to the community of other organisms that share our bodies (true)," 3) "Death is a part of the biology of life (true)," 4) "Many diseases result from interactions between genes and the environment (true)," 5) "Women can wait to have a baby until their late 30s and still have a good chance of having a baby" (false, Maheshwari, Hamilton, and Bhattacharya 2008), and 6) "Do you believe people can die from the measles (yes)?" Each item ranged from 1 = strongly disagree to 5 = strongly agree. Responses considered accurate based upon contemporary western science are in parentheses at the end of each statement and are coded 1 for the highest possible category (i.e., strongly agree, strongly disagree for the fertility item); all other responses are coded as 0.

Because six questions focused on vaccination, we grouped them together as follows: 1) "Vaccines use our body's natural defenses to cure disease (true)" and 2) "How important do you think it is that children be vaccinated? (very important)" Four remaining vaccination items were similar across two measures in 2014 and 2015: 3) (2014) and 4) (2015) "If all children were to receive vaccines, fewer, more or about the same number of people will get sick? (fewer)" and 5) (2014) and 6) (2015) "When a child receives the measles vaccine, the vaccine protects, harms, or doesn't make much difference to the child's health? (protects)" Accurate responses were coded 1 and all others 0. Because the scientific consensus indicates that vaccination is important, we considered "very important" as accurate for the question about the importance of vaccination.

We considered those endorsing in the following *biological science interest* topics as having higher science interest: 1) "How interested are you in learning more about gut microbes and human health?," 2) "How interested are you in learning more about genetically engineered foods and human health?," and 3) "How interested are you in learning more about vaccines and human health?" (1 = not at all interested to 4 = very interested) (Cronbach's alpha = 0.76). We measured *general science identity* with the following questions: 1) "How curious are you about the world?" (1 = not at all to 4 = very), 2) "How much do you think you are a science kind of person?" (1 = not at all to 4 = totally), 3) "How much do you like science?" (1 = not at all to 4 = a lot), and 4) "How much does science help you make decisions that affect your body?" (1 = I don't know, 2 = not at all, 5 = a lot)

(Cronbach's alpha = 0.70). We created indicator variables in which 1 indicates the highest positive category (e.g., like science very much, very curious about the world) and 0 indicates any other response. For the item, "How much does science help you make decisions that affect your body?" the response option "I don't know" was coded as 0.

Independent variables

We measured *political party affiliation* with the question, "Generally speaking, do you consider yourself a Democrat, Republican, Independent, or something else?" We created a set of indicator variables for Democrat, Independent, Republican, and Other political party affiliation. Because it was the largest group, we selected Republicans as the reference group (characteristic of Nebraska).

We measured *political ideology* with the question, "In general how do you see yourself politically?" We created a set of indicator variables for liberal (1 = very liberal or liberal), neutral (1 = middle of the road), conservative (1 = conservative or very conservative) and Other ideology (1 = Other ideology).[1] Because it is the largest category, conservatives were selected as the reference group (characteristic of Nebraska).

To measure *religious affiliation* we created a series of indicator variables based upon the question, "Do you consider yourself to be Protestant, Catholic, Jewish, Muslim, or something else?" No religious affiliation was a response option. We further distinguished between conservative Protestant and mainline Protestants using the question, "Within the Protestant faith, do you consider yourself to be: a) evangelical Protestant, b) fundamental Protestant, c) mainline Protestant, or d) liberal Protestant?" We coded evangelical and fundamental Protestants as "conservative Protestants" and mainline and liberal Protestants as "mainline Protestants." We coded respondents who reported a Protestant affiliation but who did not provide a denominational affiliation as "nonspecific Protestants." Because few people selected Jewish, Muslim, or another affiliation, we combined members of these groups into the single category of "other religion." In addition, because prior religion and science research has focused on conservative Protestants, we selected them as the reference group. We measured *religious service attendance* using the question, "How often do you attend religious services?"(1 = never, 8 = several times a week).[2]

Control variables

Consistent with prior research on public attitudes about science we included several control variables that could explain apparent associations among political, religious, and science outcomes: age, gender, race/ethnicity, marital status, education, geography, and self-rated health. Similar to the state of Nebraska there were few nonwhite respondents (i.e., African American, Hispanic, Asian American, American Indian, Pacific Islander); thus we collapsed *race/ethnicity* into an indicator variable for nonwhite (=1) compared to white (=0). We measured *educational attainment* with the variable, "What is the highest level of education you have attained?" We created indicators for "high school diploma or less" (reference = 0), "greater than high school but less than a bachelor's degree" (some college = 1), and "bachelor's degree or greater" (=1).

We included an indicator for marital status because marriage is still relevant for fertility (Mahoney 2010) and one of the outcomes addresses knowledge of fertility. In addition, married individuals tend to have stronger social connections and therefore might have more access to biological science knowledge (Hout and Fischer 2002). We measured *marital status* with an indicator variable for not married (=1) if the respondent had never been married, divorced, widowed, separated, or cohabiting. Additionally, Nebraska has many farmers (USDA NASS 2017) and some of the outcomes items relate to farming (e.g., microbes or genetically modified organisms), therefore we included an indicator for *geography* (live in the open country/on a farm = 1, in a town/city = 0). Finally, because our focus was primarily on biological science knowledge and health, we included a measure of self-rated health (1 = poor, 4 = excellent) to measure motivation to learn more about specific biological science topics.

Analytic strategy

Because the data came from surveys conducted in three different years, we first assessed if we could combine them into one analysis or keep them separate. We conducted Bonferroni tests of differences in means or proportions to compare years (see Table 1). We conducted year-specific analyses because several variables differed by year (e.g., means/proportions of conservative ideology, no religious affiliation, nonwhite, open country/farm) and for the most part different dependent variables were asked in different years.

There was minimal missing data (< 5 percent) for most variables. To maintain as much data as possible, we imputed missing data across 10 data sets using the Stata "ice" command (White, Royston, and Wood 2011). We followed the multiple imputation then deletion (MID) approach (Von Hippel 2007). The MID approach includes both the dependent and independent variables in the imputation model, then omits imputed values of the dependent variable(s) following imputation. The MID method preserves the underlying covariance between the independent and dependent variables and helps to protect imputation estimates from problematic imputed values and unnecessary statistical error resulting from imputed values of the dependent variable(s) (Von Hippel 2007). We conducted robustness checks on the MID method by comparing both imputation estimates that did not impute on the dependent variables and those that imputed on the dependent variables but did not omit imputed cases on the dependent variables. Results were consistent across the three models (available upon request).

