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Worldview-motivated rejection of science and the norms of science

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### Abstract

Some scientific propositions are so well established that they are no longer debated by the relevant scientific community, such as the fact that greenhouse gas emissions are altering the Earth's climate. In many cases, such scientifically settled issues are nonetheless rejected by segments of the public. U.S. surveys have repeatedly shown that the rejection of scientific evidence across a broad range of domains is preferentially associated with rightwing or libertarian worldviews, with little evidence for rejection of scientific evidence by people on the political left. We report two preregistered representative surveys (each  $N > 1000$ ) that (1) sought to explain this apparent political asymmetry and (2) continued the search for the rejection of scientific evidence on the political left. To address the first question, we focused on Merton's classic analysis of the norms of science, such as communism and universalism, which continue to be internalized by the scientific community but which are not readily reconciled with conservative values. Both studies show that people's political worldviews are associated with their attitudes towards those scientific norms, and that those attitudes predict people's acceptance of vaccinations and climate science. The norms of science may thus be in latent conflict with the worldviews of a substantial segment of the public. To address the second question, we examined people's views on the role of inheritance in determining people's intelligence, given that the belief in the power of learning and environmental factors to shape human development is a guiding principle of leftwing thought. We find no association between core measures of political worldviews and people's view of heritability of intelligence, although two subordinate constructs, nationalism and social dominance orientation, were associated with belief in heritability.

### **Worldview-motivated rejection of science and the norms of science**

According to Donald Trump, vaccinations cause autism and climate change is a hoax that was created by the Chinese to make U.S. manufacturing non-competitive (Matthews, 2017). According to others, AIDS is an invention of the U.S. government (Bogart, Galvan, Wagner, & Klein, 2011), and now even the Earth is flat again (Landrum, Olshansky, & Richards, 2019; Strauss, 2016). Many established scientific propositions that have been accepted by the relevant expert communities are subject to public dispute and, sometimes, outright rejection by sizable segments of the population. For example, some 20% of the American public have been shown to echo Donald Trump's views by declaring that climate change "is a hoax perpetrated by corrupt scientists" (Lewandowsky, Gignac, & Oberauer, 2013).

Those opinions are not without adverse consequences: Whenever well-established medical research findings are rejected, a detrimental impact on public health ensues, as in the case of anti-vaccination movements (Gangarosa et al., 1998; Smith, Yarwood, & Salisbury, 2007). When science denial becomes official government policy, the death toll can run in the hundreds of thousands, as in the case of South Africa's President Mbeki, who refused to accept the link between HIV and AIDS and denied patients access to antiretroviral treatments (Chigwedere, Seage, Gruskin, Lee, & Essex, 2008).

There has been increasing research interest in the psychological variables that explain why people reject scientific facts (for recent summaries, see Lewandowsky, 2021a; Lewandowsky & Oberauer, 2016). Two consistent findings have emerged from this research: First, general levels of education, scientific knowledge, and science literacy are at best modestly predictive of general attitudes and trust in science (e.g., Allum, Sturgis, Tabourazi, & Brunton-Smith, 2008). Second, numerous studies have shown that people's worldviews, that is their deeply-held beliefs about the world and about how society should

be organized, predict their attitudes towards science across a wide range of topics and domains. To date, studies conducted mainly in the United States have converged on the conclusion that the rejection of science is primarily associated with rightwing or libertarian worldviews. Whether it is climate change (e.g., Hamilton, 2011; Hamilton, Hartter, Lemcke-Stampone, Moore, & Safford, 2015; Hornsey, Harris, Bain, & Fielding, 2016; Lewandowsky et al., 2013), vaccinations (e.g., Hamilton, Hartter, & Saito, 2015; Hornsey, Harris, & Fielding, 2018; Kahan, Braman, Cohen, Gastil, & Slovic, 2010; Lewandowsky et al., 2013; Lewandowsky, Woike, & Oberauer, 2020), evolution (e.g., Hamilton, 2015; Lewandowsky et al., 2020), genetically-modified organisms (e.g., Hamilton, 2015), or even nuclear energy (e.g., Hamilton, 2015), people on the political left trust scientists more on those issues and tend to accept the pertinent scientific findings more than their counterparts on the political right.

Worldviews have been repeatedly found to override other variables, such as knowledge and education or science literacy. For example, polarization on climate change along political lines has been found to increase with self-reported knowledge of climate change (Hamilton, 2011), scientific literacy and numeracy (Kahan et al., 2012), and education (Hamilton, Hartter, Lemcke-Stampone, et al., 2015). Whereas greater education or knowledge is associated with increased acceptance of climate science among liberals, the reverse is true for conservatives.

Although survey data cannot be generalized beyond their specific cultural context, the association between worldviews and rejection of climate science and vaccinations has also been observed in countries other than the United States: The same basic association between rightwing or libertarian worldviews and rejection of climate science has been obtained in Australia (Cook & Lewandowsky, 2016) and the United Kingdom (Capstick & Pidgeon, 2014), using a variety of different worldview measures. A recent meta-analysis

confirmed the presence of the association across 56 nations for climate change (Hornsey et al., 2016), and across 24 nations for vaccinations (Hornsey et al., 2018).

The research to date has left open two important questions: First, what explains the seemingly pervasive association between rightwing—but not leftwing—worldviews and the rejection of science? What underlying explanatory variables, if any, can be identified that might explain the propensity for rejection of science by the political right? Might the intrinsic attributes of the scientific enterprise be uniquely challenging to people with rightwing or libertarian worldviews? Or is the association merely the result of conflicting imperatives between scientific findings and their economic implications, as in the case of climate change? Second, are there any domains in which the role of worldviews is reversed—that is, do liberals reject scientific findings that conservatives or libertarians endorse? Is there “science denial” somewhere on the political left? We address both questions in the present study.

#### *Attitudinal asymmetry and the nature of science*

In the context of climate change, the reasons for the strong association between rightwing worldviews and denial are easy to understand. Climate change is the result of unfettered fossil-fuel powered economic growth during the last century. Successful climate mitigation will require deep cuts to greenhouse gas emissions (e.g., Knutti & Rogelj, 2015) that are not achievable without a significant intervention in the operation of the global economy, be it through taxes, a price on carbon, or regulations.

Climate change therefore presents a vexing dilemma to people who are emotionally and intellectually vested in free-market economics: Accept the science and accept that unregulated markets can give rise to problems whose solution requires state intervention, or reject the scientific findings and continue operating in the belief that unregulated markets are the best approach to delivering economic prosperity. The available body of

data suggests that many conservatives resolve this dilemma by rejecting the scientific evidence. Similar arguments can be advanced in the context of vaccinations: libertarians may oppose public-health measures, such as mandatory (or nearly-mandatory) childhood vaccinations as government intervention (Kahan et al., 2010). Likewise, evolution might be opposed for religious reasons, and via the association between religiosity and rightwing worldviews (Malka, Lelkes, Srivastava, Cohen, & Miller, 2012), this opposition will be detected in studies relating worldview to acceptance of evolution.

However, it is less clear why rightwing worldviews would predispose people to be more distrustful of scientists even when it comes to nuclear power or genetically-modified organisms—both are issues that mesh well with free markets and free enterprise. It is also not immediately clear why there has been an ongoing gradual erosion of trust in science among conservatives—but not liberals—since the mid 1970s (Gauchat, 2012). Whereas conservatives and liberals did not differ in their trust in science in the 1970s, by 2010 the polarization had become quite striking, with liberals retaining trust in the scientific community and conservatives having drastically reduced theirs. Several candidate attitudes might be implicated in this general and growing distrust of science among conservatives.