To answer our core questions we conducted bivariate associations of the variables measuring political and religious characteristics with all of the biological science knowledge, science interest, and science identity measures. We then conducted multivariate associations using the same set of focal independent and dependent variables, adding relevant control variables. Our goal was to determine if political and religious associations are spurious or remain after adjusting for differences in composition (e.g., level of education, age, race/ethnicity).

Findings

Table 1* shows descriptive statistics by year. In addition to the mean or proportion of each variable by year, we also provided the percentage of items missing data. Because all of the dependent variables are dichotomous, the mean value indicates the proportion of respondents reporting accurate biological science knowledge, high science interest, and high science identity. We provide means for service attendance, age, and self-rated health in the original metric in the descriptive statistics in Table 1 (with standard deviations) yet center these

* Tables 1 – 5 follow the **References**.

variables in the multivariate analyses to make the constant more easily interpretable. To assess the consistency of the means and proportions across the years we provide subscripts indicating significant differences among the years.

Similar to the population of Nebraska most participants were white, Republican, conservative, mainline Protestant or Catholic, and well educated (US Census Bureau 2017). More women than men responded to the survey. Participants ranged in age from 18 to 100; the average age for all survey years was in the 50s. Less than a fifth of the participants accurately answered most of the general biological science knowledge questions, but about half accurately responded that death is part of the biology of life. Accurate knowledge of vaccines depended upon the specific question. Only 20 percent knew that vaccines use our bodies' natural defenses to cure illness. Much higher percentages (62–92 percent) accurately answered other questions about vaccines. Just over half of the participants said they were curious about the world (a characteristic of scientists), about a third said that they like science, and about a third said that they use science for health decisions that affect their bodies—yet fewer think of themselves as a science kind of person (19 percent). Between 20–30 percent expressed interest in learning more about various contemporary science topics (i.e., GMOs, gut microbes, and vaccines).

We next explored if politics and religion are associated with the focal dependent variables (Table 2). Several of the science-related measures are unique to our study; therefore, we also provided the bivariate education associations as a validity check to ensure that the measures are reasonable science knowledge items. Table 2 contains the proportion of accurate answers by party affiliation, ideology, religious affiliation, and level of educational attainment. For service attendance, we show the mean level of attendance among those who answered inaccurately ("Inaccurate") and accurately ("Accurate"). We used ANOVA F-tests to determine if differences between groups were statistically significant.

Table 2 provides evidence that politics and religion are associated with knowledge of several science topics. There were significant bivariate associations for all types of items. Overall, higher proportions of Democrats, liberals, other religions, the religiously unaffiliated, and people with lower service attendance had higher science knowledge, interest, and identity than other groups. A few measures, however, had remarkably consistent proportions across political parties (e.g., about 62 percent of each party knew that people can die from the measles, and 15–23 percent knew that many diseases result from gene–environment interactions).

For most measures people with higher levels of education tended to give responses that were more accurate and had higher science interest and identity than people with less education. There were five measures not associated with education: a) "Many diseases result from interactions between genes and the environment," b) "Women can wait to have a baby until their late 30s and still have a good chance of having a baby," c) "How important do you think it is that children be vaccinated?," d) "If all children were to receive vaccines, what option best describes the result?," and e) "How interested are you in learning more about vaccines and human health?" Thus, these items may not capture general science knowledge, schools may not teach these topics, or these topics may be too recent to have educational associations.

Having established that religion and politics are associated with at least some science knowledge, interest, and identity measures, we next assessed if the associations persisted when we controlled for characteristics that are associated with the focal independent variables (politics and religion) and science outcomes. We separated the logistic regression models into three tables based on broader groupings of a) biological science knowledge, b) biological science knowledge specific to vaccination, and c) biological science interest and general science identity.

Biological science knowledge

Table 3 shows binary logistic regression results as odds ratios for the biological science knowledge items. In the full model few of the political party affiliation associations remain, but the item about genes and the environment was significant, with Democrats having less accurate knowledge than Republicans. In addition, political liberals had more accurate knowledge than conservatives on the questions about communities of organisms and genes and the environment but less accurate knowledge about fertility.

There were also differences between religious groupings and several of the biological science knowledge items. Conservative

Protestants had less accurate evolution knowledge than mainline Protestants, Catholics, other religions, or the nonaffiliated. Similarly, almost all religious groups were more likely to have accurate knowledge about communities of organisms and death as a part of life compared to conservative Protestants. Higher service attendance was associated with lower knowledge of gene-environment interactions in both the bivariate and multivariate models. Higher attendance, however, was associated with higher knowledge about women's fertility in their late 30s in both the bivariate and multivariate analyses. Additionally, mainline Protestants and Catholics were more likely than conservative Protestants to know one can die from the measles. In the full model those with higher levels of education had more accurate knowledge for three of the six biological science knowledge items. Therefore, certain demographic factors, but not all, explain some of the religious and political associations with biological science knowledge. Every science outcome was associated with either politics or religion in the final models.

Biological science knowledge specific to vaccination

Table 4 shows binary logistic regression results for vaccine-specific outcomes. Three outcomes in 2015 ("vaccines work with the body's natural defenses," "importance of childhood vaccinations," "if all children were vaccinated would this result in more or fewer sick) had party affiliation associations in the bivariate models but not the multivariate models. Three other items ("if all children were vaccinated," asked in 2014, "when a child receives the measles vaccine would this help or harm health," asked in 2014 and 2015) continued to be associated with party affiliation in the full model. Democrats had more accurate knowledge than Republicans on whether childhood vaccinations would result in more or fewer sick children in 2014. Other party affiliations had less accurate knowledge than Republicans on whether vaccinations would result in more or fewer sick in 2014; the same was true for the measles vaccination helping rather than harming health in 2014 and 2015. Additionally, liberals were more likely than conservatives to know that vaccines use our body's natural defenses and that it is important for children to be vaccinated.

There were fewer religious affiliation associations with the vaccine items. Mainline Protestants were more likely than conservative

Protestants to accurately answer that when all children receive vaccines, the result is fewer sick children (2014), and those with no affiliation were less likely than conservative Protestants to accurately answer the 2015 version of the item regarding what happens when a child receives the measles vaccine. In addition, higher religious service attendance was associated with less accurate responses about measles vaccinations helping health in 2014 and 2015.