*The norms of science.* We first explore the possibility that the—often tacit—norms and principles that guide the scientific enterprise might be less compatible with conservative than liberal worldviews. Perhaps the most well known and influential analysis of the norms of science was articulated by sociologist Robert Merton (e.g., 1942), who argued that the results of scientific research should be the common property of the scientific community (“communism”); that knowledge should transcend racial, class, national, or political barriers (“universalism”); that scientists conduct research for the benefit of the scientific enterprise rather than for personal gain (“disinterestedness”); and that scientific claims must be exposed to critical scrutiny before being accepted

(“organized skepticism”). Survey results suggest that those norms continue to be broadly internalized by the scientific community (Macfarlane & Cheng, 2008). Several of those norms are potentially challenging to conservative worldviews, and our two studies were designed to explore this potential conflict. The first study focused on the scientific norms of communism and universalism, together with other implications of the scientific enterprise that might be at odds with conservative worldviews. The second study explored the full range of Merton’s scientific norms. Both studies examined the association between attitudes towards those norms to the acceptance of scientific constructs.

The scientific norms of communism and universalism stand in opposition to nationalism. Conservatism has long been linked to nationalism and patriotism, at the expense of embracing cooperative internationalism (e.g., Kosterman & Feshbach, 1989).<sup>1</sup> In a direct examination of the link between nationalism and scientific attitudes, Tranter and Lester (2017) found that (Australian) self-declared patriots were less likely to accept climate change as happening than citizens who professed less patriotism. In another Australian sample, Devine-Wright, Price, and Leviston (2015) similarly found that people who felt attached to their country more than to the Earth as a whole were more likely to deny climate change than people with a global attachment. Krange, Kaltenborn, and Hultman (2018) recently reported similar results in a Norwegian sample. In the U.S., Ranney, Munnich, and Lamprey (2016) reported two experiments that temporarily reduced participants’ nationalism by providing them with “supra-nationalist” information; that is, information that contextualized the United States in a community of nations rather than in the more usual portrayal of American exceptionalism. This intervention increased acceptance of climate change by a considerable margin.

There is thus at least tentative evidence that scientific attitudes might be affected by a person’s degree of patriotism or nationalism, or conversely, by their embrace of internationalism. However, to date those variables have been explored largely in the

context of climate change, which is a global problem whose resolution requires international cooperation. The involvement of nationalism in climate attitudes may therefore be related to the specific international attributes of climate change, rather than reflecting a more general role of nationalism in the rejection of science based on its universalist and communist norms.

Our first study therefore included a number of different scientific constructs in order to establish the breadth of involvement of nationalism in the rejection of science. In particular, we probed attitudes towards climate science, where we expected nationalism to be implicated because of the associated global governance issues. We also probed other scientific propositions that have no global governance implications (vaccinations and heritability of intelligence) where nationalism would only be implicated indirectly, via its presumed conflict with the norms of science. Our first study also probed two further potential predictor constructs, namely the belief in human exceptionalism and religiosity, that are potentially in conflict with scientific norms and findings, and that might help explain why conservatives are more prone to rejecting scientific findings.

*Human exceptionalism.* The idea that humans are exceptional and differ from all other life forms has been, at least tacitly, at the root of much Western philosophy and nearly all science from its Cartesian origins onward. This anthropocentrism is at the core of traditional Judeo-Christian thought, which sees the human as an *imago Dei*, an image of God, that is clearly separate from other beings and nature itself (e.g., Marchesini, 2015). This proclivity for exceptionalism is so widespread that it arguably has affected scientific practice, and may have prevented “the research community from finding the frame in which humans are ordinary” (Finlay & Workman, 2013, p. 199).

A corollary of human exceptionalism vis-à-vis other species is the belief in “human development”; that is, consumption-based economic growth to increase living standards and hence human well being (e.g., Srinivasan & Kasturirangan, 2016). Although the



valorization of human wellbeing is central to this pursuit, it ironically entails harmful effects on the environment that ultimately may compromise human well-being.

The role of science vis-à-vis human exceptionalism is ambivalent: On the one hand, without science no human development on the scale observed during the last century would have been possible. Science therefore has been a powerful tool in the pursuit of exceptionalist goals. On the other hand, the over-arching outcome of the centuries of research since the scientific revolution has been a diminution of the status of human beings: The Earth was considered the center of the universe for millennia, whereas we now know our planet to be a rather small and insignificant object in a universe full of an untold number of galaxies. Similarly, whereas Saint Augustine could claim that humans were created in the image of God, research has increasingly revealed surprising cognitive similarities between us and other species. For example, chimpanzees have been shown to be capable of altruism (Warneken & Tomasello, 2006; Warneken, Hare, Melis, Hanus, & Tomasello, 2007). Indeed, chimpanzees may have at least a rudimentary “theory of mind” (Karg, Schmelz, Call, & Tomasello, 2015). Although the boundaries of primate cognition are still being debated, there is no doubt that scientific progress—especially in evolutionary biology—has placed *homo sapiens* within a continuous development of species, eroding support for the notion that humans are exceptional.

A person with a commitment to human exceptionalism may therefore be reluctant to embrace the scientific method or its findings, lest it further reduce the human stature in the universe. In support, Gottlieb and Lombrozo (2017) showed in a number of studies that the more people thought that a behavior (e.g., recognizing faces, falling in love) was a uniquely human ability, the less likely they deemed it to be that science could ever explain that behavior, and the more discomfort they felt at the idea that science might investigate those phenomena. Similarly, much research into environmental attitudes (e.g., Polonsky, Vocino, Grimmer, & Miles, 2014; Rudman, McLean, & Bunzl, 2013; Whitmarsh, 2011) has

relied on the New Environmental Paradigm (NEP) Scale (Dunlap, Van Liere, Mertig, & Jones, 2000), which subsumes two factors that are pertinent to anthropocentrism and exceptionalism. This research has generally found that NEP scores are predictive of attitudes about climate change (Whitmarsh, 2011) and behaviors such as pro-environmental purchases (Polonsky et al., 2014). However, we are not aware of any research that has related exceptionalism to acceptance of science more generally. We therefore included a measure of human exceptionalism in our first study.

*Religion and science.* There is clear evidence that the rejection of some scientific propositions is driven by religious beliefs. For example, J. D. Miller, Scott, and Okamoto (2006) showed an association between religiosity and rejection of evolution across multiple countries. Similarly, using General Social Survey data, Jelen and Lockett (2014) showed that membership in an evangelical denomination and a literal belief in the authority of the Bible predicted rejection of evolution and stem cell research, although it was only marginally related to the rejection of climate change. This difference between a strong association for evolution and a reduced magnitude for climate change was replicated by Ecklund, Scheitle, Peifer, and Bolger (2017). Similar results were reported by Rutjens, Sutton, and van der Lee (2018), who additionally showed that religious conservatives had particularly low faith in science generally and were reluctant to support funding for it.

However, religion is not necessarily a barrier to acceptance of science: Most famously, in June 2015, Pope Francis released his encyclical *Laudato si*, in which he declared climate mitigation to be a moral imperative.<sup>2</sup> Moreover, in an Australian sample (Morrison, Duncan, & Parton, 2015), Buddhists were found to be even more concerned about climate change than non-religious respondents (who in turn were more concerned than Christians). On balance, therefore, the involvement of religion in the rejection of science appears nuanced and is worthy of further exploration. Our study therefore also included an assay of religiosity.

*Science denial on the left?*

Our preceding analysis provided several reasons why the rejection of science might be expected to be particularly prevalent on the political right. An empirical test of this analysis should therefore also include a search for scientific propositions that, for political or ideological reasons, are expected to be in conflict with *leftwing* political views. Does the general harmony between the norms of science and leftwing worldviews override the worldview challenge posed by a specific scientific issue?

Past attempts to assign science denial to the political left have focused on genetically-modified (GM) foods and vaccinations, based largely on media reports that claimed left-wing opposition to GM foods (e.g., Shermer, 2013) and a left-wing anti-vaccine stance (e.g., Mooney, 2011). Those suggestions have not withstood scrutiny: Attitudes towards GM foods have turned out to be uncorrelated with political views (Lewandowsky et al., 2013), and distrust of GM scientists has turned out to be greater on the political right than the left (Hamilton, 2015). Likewise, research has linked opposition to mandatory human-papillomavirus (HPV) immunizations against cervical cancer to free-market and individualistic worldviews (Kahan et al., 2010), and general skepticism of vaccinations has also been found to be particularly prevalent among free-market enthusiasts (Lewandowsky et al., 2013, 2020). Endorsement of complementary and alternative medicine (CAM) has also been found to be higher among conservatives than liberals (Lewandowsky et al., 2020), contrary to anecdotal claims of a symbiosis between alternative medicine and other left-wing ideas under the umbrella of “New Age” thinking (Keshet, 2009).

Here, our search for science denial on the political left focuses on people’s ideas about the environmental determinants of intelligence. The belief in the ability to improve people and their circumstances, often known as meliorism, is at the heart of liberalism (e.g., Castagno, 2017; Porter, 2013), whereas disbelief or skepticism in that possibility

characterizes conservatives. Accordingly, there is evidence that higher ratings of social conservatism are associated with lower ratings of the possibility of general human improvement (L. Miller & Seligman, 1999). In the specific context of intelligence, people have been shown to be split on whether they see intelligence as fixed and trait-like “entities” or as malleable and “incremental” processes (Dweck, Chiu, & Hong, 1995). There is evidence that political attitudes affect people’s support for educational policies that rest on the view that intelligence is malleable. For example, liberal (as opposed to conservative) participants are more likely to support policies such as an equal distribution of property taxes across school districts, and this support is further amplified by an experimental manipulation that emphasizes that most people have the potential to become highly intelligent (Rattan, Savani, Naidu, & Dweck, 2012).

Those optimistic attitudes stand in at least partial conflict with a large body of evidence that reveals environmental influences on intelligence to be quite limited. First, there is little evidence that intelligence can be boosted by training. Although two recent meta-analyses have suggested that fluid intelligence *can* be improved by extensive training on a variety of other tasks (Au et al., 2015; Karbach & Verhaeghen, 2014), those results have been challenged by critics who argued that any beneficial effects disappear when an appropriate control group is used (Dougherty, Hamovitz, & Tidwell, 2016; Melby-Lervåg & Hulme, 2016). All meta-analyses agree that, if there is an effect of training on intelligence at all, it is fairly small.

Second, individual differences in intelligence are to a large part related to genetic differences, with current estimates of heritability hovering around 50% (Hill et al., 2018; Polderman et al., 2015; Sauce & Matzel, 2018). Although these estimates vary across studies and with variables such as the age of the subject population, there is no credible evidence that would deny a notable role of heritability in determining people’s intelligence. Both our studies therefore included items that queried people’s acceptance of the

heritability of intelligence and its limited malleability. We expected those items to be particularly challenging to people with left-wing political views. We would therefore expect a positive association with indicators of conservatism and endorsement of the heritability construct.

### Study 1

The first study measured 4 attitudinal constructs and related them to people's beliefs about 3 scientific issues. The first attitudinal construct, nationalism, touches directly on the communist and universalist norms of science. The second construct, human exceptionalism, provided a potential window into the discomfort that might arise from science increasingly questioning the often-presumed uniqueness of human beings. The final two constructs, religiosity and free-market attitudes, constitute two important strands of conservative attitudes (Everett, 2013) and are established statistical proxies for general conservatism (e.g., free-market endorsement is strongly associated with conservatism;  $r = .76$ , Lewandowsky et al., 2013). All constructs were scored such that greater values reflected greater endorsement.

The scientific attitudes we examined covered a broad range of domains. We probed attitudes towards climate change and its human causes, the safety and efficacy of vaccinations, and whether intelligence is genetically determined (called *IQ Heritable* for brevity from here on). These constructs were also scored to map greater values into greater endorsement. For climate change and vaccination, greater endorsement also implied greater acceptance of the scientific “gold standard”: the items were designed such that full acceptance of the relevant scientific knowledge would translate into complete endorsement. For IQ Heritable, the “gold standard” is less clearly defined because heritability is a matter of degree and the ground truth is not precisely known. We are

therefore more concerned with associations between IQ Heritable and other constructs rather than specific levels of endorsement.

The sampling plan and procedure as well as an analysis plan were preregistered before data collection commenced. The preregistration document including a complete copy of the survey and a proposed analysis script in R can be found at <https://osf.io/su8nf/>.

### *Method*

*Materials.* The survey comprised 46 items, broken down into 3 demographic queries presented at the outset (age, gender, and the age of acquisition of English), 39 items to measure our core constructs, 2 items that targeted claims that climate change is a “hoax” (not analyzed here), and two items that served as attention filter. The first attention filter asked people to identify which of a list of 5 items was not an animal, and the second attention filter consisted of a renewed query of participants’ age at the end of the survey.

The 39 core items and the first attention filter were presented in a different random order for each participant. Table S1 provides a verbatim list of the 39 core survey items together with brief labels (e.g., *HumConsc* for “Humans are the only living beings who are conscious”) that are used for presentation of the results. For illustration, Table 1 shows one representative items for each construct used across the two studies.

The items for human exceptionalism, nationalism, and heritability of intelligence were designed by the authors for this study. The items for the free-market, vaccinations, and climate-science constructs were taken from our earlier research (e.g., Lewandowsky et al., 2013). All items for those constructs used a 7-point response scale ranging from “Strongly agree” to “Strongly disagree”. The religiosity items were taken from (Rohrbaugh & Jessor, 1975) and retained the original 5-point response scales (see Table S1), with the

exception of *RelComf* which used the 7-point scale (“Strongly agree” – “Strongly disagree”) to retain consistency with all other items querying agreement.

*Ethics statement.* The Ethics Committee of the Department of Psychology at the University of Zurich approved the study. The survey was prefixed by an introductory information sheet outlining the research. Participants indicated their informed consent after reading this information sheet by a mouse click, which commenced presentation of the survey questions.

*Participants and procedure.* A sample of 1,000 U.S. residents 18 years and older was recruited during March 2017 via electronic invitations by Qualtrics.com, a firm that specializes in representative internet surveys. Participants were drawn from a completely bipartisan panel of more than 5.5 million U.S. residents (as of January 2013), via propensity weighting to ensure representativeness in terms of gender, age, and income. Participants were compensated by Qualtrics using the company’s standard reward scheme.