Biological science interest and general science identity

Similar to patterns for biological science and vaccination knowledge, Table 5 shows there were more political and religious associations with the science interest and identity items at the bivariate rather than multivariate level, but important differences remain. First, Other political party members and Independents had higher interest in learning more about gut microbes, and Independents had higher interest in learning about genetically engineered foods compared to Republicans. In addition, Other party members were more likely to think of themselves as a science kind of person than Republicans. Democrats did not differ from Republicans on any of the science interest and identity items in the adjusted model, suggesting that other characteristics—such as education or gender—could explain the bivariate associations between these groups. Liberals, however, indicated more interest in learning about GMOs and vaccines than conservatives.

Science identity was also associated with religion. Respondents with no affiliation or Other affiliation had higher curiosity than conservative Protestants. Higher service attendance was associated with less liking of science but greater interest in learning about vaccines. There were no differences among mainline Protestants and Catholics compared to conservative Protestants for any of the interest and identity items. Higher education was also associated with higher science interest and identity across five of the seven items. Overall, the patterns of associations for science interest and identity by politics and religion were similar to the biological science knowledge and vaccine items. There were fewer significant associations in the multivariate models, yet some showed indications of differential biological science knowledge, science interest, and science identity across political and religious alignments.

Discussion

Based upon frameworks of value predispositions and schemas, plus prior research addressing public opinion and science trust, we predicted that individuals with more conservative political and religious alignments would have less accurate biological science knowledge, less interest in science, and lower indicators of science identity. Several bivariate associations suggest science framing through value predispositions and schemas associated with politics and religion. Many but not all of these associations appear spurious, however, when covariates are included in the model. We discuss the possible reasons and implications of our findings below.

Our results show that for some science knowledge, interest, and identity outcomes political partisanship and religiosity matter. For example, conservative Protestants were less likely to accurately answer that humans and apes share a common ancestor, that we owe our lives to the community of organisms that share our bodies, and that death is a part of the biology of life. In addition, more frequent religious service attenders were less likely to provide accurate answers to three of the six biological science knowledge items. Evolution and questions of life after death have generated a long history of religious and science contention over the nature and meaning of the universe (Johnson et al. 2015; Miller 2004), and these differences in knowledge likely reflect differential values and worldviews by religious identities. More politically conservative respondents were also less likely to provide accurate answers to the questions about owing our lives to the community of organisms that share our bodies and that many diseases result from interactions between genes and the environment. These science topics, thus, appear to be influenced by value predispositions and schemas connected to politics and religion that shape worldviews and an understanding of specific biological science topics.

Our findings also show evidence of the politicization of science. Compared to Republican and political conservatives, those with Other affiliations and ideologies were generally less likely to provide accurate responses to the vaccination items. In particular, Other party (2014, 2015) and Other ideology (2015) respondents were less likely to accurately answer that when a child receives the measles vaccine, the vaccination helps rather than harms health. Researchers suggest that antivaccination views may be shaped by concerns over childhood vaccination mandates, the chemical composition of vaccines, and concerns over healthcare autonomy and choice, in particular among individuals who identify as more politically Libertarian or Independent (Blank and Shaw 2015; Lewandowsky et al. 2013; Song 2014). Vaccination knowledge thus becomes politicized to the extent that the acceptance or rejection of vaccine knowledge occurs by virtue of alignments between the science of vaccines and political and economic mandates and interests.

Additionally, Democrats and mainline Protestants were more likely than Republicans and conservative Protestants to know that childhood vaccinations result in fewer sicknesses (2014). These associations, however, disappeared in 2015. This is a somewhat unexpected finding as there was no indication that the proportion of Democrats and mainline Protestants differed across these survey years. A highly publicized measles outbreak associated with nonvaccinated children at Disneyland in late 2014 (Zipprich et al. 2015), however, may have raised awareness about the importance of vaccines in preventing measles across political and religious groups, thus lowering distinctions between these groups during this time.

Unique to this study, we also found associations between politics, religion, and measures of science interest and general science identity. Compared to Republicans, both Independents and Other party affiliates had pro-science responses for three of the seven measures. Democrats did not differ from Republicans on any of the seven items. Liberals had greater interest in learning more about GMOs and vaccines than conservatives. In fact, even though liberals had higher vaccination accuracy than conservatives, liberals were interested in learning even more about vaccinations compared to conservatives. Additionally, though higher religious service attenders had lower childhood vaccination knowledge accuracy in 2014 and 2015, higher service attenders were also interested in learning more about vaccines. Other religious affiliates and the nonaffiliated were more curious about the world, and Other religions reported liking science more than conservative Protestants. We were surprised that conservative Protestants had lower curiosity than nonspecific Protestants and Other religions because the item did not specifically reference the word "science."

Limitations and strengths

As with any study, this study is not without limitations. First, we created our constructs of biological science knowledge and vaccination knowledge by selecting several unique variables across three NASIS years. As such, we evaluate these items individually and do not assume the items represent, for example, an underlying latent factor. The science interest and identity items, however, were all selected from the 2015 version of the survey. While we assess these items individually, we include Cronbach's alpha scores because we assume they share an underlying covariance indicative of having higher science interest or identity generally. Second, while Gauchat (2008) suggests that social bonds within religious groups may influence anti-science attitudes, our measure of service attendance might underestimate potential social network influences. Third, we are limited by our sample size to obtain more reliable estimates of Other party, ideology, or religion as well as our ability to infer from interactions between political and religious alignments. Future research should continue to determine the composition of the Other party (e.g., are they mostly Libertarian?), ideology, and religious groups and to make efforts to increase the statistical power necessary to draw inferences about these groups and the interactions between political and religious alignments. Last, our data are limited to adults living in Nebraska in 2011, 2014, and 2015. Therefore, we can generalize only to residents of this state. That said, the elements of our analyses that replicate prior research (i.e., trust, opinion) show similar findings, suggesting that Nebraska is potentially a reasonable proxy for adults in the United States. We do note, however, that Nebraska is generally a red state and the majority of residents identify with a Christian faith (US Census Bureau 2017). Of course, research should continue to explore the innovative measures of biological science knowledge, interest, and science identity on a national population.

Despite these limitations this study makes contributions. We found mixed support for our predictions. There were more differences between Other party affiliations and Republicans, and for one item Democrats had lower odds of an accurate answer (genes and environment) than Republicans. Liberals had more accurate science knowledge on several items, with the exception of how late women can wait to have a baby. Few studies have explored vaccines even though vaccinations are a major public health issue that is often under government regulation. In the adjusted models those in Other political groups are more different from Republicans overall across the vaccination items. In addition, we know of no population studies that have explored associations between political and religious alignments and science interests and identities. The fact that we find few associations with these outcomes in the adjusted models suggests that, in this case, political and religious framing of science is perhaps more topic specific. The relatively few differences in the adjusted models are between Independents or those in Other parties compared to Republicans, or between liberals and conservatives. The lack of consistent overall patterns also suggests that certain hot-button topics might invoke political or religious value predispositions and schemas specifically and not simplistic pro- or anti-science framing broadly.

Efforts to communicate science to lay audiences often focus on clear language (e.g., avoiding jargon), accuracy, and relevance. The findings from this study suggest that an additional hurdle to conveying science knowledge (beyond trust in science) is overcoming value predispositions and schemas shaped by particular political or religious perspectives. Our findings are relevant for public health care workers, politicians, clergy, and others because these people encounter a public whose science understanding influences important life decisions including informed health care, voting, and public policy. Science communicators and public health workers and providers may benefit from collaborating with political and religious leaders to find ways to convey important contemporary western science knowledge in ways that will be best received and understood by people with varied political and religious alignments.

Notes

1. Prior research has measured affiliation and ideology using a seven-point scale (e.g., Goren 2005). Our survey measure of party affiliation was asked in terms of nominal categories. Our measure of ideology was asked along a five-point scale (i.e., very liberal–very conservative). We did sensitivity analyses for ideology using continuous and categorical measures. To allow for potential nonlinearities and to retain a meaningful "Other" category, we used indicator variables for "liberal," "conservative," and "neutral."
2. Following work by Hout (2017) and Presser and Chaves (2007), we include "religious service attendance" as a focal indicator of religiosity and religious practice broadly defined, in particular among those who identify with a Christian faith in the United States. We also note that when referring to the associations between religion and science, most respondents identified with a Christian faith.

Acknowledgments — This project was presented at the Society for the Study of Social Problems' (SSSP) 2017 annual conference in Montreal, Quebec, Canada.

Funding — This project was supported in part by the National Institutes of Health Science Education Partnership Award (SEPA) Grant 1R25OD010506 (2012–2018).

References

Blank, Joshua M. and Daron Shaw. 2015. "Does Partisanship Shape Attitudes toward Science and Public Policy? the Case for Ideology and Religion." *The Annals of the American Academy of Political and Social Science* 658 (1):18–35. doi: 10.1177/0002716214554756.

Brossard, Dominique and Matthew C Nisbet. 2006. "Deference to Scientific Authority among a Low Information Public: Understanding U.S. Opinion on Agricultural Biotechnology." *International Journal of Public Opinion Research* 19 (1):24–52. doi: 10.1093/ijpor/edl003.

Ecklund, Elaine Howard. 2010. *Science Vs. Religion: What Scientists Really Think*. Oxford: Oxford University Press.

Evans, John Hand Michael S Evans. 2008. "Religion and Science: Beyond the Epistemological Conflict Narrative." *Annual Review of Sociology* 34:87–105. doi: 10.1146/annurev.soc.34.040507.134702.

Evans, John H. and Justin Feng. 2013. "Conservative Protestantism and Skepticism of Scientists Studying Climate Change." *Climatic Change* 121 (4):595–608. doi: 10.1007/s10584-013-0946-6.

Gauchat, Gordon. 2008. "A Test of Three Theories of Anti-Science Attitudes." *Sociological Focus* 41 (4):337–57. doi: 10.1080/00380237.2008.10571338.

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. doi: 10.1177/0003122412438225.

Gauchat, Gordon. 2015. "The Political Context of Science in the United States: Public Acceptance of Evidence-Based Policy and Science Funding." *Social Forces* 94 (2):723–46. doi: 10.1093/sf/sov040.

Goren, Paul. 2005. "Party Identification and Core Political Values." *American Journal of Political Science* 49 (4):881–96. doi: 10.1111/ajps.2005.49.issue-4.

Hartman, Andrew. 2015. *A War for the Soul of American: A History of the Culture Wars*. Chicago, IL: University of Chicago Press.

Hill, Patricia Wonch, Julia McQuillan, Amy Spiegel, and Judy Diamond. 2017. "Discovery Orientation, Cognitive Schemas, and Disparities in Science Identity in Early Adolescence." *Sociological Perspectives* 61 (1):99–125. doi: 10.1177/0731121417724774.

Ho, Shirley S., Dominique Brossard, and Dietram A Scheufele. 2008. "Effects of Value Predispositions, Mass Media Use, and Knowledge on Public Attitudes toward Embryonic Stem Cell Research." *International Journal of Public Opinion*

Research 20 (2):171–92. doi: 10.1093/ijpor/edn017.

Hout, Michael. 2017. "American Religion: All or Nothing at All." *Contexts* 16 (4):78–80. doi: 10.1177/1536504217742401.

Hout, Michael and Clause S Fischer. 2002. "Why More Americans Have No Religious Preference: Politics and Generations." *American Sociological Review* 67 (2):165–90. doi: 10.2307/3088891.

Johnson, David R., Christopher P Scheitle, and Elaine Howard Ecklund. 2015. "Individual Religiosity and Orientation toward Science: Reformulating Relationships." *Sociological Science* 2:106–24. doi: 10.15195/v2.a7.

Lam, L. 2008. "Science Matters: A Unified Perspective." in *Science Matters: Humanities as Complex Systems*, edited by M. Burguete and L. Lam. Singapore: World Scientific.

Lewandowsky, Stephan, Gilles E. Gignac, and Klaus Oberauer. 2013. "The Role of Conspiracist Ideation in Worldviews in Predicting Rejection of Science." *PLoS One* 8 (10):1–11. doi: 10.1371/journal.pone.0075637.

Maheshwari, A, M Hamilton, and S. Bhattacharya. 2008. "Effect of Female Age on Diagnostic Categories of Infertility." *Human Reproduction* 23 (3):538–42. doi: 10.1093/humrep/dem431.