## *Results*

The final sample included 1051 responses that passed the Qualtrics quality checks (including the two attention filters) and were delivered to the authors. This data file can be accessed at <https://osf.io/bg4fb/> (potentially identifying information has been removed). Although our preregistered analysis plan did not specify any further exclusion criteria, we discovered that several participants responded identically (before reverse-coding) to all items for one or more constructs. We deemed this to be indicative of potential inattention and therefore eliminated any participant who responded identically to all items for more than one construct. After exclusion, 974 observations were retained

for analysis. The final sample included 471 men and 503 women, with a mean age of 47 (median 47; range 19–89). Only 4 participants had learned English less than 5 years ago; they were retained for analysis. The R scripts for all analyses reported in this article can be found at <https://git.io/fpEYo>, together with the L<sup>A</sup>T<sub>E</sub>X source file that weaves the results of the analysis in R directly into the paper. The online supplement (Table S2 and Figure S1) summarize the raw responses and distribution of composite scores.

*Latent variable modeling.* Our preregistered analysis plan identified structural equation modeling (SEM) as our principal analysis technique. Thus, each construct of interest was represented by a latent variable that was estimated from the responses to the corresponding multiple items. Latent variables are not directly observable but have the advantage of avoiding attenuation of the observed effects through measurement error (Coffman & MacCallum, 2005). Alternative methods, such as multiple regression based on composite scores with imperfect reliability, yield results that are more prone to measurement error, rendering their interpretation problematic (Osborne & Waters, 2002). The analysis plan did not specify particular models for exploration, other than that we would seek to predict endorsement of climate science and of vaccination attitudes, and attitudes towards heritability of intelligence, from the other constructs. Our latent variable modeling thus conformed to the analysis plan without being exactly prescribed by it.

SEM models with more than 20 indicator variables (i.e., items) are often too large to achieve adequate levels of model fit (Bentler & Chou, 1987). One way to overcome this problem is by averaging the item scores measuring each construct into a single-indicator variable for SEM, a procedure known as item parceling. One criticism of item parceling is



that it may obscure multi-dimensionality (Little, Cunningham, Shahar, & Widaman, 2002). To preempt this criticism, we first modeled the latent variable for each construct based on all of its respective items to determine its dimensionality. All SEM was conducted using the *lavaan* package in R (Rosseel, 2012).

*Measurement models.* Six of the constructs were found to exhibit an essentially uni-dimensional structure, although in most cases one correlation between the residuals of two items had to be added to the single-factor model to achieve a satisfactory fit. Table 2 reports the fit statistics for those 6 measurement models. For the three constructs that had been employed in previous research (Lewandowsky et al., 2013), the fit statistics were similar and the correlated residuals involved the same items as before. For the nationalism construct, the item *IntBigProb* was dropped from the model because it did not load onto the latent variable. The model with the remaining 6 items fit very well with a single correlated residual.

Unlike for the other constructs, it proved impossible to create a simple unidimensional measurement model for the IQ Heritable construct. This difficulty arose because the items of opposing polarity could not be assigned to a single factor. Instead, items that were phrased such that endorsement implied environmental determinants (*IQStim*, *IQAdopt*, *IQEd*, *IQUpbring*), and those whose endorsement implied heritability (*IQGen*, *IQTwins*, *IQParents*), could each be modeled by a single-factor model that fit extremely well, but with only a modest correlation between the two factors when combined into a two-factor model,  $r = 0.2$ ,  $p < 10^{-4}$ . To model all items together, we therefore created a hierarchical two-factor model, in which the component factors loaded

onto a second-order factor, with the loadings of the two component factors constrained to be equal. That second-order factor reflects whatever variance is shared by the component factors, beyond the “nuisance” variance arising from reverse scoring. Because the loadings were constrained to be equal, items of each polarity were given equal weight.

This hierarchical model fit very well,  $\chi^2(13) = 33.66$ ; SRMR=0.028; CFI=0.982; RMSEA=0.04 (90% CI: 0.024–0.057).<sup>3</sup> Because the IQ Heritable construct required a more complex model, thus defying the requirements for item-parceling, we first focus on the single-indicator latent variables for the other constructs.

*Single-indicator latent variable models.* We modeled the 6 unidimensional constructs via single-indicator latent variables (Hayduk, 1996; Jöreskog & Sörbom, 1982). In single-indicator models, each latent variable is defined by one indicator consisting of an equally-weighted composite of the relevant items (i.e., the mean of the item scores). The supplement provides further details about the single-indicator models, including summary and fit statistics (Table S3).

The top panel of Table 3 shows the correlation matrix for the 6 single-indicator latent variables. All correlations were significant ( $p < .0001$ ) with the exception of the correlation between Vaccinations and Exceptionalism,  $p = 0.113$ . The results replicate previous research, with a strong negative correlation between endorsement of free markets and acceptance of climate science and a smaller negative correlation between free market and vaccinations. Both sign and magnitude of those correlations mesh well with previous research (Lewandowsky et al., 2013).

The bottom panel of Table 3 contains the correlations between the IQ Heritable construct (represented by the second-order factor in the hierarchical model) and the single-indicator latent variables for the other constructs. All correlations are quite modest, with only that involving Nationalism exceeding the significance threshold. Notably, the correlations with free-market endorsement and religiosity, our proxies for political attitudes, were negligible.

The results in the table that are most novel and relevant involve the Exceptionalism, Nationalism, and Religiosity constructs. In line with our expectation that the norms of science challenge conservative worldviews, greater religiosity and endorsement of the free market were also associated with greater nationalism. Nationalism, in turn, was associated with reduced acceptance of two of our scientific constructs (climate and vaccinations), but conversely, it was associated with increased belief that intelligence is heritable. Similarly, the belief in human exceptionalism was positively associated with religiosity and belief in the free market, but negatively with the three scientific constructs, although only one of those correlations, with climate, reached significance. The positive associations between Exceptionalism and our proxies for conservatism are in line with previous research that has found an association between aspects of right-wing thought and “speciesism”, that is support for the exploitation of animals to satisfy human interests (Dhont & Hodson, 2014; Dhont, Hodson, & Leite, 2016). The strong association with Nationalism in particular mirrors prior work showing that dominance-based attitudes correlate highly with the view that humans are superior to other beings (Dhont et al., 2016).

*Predictive models.* We next identified individual predictive models for each of the three scientific constructs. In each case, we first fit a full model involving all potential predictor constructs (human exceptionalism, nationalism, religiosity, and free-market endorsement) and then eliminated predictors until we found the simplest possible model that did not incur a significant loss of fit in comparison to more complex models. Table 4 shows, for each scientific construct, the fit statistics for the simplest model and its predictors. Note that the fit of the predictor model for IQ Heritable is poor.

For a final unifying model we sought to predict all scientific constructs simultaneously. Using the same approach as before, we eliminated predictors from the full model until we found the simplest possible model that did not incur a significant loss of fit. This overall model is shown in Figure 1. The model fit acceptably well,  $\chi^2(54) = 270.58$ ;  $p < 10^{-4}$ ; SRMR=0.072; CFI=0.904; RMSEA=0.064 (90% CI: 0.057– 0.072).