Mahoney, Annette. 2010. "Religion in Families, 1999–2009: A Relational Spirituality Framework." *Journal of Marriage and Family* 72 (4):805–27. doi: 10.1111/(ISSN)1741-3737.

McCright, Aaron M and Riley E Dunlap. 2011. "The Politicization of Climate Change and Polarization in the American Public's View of Global Warming, 2001-2010." *The Sociological Quarterly* 52:155–96. doi: 10.1111/j.1533-8525.2011.01198.x.

Miller, Jon D. 2004. "Public Understanding Of, and Attitudes Toward, Scientific Research: What We Know and What We Need to Know." *Public Understanding of Science* 13:273–94. doi: 10.1177/0963662504044908.

Miller, Jon D. 2010. "The Conceptualization and Measurement of Civic Scientific Literacy for the Twenty-First Century." Pp. 241–55 in *Science and the Educated American: A Core Component of Liberal Education*, edited by Jerrold Meinwald and John G. Hildebrand. Cambridge, MA: American Academy of Arts and Sciences.

National Science Foundation. 2012. "Science and Engineering Indicators 2012." Retrieved March 6, 2018 (http://www.nsf.gov/statistics/seind12/c0/c0i.htm).

Nebraska Annual Social Indicators Survey. 2011. NASIS 2010-2011 Methodology Report. University of Nebraska-Lincoln. US: Bureau of Sociological Research.

Nebraska Annual Social Indicators Survey. 2014. NASIS 2013-2014 Methodology Report. University of Nebraska-Lincoln. US: Bureau of Sociological Research.

Nebraska Annual Social Indicators Survey. 2015. NASIS 2014-2015 Methodology Report. University of Nebraska-Lincoln. US: Bureau of Sociological Research.

Nisbet, Matthew C. 2005. "The Competition for Worldviews: Values, Information, and Public Support for Stem Cell Research." *International Journal of Public Opinion Research* 17 (1):90–112. doi: 10.1093/ijpor/edh058.

Nisbet, Matthew C and Chris Mooney. 2007. "Framing Science." *Science* 316 (5821):56. doi: 10.1126/science.1142030.

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

Pew Research Center. 2009. "Religion and Science in the United States: Scientists and Belief." Retrieved March 8, 2018 (http://www.pewforum.org/2009/11/05/scientists-and-belief/).

Pew Research Center. 2015. "Public and Scientists' Views on Science and Society." Retrieved February 20, 2017 (http://assets.pewresearch.org/wp-content/uploads/sites/14/2015/01/PI_ScienceandSociety_Report_012915.pdf).

Presser, Stanley and Mark Chaves. 2007. "Is Religious Service Attendance Declining?" *Journal for the Scientific Study of Religion* 46 (3):417–23. doi: 10.1111/jssr.2007.46.issue-3.

Schwadel, Philip. 2011. "The Effects of Education on Americans' Religious Practices, Beliefs, and Affiliations." *Review of Religious Research* 53 (2):161–82. doi: 10.1007/s13644-011-0007-4.

Sherkat, Darren E. 2011. "Religion and Scientific Literacy in the United States." *Social Science Quarterly* 92 (5):1134–50.

Sherkat, Darren E. 2017. "Religion, Politics, and Americans' Confidence in Science." *Politics and Religion* 10 (1):137–60. doi: 10.1017/S1755048316000535.

Song, Geoboo. 2014. "Understanding Public Perceptions of Benefits and Risks of Childhood Vaccinations in the United States." *Risk Analysis* 34 (3):541–55. doi: 10.1111/risa.2014.34.issue-3.

Sturgis, Patrick and Nick Allum. 2004. "Science in Society: Re-Evaluating the Deficit Model of Public Attitudes." *Public Understanding of Science* 1:55–74. doi: 10.1177/0963662504042690.

United States Census Bureau. 2017. "Quick Facts: Nebraska". Retrieved March 8, 2018 (https://www.census.gov/quickfacts/NE).

United States Department of Agriculture, National Agricultural Statistics Service (USDA NASS). 2017. "2017 State Agricultural Overview-Nebraska." Retrieved April 18, 2018 (https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=NEBRASKA).

Von Hippel, Paul T. 2007. "Regression with Missing Ys: An Improved Strategy for Analyzing Multiply Imputed Data." *Sociological Methodology* 37 (1):83–117. doi: 10.1111/j.1467-9531.2007.00180.x.

White, Ian R., Patrick Royston, and Angela M Wood. 2011. "Multiple Imputation Using Chained Equations: Issues and Guidance for Practice." *Statistics in Medicine* 30 (4):377–99. doi: 10.1002/sim.4067.

Zigerell, L.J. 2012. "Science Knowledge and Biblical Literalism." *Public Understanding of Science* 21 (3):314–22. doi: 10.1177/0963662510391723.

Zipprich, Jennifer, Kathleen Winter, Jill Hacker, Dongxiang Xia, James Watt, and Kathleen Harriman. 2015. Measles Outbreak-California, December 2014-February 2015. Centers for Disease Control and Prevention. Retrieved June 18, 2018 (https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6406a5.htm).

Table 1. Descriptive statistics for all study variables by survey year (Nebraska Annual Social Indicators Surveys; NASIS).[1]

	2011 (N = 906)		2014 (N = 1,018)		2015 (N = 1,143)	
	M/P	**% miss**	**M/P**	**% miss**	**M/P**	**% miss**
Dependent variables[a]						
Biological science knowledge						
Apes and humans (2011)	0.17	*3.7*				
Body is a bio-community (2011)	0.13	*5.6*				
Death is part of biology of life (2011)	0.51	*3.7*				
Gene-environment and disease (2011)	0.19	*5.0*				
Wait until late 30s for pregnancy (2011)	0.18	*2.8*				
Can you die from measles? (2014)			0.62	*2.8*		
Vaccination-specific						
Vaccines use bodies' defenses (2011)	0.20	*4.6*				
Importance of vaccines (2015)					0.91	*3.6*
Vaccines prevent sickness (2014)			0.77	*2.6*		
Vaccines prevent sickness (2015)					0.90	*3.5*
Vaccines promote health (2014)			0.85	*2.8*		
Vaccines promote health (2015)					0.92	*3.6*
Science interest and identity						
Interest in gut-microbes (2015)					0.20	*3.8*
Interest in GMOs (2015)					0.30	*3.5*
Interest in vaccines (2015)					0.27	*3.4*
Curious about the world (2015)					0.54	*3.4*
Consider self a science person (2015)					0.19	*3.7*
How much like science (2015)					0.34	*3.9*
Science in decision-making (2015)					0.33	*3.9*
Independent variables[b]						
Political party						
Democrat (Dem)	0.29	*4.8*	0.25	*4.2*	0.29	*4.9*
Republican (Rep)	0.44	*4.8*	0.42	*4.2*	0.44	*4.9*

Table 1. Descriptive statistics for all study variables by survey year (Nebraska Annual Social Indicators Surveys; NASIS).[1]

	2011 (N = 906)		**2014 (N = 1,018)**		**2015 (N = 1,143)**	
	M/P	**% miss**	**M/P**	**% miss**	**M/P**	**% miss**
Independent (Ind)	0.23	*4.8*	0.25	*4.2*	0.24	*4.9*
Other party (Other)	0.03	*4.8*	0.04	*4.2*	0.04	*4.9*
Political ideology						
Liberal (Lib)	0.17	*6.7*	0.16	*4.2*	0.19	*4.9*
Conservative (Con)	0.42	*6.7*	0.42[a]	*4.2*	0.39[b]	*4.9*
Neutral (Neu)	0.38	*6.7*	0.35	*4.2*	0.39	*4.9*
Other ideology (Other)	0.03		0.04	*4.2*	0.03	*4.9*
Religious affiliation						
Conservative Protestant (CP)	0.21	*3.9*	0.20	*2.7*	0.21	*5.1*
Mainline Protestant (MP)	0.24	*3.9*	0.24	*2.7*	0.22	*5.1*
Other Protestant (OP)	0.06	*3.9*	0.05	*2.7*	0.06	*5.1*
Nonspecific Protestant (NSP)	0.14[a]	*3.9*	0.13[b]	*2.7*	0.09[c]	*5.1*
Catholic (Cath)	0.26	*4.2*	0.26	*3.1*	0.29	*5.6*
Other religion (Other)	0.04	*4.2*	0.04[a]	*3.1*	0.02[b]	*5.6*
No religion (None)	0.09[a]	*4.2*	0.11	*3.1*	0.13[b]	*5.6*
Service attendance (range: 1– 8)	4.96	*4.0*	4.88	*4.2*	4.75	*2.1*
Control variables[c]						
Age (range: 18–100)**[1]**	55.36	*6.3*	56.86[a]	*5.3*	59.72[b]	*1.8*
Women	0.61	*3.5*	0.57	*2.1*	0.60	*3.9*
Nonwhite**[2]**	0.03[a]	*3.9*	0.07[b]	*2.9*	0.10[c]	*4.4*
Not married	0.36	*3.6*	0.36	*2.6*	0.38	*2.2*
High school or less	0.22	*6.1*	0.26	*4.5*	0.26	*6.3*
Some college	0.35	*6.1*	0.35	*4.5*	0.37	*6.3*
BA or greater	0.43	*6.1*	0.39	*4.5*	0.44	*6.3*
Open country/farm	0.15[a]	*4.7*	0.20[b]	*2.6*	0.16	*1.7*
Self-rated health (range: 1– 4)	3.03	*3.3*	2.98	*2.5*	2.98	*4.2*

1. Because we needed to make three comparisons (2011, 2014, and 2015) we used Bonferroni tests of specific differences between years; the following are variables that differ significantly by year at the 0.05 level: no religious affiliation (2011 and 2015), Other religious affiliation (2014 and 2015), conservative ideology (2014 and 2015), nonspecific Protestant (2011, 2014, and 2015), rural (2011 and 2014), high school or less (2014 to 2015), nonwhite (2011, 2014, and 2015), and age (2014 and 2015). These differences are also indicated in the table by different superscripts within a row. Means and proportions without superscripts are not significantly different between years.

a. All of the science-related dependent variables are dichotomous and coded so that accurate = 1 and inaccurate = 0.

b. Most of the independent variables are dichotomous and coded so that the name of the variable is coded 1 and all else is coded 0; service attendance is ordinal and measured on a range from 1–8. Standard deviation (SD) service attendance: 2011 = 2.23; 2014 = 2.24; 2015 = 2.24.

c. Most of the control variables are dichotomous and coded so that participants in the category that names the variable have a value of 1 and all else are coded 0; age is measured in years and ranges from 18–100 and self-rated health is ordinal and ranges from poor (1) to excellent (4) health. SD age: 2011 = 16.91; 2014 = 16.93; 2015 = 16.96.

d. SD self-rated health: 2011 = 0.73; 2014 = 0.77; 2015 = 0.74.

Table 2. Bivariate associations of NASIS science items by independent variables and educational attainment (proportions or means shown).