### *Discussion*

The first study explored two issues: The role of the norms of science—in particular its universality and communism—in determining people’s attitudes towards scientific propositions, and whether leftwing worldviews would lead people to reject the clear evidence for a heritability component in determining individual differences in intelligence. Our results cast light on both issues.

Concerning the role of norms, we observed strong positive correlations between nationalism—a construct that is in intrinsic opposition to the universality and communality of science—and our proxies for conservatism, free-market attitudes and religion. Moreover, nationalism predicted reduced acceptance of two scientific issues,

relating to climate and vaccinations, suggesting that when people's attitudes mesh well with the tacit norms of science (i.e., by rejecting nationalism), they are also more likely to endorse scientific propositions. The negative impact of nationalism on vaccinations is particularly notable because vaccinations typically do not require any overt international cooperation (the data were collected before the COVID-19 pandemic). Another notable aspect of the results is the positive association between Nationalism and IQ heritable. This associations is explainable by the theme of an invariant hierarchy among humans that suffuses both nationalism (at the level of countries) and the idea of heritability of intelligence (at the level of individuals). We explore this further in the next study.

We found limited support for our notion that belief in human exceptionalism would predispose people to be more skeptical in their acceptance of scientific propositions. Exceptionalism was negatively associated with acceptance of climate change, although it was unrelated to IQ Heritable and, in the final predictive model (Figure 1), it was a small but positive predictor of acceptance of vaccination.

At the level of pairwise correlations, our results are consonant with the negative associations between religiosity and acceptance of climate change, and between religiosity and endorsement of vaccination reported by Rutjens et al. (2018).<sup>4</sup> In the final predictive model, religiosity was still negatively associated with Vaccinations, although it did not contribute directly to explaining attitudes towards climate change or the heritability of intelligence.

Turning to the heritability of intelligence, we found no associations involving religiosity or free-market attitudes, two powerful proxies for conservatism. The only hint in our data that people on the left might be more inclined to think that intelligence can

be shaped by the environment arises from the positive association between nationalism (which is less prevalent among people on the left) and heritability. These results must, however, be interpreted with caution. The IQ Heritable construct turned out not to be estimable by a uni-dimensional measurement model. Unlike for the other constructs, the polarity of the items exerted a major influence, and standard reverse scoring was insufficient to unify people's responses under a single factor. We instead had to construct a hierarchical two-factor model to accommodate polarity, and used the second-order factor in our SEM analyses. That factor captured the variance that was shared by all items, thus justifying its use in our further modeling. Nonetheless, some degree of skepticism might be in order when interpreting the IQ Heritable construct (e.g., the fit of the simple predictive model for that construct was poor by some measures; see Table 4). Our conclusion that attitudes towards intelligence are largely independent of political worldviews must therefore remain provisional and is in need of further empirical scrutiny.

In summary, the first study again failed to find a notable association between left-leaning political views and potential rejection of scientific evidence, in this case relating to the heritability of intelligence. The first study also provided several glimpses into the possibility that conservative political leanings may be in intrinsic conflict with the norms of the scientific enterprise, in particular its universality and communism. The purpose of the next study was to solidify those glimpses into a more direct examination of the relationship between scientific norms and political views.

## Study 2

The second study again related beliefs about the same scientific issues to a number of potential predictors. Based on the results of Study 1 and pilot testing, the items probing beliefs about heritability of intelligence were revised in order to achieve unidimensionality.

Unlike Study 1, we used a more direct measure of people's attitudes towards the norms of science by developing items that targeted the 4 major norms (communism, disinterestedness, scepticism, and universality; Merton, 1942). Table 1 provides sample test items for each of those 4 norms (the complete list is in Table S4). We also replaced free-market attitudes with a broader measure of conservatism. Although free-market attitudes tend to be highly correlated with conservatism (Lewandowsky et al., 2013), economic libertarianism and social conservatism form two distinct strands of conservatism (Everett, 2013). We therefore used a scale that bridged those two strands and is known to be unidimensional (Lewandowsky, 2021b).

Finally, we replaced religiosity and Exceptionalism by an individual-differences variable that measures people's preferences for group-based social hierarchies, known as social dominance orientation (SDO). There were two reasons for this choice: First, previous research has identified SDO as a driver of climate denial that is sometimes sufficiently powerful to mediate, and render non-significant, the effects of conservatism more generally (Jylhä & Akrami, 2015; Jylhä, Cantal, Akrami, & Milfont, 2016; Milfont, Richter, Sibley, Wilson, & Fischer, 2013). Second, and more important, SDO taps sentiments that are similar to nationalism but at the level of groups within a country. To the extent that endorsement of the heritability of intelligence reflects the belief that

groups or nations should be ranked along a hierarchy, we would therefore expect SDO to be a predictor of the IQ construct, similar to Nationalism in Study 1.

The sampling plan, procedure, and analysis plan were preregistered before data collection commenced. The preregistration can be found at <https://osf.io/c8qfx>.

### *Method*

*Materials and participants.* The survey comprised 47 items, broken down into 2 demographic queries presented at the outset (age and gender), 2 attention filters, and 43 items to measure the attitudinal constructs (see Table S4). The attention filters queried people’s agreement with the statements that “the Earth orbits around the moon” and “the moon orbits around the Earth”. The 43 core items and the attention filters were presented in a different random order for each participant. All core items and attention filters used a 7-point response scale ranging from “Strongly disagree” to “Strongly agree”, with the exception of one of the conservatism items (*POL\_CONS5*), which used an 11-point scale (see Table S4).

Items for climate science and vaccinations were identical to Study 1, and some of the items for heritability of intelligence were also re-used from Study 1. The conservatism items were used in previous related research (see Lewandowsky, 2021b, for details). Social Dominance Orientation (SDO) was measured using the  $SDO_{7(s)}$  scale (Ho et al., 2015, Appendix B). All constructs were scored such that greater values represented greater endorsement.

A new representative sample of 1,000 U.S. residents 18 years and older was requested from Qualtrics during March 2019.



*Ethics statement.* The Ethics Committee of the Faculty of Science at the University of Bristol approved the study. Participants again indicated their informed consent after reading an information sheet that prefixed the survey.

### *Results and discussion*

The final sample delivered by Qualtrics included 1042 responses that passed the Qualtrics quality checks (including the two attention filters). This data file can be accessed at <https://osf.io/4wy6m/> (potentially identifying information has been removed). We again eliminated any participant who responded identically (before reverse scoring) to all items for more than one construct ( $N = 4$ ), yielding a final set of 1038 observations for analysis. The final sample included 502 men and 523 women (11 nonbinary), with a mean age of 45.8 (median 46; range 18–82). Table S5 and Figure S2 summarize the raw responses and show the distributions of composite scores.

*Measurement models and single-indicator models.* We followed the same approach as in Study 1 to construct single-indicator latent variable models after establishing unidimensionality.

For the norms of science construct, we first formed composites of the items in the 4 subscales (communism, disinterestedness, scepticism, and universality), and those 4 composites were then used as indicator variables for the measurement model. Because the expected relationship between political views and the norms of science were of particular interest, we first considered the correlations between conservatism and the 4 subscales (Table 5). The table shows that greater conservatism was associated with reduced endorsement of the norms of science overall (bottom row) and with reduced endorsement

of 3 out of 4 of the subscales. Only skepticism appeared to be apolitical and was not associated with the conservatism scale. Because the measurement model for norms based on the 4 composites for the subscales fit extremely well (Table 6), and because conservatism was strongly associated with reduced endorsement of norms overall, we do not differentiate between the subscales from here on.