	Party affiliation				Political ideology				Religious affiliation							Service attendance		Educational attainment		
A	**Dem**	**Rep**	**Ind**	**Other**	**Lib**	**Con**	**Neu**	**Other**	**CP**	**MP**	**OP**	**NSP**	**Cath**	**Other**	**None**	**Inaccurate**	**Accurate**	**HS or less**	**Some Coll.**	**BA or more**
A																				
1	.29	.07	.18	.26 ***	.46	.08	.13	.27 ***	.02	.20	.13	.14	.14	.40	.50 ***	5.27	3.37 ***	.08	.14	.24 ***
2	.20	.08	.13	.13 ***	.31	.09	.09	.16 ***	.03	.18	.13	.05	.12	.37	.28 ***	5.08	3.91 ***	.09	.10	.18 **
3	.58	.45	.49	.67 **	.69	.49	.44	.50 ***	.34	.56	.62	.54	.51	.59	.59 ***	5.18	4.75 **	.41	.48	.59 ***
4	.22	.15	.23	.17	.36	.15	.15	.20 ***	.07	.18	.38	.18	.21	.28	.32 ***	5.11	4.29 ***	.18	.16	.22
5	.17	.21	.11	.20 *	.14	.20	.17	.20	.21	.16	.13	.20	.20	.10	.10	4.84	5.49 ***	.14	.19	.17
6	.62	.62	.61	.62	.73	.57	.62	.63 **	.56	.67	.62	.54	.65	.74	.60 *	5.02	4.81	.50	.61	.72 ***
B																				
1	.26	.17	.18	.21 *	.38	.16	.15	.32 ***	.11	.22	.30	.17	.21	.29	.33 **	5.05	4.50 **	.13	.16	.28 ***
2	.95	.91	.90	.79 **	.93	.90	.94	.71 ***	.88	.95	.90	.90	.92	.89	.90	4.74	4.73	.92	.92	.92
3	.86	.77	.73	.54 ***	.86	.75	.80	.48 ***	.72	.89	.62	.71	.80	.78	.66 ***	4.94	4.88	.71	.78	.83 ***
4	.89	.93	.89	.77 **	.91	.92	.91	.63 ***	.90	.96	.84	.90	.89	.82	.86 **	4.45	4.76	.90	.89	.93
5	.90	.84	.83	.64 ***	.90	.85	.85	.65 **	.84	.88	.82	.84	.86	.90	.74 *	4.52	4.96 *	.75	.86	.91 ***
6	.94	.93	.89	.76 ***	.94	.92	.92	.61 ***	.92	.95	.85	.95	.89	.89	.88 *	4.38	4.76	.88	.90	.95 **
C																				
1	.24	.14	.22	.36 ***	.29	.14	.19	.34 ***	.18	.17	.32	.16	.18	.41	.26 ***	4.79	4.46 *	.15	.19	.23 *
2	.35	.24	.33	.43 ***	.45	.27	.26	.27 ***	.28	.29	.39	.24	.27	.51	.40 ***	4.82	4.82 *	.19	.29	.37 ***
3	.29	.25	.28	.33	.35	.24	.25	.36 *	.27	.27	.39	.25	.25	.46	.27 *	4.69	4.84	.23	.26	.29
4	.60	.49	.57	.47 *	.70	.49	.51	.44 ***	.47	.53	.59	.43	.54	.74	.68 ***	4.97	4.53 ***	.47	.47	.64 ***
5	.22	.15	.21	.38 ***	.27	.17	.17	.26 **	.14	.20	.22	.10	.18	.38	.30 ***	4.83	4.27 **	.09	.16	.28 ***
6	.35	.29	.39	.44 **	.39	.31	.33	.33	.27	.34	.37	.22	.34	.48	.50 ***	4.96	4.26 ***	.19	.31	.44 ***
7	.36	.30	.30	.35	.45	.29	.30	.36 **	.28	.35	.37	.26	.31	.38	.41	4.79	4.60	.21	.25	.45 ***

*p < 0.05; **p < 0.01; ***p < 0.001.

A. Biological science knowledge items:

1) Humans share common ancestors with apes. (2011)
2) We owe our lives to the community of other organisms that share our bodies. (2011)
3) Death is part of the biology of life. (2011)
4) Many diseases result from interactions between genes and the environment. (2011)
5) Women can wait to have a baby until their late 30s and still have a good chance of having a baby. (2011)
6) Do you believe that people can die from the measles? (2014)

B. Vaccinations items:

1) Vaccines use our body's natural defenses to cure disease. (2011)
2) How important do you think it is that children be vaccinated? (2015)
3) If all children were to receive vaccines, what option best describes the result (more sick, fewer sick)? (2014)
4) If all children were to receive vaccines, what option best describes the result (more sick, fewer sick)? (2015)
5) When a child receives the measles vaccine, what option best describes the result (improve health, harm health)? (2014)
6) When a child receives the measles vaccine, what option best describes the result (improve health, harm health)? (2015)

C. Science interest and identity items:

1) How interested are you in learning more about gut-microbes and human health? (2015)
2) How interested are you in learning more about genetically engineered foods and human health? (2015)
3) How interested are you in learning more about vaccines and human health? (2015)
4) How curious are you about the world? (2015)
5) How much do you think you are a science kind of person? (2015) 6) How much do you like science? (2015)
7) How much does science help you make decisions that affect your body? (2015)

Table 3. NASIS binary logistic regression results (odd ratios) for biological science knowledge (SK) items by independent and control variables.[1]

	Survey year 2011					Survey year 2014
	SK1[a] OR	SK2 OR	SK3 OR	SK4 OR	SK5 OR	SK6 OR
Independent variables						
Party affiliation (Rep omitted):						
Democrat	2.09	0.95	1.28	0.39 *	0.97	0.62
Independent	1.15	0.86	1.06	1.06	0.72	0.76
Other party	2.90	1.16	1.69	0.61	0.40	0.45
Political ideology (Con omitted):						
Liberal	2.22	3.55 **	1.62	5.57 ***	.38 *	1.91
Neutral	0.46 *	1.17	0.67	0.99	0.58	1.35
Other ideology	0.83	2.00	0.68	1.48	1.06	0.94
Religious affiliation (CP omitted):						
Mainline Protestant	4.34 ***	3.61 **	1.85 **	1.37	1.17	2.10 **
Nonspecific Protestant	2.56	1.83	2.63 **	1.12	0.70	0.86
Catholic	4.56 ***	2.86 **	1.74 *	1.56	1.19	1.90 **
Other religion	7.85 **	4.39 *	2.10	0.44	0.47	2.31
No religion	9.29 ***	3.89 *	0.68	1.15	1.96	0.79
Mean attendance	0.67 ***	0.88	0.87 **	0.84 **	1.21 ***	0.94
Control variables						
Mean age	0.99	1.03 *	0.99	1.00	0.97 ***	0.98 **
Women	0.87	0.57 *	0.96	1.60	3.10 ***	1.16
Nonwhite	2.31	0.92	0.74	0.86	0.96	1.24
Not married	0.98	0.48 *	1.06	0.61	1.08	0.83
Some college	1.32	1.26	1.38	1.03	1.14	1.41
Bachelors or greater	2.18	2.45 *	1.88 *	1.19	0.67	1.95 **
Open country/farm	0.72	1.57	1.53	1.04	1.07	0.71
Mean self-rated health	1.23	1.11	0.99	0.93	1.19	0.77 *
Intercept[b]	0.02 ***	0.03 ***	0.45 *	0.13 ***	0.13 ***	0.87

*p < 0.05; ** p < 0.01; *** p < 0.001

1. N ranges from 856 (SK3) to 881 (SK5).

a. 1) Humans share common ancestors with apes. (2011)
   2) We owe our lives to the community of other organisms that share our bodies. (2011)
   3) Death is part of the biology of life. (2011)
   4) Many diseases result from interactions between genes and the environment. (2011)
   5) Women can wait to have a baby until their late 30s and still have a good chance of having a baby. (2011)
   6) Do you believe that people can die from the measles? (2014)

b. Results from Stata ICE with ten imputed data sets using the multiple imputation with deletion (MID) method.

Table 4. NASIS binary logistic regression results (odd ratios) for vaccination (Vacc) items by independent and control variables.[1]

	Survey year 2011	Survey year 2015	Survey year 2014	Survey year 2015	Survey year 2014	Survey year 2015
	Vacc1[a]	**Vacc2**	**Vacc3**	**Vacc4**	**Vacc5**	**Vacc6**
	OR	**OR**	**OR**	**OR**	**OR**	**OR**
Independent variables						
Party affiliation (Rep omitted):						
Democrat	0.55	2.00	1.94 *	0.65	1.53	0.97
Independent	0.54	0.82	0.71	0.66	0.75	0.58
Other party	0.52	0.65	0.35 *	0.56	0.25 *	0.32 *
Political ideology (Con omitted):						
Liberal	4.81 ***	1.09 *	1.66	1.12	1.71	1.20
Neutral	0.95	2.29	1.48	1.72	1.65	1.43
Other ideology	2.78	0.39	0.49	0.32	0.83	0.20 *
Religious affiliation (CP omitted):						
Mainline Protestant	1.47	2.03	3.06 ***	2.30	1.35	0.72
Nonspecific Protestant	0.76	1.10	0.98	1.01	1.13	1.37
Catholic	1.73	1.17	1.47	0.97	1.07	0.56
Other religion	0.32	2.08	1.37	1.02	3.52	1.87
No religion	2.23	0.64	0.42 *	0.53	0.55	0.29*
Mean attendance	0.90	0.91	0.86 *	0.83 *	0.97	0.88
Control variables						
Mean age	0.98 *	0.98 *	1.01	0.98 *	1.01	1.00
Women	0.85	1.76 *	0.82	1.39	0.80	1.28
Nonwhite	1.25	0.64	0.43 *	0.78	0.80	0.51
Not married	1.09	1.19	0.79	0.74	0.54 **	0.75
Some college	1.20	0.90	2.22 **	0.99	2.62 ***	1.11
Bachelors or greater	1.69	1.33	2.78 ***	1.49	3.87 ***	1.88
Open country/farm	0.95	0.94	0.82	1.12	0.69	0.93
Mean self-rated health	1.15	1.08	0.86	1.52 *	0.99	1.18
Intercept[b]	0.13 ***	4.82 ***	1.77	9.54 ***	3.23***	15.51 ***

*p < 0.05; **p < 0.01; ***p < 0.001.

1. N ranges from 865 (Vacc1) to 1,103 (Vacc4).

a. 1) Vaccines use our body's natural defenses to cure disease. (2011)
   2) How important do you think it is that children be vaccinated? (2015)
   3) If all children were to receive vaccines, what option best describes the result (more sick, fewer sick)? (2014)
   3) If all children were to receive vaccines, what option best describes the result (more sick, fewer sick)? (2015)
   4) When a child receives the measles vaccines, what option best describes the result (help health, harm health)? (2014)
   5) When a child receives the measles vaccines, what option best describes the result (help health, harm health)? (2015)

b. Results from Stata ICE with ten imputed data sets using the multiple imputation with deletion (MID) method.

Table 5. NASIS binary logistic regression results (odd ratios) for science interest and identity (SI) items by independent and control variables.[1]

	Survey year 2015						
	SI1[a]	**SI2**	**SI3**	**SI4**	**SI5**	**SI6**	**SI7**
	OR	**OR**	**OR**	**OR**	**OR**	**OR**	**OR**
Independent variables							
Party affiliation (Rep omitted):							
Democrat	1.71	1.20	1.13	1.02	1.36	.98	1.06
Independent	1.87 *	1.63 *	1.12	1.29	1.38	1.26	1.15
Other party	3.00 *	2.48	1.42	.99	3.40 *	1.43	.98
Political ideology (Con omitted):							
Liberal	1.66	1.87 *	1.82 *	1.38	1.01	0.81	1.57
Neutral	0.96	0.78	1.09	1.10	1.00	1.10	1.10
Other ideology	0.91	0.91	1.28	0.86	1.27	1.03	1.59
Religious affiliation (CP omitted):							
Mainline Protestant	0.73	1.02	0.94	1.02	1.19	1.30	0.93
Nonspecific Protestant	0.41 *	0.61	0.80	0.79	0.48	0.57	0.70
Catholic	0.65	0.79	0.81	1.21	0.86	1.26	0.87
Other religion		1.86	1.98	3.16 *	2.11	2.77 *	1.11
No religion	1.00	1.34	1.37	1.94 *	1.33	1.63	1.05
Mean attendance	1.08	1.08	1.12*	0.98	0.97	0.90 *	0.98
Control variables							
Mean age	1.02 *	1.01 *	1.00	1.00	1.02 ***	1.01 *	1.00
Women	1.59 *	1.17	1.22	0.65 **	0.43 ***	0.39 ***	0.94
Nonwhite	1.17	1.78 *	1.51	1.30	1.30	1.83 *	1.60
Not married	0.85	0.87	1.10	0.99	1.10	0.90	1.04
Some college	0.85	1.31	1.06	0.89	1.65	1.93 *	1.24
Bachelors or greater	1.15	2.12 *	1.47	1.98 **	3.52 ***	3.05 ***	2.79 ***
Rural	0.80	1.14	0.90	0.80	1.33	1.06	1.48
Mean self-rated health	0.97	0.99	1.00	1.00	0.95	1.01	1.31 *
Intercept[b]	0.14 ***	0.18 ***	0.19 ***	0.89	0.10 ***	0.30 ***	0.21 ***

*p < 0.05; **p < 0.01; ***p < 0.001.

1. N ranges from 1,099 (SI3 and SI4) to 1,105 (SI1 and SI7).

a. 1) How interested are you in learning more about gut-microbes and human health? (2015)
2) How interested are you in learning more about genetically engineered foods and human health? (2015)
3) How interested are you in learning more about vaccines and human health? (2015)
4) How curious are you about the world? (2015)
5) How much do you think you are a science kind of person? (2015)
6) How much do you like science? (2015)
7) How much does science help you make decisions that affect your body? (2015)

b. Results from Stata ICE with ten imputed data sets using the multiple imputation with deletion (MID) method.