We followed a similar approach for SDO. We first averaged responses within pairs of items that queried the same aspect of SDO using opposing polarity (items *SDO1* and *SDO4*; *SDO2* and *SDO3*; *SDO5* and *SDO7*, and *SDO6* and *SDO8*) before using the resulting 4 averages as indicator variables. For the remaining constructs, indicator variables were entered directly into the measurement models.

All constructs were found to exhibit an essentially uni-dimensional structure, although in most cases one correlation between the residuals of two items had to be added to the single-factor model to achieve a satisfactory fit. We also eliminated item *IQ\_GEN5* from the model for IQ heritability because its loading on the common factor was small and fit improved substantially when the item was removed. Unlike in Study 1, however, it was possible to create a single-dimensional measurement model for the IQ heritability construct.

Table 6 reports the fit statistics for the 6 measurement models. For the constructs that were also used in Study 1 or previous research (Lewandowsky et al., 2013), the fit statistics were similar and the correlated residuals involved the same items as before. As in Study 1, these measurement models were used to estimate  $\omega$  for each latent variable's single indicator (see Table S6).

*Correlations among latent variables.* Table 7 shows the correlation matrix for the 6 single-indicator latent variables. All correlations were significant at  $p < .0001$ , except for the correlation between IQ heritable and norms of science,  $p < .003$ , and a non-significant correlation between IQ Heritable and Vaccinations.

*Predictive models.* We next identified individual predictive models for each of the three scientific constructs (IQ Heritable, Climate, and Vaccinations). As in Study 1, we first fit a full model involving all potential predictor constructs (Norms of science, Conservatism, and SDO) and then eliminated predictors until we found the simplest possible model that did not incur a significant loss of fit. Table 8 summarizes those models. Note that the model for climate science was fully saturated and hence fit perfectly. Removal of any of the three predictors was associated with highly significant loss of fit.

Using the same approach as in Study 1, we selected the simplest possible model to predict all scientific constructs. This overall model is shown in Figure 2. The model fit very well,  $\chi^2(5) = 10.62$ ,  $p = 0.0595$ ; SRMR=0.016; CFI=0.996; RMSEA=0.033 (90% CI: 0– 0.061). The predictive model replicated Study 1 in several important ways. First, conservatism and the closely allied SDO construct predicted rejection of climate science, as expected. Second, SDO predicted endorsement of the heritability of intelligence, confirming the suggestion that any hierarchical view of the world—whether at the level of nations or groups within a society—finds its reflection in the expectation of innate and presumably invariant differences in intelligence between individuals. The predictive model also highlighted a novel contribution of Study 2, namely the findings that acceptance of the norms of science was negatively associated with conservatism and SDO, and that it

predicted endorsement of two scientific findings relating to climate change and vaccinations (see also Table 7).

## General Discussion

### *Worldviews and the heritability of intelligence*

We chose to probe people's attitudes about the sources of individual differences in intelligence because of the centrality of the belief in human improvement in liberal and left-wing thought (Porter, 2013; Rattan et al., 2012). Across both studies, our results provide little evidence that this belief impairs people's recognition that intelligence is, at least in part, heritable. In Study 1, we found no association between religiosity or free-market attitudes, two powerful proxies for conservatism, and people's belief that intelligence is shaped by the environment rather than genetics. In Study 2, the zero-order correlation between conservatism and heritability was positive and significant (implying that liberals were less likely to endorse heritability of intelligence) but when other variables were controlled in the predictive model, this relationship disappeared.

Our results mesh well with a recent survey of sociologists, a discipline that has been cited as being particularly "left-wing" (Winegard & Winegard, 2017), which found that more than 80% of respondents endorsed a role of genetics in determining people's intellectual potential (Horowitz, Yaworsky, & Kickham, 2014). This clear endorsement of heritability among people seen as predominantly "left-wing" is not compatible with the suspicion that this particular scientific evidence might be dismissed in favor of ideology among people on the left. The only hint in our data that people on the left might be more inclined to think that intelligence can be shaped by the environment arises from the

positive association between nationalism (Study 1) or SDO (Study 2) and heritability.

Both nationalism and SDO are less prevalent on the left than the political right, although both only tap a subset of the liberal-conservatism spectrum.

Our findings thus add to the catalogue of unsuccessful attempts to find strong evidence for science denial on the political left in attitudinal surveys. Although there has been some media speculation that people on the left are unreasonably skeptical of genetically-modified (GM) foods (Kloor, 2012; Shermer, 2013) or vaccinations (Mooney, 2011), those speculations have failed to find much empirical support to date. Although in a regional survey liberals appear to be more wary of GM foods by supporting legislation requiring labeling (Hamilton, 2014), they also trust scientists more on questions relating to GM than conservatives (Hamilton, 2015). In a nationally representative survey in the U.S., neither conservatism nor free-market endorsement predicted attitudes towards GM foods (e.g., Lewandowsky et al., 2013). In another recent analysis of U.S. responses to the International Social Survey Program, Rutjens et al. (2018) found a small but significant effect of conservatism ( $\beta = -.08$ ), indicating that conservatives were *less* sceptical of GM. Across three studies, Rutjens et al. (2018) nonetheless conclude that “GM food skepticism is not driven by political or religious beliefs” (p. 395).

Concerning vaccinations, Hamilton, Hartter, and Saito (2015) showed that trust in scientists regarding vaccinations was greater among Democrats than Republicans, and Kahan et al. (2010) showed that conservatives’ opposition to vaccination was particularly acute in the context of sexually transmitted diseases such as the human-papillomavirus (HPV) responsible for cervical cancer. Similarly, free-market endorsement has repeatedly been shown to be a predictor of rejection of vaccinations (Lewandowsky et al., 2013, 2020,

and the present Study 1). Intriguingly, when conservatism is considered separately from free-market endorsement, it is not associated with attitudes towards vaccinations (Model 2 in Lewandowsky et al., 2013; Lewandowsky et al., 2020, and the present Study 2, although the present measure of conservatism included one free-market item). The available data thus suggest that it is libertarianism, rather than socio-political conservatism, that makes people reluctant to endorse vaccinations, perhaps because the issue is overshadowed by potential government interference (e.g., by making vaccinations mandatory). Either way, the conjecture that vaccinations are primarily rejected by people on the political left finds no support in the data (see also, Hornsey et al., 2018).

#### *Worldviews and the norms of science*

The broad range of results showing conservatives to be more likely to reject scientific findings than liberals motivated our question whether there is anything about the scientific enterprise itself that may challenge people with rightwing or libertarian worldviews. We were particularly concerned with the universalist and communist norms of science (Merton, 1942); namely, that science transcends racial, class, and national barriers and that its findings belong to the community as a whole. Those norms stand in obvious opposition to streams of conservative thought, and in support our first study confirmed that nationalism was a predictor of the rejection of well-established scientific findings relating to climate change and vaccinations.

Our second study extended this using a more direct and broader test of people's attitudes towards the norms of science. Endorsement of the norms of science was a

positive predictor of acceptance of climate science and vaccinations, and it was negatively associated with conservatism and SDO.

Taken together, the results of our two studies provide a potential explanation for why conservatives are more likely to reject scientific findings than liberals. Previous accounts have focused on the ideologically asymmetrical challenge posed by current scientifically-based problems (Kahan, 2015; Lewandowsky & Oberauer, 2016). On that account, conservatives reject climate science not because they reject science *per se* but because climate mitigation requires changes to current economic practice.

Our findings show that this view is, at best, incomplete. In addition to the obvious clash between conservative views and specific scientific results, we have identified a general tension between conservative thought and the norms of science (bearing in mind the exception for skepticism; see Table 5). The pervasive rejection of science by people on the right observed here and in many other studies is thus not just coincidental or dictated by political pragmatics, but also represents a deep conflict between science and conservatism.

#### *Attitudinal asymmetry and potential cognitive symmetry*

The finding that science denial primarily—or indeed exclusively—involves the political right meshes well with reports of greater gullibility and receptivity to false information among people on the political right. For example, Sterling, Jost, and Pennycook (2016) found that individuals who endorsed a neoliberal, free market ideology were more susceptible to what they called “pseudo-profound bullshit;” that is, vague or meaningless statements composed of intellectual lingo such as “consciousness is the growth of coherence, and of us.” Similar findings were reported by Pfattheicher and Schindler

(2016). This asymmetrical theme is also revealed in recent “big-data” analyses, which have reported evidence of substantial selective exposure to fake news, with Trump supporters consuming more news from untrustworthy websites than others (Guess, Nyhan, & Reifler, 2020). Similarly, a recent large-scale study of Twitter users has found that sharing of misinformation was disproportionately concentrated among older Republicans (Grinberg, Joseph, Friedland, Swire-Thompson, & Lazer, 2019). Perhaps unsurprisingly, rejection of science, endorsement of pseudo-profound but meaningless statements, and susceptibility to “fake news” may turn out to be diverse sides of the same political coin.

In striking contrast to those reports of asymmetry, laboratory experiments have repeatedly shown that the propensity to engage in cognitive shortcuts—that is, responding on the basis of superficial association rather than deep reflection—is distributed evenly across the political divide. When participants are presented with synthetic data (e.g., hypothetical results of gun control laws) that are amenable to a quick—but inaccurate—interpretation, as well as to a competing complex—and accurate—interpretation, the quick but inaccurate interpretation is triggered when it is worldview congruent, irrespective of the person’s beliefs. Conversely, the more complex and accurate reading of the data is recruited only when the quick interpretation challenges participants’ worldview, and this effect also holds irrespective of a person’s beliefs (Kahan, Peters, Dawson, & Slovic, 2013; Washburn & Skitka, 2018). These data suggest that when people are asked to engage in cognitive processing to interpret data in the laboratory, as opposed to expressing their pre-existing attitudes in a survey, then conservatives and liberals engage seemingly identical cognitive processes. Similar nearly-symmetrical



processing of corrections to misinformation has been reported by Swire-Thompson and Lazer (2020) with Trump voters and Sanders voters.<sup>5</sup>

We are thus presented with a puzzle: if people across the political spectrum can engage the same cognitive processes to interpret numeric data or process corrections in the laboratory, how can they differ so reliably and asymmetrically in their attitudes towards a broad range of scientific findings? The present results suggest that the resolution of the puzzle may lie in the tension between the norms that govern the scientific enterprise and conservative political thought. Conservatives are less likely to endorse the norms of science, and therefore are more inclined to distrust scientific results in general. This general propensity to distrust science is tapped in surveys that ask about a person's pre-existing view about scientific findings on a broad topic such as climate change or vaccinations. Those views, in turn, have likely been formed over time based on information from the media, friends and family, community leaders, and other public sources that a person finds credible. On each of those occasions, there is an opportunity to consider that testimony through the lens of the norms of science. By contrast, in laboratory experiments where people are asked to draw their own conclusions from specific data, it appears that the propensity to distrust science is not activated by the task at hand. This account is necessarily speculative but it gives rise to several interesting empirical questions about the relationship between the two paradigms that can be explored in future research, such as whether explicit reminders about the norms of science would affect subsequent interpretation of the data, or conversely, whether partisan differences in attitudes might become attenuated by prior processing of data.

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### Footnotes

<sup>1</sup> For the purposes of this paper, we are only concerned with cooperative internationalism, that is the idea that countries should cooperate multilaterally to solve global problems (Todorov & Mandisodza, 2004). We are not concerned with another variant of internationalism, now often referred to as “Conservative Internationalism” (Laderman, 2018), which relies on military strength to achieve global objectives and largely eschews multilateralism.

<sup>2</sup> The encyclical did not shift American public attitudes about climate change overall. Among those who had heard of the encyclical, the Pope’s intervention increased polarization: concern about climate change was increased among liberals, but it decreased among conservatives, who also devalued the Pope’s credibility on climate issues (Li, Hilgard, Scheufele, Winneg, & Jamieson, 2016).

<sup>3</sup> Evaluating the fit of a structural equation model involves is a complex judgment based on a number of available fit indices (Hu & Bentler, 1999). The  $\chi^2$  statistic compares the goodness of fit between the obtained covariance matrix and the predicted matrix derived from the model, where a significant test indicates model *misfit*. The  $\chi^2$  statistic is rarely used to make decisions about fit because for models based on more than 400 cases, the  $\chi^2$  is almost always statistically significant (Kenny, 2020). In addition, the value of the statistic is also affected by the magnitude of the correlations in the model, with larger correlations giving rise to poorer fit (Kenny, 2020). For these reasons, researchers have focused on alternative measures of fit. We report three additional measures: (a) The Comparative Fit Index (CFI), which is an incremental fit index that can be interpreted in



a manner analogous to  $R^2$ , with 0 representing complete lack of fit and 1 a perfect fit.

Values of CFI in excess of .90 or .95 are considered to indicate a good fit (Hu & Bentler, 1999).

(b) The Standardized Root Mean Square Residual (SRMR) which represents the standardized difference between observed and predicted correlations. A value of zero indicates perfect fit and values less than .08 are generally considered a good fit (Hu & Bentler, 1999).

(c) The Root Mean Square Error of Approximation (RMSEA) is an absolute measure of fit that is derived from  $\chi^2$  and considers sample size and model complexity. Lower values of RMSEA denote better fit, and conventionally a 90% confidence interval of the estimate is reported, where ideally the lower value is no higher than .05 and the upper value less than .08 (Kenny, 2020).

<sup>4</sup> Rutjens et al. (2018) used three different measures of religiosity, not all of which correlated equally with climate skepticism and vaccination skepticism. However, the broadly negative relationship between measures of religiosity and attitudes towards those two important scientific issues was replicated here.

<sup>5</sup> There are, however, exceptions to this symmetry. In some experimental studies, interventions had different effects on people with different worldviews. For example, Tullett, Hart, Feinberg, Fetterman, and Gottlieb (2016) found conservatives to be more likely to avoid seeking novel data in response to an open-ended question (e.g., “justness” of the world) than liberals. Moreover, a recent meta analysis has identified consistent cognitive differences on a number of measures between people on the political left and

right (Jost, 2017). The list of measures is extensive and includes assays of analytical reasoning such as the cognitive reflection test (Frederick, 2005).

Table 1  
*Sample items for all constructs used in both studies and their short names*

Construct	Item name	Item
Study 1		
Exceptionalism	<i>HumConsc</i>	Humans are the only living beings who are conscious.
Nationalism	<i>Allegiance</i>	Every human must have an allegiance to one country and one country only.
IQ Heritable	<i>IQGen</i>	When people differ in intelligence, it is mostly due to differences in their genetic endowment.
Religiosity	<i>RelComf</i>	Religion gives me a great amount of comfort and security in my life.
Free market	<i>FMMoreImp</i>	The preservation of the free market system is more important than localized environmental concerns.
Climate science	<i>CO2causesCC</i>	Human CO2 emissions cause climate change.
Vaccinations	<i>VaxSafe</i>	I believe that vaccines are a safe and reliable way to help avert the spread of preventable diseases.
Study 2 (new constructs only)		
Norms of Science	<i>NOR_COM1</i>	Scientific findings should be available to everybody everywhere in the world
	<i>NOR_DIS1</i>	Scientists should put evidence ahead of their own views
	<i>NOR_SCEP1</i>	Scientists should always keep an open mind and be prepared to change their conclusions if new evidence comes along
	<i>NOR_UNIV1</i>	The truth of a scientific discovery does not depend on the nationality, gender, race, or faith of the scientist making it
Conservatism	<i>POL_CONS1</i>	People are better off in a free market economy
Social Dominance Orientation	<i>SDO1</i>	An ideal society requires some groups to be on top and others to be on the bottom

Table 2  
*Model fit indices associated with the measurement models for all uni-dimensional constructs in Study 1*

Construct	$\chi^2$	df	SRMR	CFI	RMSEA	90% CI	Correlated residuals
Exceptionalism	21.49	4	0.033	0.968	0.067	0.041 – 0.096	<i>HumRational</i> ↔ <i>EarthHierar</i>
Nationalism	29.59	8	0.028	0.98	0.053	0.033 – 0.074	<i>IntEnjoy</i> ↔ <i>IntWeb</i>
Religiosity	15.22	5	0.009	0.997	0.046	0.021 – 0.073	—
Free market	3.67	4	0.013	1	0	0 – 0.047	<i>FMMoresBest</i> ↔ <i>FMMoreImp</i>
Climate science	21.05	4	0.015	0.99	0.066	0.04 – 0.095	<i>CNatFluct</i> ↔ <i>HumansInsign</i>
Vaccinations	14.72	4	0.02	0.994	0.052	0.026 – 0.082	<i>VaxNegSide</i> ↔ <i>VaxRisky</i>

Table 3  
*Correlations among 6 unidimensional latent variables in Study 1*

	Exceptionalism	Nationalism	Religiosity	Free market	Climate	Vaccinations
Exceptionalism	1	0.457	0.510	0.387	-0.432	-0.075
Nationalism	0.457	1	0.233	0.443	-0.528	-0.194
Religiosity	0.510	0.233	1	0.309	-0.309	-0.176
Free market	0.387	0.443	0.309	1	-0.771	-0.218
Climate	-0.432	-0.528	-0.309	-0.771	1	0.370
Vaccinations	-0.075	-0.194	-0.176	-0.218	0.370	1

IQ Heritable	0.010	0.350	-0.049	0.033	-0.079	0.072
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Table 4  
*Model fit indices and predictors associated with the simplest predictive model for each scientific construct in Study 1*

Construct	$\chi^2$	df	SRMR	CFI	RMSEA	90% CI	Predictors
IQ Heritable	246.12	40	0.081	0.881	0.073	0.064 – 0.082	Nationalism
Climate	14.56	1	0.018	0.983	0.118	0.07 – 0.175	Nationalism; free market
Vaccinations <sup>a</sup>	4.02	1	0.014	0.993	0.056	0.007 – 0.117	Nationalism; free market; religiosity

<sup>a</sup> The vaccination model suffered a marginally significant loss of fit when Exceptionalism was removed. We present the smaller model because it fits very well.

Table 5

*Correlations between conservatism and individual scientific norms in Study 2*

	Conservatism	Universalism	Disinterestedness	Communism	Scepticism
Universalism	-0.217				
Disinterestedness	-0.140	0.395			
Communism	-0.412	0.294	0.274		
Scepticism	-0.005	0.405	0.409	0.177	
All norms	-0.317	0.771	0.733	0.680	0.596

*Note.* All correlations are significant at  $p < .0001$ , with the exception of Conservatism  $\times$  Scepticism, for which  $p > .1$ . The All norms score was obtained by averaging each participant's responses across all items pertaining to norms. Scores for the individual norms were obtained by averaging responses within each relevant subscale.

Table 6  
*Model fit indices associated with the measurement models for all uni-dimensional constructs in Study 2*

Construct	$\chi^2$	df	SRMR	CFI	RMSEA	90% CI	Correlated residuals
Norms of science	14.92	2	0.026	0.978	0.079	0.045 – 0.118	—
Conservatism	15.42	4	0.021	0.99	0.052	0.027 – 0.081	<i>POL_CONS2</i> ↔ <i>POL_CONS4</i>
IQ heritable	7.24	4	0.013	0.995	0.028	0 – 0.06	<i>IQ_GEN2</i> ↔ <i>IQ_GEN2</i>
Climate science	8.27	4	0.011	0.999	0.032	0 – 0.063	<i>CNatFluct</i> ↔ <i>HumansInsign</i>
Vaccinations	5.68	4	0.008	0.999	0.02	0 – 0.054	<i>VaxNegSide</i> ↔ <i>VaxRisky</i>
Social dominance orientation (SDO)	0	1	0	1	0	0 – 0	<i>SDO1E4</i> ↔ <i>SDO2E3</i>



Table 7  
*Correlations among 6 unidimensional latent variables in Study 2*

	IQ heritable	Climate	Vaccinations	SDO	Norms of science	Conservatism
IQ heritable	1	-0.156	-0.064	0.382	-0.143	0.246
Climate	-0.156	1	0.381	-0.636	0.498	-0.731
Vaccinations	-0.064	0.381	1	-0.209	0.494	-0.209
SDO	0.382	-0.636	-0.209	1	-0.574	0.577
Norms of science	-0.143	0.498	0.494	-0.574	1	-0.385
Conservatism	0.246	-0.731	-0.209	0.577	-0.385	1

Table 8  
*Model fit indices and predictors associated with the simplest predictive model for each scientific construct in Study 2*

Construct	$\chi^2$	df	SRMR	CFI	RMSEA	90% CI	Predictors
IQ Heritable	0.73	1	0.006	1	0	0 – 0.077	Norms; SDO
Climate	0	0	0	1	0	0 – 0	Norms; SDO; Conservatism
Vaccinations	3.09	1	0.012	0.996	0.045	0 – 0.106	Norms; SDO

### Figure Captions

*Figure 1.* Final predictive structural equation model for Study 1. All links and correlations shown are standardized and significant; all  $p < .0001$  unless shown otherwise in the figure. Negative values are highlighted by gray shading. Indicator variables and their loadings, and disturbances on endogenous factors as well as the first-order factors for the IQ Heritable construct are not shown. Links between latent variables that are not shown are not significant or constrained to zero. Loadings and variances of single-indicator latent variables are reported in Tables 2 and S3.

*Figure 2.* Final predictive structural equation model for Study 2. All links and correlations shown are standardized and significant; all  $p < .002$ . Negative values are highlighted by gray shading. Indicator variables and their loadings, and disturbances on endogenous factors are not shown. Links between latent variables that are not shown are not significant or constrained to zero. Loadings and variances of single-indicator latent variables are reported in Tables 6 and S6.



